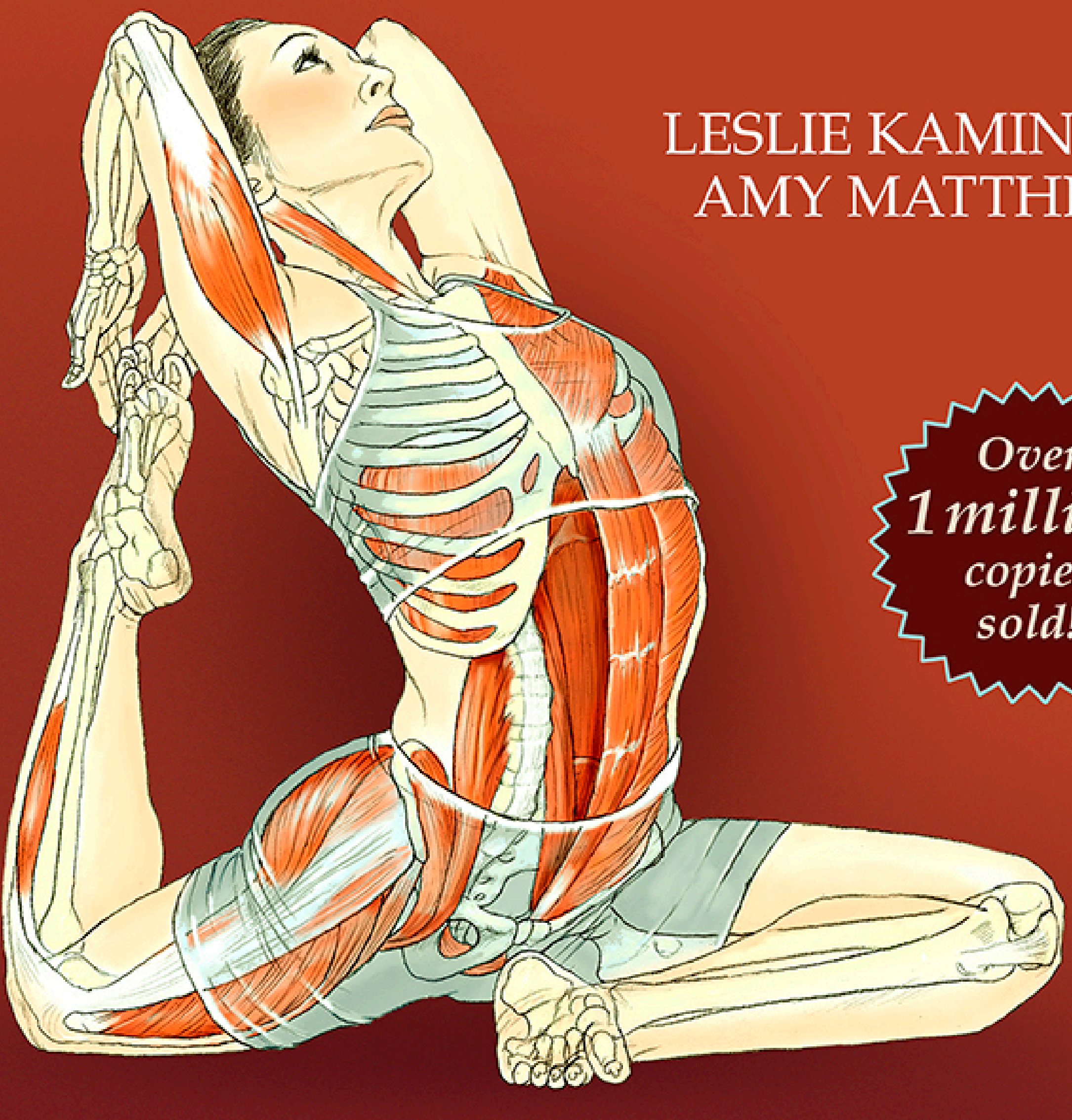
THIRD EDITION

YOGA Anatomy

Your illustrated guide to postures, movements, and breathing techniques

LESLIE KAMINOFF
AMY MATTHEWS



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Third Edition

Leslie Kaminoff

Amy Matthews

Illustrated by
Sharon Ellis and Lydia Mann

HUMAN KINETICS

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To my late yoga teacher, T.K.V. Desikachar, I offer this book in gratitude for your unwavering insistence that I find my own truth. My greatest hope is that this work has justified your confidence in me.

To my philosophy teacher, Ron Pisaturo—the lessons will never end.

Finally, to Glenn Marcus. It is rare in one's life that a person can find someone to call a true friend and even rarer to find a mentor who lovingly demands nothing less than the absolute best from you. To find both in one person is nothing short of a miracle. You are truly sui generis.

Leslie Kaminoff

In gratitude to all the students and teachers who have gone before—especially Philip, one of my first students, my teacher, and a friend who has gone before. Your curiosity and willingness to explore inspired me as a teacher when I was just starting on this path, and your friendship is still missed.

Amy Matthews

CONTENTS

Preface vi

Acknowledgments viii

Introduction x

1 ANATOMY AS A STORY 1

2 SKELETAL SYSTEM 7

3 MUSCULAR SYSTEM 21

4 NERVOUS SYSTEM 35

5 YOGA AND THE SPINE 49

6 DYNAMICS OF BREATHING 75

7 INSIDE THE ASANA 111

8 STANDING POSES 121

9 SITTING POSES 175

10 KNEELING POSES 213

11 SUPINE POSES 233

12 PRONE POSES 259

13 ARM SUPPORT POSES 271

References 309

Bibliography and Resources 311

Asana Indexes 313

Joint Index 319

Muscle Index 323

About the Authors 327

About the Illustrators 329

PREFACE

A full decade after completing work on our previous edition, I am very pleased to be writing a preface to a new, third edition of our book *Yoga Anatomy*. This past year of collaboration with my dear friend Amy Matthews and my life and work partner, Lydia Mann, has been one of extraordinary upheaval and challenge for us all. As it is with so many people affected by the ongoing worldwide COVID-19 pandemic, we have been dislodged from our usual locations, relationships, and routines. Far from providing a quiet, sequestered retreat for writing, this past year has presented its own unique and unprecedented challenges—all of which our little pod has overcome with the much appreciated support of the team at Human Kinetics.

Since its initial release in 2007, *Yoga Anatomy* has not only been adopted as a standard text in the training of yoga teachers, it also has become a touchstone for the careers of its creators. Until this past year of nearly continuous quarantining, Amy and I had each been traveling to teach workshops and training programs to students around the world who know of us mostly as the authors of this work, which has more than 1,000,000 copies in print over two editions and has been translated into 26 languages.

The lessons learned and growth we experienced as teachers became apparent when we returned to the words we had penned 10 years ago and found that we would say them differently now. That is why this edition embodies a distinct shift in tone from previous ones. We have combed through the text and replaced occurrences of "his" or "her" with the neutral "they" or "them." We have also replaced many instances of the word "the" with the words "our" and "ours" or "you" and "your," as in "*your* diaphragm" versus "*the* diaphragm." These are just a couple of facets of our goal of creating a text that sparks a spirit of inquiry in the reader and practitioner rather than making definitive or prescriptive statements about anatomy in the abstract, as if everyone had the same body. In that spirit, we have inserted Cueing Callouts where our perspective may conflict with flawed anatomical assumptions or questionable teaching instructions.

Additionally, we have expanded and clarified some of the philosophical content of the book within the introduction and existing chapters and added a new jointly authored chapter 1: Anatomy as a Story. Chapters 2 and 3 on the skeletal and muscular systems have been updated and are now joined by a new chapter 4: Nervous System, in which Amy delivers a deftly nuanced summation of some of its key structures and functions most relevant to yoga.

I have significantly expanded the scope of chapters 5 and 6, on the spine and breathing, to include more material on disc anatomy and damage and back pain and emotions and also a concluding section on breathing that encompasses some of yoga's esoteric, metaphorical anatomy. We have also moved the spine and breathing chapters from the beginning to the end of the first part of the book, an idea of Amy's that I initially resisted, but now agree better serves the progression of the material.

Throughout, beautiful new illustrations have been produced by Lydia, who has been an essential part of the *Yoga Anatomy* team from the project's conception 15 years ago. She was the project photographer, original cover artist, information designer, and overall “author wrangler.” She is now the official project illustrator, and all the new illustrations in the third edition are her work, including the charming stick figures that accompany each asana.

We are confident this new edition of *Yoga Anatomy* will continue to be a valuable resource for practitioners and teachers of yoga and all other forms of healthy movement. We hope you enjoy using it as much as we enjoyed putting it together. Please continue to let us know about your experiences in using our book. And, if we happen to revisit this material another 10 years from now, we reserve the right to evolve in our perspective.

Leslie Kaminoff
Cape Cod, Massachusetts
January 30, 2021

ACKNOWLEDGMENTS

This has been a truly collaborative project that would never have happened without the invaluable, ongoing support of an incredibly talented and dedicated team. Lydia Mann, a true partner in life, work, and love, is a gifted designer, artist, and friend who supported me through every phase of this project: organizing, clarifying, and editing the structure of the book; shooting the majority of the photographs (including my author photo); designing the cover; and taking over the production of new illustrations for this third edition. Without Lydia's help and skill, this book would still be lingering somewhere in the space between my head and my hard drive.

My brilliant colleague and collaborator, Amy Matthews, was responsible for the detailed and innovative asana analysis that forms the backbone of the book and for authoring or coauthoring significant portions of the chapters leading into the section on asana analysis. Working with Amy continues to be the richest and most rewarding professional relationship I've ever had.

The editorial, production, and marketing team at Human Kinetics is made up of world-class collaborators, and I deeply appreciate the professionalism and flexibility they've extended to us as we struggled to bring so many moving parts together in reasonable proximity to our deadlines.

For the original production of *Yoga Anatomy* a profound debt of gratitude is owed to my family: Uma Elizabeth McNeill and my sons Alex, Jai, and Shaun. Their patience, understanding, and love carried me through the original three-year process of conceiving, writing, and editing this book. Their sacrifice of the many hours that would otherwise have been spent with me made this work possible. I wish also to thank my father and mother for cheering on their son's unconventional interests and career for the past five decades. Allowing a child to find his own path in life is perhaps the greatest gift a parent can give.

For education, inspiration, and coaching along the way, I thank Swami Vishnu Devananda, Lynda Huey, Leroy Perry Jr., Larry Payne, Craig Nelson, Gary Kraftsow, Yan Dhyansky, William LeSassier, David Gorman, Bonnie Bainbridge Cohen, Len Easter, and Gil Hedley. I also thank all my students and clients past and present for being my most consistent and challenging teachers.

A big thank you goes out to all the models who posed for our images: Amy Matthews, Alana Kornfeld, Janet Aschkenasy, Mariko Hirakawa (our cover model for the American editions), Steve Rooney (who also donated the studio at International Center of Photography for a major shoot), Eden Kellner, Elizabeth Luckett, Derek Newman, Carl Horowitz, Jason Brown, Jyothi Larson, Nadiya Nottingham, Richard Freeman, Arjuna, Eddie Stern, Shaun Kaminoff, Uma McNeill, and Lydia Mann. Thanks also go to the Krishnamacharya Yoga Mandiram for permission to use the iconic photographs of Sri T. Krishnamacharya as reference for the mahamudra and mulabandhasana drawings.

Invaluable support for this project was also provided by Jen Harris, Edya Kalev, Leandro Villaro, Rudi Bach, Jenna O'Brien, and all the teachers, staff, students, and supporters of The Breathing Project.

Leslie Kaminoff

I begin once again by thanking Leslie for his generosity of spirit. Since he initially invited me to be a part of The Breathing Project in 2003, he has unfailingly supported my approach to teaching and recommended my classes and workshops to his students. In our many years of work together to produce programming at The Breathing Project and to create, revise, and now reconceive this book, he and I have had many conversations about movement, teaching, anatomy, yoga, and philosophy that have helped me polish and refine what I want to say and how I want to say it.

For me to be the educator that I now am, I thank my family. My parents encouraged me to ask questions, to look things up, and to do my own research. They also modeled generosity, respect, and integrity in ways that have been foundational for many of my own values.

Thanks to all the teachers who encouraged my curiosity and passion for understanding things. Diane Wood was my most inspiring teacher in high school. She balanced rigorous and reflective critical thinking with warmth, humor, and humanity in a way that I aspire to in my own teaching. My college advisor, the late Karen J. Warren, set me on a path of inquiry about context, values, and ecofeminist philosophy that continues to shape my work today. Alison West, Irene Dowd, Gil Hedley, and Bonnie Bainbridge Cohen have all been significant teachers in the last 20 years; they have inspired me to explore with rigor, question my assumptions, and expand my ideas.

The first and second editions of this book would not have happened without an amazing circle of people: my dear friends Aynsley and Michelle; Karen, whose partnership and loving support sustained me in creating the first edition; my Body-Mind Centering (BMC) "litter-mates" Wendy, Kidney, Elizabeth, Michal, and Tarina; the BMC students who welcomed me as a teacher in California, especially Moonshadow, Raven-Light, Sarah, Michael, Rosemary, and Jesse; Chloe Chung Misner, who reminded me to be in my bones; and in NYC the staff and students at The Breathing Project.

In the years since the second edition was published, I have had the opportunity to grow as a teacher in collaboration with amazing colleagues. Many thanks to Thomas, Mary Lou, Friederike, Jens, Walburga, Gloria, and all the BMC teachers and students who have shared classrooms and conversations with me.

Sarah Barnaby is my dear friend and cherished colleague, collaborator, and cocreator. What we have created in Babies Project, and the work we are doing to help babies and their caregivers, is one of the things I am proudest of in my life. Thank you for the inspiring rabbit holes, critical conversations, and cocktails.

And a profound thank you to Paul, for so many many things. You have my heart.

Amy Matthews

INTRODUCTION

This is a book about yoga asana—postural, movement, and breath practices—viewed through the lens of anatomy, kinesiology, and physiology, which are the studies of the structure, mechanics, and function of our human bodies. This is also a book cowritten by two people who have made an intense study of both Eastern and Western philosophy, along with a lifelong exploration of human structure, movement, and consciousness.

Both fields—yoga and anatomy—contain a potentially infinite number of macro- and microscopic details, all of which are endlessly fascinating and potentially useful, depending on your interests. Our intention is to present the details of anatomy that are of most value to people involved in yoga, whether as students or as teachers. In the writing of *Yoga Anatomy*, we have always been mindful of finding a balance between presenting information simple enough to be useful, yet detailed enough to be informative. That principle has guided all the choices of what we depict in the text and illustrations within these pages.

THE AUTHORS

We (Amy and Leslie) have been friends and professional colleagues for nearly 20 years, and in that time we have developed a dynamic work process in which our skills, interests, and experience both complement and contrast each other. The perspective of this book is rooted in many foundational principles upon which we deeply agree, and the sections of *Yoga Anatomy* we coauthored (this introduction and chapters 1 and 7) reflect those values. Where our interests and specialties diverge, we have chosen to take over authorship of specific chapters. Chapters 2, 3, and 4—bones, muscles, and nervous system—were written by Amy. Chapters 5 and 6—spine and breath—were written by Leslie. In the asana analysis section of the book, we collaborated on the initial method used in analyzing the poses. The detailed breakdown of joint and muscle actions was undertaken by Amy, drawing on her training as a certified movement analyst and teacher of Body-Mind Centering and being an all-around anatomy geek. The breathing inquiries for each pose are the work of Leslie, drawing on his years of study and teaching inspired by the therapeutic, breath-centered yoga tradition of his main teacher, T.K.V. Desikachar.

FOUNDATIONAL PRINCIPLES

Yoga philosophy speaks of getting at something deep within us—the true self. The goal of this quest is often stated in mystical terms, implying that our true selves exist on some nonmaterial plane. That perspective has historically set the body and soul—the material and the spiritual—at odds with each other and has depicted our physical bodies as the obstruction to liberation rather than the vehicle to it.

In this book, we suggest a different stand: One way to fully realize ourselves is to journey with and within our physical bodies, not devalue or transcend them. This perspective not only helps us to understand our anatomy more fully, but it also allows us to directly experience a reality that can give rise to the core concepts of yoga. We have concluded that the deepest principles of yoga can be uncovered as a subtle and profound appreciation of how our human systems operate. From our perspective, the subject *and* object of yoga is the self, and the self is an indivisible attribute of a physical body.

PRACTICE, DISCERNMENT, AND SURRENDER

Some of the most ancient teachings we've inherited were developed through centuries of observation of life in all its forms and expressions. The observation of human movement and behavior gave rise to a definition of yoga practice (kriya yoga) as classically formulated by Patanjali (and restated by Reinhold Niebuhr in his famous serenity prayer). It is stated as this question: "Can we find the discernment (swadhyaya) to distinguish the things we can change (tapas) from the things we cannot change (ishvara pranidhana)?"

For us as authors, this question has provided a key motivation to study anatomy in the context of yoga and has profoundly shaped each of our approaches to teaching. Starting with our first attempts to practice and teach asana, many related questions arose. Why are some of the physical postures relatively easy and some so difficult? Why do some people struggle with poses that we find easy or vice versa? Furthermore, why are some of our challenges easy to overcome while others seem so persistent? How much energy should we devote to working through our own resistance? When should we work on surrendering to something that's not likely to change?

Both the work (tapas) and the surrender (ishvara pranidhana) require effort because surrender is itself an act of will. These fundamental, ongoing questions produce answers that—like our bodies—seem to change every day, and that is precisely why we must never stop asking them.

WELCOME TO OUR LABORATORY

The context that yoga provides for the study of anatomy is rooted in the exploration of how our life force expresses itself through the movements of our body, breath, and mind. The ancient symbolic language of yoga has arisen from the experimentations of millions of seekers over thousands of years, but the procedures they employed were not recorded in the language of Western anatomy.

This book does not attempt to translate the metaphorical language of prana, chakras, nadis, and so on into their anatomical correlates so much as provide a tour of the common laboratory we all share—our human bodies. Rather than offer a manual for the practice of a particular system of yoga, we hope to offer a solid grounding in the principles of physical practice common to all systems of yoga.

We begin our exploration of the laboratory of our bodies in the chapters on the skeletal, muscular, and nervous systems. An appreciation of the basics of these systems and the terms employed in describing them will lay a solid groundwork for integrating the more complex material in the asana analysis section. In this section we honor the yogic perspective of dynamic interconnectedness by offering information and inquiries for alignment, breathing, and self-awareness that can aid you in your process of self-exploration. In this way we avoid an analysis of the poses that leads to a prescriptive and restrictive listing of their effects or benefits.

Because yoga practice emphasizes the relationship between them, we pay particular attention to the breath and the spine, devoting separate chapters to each. Along the way, a certain amount of "myth busting" will occur, as we challenge many misconceptions about asana cueing, spinal safety, and breathing. Look for this material in the Cueing Callouts as well as sidebars that highlight this information.

ALL WE NEED IS ALREADY PRESENT

The ancient yogis held the view that we actually have three bodies: physical, astral, and causal. From this perspective, yoga anatomy is the study of the subtle currents of energy that move through the layers, or sheaths, of those three bodies. The purpose of this work is to neither support nor refute this view. We simply offer the perspective that if you are reading this book, you have a mind and a body that are inhaling and exhaling in a gravitational field. As such, you are invited to envision the practice of yoga as a process that will enable you to think more clearly, breathe more effortlessly, and move more efficiently. This is, in fact, a possible starting point and definition of yoga practice: the integration of mind, breath, and body.

Another ancient principle tells us that the main task of yoga practice is the removal of obstacles that impede the natural functioning of our systems. This sounds simple enough, but runs counter to a common feeling that our problems are caused by something that's missing. This approach to yoga suggests that everything essential for our health and happiness is already present in our systems. We merely need to identify and resolve some of the obstacles that obstruct those natural forces from operating "like a farmer who cuts a dam to allow water to flow into the field where it is needed."[1] This is great news for anyone regardless of age, infirmity, or inflexibility; if there is breath and mind, then there can be yoga.

In this context, the practice of asana becomes a systematic exploration of removing obstacles to the deeper self-supporting forces of breath and posture. Our postural and breath habits operate mostly unconsciously unless an intentional change (tapas) is introduced into the system by a practice such as yoga. This is why we often refer to yoga as a controlled stress experience.

Rather than view asana practice as a way of imposing order on the human system, we encourage you to use the poses as a way of uncovering the intrinsic harmony that is already there. This doesn't mean we ignore issues of alignment, placement, and sequencing. We simply maintain that achieving healthy alignment is a means to a greater end, not an end in itself. We don't live to do yoga; we do yoga so that we may live—more easily, joyously, and gracefully.

1. Yoga Sutra of Patañjali: 4.3 Translated by T.K.V. Desikachar.

1

ANATOMY AS A STORY

The study of yoga and the study of Western anatomy are deep and rich fields that offer ways to organize our understanding of ourselves and how we move, think, feel, and experience the world. These studies give us ways to engage with questions about the nature of life, what it is to be human, how our existence began, and what its purpose might be.

In this book, we'll dive into how these two studies meet: What information can we glean, what questions arise, and what new perspectives are possible when we apply Western anatomical information to yoga? In the first six chapters, we'll explore in detail concepts that might help your inquiry as you look at the chapters of asana analysis.

Before we dive in, though, it's important to recognize that each study—of yoga and of anatomy—brings a particular perspective or context, a lens through which it looks at the world. Each also provides a kind of map for organizing our observations and for naming what we see. The maps they offer are not the same; they carry the imprint of different cultures and express different values.

As authors, our work is also shaped by our history and values, and what we write is offered through the lens of our context. We have both studied western philosophy as well as yoga as taught by T.K.V. Desikachar. Leslie's work in sports medicine and manual therapies has shaped his perspective, as has Amy's work in somatic movement practices. Awareness of the context and perspective of any approach is important to recognize so we know what (and whose) values are shaping what we study and so we can make choices about where these perspectives intersect with our own context, values, and maps of the world.

Later in this chapter, we'll outline a basic background for traditional principles of anatomy and kinesiology. But first let's unpack more of what we mean by *context* and *maps*.

CONTEXT

When we see people doing asana (or walking down the street or playing basketball or washing dishes), there are so many things to notice: what they are wearing, the shape of their bodies, which body parts are moving, their hair color, their skin, their eyes, how fast or slow they are moving, and so on.

From those initial observations, we make assumptions, often automatically and unconsciously, such as gender and age, level of fitness, economic class and education level, even mood and emotional state. Both our initial observations and the conclusions we draw from them are shaped by the lens we look through. We might think we are neutral observers, but what we notice in the first moments is a reflection of what we are choosing to see.[1]

If the lens through which we see our world shapes what we see, then what shapes the lens we use? Our context. Starting as infants, we learn to organize what we see and feel in ways that make sense to us, weaving together what we're taught by our parents and other caregivers, the stories we hear and tell ourselves, and the experiences of ourselves and our peers.

We've been steeped in this contextual framework by our family, culture, education, and all the subtle and overt messages we've been given in our life about what is true, whom to trust, what to expect, and where to find value. Whether we choose to adopt or resist these influences, in some way they become the foundation for our expectations of ourselves and others. This context becomes the frame for the story we tell about how the world works, both as individuals and as cultural communities.

THE MAP IS NOT THE TERRITORY

Alfred Korzybski, who helped found the field of general semantics, used the phrase *the map is not the territory* to articulate the idea that a description of an object is not the same as the object itself. By necessity, a map leaves out some things so that other things can be clearly signaled or indicated. (The assumption is that if every detail of a territory were illustrated on a map, there would be too much information to make a good choice. It would also be impossible to make a map any smaller than the territory itself, which makes it not a map.)

Maps are useful. They can tell us where we are and how to get where we want to go. But the usefulness of a map is directly related to the relationship between what it shows and what we need to find. In explicit (and not-so-explicit) ways, maps express a set of values. A mapmaker curates the things shown on a map to meet the needs and expectations of the intended audience and to suit the context.

The idea that maps are an expression of context and values is important. When we look at the maps we use to understand ourselves and our world—our constructs for explaining nature and science, culture and language, bodies and relationships, and philosophy and learning—we are looking at expressions of our context and values.

In this book we are using the biological studies of anatomy and kinesiology (and some physiology) to talk about the study of yoga through asana (physical positions). We

> It is important to remember that the fields of yoga and anatomy contain many different maps. Neither of these studies have a single united perspective on what the truth is, what the inquiry is about, or even how yoga or anatomy should be defined.
>
> As the authors, we are working from our own experiences and perspectives. If yours differs, we hope you'll entertain the ideas we offer and see how they intersect with your own.

1. In the somatic practice of Body-Mind Centering, we use the term *presensory motor focus* to describe the action of predisposing ourselves to see something. This is considered both a conscious and an unconscious process and part of how we filter the enormous amount of sensory input we receive every moment.

believe that both anatomy and yoga are profoundly useful studies that offer frameworks for inquiring how we experience our bodies and our consciousness. These frameworks give us language for communicating about these experiences, learning from them, and teaching them to others.

There are limitations to the maps provided by yoga and by anatomy. The descriptions and explanations we offer might not match your experience or might constrain your view of things in a way that isn't useful. We invite you to engage with this material in the context of your own life and experiences. These ideas might reinforce what you've found in your own studies or might challenge something you've studied before. And if your experience doesn't fit into these maps, please value your own history, experience, and knowledge. Make your own map.

DEFINING TERMS ON THIS MAP

Using the map of anatomy, we'll begin by outlining the underlying organization of this perspective and defining basic terms.

Biology (literally, the science of life) is the field of study that encompasses anatomy, kinesiology, physiology, and embryology. People around the world have been inquiring into the natural sciences for thousands of years, although it only came to be called biology in the late 18th century in Europe. What we study today in biology was shaped by the Age of Reason in Western Europe and is based on the prevailing theory at the time that the body could be understood by reducing it to its smallest parts working together as if it were a machine. The vocabulary is based in Greek and Latin and was developed when biologists tended to name parts of the body after the people who are said to have discovered them.

Biology has several branches, and we will look at the following:

- *Anatomy* is the study of the structure of organisms and their parts. An important part of this field is giving names to the macroscopic (observable by the naked eye) and microscopic structures in our bodies.
- *Kinesiology* is the study of how movement happens in our musculoskeletal system and includes the action of muscles on joints and the range of motion in joints.
- *Physiology* is the study of the function of an organism and of its parts. The contraction of muscles, communication of nerves, and densification of bones are all considered physiological functions as is the metabolism, growth, and locomotion of cells and tissues, organs, and systems.
- *Embryology* is the study of the in utero development of an organism from conception through the first 8 to 10 weeks of development.

> What parts are worth naming and how the parts are discerned is a more complex question of values, perspective, and context. In the organic whole of a living organism, there are no separate parts, and the word *anatomy* is derived from the Greek and Latin "to cut up." Whether it is a scalpel or an idea that divides one thing from another, the underlying principle is that anatomy is a story told with a sharp instrument and is an expression of a worldview.

CELLS, TISSUES, ORGANS, AND SYSTEMS

One fundamental theory of biology is that the *cell* is the basic unit of life and that all living things are composed of one or more cells. Cells that have the same basic shape and function work together as *tissues*; groups of different kinds of tissues that work together to perform a specific function are called *organs*. Every organ has more than one function in the body and is potentially part of more than one body system.

Body systems are collections of organs and tissues that are conceptually grouped together to play specific roles in the body. Some systems are described by their function: digestive, respiratory, eliminatory, immune, circulatory. Other systems are described more in terms of their tissues or organs: skeletal, connective, muscular, nervous, endocrine, cardiovascular.

Body systems are not distinct groupings of organs: Each organ plays a role in more than one body system, and all the body systems are interdependent and interregulating, sometimes in surprising ways.

MOVEMENT

Every system of the body is involved in every movement we make. Without the active participation of the nervous, circulatory, endocrine, respiratory, digestive, immune, connective tissue, fluid, skeletal, ligamentous, and muscular systems (to mention just a few), we wouldn't be able to create the movements of the breath or lift our arms overhead and fold forward into uttanasana, much less launch the body through space into a handstand.

DYNAMIC BALANCE OF BODY SYSTEMS

Any part of the body to which we turn our attention participates in more than one system. For example, while bones are generally considered part of the skeletal system, they also play important roles in other systems, such as the circulatory, nervous, immune, and endocrine systems. The bones are part of the circulatory and immune systems because red and white blood cells are created in the bone marrow. They are part of the nervous system because of the role calcium has in the working of neurons, and they are part of the endocrine system because of the hormones secreted by bone cells that play a role in our metabolism.

It is also true that none of these systems can work alone. For example, without the circulatory system, other systems such as the respiratory, endo-

Remember, this theory of cell, tissue, organ, and body systems is a map, a construct that helps organize how we understand how the body works. The cells, tissues, organs, and body systems don't function in quite so structured or hierarchical a manner. Body systems in particular are not at all as distinct from each other as they are usually presented within the construct.

crine, and digestive systems would not be able to distribute oxygen, hormones, and nutrients to the cells of the body. Without the nervous system, it would be impossible to coordinate the muscles of the limbs or to modulate the dilation of the blood vessels to supply the bones, brain, heart, or muscles with enough blood. All systems of the body are overlapping and interdependent (figure 1.1).

When we focus on just two or three body systems in studying movement, we run the risk of oversimplifying the incredible role that every system in the body plays in our movement practices. On the other hand, we can also dive deep into just a few points of focus and find incredible complexity that enriches our experience of the whole. For the purposes of this book, we'll discuss the functioning of the skeletal, muscular, respiratory, and nervous systems in more detail and then focus on illustrating what might happen in the skeletal and muscular systems to create asana, knowing that starting at any beginning point can bring us into a relationship with all the other systems and tissues in the body.

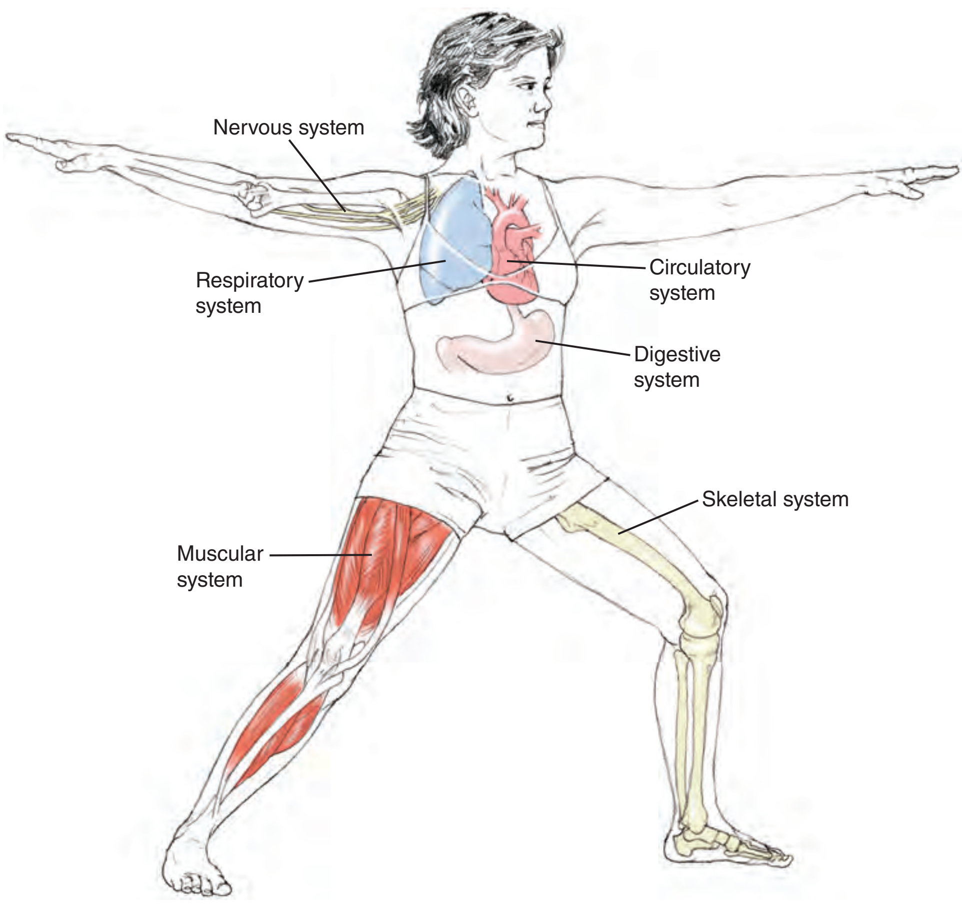


FIGURE 1.1 Several systems of the body: nervous, digestive, respiratory, circulatory, skeletal, and muscular.

USEFUL CONSTRUCT FOR A MOVEMENT SYSTEM: NEUROMUSCULOSKELETAL SYSTEM

The skeletal system, muscular system, connective tissue (or fascial) system, and nervous system are characterized as separate body systems. As previously mentioned, this theory of anatomy that maps out discrete body systems grew from a perspective that was looking for ways to depict the working of the body as if it were a machine that could be reduced to its smallest parts and then constructed in a hierarchy of complexity and importance.

We know now that our body is not a machine. We were not built, but grew ourselves. And what we understand separately about our parts leaves out essential functions that emerge from the interrelationships among our cells, tissues, organs, and systems. Especially with current research into the body's immune functions, there is a growing idea that rather than calling a certain group of organs a *system*, we might instead look at different (and shifting) constellations of events that come together in adaptive patterns to be a response to the needs of the moment. So instead of saying *endocrine system*, we might say *endocrine response* or *endocrine function*.

The model of body systems persists, however. So we propose looking at how the organs and tissues of each of these systems weave together into a dynamic whole that might be called our movement system: a neuromusculoskeletal (or skeletoneuromuscular or musculoneuroskeletal) system. While we might look at them individually, muscles, fascia, nerves, and bones are inextricably entwined as we negotiate our relationships to gravity and space, find our upright posture, feed ourselves, use tools, move through the world, and create change.

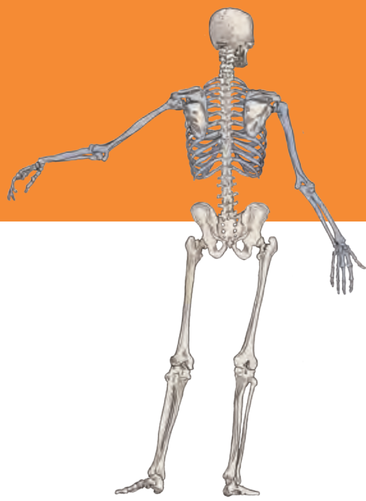
The *skeletal portion* of this system is made up of the bones, ligaments, and tissues in the joints (synovial fluid, hyaline cartilage, and fibrocartilaginous discs and wedges). The *muscular portion* is made up of the muscles and tendons that cross the joint space and attach to the bones. The *neural portion* includes the motor nerves that send messages about movement to our muscles, the sensory nerves that gather information and give us feedback, and the glial cells and other nerve cells that process and plan the exquisite sequencing and timing of our muscle actions and record movement patterns for future reference. All these tissues (nerves, muscles, tendons, bones, ligaments, and joints) are either composed of or wrapped in layers of connective tissue that provide both connectivity and discernment, communication, and separation.

CONCLUSION

In the next three chapters, we will look at what's been mapped out as the skeletal system, muscular system, and nervous system and how these systems work together to create movement in the body, starting with the skeletal system.[2]

As you read, remember to keep checking these ideas against your own map of movement experiences. Do the ideas we offer give you a new perspective? Do they remind you of what you already know? How do you frame things in the context of your own body?

2. We are aware that we are leaving out a chapter on connective tissue as a separate system. Aspects of it will be addressed in each of the other three chapters, and many articles and books are available that focus specifically on fascia and other kinds of connective tissue.



2

SKELETAL SYSTEM

Our bones are incredible structures. They play essential roles in physiological functions of the body such as synthesizing hormones and blood or storing calcium and heavy metals. They also are strong enough to resist collapsing under the force we send through them, light enough that we can move them through space, and resilient enough to adapt to stresses that come from all directions.

Ligaments do an amazing job as well. They are flexible enough to allow three-dimensional movement at the joint and strong enough to align and guide a tremendous amount of force from bone to bone across the space of the joint.

From a movement perspective, our bones and ligaments transmit the compressive and tensile forces caused by the pull of gravity and by the actions of our muscles. This allows the weight of our head when we are standing upright to be transferred to the earth, and it transfers the force generated by the muscles of our legs to our arms so we can throw a ball.

Movement in our skeletal system happens on many levels. On a cellular level, individual cells are constantly breaking down and building up the matrix of the bone and the fibers of ligaments. On a tissue level, each bone and ligament has some degree of ability to change shape in response to the forces travelling through it. On a system level, movement happens where a relationship exists between two or more bones: our joints.

JOINTS

In the skeletal system the term *joint* describes the space where the surfaces of two or more bones come into a relationship and *articulate* with each other. A joint is more of an event than a place in the sense that it depends on movement and change for its existence. If a movement is happening, however miniscule, a joint is present. (Joint is an alternate spelling of *joined*).

Conventionally, joints are classified structurally by the tissue that connects the two bones. This could be cartilage, fibrous tissue, synovial fluid, or some combination of the three. Joints can also be classified functionally by the degree of movement possible and biomechanically by the number of bones involved and the complexity of the joint.

In the analysis of asana in this book, we describe movement in synovial joints, the most mobile joints in our body. (Several of these synovial joints are also at least partly cartilaginous or fibrous.)

Synovial Joints

Starting from the center and moving outward, a synovial joint is composed of the bones that articulate with each other, the synovial fluid between them, the membrane that creates that synovial fluid, and the connective tissue that surrounds and protects the whole structure (figure 2.1).

To be more specific, the articulating surfaces at the ends of our bones are covered with a layer of hyaline cartilage that cushions and protects. These layers of hyaline cartilage are slippery and allow the ends of our bones to slide along each other with little friction.

Between these layers of hyaline cartilage, synovial fluid acts as a lubricant and facilitates the sliding of the articulating surfaces. Synovial fluid also distributes force in our joint to a slight degree, and it acts as a fluid seal between the two surfaces, as oil does between two panes of glass, holding them together. Synovial fluid is secreted by a synovial membrane (or *synovium*) that is connected to both bones. The presence of this synovial membrane defines the boundaries of the joint space: Everything outside the synovial membrane is outside the joint space.

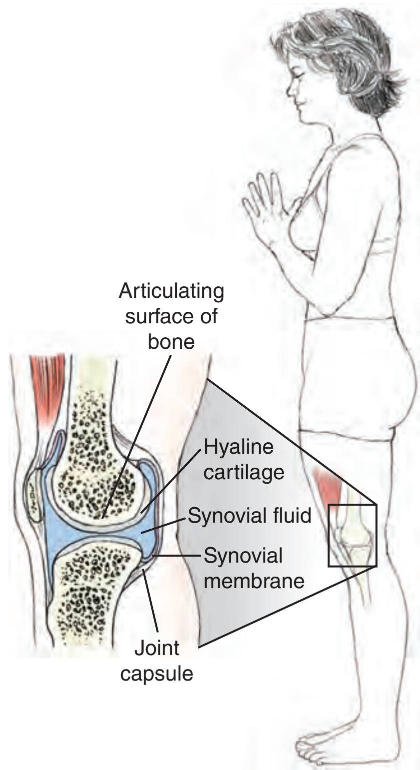


FIGURE 2.1 All synovial joints have the following: articulating surfaces of bones, hyaline cartilage, synovial fluid, a synovial membrane (synovium), and a joint capsule. (Not pictured, but present in a knee joint, is the meniscus.)

The synovial membrane is wrapped by layers of connective tissue that form our joint capsule, providing containment for the movement possibilities created by the mobility of the hyaline cartilage and synovial fluid. On the very outside of our joint capsule are fibers that thicken and organize themselves into straplike bands, the collateral ligaments. These ligaments direct the force that travels through a joint and keep the movement on track. Superficial to all these elements are the muscles that travel across our joint.

Balanced Joint Space

We can use the idea of *balanced joint space* to bring attention to the quality of the movement happening in a joint. (This concept comes from the somatic practice called Body-Mind Centering.) In a healthy, functional joint, the fluid space between two bones continually responds to the forces traveling through our bones and ligaments and into the joint by adapting and adjusting to those forces to create a dynamic state of balance. In this case, balance is not the same as symmetry, and maintaining balanced joint space through the range of motion doesn't mean that our joint space is evenly distributed at every moment. It does mean that a joint can find balance as it is articulating and can be balanced in multiple positions throughout its range of motion (ROM).

Balanced joint space is the product of a complex set of factors, including but not limited to the contours of the articulating surfaces of our bones, the viscosity of our synovial fluid, the resilience of our joint capsule and ligaments around the joint, and the assorted contractions of our muscles around the joint. In a larger sense, all of the following factors also contribute to this balance: the hydration of our tissues, the efficiency of our circulation, the ability of our sensory nerves to sense movement in the joint and our motor nerves to respond to that feedback, the state of our endocrine function, and the quality of our mind's attention.

The layer of hyaline cartilage at the end of each bone is able to absorb a tremendous amount of force and distribute that force into the trabeculae, the weight-bearing scaffolding of our bone. This force then travels through bone and joint and then the next bone and joint and then the next, until it meets a surface that can absorb the force, such as the earth, or it is discharged in some movement through space, such as throwing a ball. That force could also be received and transmitted to another structure or dispersed in unhelpful ways through soft tissues.

When our joint space is not balanced through the full range of movement and force is not distributed across the articulating surfaces, wear and tear on the hyaline cartilage occurs. Like other tissues in our body, our hyaline cartilage constantly remodels itself and can repair minor wear and tear without long-term consequences. (There are other tissues in our body, such as muscles, that remodel at a faster rate than our hyaline cartilage.) If the imbalance in our joint space is consistent and continuous over a long period of time, our hyaline cartilage cannot repair itself and can eventually become damaged or worn away. If our hyaline cartilage is worn away, the ends of our bones rub against each other. This friction eventually stimulates our bones to grow unevenly, which causes more friction and stress on the bones. This cycle of friction and growth can become quite painful and is one cause of osteoarthritis.

Lack of balance in our joint space can arise for a variety of reasons. Sometimes (but not as often as we might think) people are just born with joints that don't line up efficiently. More often, the challenge arises from inefficient movement patterns that eventually lead to imbalances in our joint capsule and ligaments, over- or underuse of the muscles surrounding our joint, or habitual patterns in our neural network. These habits are often perpetuated through familiarity and lack of awareness. Even a perfectly appropriate exercise can be dangerous if it is done for too long. The same can be said for pursuing ideas or images, no matter how appropriate, if they exclude other ideas.

When imbalances arise, our ideas about movement are at fault as much as the bones and ligaments we are born with. For example, pulling the shoulders back to open up the front of the chest is a common instruction. This is a useful instruction for people whose shoulders have slid forward around their rib cage. If, however, there is an issue in the spine, pulling their shoulders back might increase neck and upper back effort without addressing the underlying spinal issue. It also might be an effective instruction once or twice, but if someone continues to pull their shoulders back for an extended period of time, their shoulders will end up pulled so far back that they are out of balance in the other direction.

Joint Actions

Joint actions, the conventional term used to describe movement at the joints, describe fairly simple movements that are generally flat and two dimensional and happen in a single plane. Nothing in your body is perfectly flat or straight or less than three dimensional, including the articulating surfaces of your bones. Because these articular surfaces always have volume and contour, movement in your joints is always three dimensional.

The danger of using two-dimensional language to describe movement at our joints is that we simplify our concept of what movements are possible and then simplify the movements we do. We might deprive ourselves of movement choices and overuse the few options we think are available to us.

No single term for a joint action takes into account the volume of the movement possibilities at every joint. It is a fundamental fallacy to think that our human bodies work like the structures that humans have built. Human joints are frequently compared to devices used in construction to create joints, such as a hinge or a ball and socket. The mechanics of a human joint, however, are not the same as those of a joint between pieces of wood or metal or ceramic or plastic, in part because of the nature of the materials.[1]

Useful as it might be on a superficial level to compare the workings of the elbow joint to a hinge, drawing this parallel limits our ideas about how movement happens at the joint. Because all the articulating surfaces in our joints are three dimensional, every joint is capable of more than one joint action, possibly three or four. Equal amounts of movement are not possible in each action, but even if it is a tiny movement, the joint has movement in every dimension. That tiny movement could have huge repercussions on two or three joints or 5 to 10 years down the line.

Conventional Definitions of Joint Actions

The basic terms that describe joint actions apply to a majority of the joints in your body. Several terms have specific meanings in particular joints, and some terms are used in more than one joint but mean different things in different joints.

Anatomical definitions of joint actions often use planes to describe the movement. A plane is a two-dimensional surface, and the three basic planes intersect at right angles to each other. When the planes are oriented so that they intersect in the center of the body, they can be used to describe relationships within the body (anterior and posterior describe a sagittal relationship of body parts) or movements (flexion and extension describe sagittal movement of the spine). The *vertical plane* (also called the coronal or door plane) divides the body into front and back. The *horizontal plane* (also called the transverse or table plane) divides the body into top and bottom. The *sagittal plane* (also called the median or wheel plane) divides the body into right and left sides.

Spinal Joint Actions

The following terms describe movements when the joints of your spine are moving and the vertebrae articulate in relationship to each other. In these spinal actions, the actual shape of your spine changes, which is a different action than moving your spine through space (by articulating at your hips, for example, which would be an action in your legs). Common yoga language such as *forward bending* is a nonanatomical description that

1. If you are interested in reading more about these differences, Steven Vogel has written a fascinating book called *Cats' Paws and Catapults: Mechanical Worlds of Nature and People* (W.W. Norton & Company, 1998).

can refer to either a movement of your spine through space or the spinal joint action of flexion (see chapter 5, page 69).

Flexion—Movement in the sagittal plane that brings the anterior surfaces of the body toward each other.

Extension—Movement in the sagittal plane that brings the anterior surfaces of the body away from each other.

Lateral flexion—Movement in the vertical or coronal plane that bends the spine to one side or the other.

Rotation—Movement in the horizontal or transverse plane around the vertical axis of the spine:

- In *rolling*, all of the parts of the spine rotate in the same direction.
- In *twisting*, one part of the spine turns a different direction from another part of the spine.

Axial extension—Movement along the vertical axis of the spine that lengthens the spine by taking out the sagittal curves.

Circumduction—Movement that travels through space around the axis of the body, tracing a cone shape. This is not the same as rotation.

Limb Joint Actions

These terms describe the joint actions that can happen in your upper and lower limbs, which include your shoulder girdle and pelvis. As in the spine, there is a difference between moving a joint through space and actually articulating in your joint, which is the joint action. (For example, when you lift your whole arm to the ceiling, your elbow moves through space, but it doesn't necessarily articulate.)

Actions in All Limbs

For the joint actions that follow, the same terms can be used to describe movement at a variety of joints. Which bones are involved in the movement depends on which joint is articulating.

Flexion—Movement in which the anterior surfaces of the limb move toward each other; depending on the position of the spine, hips, and shoulders, this could happen in any plane. Because of a spiral in the limbs that occurs while we are embryos, flexion in the knee, ankle, and foot joints moves what we consider the back surfaces of the leg toward each other.

Extension—Movement in which the anterior surfaces move away from each other; again, depending on the position of the spine, hips, and shoulders, this could happen in any plane. And, because of that embryological spiral, extension in the knee, ankle, and foot joints moves what we consider the back surfaces of the leg away from each other.

Rotation—Movement around the axis of the limb; in the hips, shoulders, and forelegs, this is further described as internal (or medial) and external (or lateral) rotation. Rotation in the hand, foot, and forearm has special names (see the sections that follow).

Abduction—Movement of the limb away from the torso or the midline of the body; in the hand, foot, and scapula, this term describes a more specific action (see the sections that follow).

Adduction—Movement of the limb toward the torso or the midline of the body; in the hand, foot, and scapula, this term describes a more specific action (see sections that follow).

Circumduction—Movement that travels through space around the axis of the limb, tracing a cone shape. This is not the same as rotation.

Actions in Specific Limbs

Some parts of the limbs can perform movements that are not described by the general terms listed earlier. These joint actions have terms that are used for specific body parts such as *pronation* and *supination*, which only occur in the feet and forearms, or *radial deviation*, which only occurs in the wrists. In some body parts, a general joint action refers to a different movement than in the rest of the limb. For example, in the hands, abduction refers to movement away from the middle finger rather than away from the midline of the body.

Hand

Rotation—Rotation around the long axis of the hand is called *eversion* when it lifts the outer edge of the hand and *inversion* when it lifts the inner edge of the hand.

Abduction—Movement of the fingers away from the third finger.

Adduction—Movement of the fingers toward the third finger.

Radial deviation—Movement of the fingers toward the radial (thumb) side of the hand.

Ulnar deviation—Movement of the fingers toward the ulnar (pinkie) side of the hand.

Opposition—Movement of the thumb and the little finger toward each other.

Wrist

Dorsiflexion—Movement when the angle between the back of the hand (the dorsal surface) and the forearm decreases. (Sometimes called wrist flexion, from an embryological perspective this is extension of the wrist.)

Palmar flexion—Movement when the angle between the palm of the hand (the palmar surface) and the forearm decreases. (Sometimes called wrist extension, from an embryological perspective this is flexion of the wrist.)

Radial deviation, or abduction—Movement of the hand toward the radial side of the forearm (thumb side).

Ulnar deviation, or adduction—Movement of the hand toward the ulnar side of the forearm (pinkie side).

Forearm

Rotation—Rotation of the radius and ulna so that they cross each other is called *pronation*, and rotation of the radius and ulna so that they are uncrossed is called *supination*. (Sometimes pronation is described as "palm down" and supination as "palm up," but the position of the palm doesn't accurately describe these actions because of the movements available in the shoulder joint and scapula.)

Clavicle

Elevation—Movement of the distal end (furthest from the center of the body) of the clavicle upward in the vertical plane.

Depression—Movement of the distal end of the clavicle downward in the vertical plane.

Upward rotation—Rotation of the clavicle around its long axis to roll the top surface backward.

Downward rotation—Rotation of the clavicle around its long axis to roll the top surface forward.

Protraction—Movement of the distal end of the clavicle forward, usually accompanied by scapular protraction (sliding forward).

Retraction—Movement of the distal end of the clavicle backward, usually accompanied by scapular retraction (sliding backward).

Shoulder (Glenohumeral Joint)

Flexion—Movement of the arm sagittally forward in space.

Extension—Movement of the arm sagittally backward in space.

Abduction—Movement of the arm from alongside the torso to open to the side and away from the body.

Adduction—Movement of the arm from an abducted position toward the side of the body.

Horizontal abduction—Movement of the arm from a flexed position in front of the body to open to the side and away from the body.

Horizontal adduction—Movement of the arm from an abducted position to the side of the body to a flexed position in front of the body.

Protraction—Movement that slides the head of the humerus forward in the sagittal plane.

Retraction—Movement that slides the head of the humerus backward in the sagittal plane.

Scapula

Elevation—Sliding of the scapula upward in the vertical plane.

Depression—Sliding of the scapula downward in the vertical plane.

Upward, or lateral, rotation—Rotation of the scapula in the vertical plane in such a way that the glenoid fossa faces upward and the inferior angle moves laterally to the side.

Downward, or medial, rotation—Rotation of the scapula in the vertical plane in such a way that the glenoid fossa faces downward and the inferior angle moves medially toward the spine.

Abduction, or protraction—Movement in the horizontal plane away from the spine, which wraps the scapula toward the front of the body.

Adduction, or retraction—Movement in the horizontal plane toward the spine, which draws the scapulae toward each other in the back.

Foot

Rotation—Rotation around the long axis of the foot is called *eversion* when it lifts the outer edge of the foot and *inversion* when it lifts the inner edge of the foot.

Abduction—Movement of the forefoot toward the lateral edge (little toe side) of the foot without moving the heel; the movement of the toes away from the second toe.

Adduction—Movement of the forefoot toward the medial edge (big toe side) of the foot without moving the heel; the movement of the toes toward the second toe.

Pronation and supination—In the feet, *pronation* is sometimes considered the same thing as *eversion* and is sometimes a combination of *eversion* and *abduction*. And in the feet, *supination* is sometimes used interchangeably with *inversion* and is sometimes a combination of inversion and *adduction*.

Ankle

Plantar flexion—Movement when the angle between the sole of the foot (the plantar surface) and the back of the foreleg decreases; pointing the foot. (Commonly called ankle extension, from an embryological perspective this is ankle flexion.)

Dorsiflexion—Movement when the angle between the top of the foot (the dorsal surface) and the foreleg decreases. (Commonly called ankle flexion, from an embryological perspective this is ankle extension.)

Pelvis

Nutation—Movement of the sacrum separately from the pelvic bones in such a way that the top of the sacrum tips forward, or nods, and the bottom of the sacrum (near the coccyx) tips back. This is movement at the sacroiliac (SI) joint, between the sacrum and pelvic or innominate bone, not movement of the full pelvis (which would be an anterior or posterior tilt of the pelvis caused by joint action at the hip joints or lumbar spine).

Counternutation—Movement of the sacrum in such a way that the top of the sacrum tips backward and the bottom of the sacrum (near the coccyx) tips forward. This is movement at the SI joint, between the sacrum and innominate bone, not movement of the full pelvis (which would be an anterior or posterior tilt of the pelvis caused by joint action at the hip joints or lumbar spine).

Range of Motion in Joints

The amount of movement available in a joint is called the *range of motion* (or ROM) of a joint. This ROM is the product of the shape of the bones, the tone of the ligaments connecting the bones, and the engagement of the muscles that cross the joint. (The muscular engagement is a product of intentions, habits, and patterns in our nervous system). What's happening in the rest of the joints, both those nearby and those that are farther away, has an effect on the ROM in any joint.

The following are key points about range of motion:

- Different joints in your body have different ranges of motion.
- A single joint might have a different amount of movement in different planes of motion (more flexion and extension than adduction and abduction, for example). A single joint might also have different amounts of movement in one plane of motion (more flexion than extension, for example).
- More movement in a joint is not always better. There are joints in which it's appropriate to have a small ROM, and working to increase that ROM might make it harder to maintain balance in the joint space and increase the chances of damaging your joint.
- Joints that have a greater ROM are not more important. Because a joint has more range in more directions doesn't mean that the role it plays in movement is more significant than a joint with just a few degrees of movement. For example, your hip joint is not more important than your sacroiliac joint; its movements are just easier to perceive and analyze.
- The range of motion in a joint can vary widely from person to person and still be functional and healthy. (Again, more ROM is not better or more important in the scope of functional and expressive movement.)

Every movement we do, including moving into and out of asana, is the product of many joints working together. Knowing the ROM in a single joint doesn't tell us what overall movements are possible. It might be the case that one person has more rotation in their shoulder joint and another person has more rotation in their radioulnar joint and that both people are able to rotate their hands as much as necessary.

Finding balanced joint space to support the health of our joints, then, becomes about more than what is happening in a single joint. It involves paying attention to the other joints and how movement travels through our whole body.

PATHWAYS OF WEIGHT AND FORCE

When we move, more than one joint is always involved. As soon as we begin a movement, it travels to the joints at the other ends of our moving bones and into the next bones and joints and the next bones and joints and the next—all the way into our spine and all the way out to our periphery. (Even if you are passive and someone else moves you, that movement still travels through your tissues.)

One of the roles of bones and ligaments is to transfer compressive forces through your body. If we look at how these forces travel, we can create a map of movement with three basic pathways[2]: one that connects your skull and your tail through your spine; one that connects your fingers to your spine via your arm, scapula, and ribs; and one that connects your toes to your spine via your leg and pelvis. Let's examine the bones in each pathway:

2. These pathways of weight and force through the bones, ligaments, and joints come (in this form) from the principles of Body-Mind Centering and the Bartenieff Fundamentals.

- *Head to tail:* Occipital condyles of your skull to the superior facets of your atlas (C1) (via the atlanto-occipital joints), to the facets of the axis (C2) (via the atlantoaxial joints), to the body of the axis, through the bodies of your vertebrae from C2 to L5 and their intervertebral discs (via the intervertebral joints), to your sacral plateau (via the intervertebral joint between the disc of L5 and the top of the sacrum), through the body of your sacrum to its apex, and through the sacrococcygeal joint to your coccyx (tailbone) (figure 2.2).

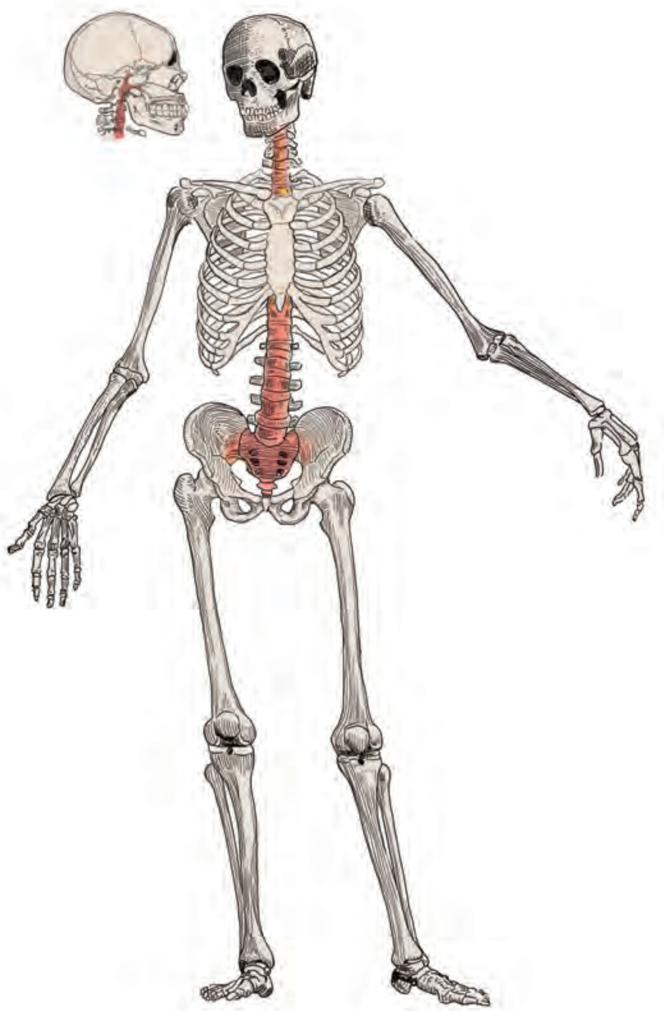


FIGURE 2.2 The pathway of weight and force from head to tail.

- *Fingers to spine:* The bones of your fingers and your hand to your radius and ulna (via the joints of your fingers, hand, and wrist), to your humerus (via your elbow joint), to the glenoid fossa of your scapula (via the glenohumeral joint), through the bone of your scapula via the lateral border to the inferior angle to the medial border and to the spine of your scapula, to your clavicle (via the acromioclavicular joint), to your sternum (via the sternoclavicular joint), to your ribs (via the sternocostal joints), to the bodies of your vertebrae in your spine (via the costocorporeal joints) and into the spinal pathway (figure 2.3).

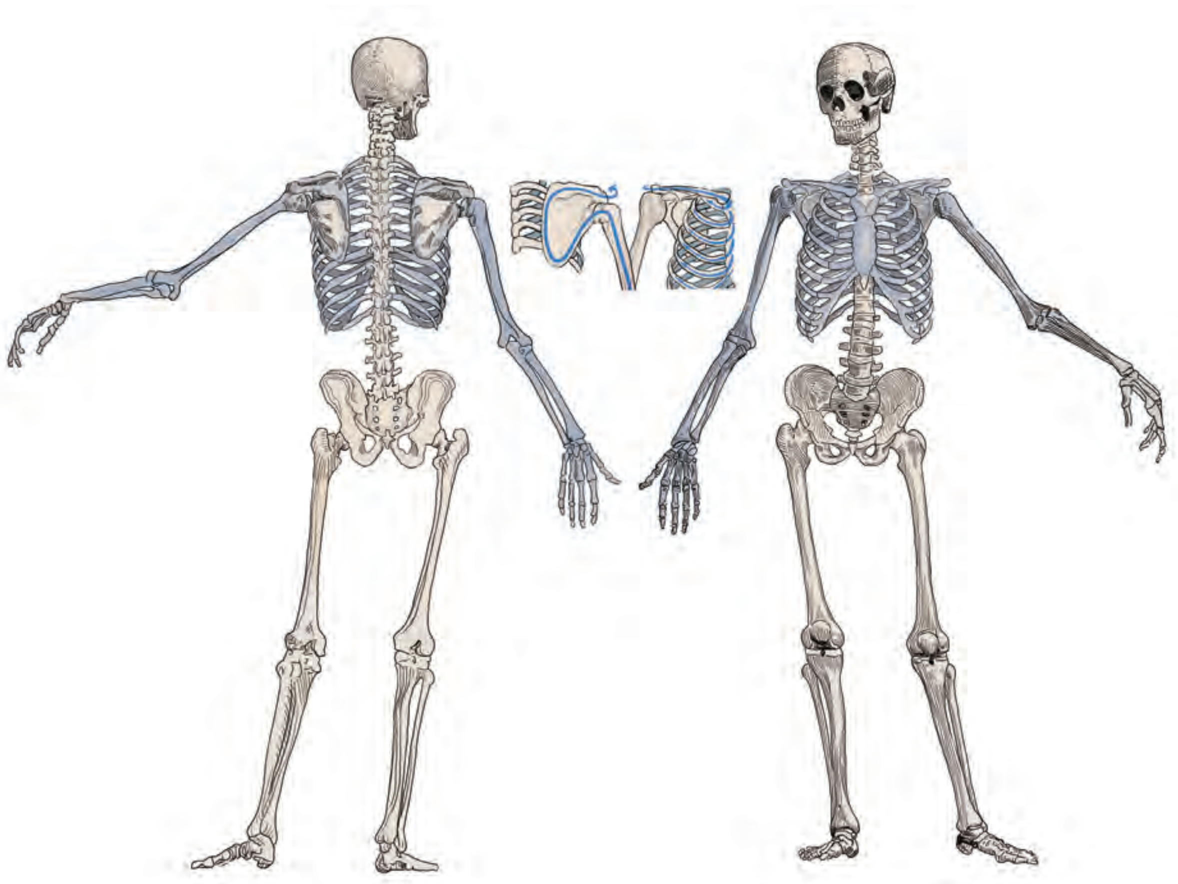


FIGURE 2.3 The pathway of weight and force from fingers to spine.

- *Toes to spine:* The bones of your toes and your foot to your tibia and fibula (via the joints of your toes, foot, and ankle), to your femur (via the knee joint), to the acetabulum of your pelvic half (via your hip joint), through the bone of your pelvic half to the wings of your sacrum (via the sacroiliac joint), to the body of your sacrum and into the spinal pathway (figure 2.4).

FIGURE 2.4 The pathway of weight and force from toes to spine.

These pathways (figure 2.5) are direct and fairly simple, although not necessarily straight, and force can travel along them in both directions (from your fingers to your spine or from your spine to your fingers). We might use part of a pathway or connect them to find our way from fingers to toes or from head to feet, for example.

All these pathways of weight use multiple joints, and an important role of your ligaments is to transmit forces through these joints in a variety of positions. This allows us to have a clear pathway of weight in our spine or a limb when it is not perpendicular to gravity or in a fixed position, and we can continually reestablish a clear pathway of weight while moving.

FIGURE 2.5 All the intersecting pathways.

WORKING PRINCIPLES OF BONES AND LIGAMENTS

The principles of *balanced joint space* and *pathways of weight* can work together to support the following ideas about movement in our skeletal system:

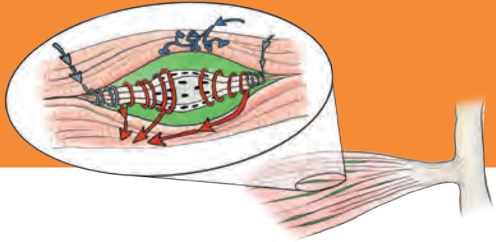
Functional and expressive movement travels through your body. This movement might be large enough to easily sense or it might be small and imperceptible. Pathways for movement can be blocked by overwork or holding patterns or can be dispersed through a lack of clarity or the presence of too many choices (as happens in overmobilized joints). Cultivating clear pathways of weight and force can help support balanced joint space; cultivating balanced joint space can help support clear pathways of weight.

Stability in a joint is derived from connectivity, not fixation. Inhibiting all movement in a joint (fixing it) is not the same as creating stability in a joint. Because the role of our joints is to create movement, a stable joint is one that has a clear relationship between the articulating bones and has available the appropriate amount of movement (whatever that might be). If a joint is overmobilized, we need to explore and adjust how movement is being distributed through the whole pathway of weight.

A little movement in a lot of places can help us find balanced joint space. If one joint doesn't move as much as it could, it might cause another joint nearby to overmobilize for movement to travel through the pathway. Observing movement through all the joints in a pathway of weight can help us evaluate where to encourage more movement and where to limit the amount of movement. These observations can also help us recognize the cumulative effects of many small movements in the overall gestures of our limbs and spine.

CONCLUSION

Whether you experience yourself as flexible or stiff, this map of your bones, joints, and ligaments can offer a different perspective on your experience of movement. Instead of working harder or going farther, what happens if you focus on what it might feel like to have balanced joint space and clear pathways of weight and force? We propose that success in an asana (or any movement) should be gauged by the experience of the whole person, rather than in the range of motion in a single joint. Look at your pattern of movement: Where is there more movement and where is there less movement? Where does the movement travel with ease and where does it seem challenging? If something seems challenging, is it serving the whole pattern or creating congestion? If there's a place that moves with great ease, is it still relating to your bones and joints around it? What would bring balance?



3

MUSCULAR SYSTEM

If we frame the role of your skeletal system as transferring weight and force by way of your ligaments through your bones in any arrangement your joints allow, then the role of your muscular system is to move your bones into place so that the bones can do their job. Muscles create movement, joints enable movement, and connective tissue translates movement from tissue to tissue. Bones absorb and transmit movement, and nerves coordinate and organize the whole gorgeous dance.

Muscles work together in complex ways. There's not a right muscle for any joint action, but a whole assortment of muscles that might participate in a movement. There are many ways to do it well, and the best combination of muscles for one person might be unsuitable for another person.

Instead of creating a map of individual muscles working separately, let's look at muscles working together as a matrix of potential movement choices that affects every articulation in your body. In this map of connections, muscles do not work in isolation, and a single muscle never works without support and modulation from other muscles. Each muscle has an effect on every other muscle, whether they are nearby or far away.

BASIC MUSCLE ANATOMY

What we usually think of as a working muscle is actually an organ made up of at least four different tissues: muscle tissue, connective tissue, nerves, and blood vessels (figure 3.1). Muscle tissue itself has the ability to contract and create movement. Connective tissue communicates the power of that contraction to whatever the muscle is connected to, such as bones, organs, or skin. Nerves tell muscles when to fire, for how long, and at what intensity, and blood vessels provide the nourishment that allows muscle tissue to be active.

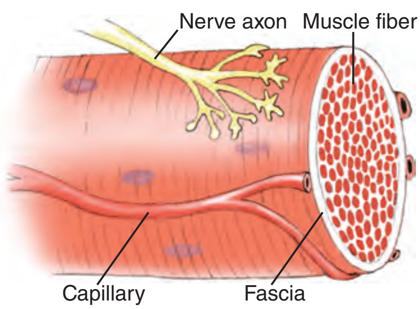


FIGURE 3.1 Muscles are composed of several tissues working together: muscle fibers, nerves, capillaries (blood vessels), and fascia (connective tissue).

Muscles are divided into three basic types: skeletal, cardiac, and smooth. Skeletal muscle is generally attached to bones and creates movement at your joints. It has alternating bands of light and dark fibers that give the tissue its striated appearance. Skeletal muscle is controlled by the somatic portion of your nervous system, Teaching about muscles often uses a fairly simple model of "this muscle does this action," but muscles play many roles in many actions. To feel how interconnected your muscles are, try this experiment: Lie on your back. Open your arms to the sides at a comfortable level, palms facing up. Your legs can be bent or extended. Take time to settle into this position. Then, starting with a very small movement, begin to wiggle your fingers.

Can you feel how the muscles in your forearms are activated as you wiggle your fingers? How about the muscles in your upper arms? The muscles in your shoulders and upper back? Can you feel the muscles around your spine respond to the wiggling of your fingers? How about the muscles in your jaw? Can you follow the movement to your feet?

If it feels as though the movement doesn't travel anywhere, see whether you can feel where it stops. Are you holding on to anything in your muscles that you don't need to? What can you release so that the movement can travel with ease through your body?

which makes many of its functions voluntary, or under our conscious control. Cardiac muscle is in your heart, and smooth muscle is in your blood vessels, airways, and visceral organs. Cardiac tissue is also striated but is stimulated by your autonomic nervous system and hormones from your endocrine system. Smooth muscle is not striated and, like cardiac muscle, is stimulated by your autonomic nervous system and your endocrine system.

The skeletal muscle tissue that we see with the naked eye is made up of bundles of fascicles. The fascicles are made up of bundles of muscle fibers, which are your actual muscle cells. Inside your muscle cells are bundles of myofibrils (or myofilaments; see figure 3.2). Each of these bundles of myofibrils, muscle cells, and fascicles are wrapped in a layer of connective tissue, and all these layers of connective tissue come together at the ends of your muscles to create your tendons and other tissues that connect muscles to bones (figure 3.3).

Myofibrils are made up of thick and thin filaments that lie alongside each other and overlap and are divided into units called *sarcomeres*. These thick and thin filaments are twisted strands of molecules that create contractions.

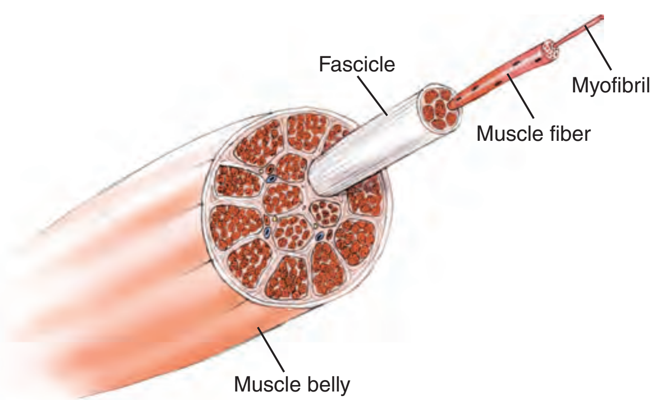


FIGURE 3.2 The muscle belly is made up of bundles of fascicles that are made up of bundles of muscle fibers (muscle cells) containing bundles of myofibrils.

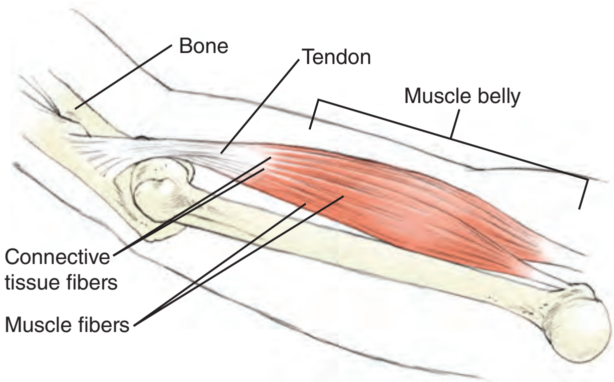


FIGURE 3.3 Fibers of connective tissue (white) run through the muscle (red). At either end of the muscle, the connective tissue comes together to create tendons, which connect to bone.

MUSCLE CONTRACTIONS

A striated muscle cell engages when a signal from a motor nerve has caused a series of chemical reactions in the cell. This causes the molecules of the thick and thin filaments to create and release bonds between the filaments, which ratchet along each other to create a sliding movement that increases their overlap and draws the two ends of the sarcomere toward each other (figure 3.4). As all the sarcomeres shorten in a myofibril, the whole myofibril shortens and the muscle fiber slides shorter. As more and more muscle fibers contract, your entire muscle might shorten by sliding the attachment points at the two ends of your muscle toward each other.

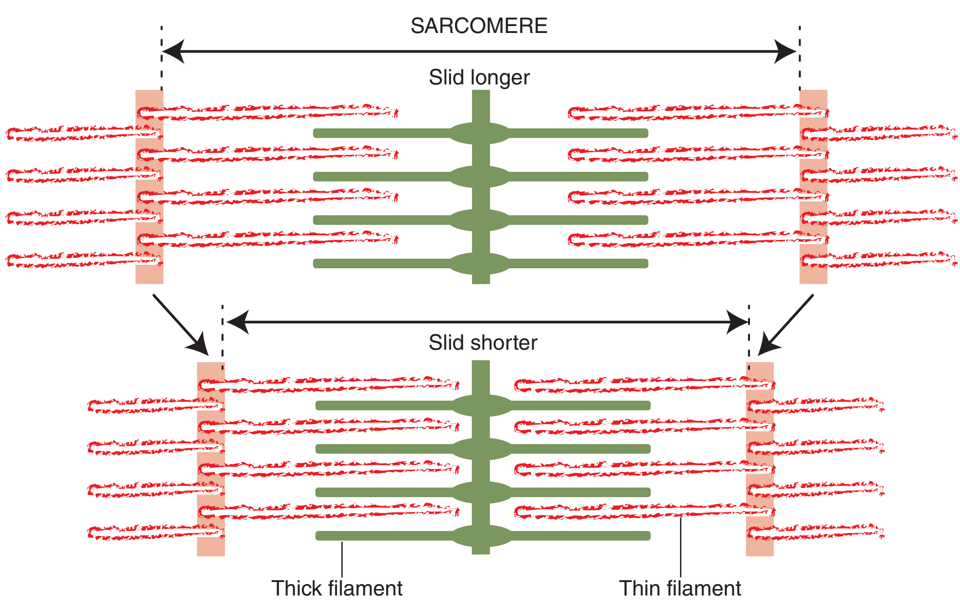


FIGURE 3.4 The shortening of a myofibril happens because thick and thin filaments slide along each other to draw the two ends of the sarcomere toward each other.

Whether or not your entire muscle actually shortens depends on outside factors, specifically how much resistance exists. If only a few filaments slide together inside the cells, they may not generate enough force to overcome the weight of whatever structure your muscle is attached to, such as the weight of your arm or the weight of your head. The weight of a body part is a product of the resistance created by gravity, which is a fundamental source of resistance for everything on this planet. We negotiate this force every time we lift an arm, stand up, roll over, or take a breath. Added resistance also comes from other forces, such as the weight of something being carried, an opposing muscle contraction, or even an emotional state (for example, excitement, anger, or the effort not to cry might create resistance, while relief, happiness, or distraction might decrease resistance).

Muscles do not contract in an all-or-nothing way. Not all of the fibers have to contract at the same time, meaning that a muscle can generate a precisely gradated amount of force, coordinated by the dialogue between your nervous system and your muscles. Because muscles work in this modulated way, they don't always shorten, even though their fibers might be actively contracting. A muscle may in fact be active and lengthening when the outside force is greater than the force that the muscle is exerting.

The words *concentric*, *eccentric*, and *isometric* are used to describe muscle actions (figure 3.5). These terms actually describe the effects of the relationship between your muscle and the resistance it meets.

In a *concentric contraction*, your muscle fibers contract and generate *more* force than the resistance that is present. This causes the ends of your muscle to slide toward each other, and the muscle shortens.

In an *eccentric contraction*, your muscle fibers contract and generate *less* force than the resistance that is present so that the ends of your muscle slide apart, and your muscle lengthens. Your muscle is active as it lengthens, so this is not the same as relaxing your muscle.

In an *isometric contraction*, your muscle fibers contract and generate the *same* amount of force as the resistance that is present so that the ends of your muscle neither move apart nor move together, and the length of your muscle does not change. Isometric contractions can be distinguished further. There is a difference in experience between intending to hold still against the resistance of something else trying to move you and intending to move but not being able to overcome the resistance to movement. There is also a difference in experience between maintaining an isometric contraction following a concentric contraction and maintaining an isometric contraction following an eccentric contraction.

> Muscles don't actually flex or extend; these terms describe joint actions. To be accurate, muscles use contractions to create all joint actions, including flexion and extension.

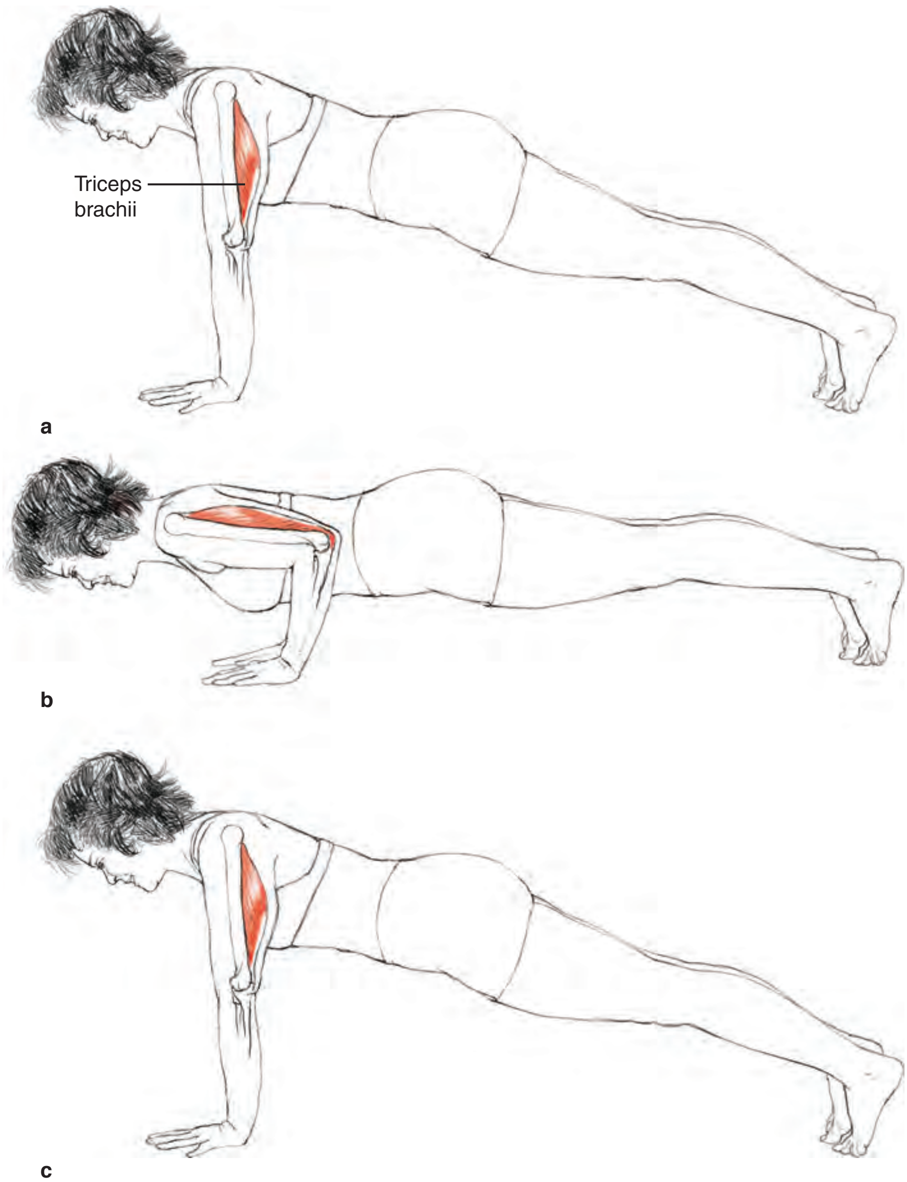


FIGURE 3.5 Examples of isometric, eccentric, and concentric contractions in the triceps brachii: moving from plank to chaturanga (*a* to *b*) is eccentric; moving from chatturanga to plank (*b* to *c*) is concentric; and maintaining plank (*a* and *c*) or chatturanga (*b*) is isometric.

MUSCLE SENSATION: FEEDBACK, FLEXIBILITY, AND STRETCHING

Our bodies have a highly specialized and adaptive way of sensing what is happening in the striated muscles through proprioceptive organs[1] called *spindles*. These spindles are capsules of connective tissue that are embedded in the extrafusal fibers of your muscles (the muscle cell we already looked at) and connect to the connective tissue fibers that run through your muscles to your tendons (figure 3.6).

Inside your spindle capsule are tiny muscle fibers called *intrafusal fibers* that connect from end to end of the capsule. These intrafusal fibers are organized so the end areas are where the contraction happens and the central area is noncontractile. When your intrafusal fibers contract, they tug on the central area and on their attachments at the ends of the spindle.

When extrafusal fibers contract, they create movement at a joint (potentially) *and* they pull on your spindle capsule, which pulls on your intrafusal fibers. This means the central portion of the intrafusal fiber—the noncontractile part—is affected by contractions from both your intrafusal fibers and your extrafusal fibers.

The contractile portion of your intrafusal fibers, on either end of the fiber, can modulate the effect of the extrafusal contraction on the central portion. These end parts can absorb the pull of your extrafusal fibers so it doesn't have so much effect on the central portion, or they can amplify the pull by adding to it, increasing the effect on the central portion. The sensory nerve endings[2] for your whole muscle are inside the spindle capsule, wrapped around the central portion of the intrafusal fiber (figure 3.6 inset).

These sensory neurons are sensitive to changes in length and some of them to the speed of that change. The amount of pull on the central portion of the intrafusal fiber is communicated through these sensory neurons to your central nervous system and is interpreted as your sense of the length of your muscle. (There are no sensory neurons connected to extrafusal fibers.)

There are also different kinds of motor neurons involved in this process: some that go to the intrafusal fibers, some that go to the extrafusal fibers, and some that go to both. These motor neurons can act independently of each other, so your intrafusal fibers might get a message to contract when your extrafusal fibers don't get the same message.

Because motor neurons to the intrafusal fibers have an effect on how much pull there is on the central portion of the intrafusal fiber, they have an effect on how much sensation there is from your sensory neurons wrapped around that central portion. This makes the sensitivity of our muscles adaptable, and it means that feeling the sensation of stretch in your muscles depends on what messages your central nervous system is sending to your intrafusal fibers. (If there isn't much pull on the central portion of your intrafusal fiber, there won't be a stretching sensation.)

Many of the movements we do in our day-to-day life involve muscles lengthening and shortening without much noticeable sensation, but there's a tremendous amount of communication and calibration going on below our conscious attention to coordinate all these activities. If we do notice a sensation of stretch, part of the reason is because

1. *Proprioception* is most traditionally defined as our ability to sense the movements we make volitionally. By this definition, proprioceptive sensory nerve endings are found in our skeletal muscles and tendons and the ligaments around our joint capsules. A proprioceptive organ is a group of tissues—in this case muscle, nerve, and connective tissue—that together generate proprioceptive feedback.
2. Sensory neurons carry information from tissues in your body to your central nervous system. This is how we sense things. Motor neurons carry instructions from your central nervous system back out to your tissues to trigger responses. This is how we take action. See chapter 4 for more on this idea.

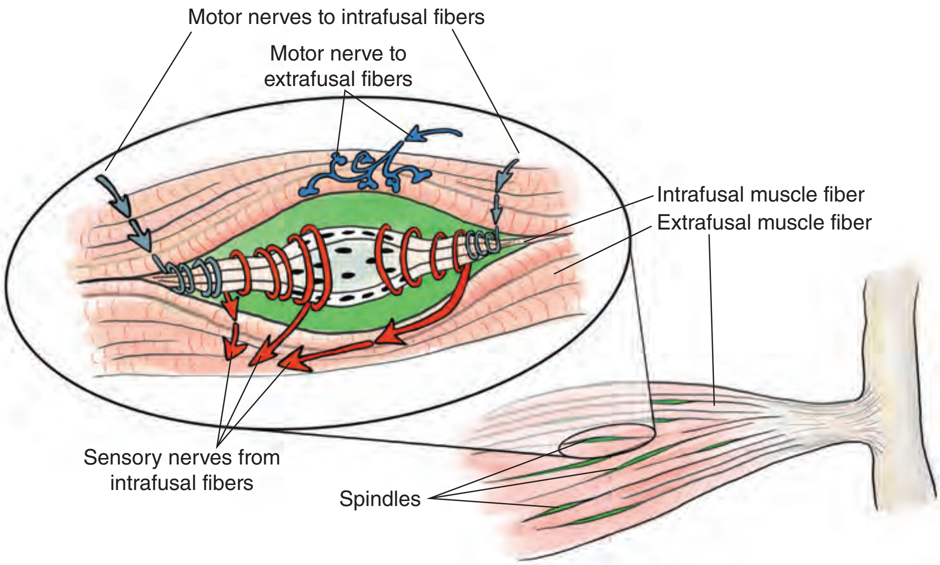


FIGURE 3.6 Spindles in extrafusal fibers. Spindles are fusiform shaped: wide in the middle and narrow at the ends. Inset: An inside view of a spindle: intrafusal fibers, sensory and motor neurons, and the extrafusal fibers around the capsule.

we are asking a muscle to lengthen more than the pattern in our nervous system is prepared for. That's when we get the sensory feedback (stretching sensation) from our spindles. (Other nonmuscular stretching sensation might come from sensory nerve endings in our fascia and tendons.)

The spindles help set functional lengths for your muscles and react when a muscle is lengthened more than usual. One of the reactions triggered by the spindles is a contraction of your extrafusal fibers, which undoes the lengthening that your spindle is sensing. This contraction of the extrafusal fibers can create more pull on the spindle and lead to more stretching sensation from the spindles. So the stretching sensation that we feel from our muscles is a sign that our muscle is shortening to return to what has been established as its functional range. The state of readiness (or resting tone) and the functional length of our muscle is continually being set and reset by our nervous system in response to what is happening internally and outside our body.

A relaxed muscle generally means that there is no intentional or voluntary contraction of the muscle fibers. If someone is conscious (even sleeping), however, there is always an underlying level of automatic activity in their muscle fibers to maintain the resting tone of their muscle. Part of the role of your spindles is to help your muscles be ready for what is needed without being overly active and wasting metabolic resources. This resting tone keeps our muscles ready to respond and automatically adjusting for slight shifts in weight and balance when we sit, stand, and walk.

In the fields of fitness and movement training, the words *lengthen, relax,* and *stretch* are used in many ways. *Lengthen* and *relax* are not the same thing in the context of muscles. A muscle can lengthen and be active (an eccentric contraction), can lengthen and be relatively inactive (a relaxed muscle), or can lengthen and gradually change from active to inactive or vice versa. In any of these situations, your muscle lengthens because an outside force (such as the pull of gravity or the pull of another muscle) acts more strongly than the muscle being lengthened. Lengthening a muscle does not necessarily mean relaxing it.

Origin and Insertion Fallacy

The places where muscles attach to bones are often classified as being the *origin* and the *insertion* of our muscles. The origin is the attachment that is closer to our torso or the center of our body, and the insertion is the attachment that is farther from our center, closer to our fingers, toes, skull, or coccyx. The underlying implication is that the origin is the fixed point and the insertion is the point that moves; however, this is only true for some of our movements. Any time we move our torso through space, we reverse the so-called origin and insertion points.

This classification of attachment points might imply that muscles develop from one point to another and they somehow grow from the origin toward the insertion. Embryologically, however, they do not do this. Instead, clusters of future muscle cells migrate to the area of their future home and organize themselves once they get there. It is not a linear point-to-point process at all.

It is also important to distinguish between *stretch* and *lengthen*. If *stretch* implies a particular quality of sensation in your muscle, then it is not interchangeable with *lengthen*. It is possible to lengthen a muscle without a stretching sensation—most of us do it all the time. Actions such as walking, talking, or picking up a cup all involve lengthening and shortening muscles, often without any particular muscular sensation at all. *Stretching* is the sensation that we get from our spindles when they are also signaling our extrafusal muscles to contract and shorten the muscle. If our goal is to increase the functional length of a muscle, seeking the sensation of stretch might have the opposite effect. More pulling generates more sensation, not necessarily more length.

MUSCLE RELATIONSHIPS: PAIRS, LAYERS, AND CHAINS

No muscle works in isolation; all muscles in the intricate web of your muscular system constantly engage with each other to balance, reinforce, modify, and modulate one another through the matrix of your connective tissue.

The relationships between muscles can be organized in a variety of ways. Drawing on the approach to muscle reeducation used in the somatic practices of Body-Mind Centering and the Bartenieff Fundamentals, we can explore how muscles balance each other in *pairs* around a single joint, how the *layers* of muscle have different effects as they shift from deep to superficial, or how *kinetic chains* of muscle and connective tissue integrate your limbs and torso.

Agonist–Antagonist Pairs

One of the common paradigms for organizing muscles is into agonist–antagonist muscle pairs. This perspective is oriented around specific joint actions and the muscles that create and modulate those joint actions.

The starting place is a specific joint, the focal joint, and a specific joint action. For every joint action there are muscles that create the movement and muscles that oppose the movement. The muscles that create the joint action are called your agonists, or prime movers, and the muscles that create the opposite joint action are called your antagonists.[3] When one muscle of the pair acts, the other muscle receives a message to respond and modulate. This relationship is called reciprocal innervation or reciprocal inhibition. These pairs of agonist–antagonist muscles often have direct relationships in your nervous system at the level of the spinal cord, though some are paired through repeated movement patterns that are recorded in your brain rather than your spinal cord.

Agonist and antagonist roles are relative, and they change as the focal joint and the joint action change. These terms do not describe an absolute quality inherent in the muscle itself, but something about its relationship to another muscle during a specific moment at a particular joint. Whether a muscle is an antagonist or an agonist depends on which joint and which joint action are the points of focus and where the main resistance to the movement is found (figure 3.7).

Sometimes, even in a simple movement, the antagonist for the first part of the movement becomes the agonist in the second part of the movement. For example, when your arm is extended out to the side, parallel to the floor, and your elbow is flexed so that your hand moves toward your shoulder, in the first part of the movement (bringing your forearm perpendicular to the floor), the triceps brachii is an antagonist to the action of your biceps brachii. In the second part of the movement (bringing your forearm from perpendicular to your shoulder), your triceps brachii is the agonist, acting eccentrically.

The muscles that support and modulate the action of the agonist or antagonist muscles are called synergistic muscles. Your synergistic muscles also act to minimize excess movement at a joint or in one part of your body to support movement in another part. When synergists act in this way, they are also called fixators. Alternatively, the term *synergistic* is used to describe a whole group of muscles that work together to create an action. Synergistic muscles are essential for maintaining balanced joint space and for the health of your joint.

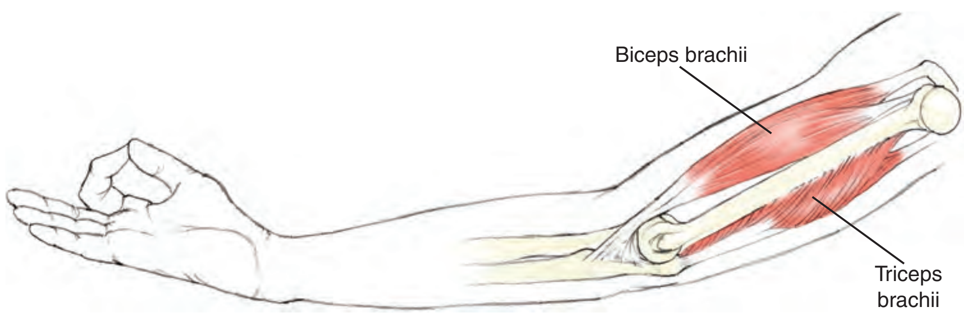


FIGURE 3.7 When the focal joint is the elbow and the joint action is flexion against gravity, the biceps brachii is the agonist, and the triceps brachii is the antagonist.

3. The word *agonist* comes from a Greek word meaning “contender” or “contestant.” *Antagonist* comes from the Greek word for “opponent.”

Organizing muscles into agonist–antagonist pairs is useful when looking at a specific action at a single focal joint. To consider how multiple joints relate to each other, it is important to examine other kinds of relationships between muscles.

One-Joint and Multi-Joint Muscle Layers

Muscle groups and individual muscles have layers. In the limbs, the deepest layers are closest to your bones, and the superficial layers are closer to your skin. In the torso, however, some of the deepest layers of muscle are deeper than your bones, and they are closest to your thoracic, abdominal, or pelvic cavities and organs.

Different muscles can cross different numbers of joints. Some can cross 1 joint, and some can cross 2 joints; some muscles in your hands and feet cross 8 or 9 joints, and some muscles in your spine cross 12 to 15 joints. Your diaphragm has an effect on over 100 joints. It crosses some of those directly and affects others by way of fascial and skeletal connections.

The deeper the layer of muscle or muscle tissue, the shorter it is (with a few exceptions).[4] The shortest, deepest layers of muscle that cross one joint are called monoarticular, or *one-joint muscles*. These one-joint muscles perform specific actions and support articulation and discrimination at each joint. They are essential for the integrity and alignment of individual joints.

As your muscle layers get more and more superficial, they become longer and broader, and they cross more joints. If a muscle crosses more than one joint, every time it acts it has a direct effect on all of the joints it crosses as well as an indirect effect on all of the joints in your body. These longer muscles are called *multi-joint muscles* if they cross two or more joints. The multi-joint muscles connect all the parts of your limbs, and they integrate your limbs into your torso. They give us the ability to negotiate large shifts of weight and movement of our whole body through space. In the diaphragm, they coordinate sophisticated shape changes in our torso.

Every joint has both one-joint and multi-joint muscles that surround it. Every joint has the possibility of discrete and specific movement and the potential for being integrated into a flow of movement that travels through your whole body.

When we forget that we have the potential to move with specificity and articulation in every joint, we might never find some of the movement possibilities that are available to us. When we use only bigger and more superficial muscles, we work too hard. On the other hand, when we focus only on our deep one-joint muscles, we can forget to look at the whole picture of movement. All the layers are essential for healthy and efficient joint movement.

Kinetic Chains of Muscles

In addition to examining specific muscles around a single joint or the layers of muscles from deep to superficial, we can also consider how our muscles work together in kinetic chains. In this case, we no longer consider individual muscles but instead look at the ways they are linked by connective tissue into long chains of dynamic action.

4. Exceptions are as follows: the extensor digitorum brevis in both your hands and feet, which lies on top of the extensor digitorum longus, and the psoas minor in your torso, which runs along the surface of the psoas major. Your psoas major and your diaphragm are also some of the deepest muscles in your body, and both cross many joints.

Whenever you engage a single muscle, it has an effect on the rest of your body by way of your connective tissue. From anywhere in the body, movement follows a kinetic chain from one muscle to another through the direct relationships of connective tissues that link your individual muscles and through the sensorimotor pathways of your nervous system that sequence the firing of your muscles.

Never in life do we use a single muscle to do a task. In an efficient, integrated movement, we engage enough muscles to produce sufficient power for the task without expending too much energy or recruiting so many muscles that we get in our own way. Becoming aware of the variety of ways that muscles relate to each other might help us find more supportive images of how our muscles work and more ways to explore asana.

FUNDAMENTAL PRINCIPLES OF SKELETAL MUSCLES

The following are basic ideas on how muscles work in relationships with your bones and nerves. Understanding these principles can help to cultivate an awareness of the complexity and sophistication of your muscular system. This awareness might also prevent the oversimplifying that is so limiting to our movement choices.

Bones support weight; muscles move bones. There is an enormous difference between how your muscles work when they are moving your bones into place to take weight and how they work when they are attempting to hold the weight themselves. When your muscles take on a weight-bearing function, they can overwork and become rigid and fixed. If your bones bear weight instead, your muscles can stay constantly moving and can continuously make microadjustments to create efficient movement and dynamic stillness along an entire pathway of weight.

> A difference also exists between the weight traveling clearly through your bones and the weight passively hanging in your joints. When we hang in a joint (by intentionally letting go of any muscular support around the joint), the ligaments around that joint must negotiate the weight, and the weight might not translate clearly from bone to bone.

Muscles work best when they can calibrate tone. One basic definition of the word *tone* is “readiness to respond.” A tissue that has high tone needs less stimulation before a response is elicited because the tissue is more prepared to respond. On the other hand, a tissue with a lower tone needs more stimulation before a response happens. Although it is related, this is not the same thing as sensitivity. A tissue can be sensitive and have low tone. It might register a stimulus at a very fine level but not react until it receives a great deal of that stimulus. Alternatively, a tissue can have high tone and low sensitivity, where it is ready to respond but not actually responding because it isn’t picking up stimulus.

All tissues need to be able to change tone in response to changes in the environment, both internal and external. The important thing is not the absolute state of tone but your tissue’s ability to adapt.

If the tone of a muscle or group of muscles is too low when a muscle is needed to participate in a task, it might not be readily available and other muscles must compensate. This can lead to imbalances in your joint space, ligament sprains, and muscle strains. On the other hand, if a muscle or group of muscles is too high in tone, the muscle tissue burns more energy than is necessary, is more likely to overwork, and potentially creates imbalances in your joint space that lead to injury.

Because of the proprioceptive organs (spindles) in muscles, muscles are able to calibrate their tone to a sophisticated degree. This means that they can be incredibly efficient about using just enough effort to get the job done.

Muscles calibrate tone and cultivate awareness through negotiating resistance. One of the things that spindles sense is what happens in your muscles when they meet resistance. They then use that information to set the level of tone for your muscles so that each muscle can meet or match the resistance it encounters.

Muscles build tone by meeting greater and greater amounts of resistance. Resistance is an essential source of feedback for your proprioceptors and is based on sensing the relationship between the muscle tissue and the source of resistance (often gravity). When a muscle has the opportunity to engage with many different degrees of resistance, it learns to adapt and calibrate its level of tone.

When there is no resistance, the nerve endings in your muscles get no feedback, and your muscles don't have the ability to use your nerves to sense changes in tone or to make finely tuned adjustments to your muscle tone.[5]

Muscles pull, they don't push. In a concentric contraction, the pulling power of your muscle is greater than the resistance. In an eccentric contraction, the pulling power of your muscle is less than the resistance. In an isometric contraction, the pulling power of your muscle is exactly the same as the resistance. In all of these cases the muscle is firing, and the molecules in your myofibrils are ratcheting together to pull. Your muscle is never actively pushing the fibers in a way that slides them apart—that happens because the resistance is greater than the pulling force being generated.

So, how is it that we can push something away? Any joint movement includes a part that is lengthening and a part that is shortening. Whether or not your joint is flexing, extending, or rotating, some muscles are lengthening and some are shortening. Your shortening muscles are concentrically contracting; your lengthening muscles are in various degrees of relaxation or are eccentrically contracting.

Flexibility and strength are expressions of the relationship between your nervous system and your muscles. A classic definition of flexibility is the ability of your muscle to lengthen, and a classic definition of strength is the ability of your muscle to generate force and speed. Both flexibility and strength in your muscles are functions of your nervous system as much as they are functions of the ability of your muscle fibers and connective tissues to adapt in length.

In most situations, flexibility is not determined by the actual physical length of your muscle or of your muscle fibers that compose that muscle. The resting length of your muscle, its tone, and the amount it will lengthen are all the result of the communication

5. Our nerves are not the only way that we get information about our body. Cells are able to communicate with each other directly and through the fluid systems of our body; juxtacrine, paracrine, and endocrine signaling are examples of this.

between your spindle, your central nervous system, and the extrafusal fibers in your muscle. This communication creates patterns in your nervous system based on previous experiences regarding what is appropriate, safe, and functional.

The strength of a muscle is dependent on its physical properties, including the actual number of muscle fibers. Muscle strength is also a product of the way that your nervous system recruits fibers and organizes your surrounding muscles and kinetic chains. When your nervous system is inefficient in the way it recruits and organizes muscles, it diminishes the functional strength of a muscle by creating a situation in which your muscle has to exert effort to overcome resistance from other muscles in the body. Increasing flexibility and strength is a process of reeducating your nervous system through conscious attention and practice as much as it is about stretching and repetitions.

CONCLUSION

Muscles surround joints and wrap around bones in sophisticated spiraling layers. Embryologically, muscles follow fluid pathways from the center of your body out into your limbs. The three dimensionality of the pathways of your muscles allows nuanced effects on the bones that they move.

In a three-dimensional paradigm, it is clear that for each person, their muscles weave together into unique patterns of dynamic lengthening and shortening that create the movements of daily life such as walking and talking, opening a bottle, or brushing their teeth. What creates integrated movement for one person is not the same pattern that creates integrated movement for another.

What happens when we expect that in any given situation every person will use their muscles in the same way? That there is a “correct” sequence of muscle actions that perform a movement? That this way works for every person? And that working harder makes a person stronger?

If we assume that we can generate a final and complete analysis of the unique and complex sequences of muscular action that are expressed in each person’s movement choices, we might very well create obstacles and limit the ways that new choices can arise. If we instead observe with a mind open to possibilities, examining each person’s pattern becomes an opportunity to witness the incredible variety of ways that we can successfully execute the simplest actions.

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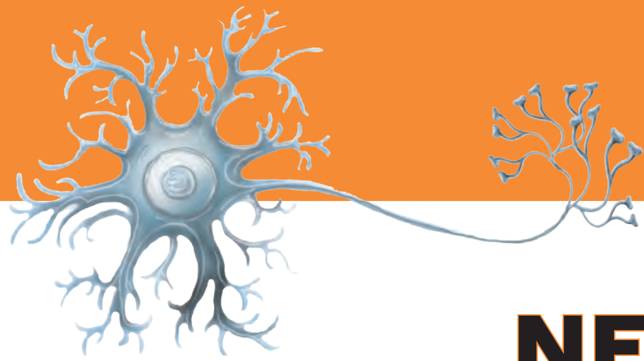

NERVOUS SYSTEM

A simple movement such as lifting your arms overhead with an inhalation is an intricate dance of muscles and bones, organs and nerves. It requires a complex coordination of skeletal muscles to move your arms and shoulder girdle. It requires changes in circulation to ensure that those muscles have the blood supply to move your bones, the internal calibration of your heart rate and blood pressure to keep blood circulating in your uplifted arms, and the lengthening or shortening of your breath to match the movement. It also requires an assortment of mostly automatic balance adjustments in your spine, ankles, and feet (which happen in response to any movement).

These internal processes are interdependent: Changing one affects all the others. It takes an incredible amount of communication, calibration, and coordination among our cells, tissues, organs, and body systems to keep these processes in a dynamic relationship to each other.

We also constantly respond to our external environment: adapting to changes in terrain and temperature, judging when to move toward something and when to run away, relating to our community and culture. Changes in our external environment cause changes in our internal environment, and changes in our internal environment color our response to the world around us.

Communication and choice-making are essential activities for survival in an organism of any size; even a single-celled bacterium adjusts its behavior in response to changes in its internal and external environments. As multicellular creatures have evolved to survive and thrive in a wide variety of environments, our tools for communicating and for making choices about how to respond have grown in complexity as well.

We have evolved several ways to physically maintain the communication and decision-making in our body that keeps us alive and constantly moving, learning, and growing. One of these is the network of cells that we call our nervous system: We use this system to sense what is outside and what is inside of us, coordinate what happens inside our bodies, and make choices about what actions to take in response (sometimes consciously, sometimes unconsciously). In this chapter, we look at how the nervous system plays its part in communication and at the many maps we have for understanding it.

NERVOUS SYSTEM MAPPED BY LOCATION

There are many ways to map out ideas about how the nervous system works. A frequent starting point is to organize things by where they are located:

- The *central nervous system*, or CNS, is made up of the cells (and parts of cells) in the brain and spinal cord.
- The *peripheral nervous system,* or PNS, is made up of the cells and parts of cells that are outside of the brain and spinal cord. (Some cells of the nervous system have one part in the CNS and another part in the PNS.)
- The *enteric nervous system,* or ENS, is sometimes categorized as its own system and sometimes included as part of the PNS. It is made up of cells that are outside of both the CNS and the PNS. (More information about the ENS is on page 44.)

In addition to a location-based map of the nervous system, there are several ways we attempt to explain *how* the nervous system works. To talk about how, we'll start with cells and how they communicate.

COMMUNICATION BEGINS IN THE CELL

Cells gather information about their environment and then communicate with each other by either directly pushing and pulling on each other or by sending signals in the form of molecules to each other. These molecular signals can travel through membranes that are touching or via the fluid that immediately surrounds the cells. In human bodies, this communication continuously happens as a kind of local conversation in our cells, tissues, and organs. Wound healing, for example, involves a great amount of local communication in our tissues, as does day-to-day growth and maintenance.

We've evolved a variety of ways to use the molecular signals created by cells to communicate throughout our body and to coordinate local conversations into systemic responses. This body-wide communication and coordination of responses happens in our endocrine, nervous, and immune systems, which are deeply interdependent and could be considered one unified system for maintaining homeostasis.[1]

In the early weeks of our development as embryos, our cells communicate with each other directly and through the fluid environment immediately surrounding the early cells. Our nervous system doesn't develop until several weeks into our embryological development. Everything that happens before the development of our nervous system is influenced by the communication between our cells and fluids.

Eventually our endocrine, immune, and nervous systems develop and add to the local communication happening in the cells, fluids, and tissues. This local conversation continues throughout our lives.

1. *Homeostasis* is the term used to describe a precise range of conditions needed in our internal environment in order to survive. The interdependent adaptability and responsiveness of our endocrine, nervous, and immune systems collaborate with ongoing cellular communication in our tissues and organs to maintain this range, which allows us to survive in a variety of external environments.

Each system communicates in a different way:

- In the endocrine system, cells create molecular signals that travel in the bloodstream to carry messages throughout the body.
- In the immune system, immune cells themselves (and the signaling molecules they create) travel through the body, communicating with different tissues and organs.
- In the nervous system, the cells have grown into networks that create specific and targeted communication over great distances as well as complex multilayered communication in central areas.

NERVE CELLS AND SYNAPSES

The cells of the nervous system are divided into two main categories: neurons and glial cells (or neuroglia). Both glial cells and neurons are essential to the specialized tasks of the nervous system: transmitting messages over long distances, and creating pathways, circuits, and networks of communication that lead to complex acts of processing, evaluating, learning, and memory.

Neurons and glial cells use synapses to communicate with each other and with other tissues in the body such as muscles and glands. A synapse is a membrane-to-membrane relationship between two cells, usually with a tiny gap between the membranes that is called the synaptic gap. Signals that stimulate or inhibit activity are transmitted across the synaptic gap by signaling molecules called neurotransmitters (figure 4.1).

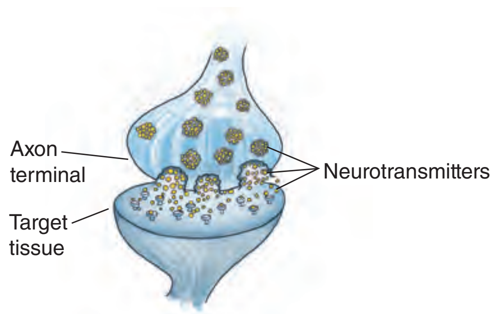

FIGURE 4.1 A synapse showing the end of an axon releasing signaling molecules (called neurotransmitters when released from a neuron or glial cell) and its target tissue, which could be another neuron or glial cell, muscle or glandular tissue, or extracellular space such as the bloodstream.

Synapses are described as having plasticity, which means their signals are strengthened or weakened in response to how much they are used. This plasticity can happen quickly (milliseconds to minutes) or over a more extended time (minutes to hours) and creates positive and negative feedback loops that can encourage or inhibit patterns of activity.

The plasticity of our synapses plays an essential role in our ability to learn, change, adapt, and create memories. It is also key to understanding why our responses to the same activity can change over time as well as vary from person to person.

Have you ever noticed that doing yoga feels different in the morning than in the evening? Or that the same asana can feel different from one day to the next? Or even that the same movement feels different when it follows different asana? There are many reasons for the differences you feel, and one of them is the plasticity of your synapses.

Synaptic plasticity also means that what you pay attention to consistently might come to have a stronger signal and be easier to feel, and what you don't attend to might not. Of course, a huge amount of the synaptic activity in your CNS is in response to things that you aren't conscious of (and don't need to be), so a synaptic pattern might be strengthened or weakened in response to many more factors than just your attention.

Glial Cells

Glial cells are a group of cells that play a variety of roles in the nervous system: creating synapses and facilitating communication, supporting homeostasis, supplying nutrients and oxygen to neurons, and providing immune functions for the brain and spinal cord. (Current research is revealing that glial cells play many more active roles in our nervous system than previously thought.)

Glial cells (figure 4.2) are divided into six groups:

1. Astrocytes are star-shaped cells that connect to each other and to neurons, blood vessels, and membranes in the brain and spinal cord. They play many roles in creating and modulating signaling networks in the CNS, including stimulating synapse creation, influencing (stimulating and inhibiting) synaptic activity, providing nourishment to neurons, and regulating blood flow in the brain.
2. Oligodendrocytes wrap around neurons in the brain and spinal cord (the CNS). This wrapping (called myelin) supports the neurons and facilitates the propagation of neuronal signals over long distances.
3. Microglia closely monitor the activity of the brain and spinal cord and provide immune functions such as removing dead and damaged cells and triggering inflammatory responses in the CNS when needed. They are closely related to white blood cells in the PNS.
4. Ependymal cells are cells in the CNS that line the inner surfaces of cavities in the brain and the central canal of the spinal cord to produce and regulate cerebrospinal fluid (and other functions).
5. Neurolemmocytes (Schwann cells) in the peripheral nervous system (PNS) wrap around the long parts (axons) of neurons (like the oligodendrocytes in the CNS). In some cases, these wrappings form myelin sheaths that help neuronal signals travel more quickly, efficiently, and predictably. In the PNS, neurolemmocytes also play a role in healing nerve damage.

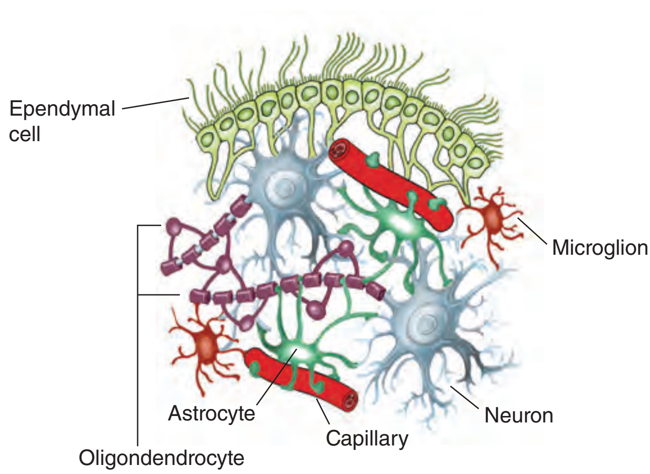

FIGURE 4.2 Cells in our brain and spinal cord include astrocytes, oligodendrocytes, microglia, ependymal cells, and neurons. Some say there are more glial cells than neurons in the nervous system; others say the numbers are equal.

6. Satellite cells are also located in the PNS. They cover the surfaces of neuronal cell bodies in ganglia (groups of cell bodies). They protect and provide nutrients to the neurons and play roles in modulating the communication that happens in the ganglia (like astrocytes in the CNS).

Neurons

Neurons (figure 4.3) are specialized cells that rapidly send messages over long distances: A single neuron might have a synapse in your spinal cord and another synapse in your little toe. A neuron might also have hundreds or thousands of synapses with other neurons and glial cells in ganglia[2] and the neural networks of your CNS.

There are three types of neurons:

1. Sensory neurons carry messages about sensory stimuli from our tissues and sensory organs to the brain and spinal cord (CNS). These are also called *afferent neurons* because the direction the message travels is toward the CNS.
2. Motor neurons carry messages about what actions to take. These messages travel from the brain and spinal cord to the effector organs (mainly muscles and glands). These are also called *efferent neurons* because the direction the message travels is away from the CNS.
3. Interneurons carry messages between neurons; there are more interneurons than sensory and motor neurons, and they are all located in the central nervous system. Interneurons and glial cells create neural circuits and neural networks between sensory neurons, motor neurons, other interneurons, and other glial cells to support complex processes such as memory and learning.

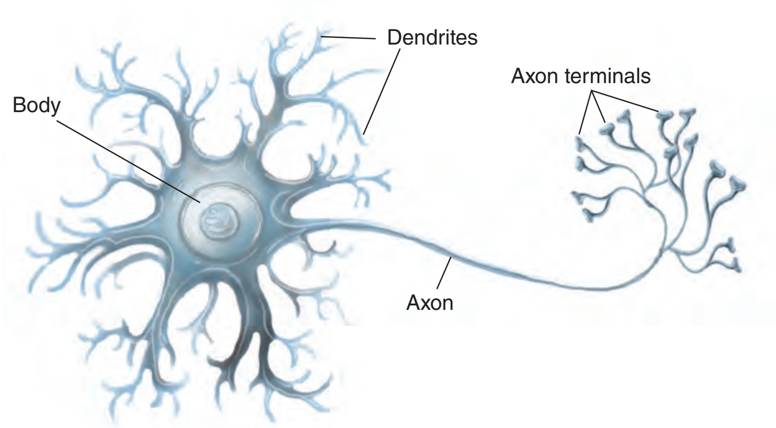

FIGURE 4.3 The word *neuron* derives from the words for sinew, cord, and fiber. Neurons are visually characterized by their long extrusions and many branches, which are called the axons and the dendrites of the neuron.

2. A ganglion is a place where a collection of neurons and glial cells group in your peripheral nervous system. (A plexus is a network of interconnected ganglia.)

SENSING, PROCESSING, AND MOTORING

> Due to the plasticity of our synapses, the continuous and overlapping cycles through sensing, processing, and motoring in our nervous system create both positive and negative feedback loops that can amplify or diminish our responsiveness to stimuli.

All the cells of our nervous system work together to pick up sensory input, process it, and generate a motoric response. Each motor response creates new experiences to sense, which leads to more processing and more responses. This cycle is called a *sensory–motor loop*; it happens constantly and continually in order to make the precise adjustments needed for us to survive, adapt, learn, and grow throughout our lives.[3]

Sensing

Sensory neurons (and associated glial cells) receive input about what's happening inside your body and in the external environment from many different tissues in your body. This sensory input can be categorized in a variety of ways. Two commonly used categories are based on *where* the sensory input comes from and *what kind* of stimulus the sensory input is.

Where It Comes From

Exteroceptors[4] are sensory neurons that are stimulated by input that comes from outside your body. These include the following:

- Photoreceptors in the eyes
- Mechanoreceptors in the ears and vestibular mechanism
- Chemoreceptors in the nose and mouth
- Thermoreceptors in the skin
- Mechanoreceptors for touch and pressure in the skin

Interoceptors are sensory neurons that are stimulated by input that comes from inside your body, specifically the tissues not involved in volitional movement. These include mechanoreceptors, chemoreceptors, and thermoreceptors in our visceral organs and blood vessels.

Proprioceptors are sensory neurons that are stimulated by input created by our own volitional movement or potentially volitional movement, including movements that might be done unconsciously, such as balancing. Proprioceptive input comes from the mechanoreceptors in our skeletal muscles and tendons and the joint capsule and collateral ligaments.

3. The endocrine system and immune system also gather information throughout the body, and all three systems (endocrine, immune, and nervous) use shared information to process, plan, and execute each system's response.

4. Charles Sherrington coined the terms *interoception*, *exteroception*, *proprioception*, and *nociception* in his 1906 book *The Integrative Action of the Nervous System*.

What Kind of Stimulus

Mechanoreceptors are stimulated by mechanical forces such as pressure, movement (displacement or change in position), vibration, and tension (sometimes called distension or stretch). Sensory neurons have receptors for the following:

- Light touch and crude touch (in the skin)
- Deep pressure (in the skin, joints, and bones)
- Tension, distension, or stretch (in the muscles, tendons, visceral organs, arteries, ligaments, and fascia)
- Displacement (in the joint capsules and collateral ligaments)
- Vibration (in the ears and vestibular mechanism)

> Currently, *proprioception* is often used in a more general way to mean our "sense of self." If used in this way, the term includes the sensory input usually described as interoception and exteroception because all of these sensations could contribute to our sense of self. *Interoception* has gone through a similar shift in meaning, and in some areas of study is used to mean much more than simply the sensory input from inside our body.

Thermoreceptors are stimulated by changes in temperature and include sensory neurons with receptors in our skin and blood vessels.

Chemoreceptors are stimulated by chemical changes both outside and inside our bodies. These include sensory neurons with receptors for the following:

- Odor (in the nose)
- Taste (in the mouth and lining of the gut)
- CO_2 levels (in the walls of the blood vessels in the aorta and carotid arteries)
- Hormones (in the brain stem)

Photoreceptors are stimulated by light and include receptors in our eyes.

Nociceptors (pain receptors) are stimulated by intense and potentially damaging stimuli (pain) that might be mechanically, chemically, or thermally induced. It's proposed that these sensory neurons can be found in many different tissues. [5]

Processing

Processing is a general term for what happens in ganglia and in our CNS when groups of neurons and glial cells engage in multiple overlapping and interconnected communications. The processing that happens in our ganglia ranges from basic monitoring and transmitting to complex evaluation and responses (on a smaller scale than what happens in our brain and spinal cord).

5. There are significant questions about whether nociceptors are their own category of receptor, or if pain is a degree of sensation that could be registered by many kinds of sensory receptors. Research into pain is a major area of study, with a wide range of proposals about what it is, how we process it, and how to prevent it.

What we don't know about how the brain works is far more than what we do know. One estimation is that we understand about 15 percent of what there is to comprehend about how the nervous system does what it does.

In our brain and spinal cord, the sensory stimuli from any particular tissue or organ joins all the other sensory stimuli coming into the CNS. These sensations combine with our previous experiences, expectations, hopes, dreams, and fears to participate in the activities of processing: interpreting, considering, comparing, remembering, evaluating, planning, projecting, and choosing. This becomes the motor planning that leads to taking action and responding.

Motoring

Motor neurons (and the glial cells associated with them) travel into the tissues of our body carrying responses (motor impulses) generated by the processing that happens in our brain, spinal cord, or ganglia. These motor impulses are most often signals to stimulate or inhibit muscular contractions or to stimulate or inhibit the secretion of signaling molecules such as hormones or neurotransmitters.[6]

The processing of interneurons and glial cells almost always modulates the relationship between sensing and motoring. There are a few places in our nervous system where a motor neuron is directly stimulated by a sensory neuron, mainly in reflex arcs in the spinal cord and in some enteric ganglia. (Even in the spinal cord reflexes and the enteric ganglia, our CNS receives sensory input about the event so that what happens contributes to the overall processing of experiences.)

LEARNING MOVEMENT

A tremendous amount of our sensing, processing, and responding happens before we are aware of it and isn't under our conscious control. We don't directly control how fast our heart beats, the activity of our digestive system, or how our kidneys regulate our fluid levels. We can influence these things through our physical activity or what we eat or drink, but we don't consciously control them.

There are also many things that we might consciously learn and practice that then become habits: walking, talking, riding a bike, driving a car, balancing on a moving train, or doing a vinyasa after many repetitions. These activities eventually function most efficiently when they happen unconsciously. Our ability to sense, process, and respond without paying attention is an important aspect of skillfulness in movement as well as essential to our survival. If we had to consciously process and plan every step of breathing or digesting or even walking, we wouldn't have the capacity to do anything else.

Our movements happen as a result of the processing activities of our brain, spinal cord, and ganglia. And that processing is constantly being informed by sensory input

6. Motor neurons are not the only ways to stimulate secretion and muscular contractions: Secretion can also be stimulated by endocrine and immune signals, and muscular contraction in the smooth muscle is generally stimulated by nerve impulses but propagated within the muscle by cell-to-cell communication.

as well as our context: our history, our hopes, our values. Learning a new movement (or trying to change a habitual movement pattern) involves the whole cycle of sensing, processing, and motoring and is different for each of us because we each have a different context.

A sensory stimulus might be processed by one person as safe and comforting and by another person as alarming and dangerous. The same stimulus might then lead to very different responses and emotional states. We can learn to change our interpretation of a stimulus, and whole groups of people can learn to have the same response to something, but it's highly problematic for a teacher to assume that everyone in a room will have the same response to a suggestion.

Sensing, processing, and motoring in the nervous system is constantly happening and constantly influenced by what is happening around us and inside us. Because so many factors are at play, we don't directly control very much of what happens, but we can influence it in many ways through what we practice as habits of movement, thought, and emotion and how we nourish ourselves and balance rest and activity.

SOMATIC, AUTONOMIC, AND ENTERIC NERVOUS SYSTEMS

Another map of the nervous system is based on the kinds of motoric responses that happen: what tissues are engaged and what the results are in our body. (This result-based organization of the nervous system overlaps with the location-based map of the CNS, PNS, and ENS and the function-based map of the sensory–motor loop.)

The *somatic nervous system* (SNS) creates responses in our musculoskeletal system, specifically in the striated muscles that we use to move, breathe, and act in the world. The SNS is what we use to do actions such as stepping one leg back or opening our mouth or flinging our arms out when we lose our balance.

The *autonomic nervous system* (ANS) creates responses in the smooth muscle of our visceral organs, the cardiac muscle of our heart, our blood vessels,[7] adipose tissue, and glands. The ANS increases or decreases activity in our glands and organs in patterns that are called sympathetic responses and parasympathetic responses, and most of our glands and organs receive messages from both sympathetic and parasympathetic motor neurons (figure 4.4).

Sympathetic responses increase our alertness and readiness to respond to events in the outside world by increasing our heart rate and blood flow to our skeletal muscles and brain or by slowing activity in our digestive system. Sympathetic responses are often characterized as a whole-body, fight-or-flight response, but this is only an extreme expression of sympathetic activity. In nonthreatening day-to-day activities, sympathetic responses can be modulated, discrete, and localized.

Parasympathetic responses increase internal activities related to digestion, homeostasis, growth, and healing by increasing peristalsis, glandular activity, and blood flow to our digestive system or by slowing the heart rate. Often characterized as being about resting and digesting, our parasympathetic responses are not simply the absence of

7. Because parts of the autonomic nervous system also affect blood flow to the skeletal muscles, striated muscle is also affected by the autonomic nervous system.

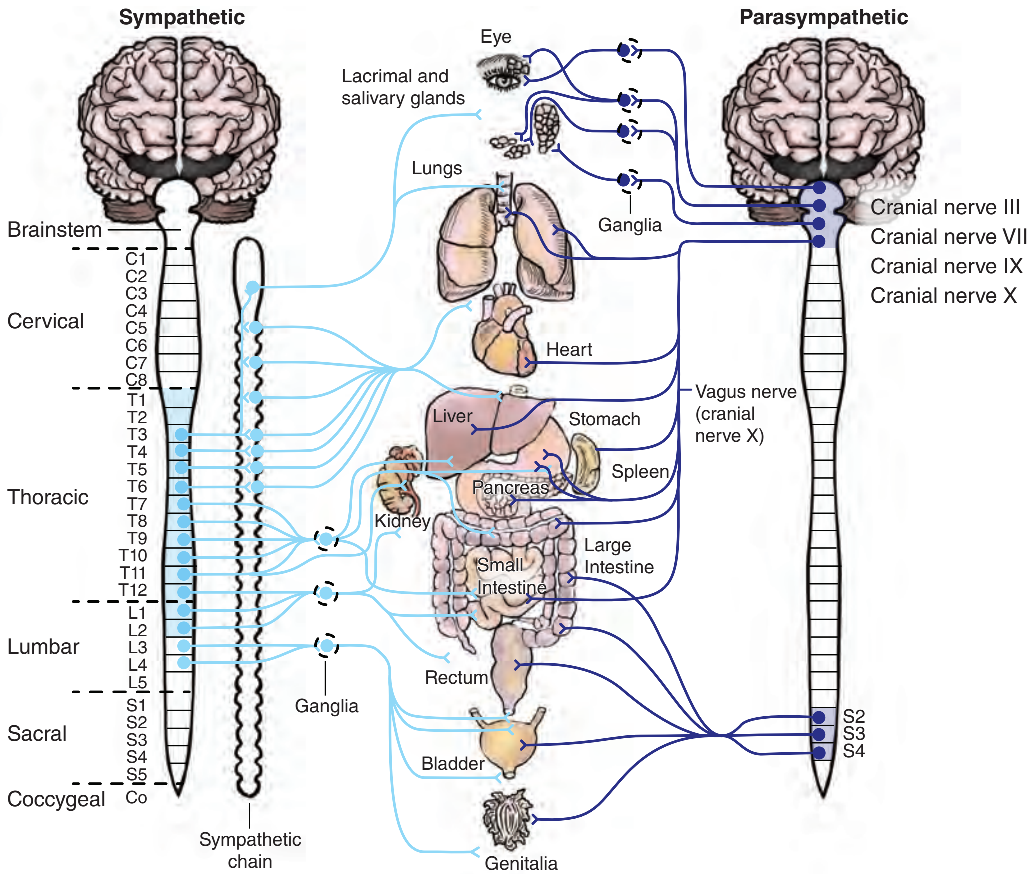

FIGURE 4.4 Tissues in the body that receive both sympathetic and parasympathetic motor impulses. Sympathetic impulses come through motor neurons that emerge from the cervical, thoracic, and lumbar portions of the spinal cord, and parasympathetic impulses come through motor neurons that emerge from the brain (cranial nerves) and the sacral portion of the spinal cord.

activity but are also active motor responses oriented to the internal environment rather than the outer world.[8]

These responses have often been characterized as antagonistic in some way as if our internal state is *either* sympathetic *or* parasympathetic. Sympathetic and parasympathetic are not all-or-nothing patterns in the body, and they do not cancel each other out. In fact, sympathetic and parasympathetic responses coordinate and modulate each other to continually adjust conditions in our internal environment in response to the various sensations coming from both inside and outside our bodies.

The *enteric nervous system* (ENS) is sometimes called our second brain because it has a network of enteric ganglia where sensory neurons, glial cells, and motor neurons

8. The parasympathetic motor nerves include our vagus nerve, which also has a sensory component. The vagus nerve travels to several tissues in our body, including our lungs, heart, digestive organs, larynx, and vocal mechanism, and it plays a role in creating systemwide changes in tone, including our heart rate variability, stress responses, and relaxation responses.

Cueing Callout: You Need Your Sympathetic Nervous System

Some yoga teachers may teach that a particular asana will help "bring up your parasympathetic nervous system" or "calm down your sympathetic nervous system." These statements are problematic because we can't function without the activity of our sympathetic nervous system. Sympathetic responses let us listen to a teacher, move consciously, be aware of the room, and sense our movement. Anything to do with paying attention has the support of our sympathetic responses. Sympathetic and parasympathetic responses can coexist: Being restfully alert, for example, has to do with both sympathetic and parasympathetic activity.

Our sympathetic nervous system is not active only when we are stressed or anxious or nervous. It is also necessary for us to be able to have experiences of joy, calm, and ease.

And it's impossible to say with certainty the effect an asana will have on a person's internal state. Our experience of being calm or anxious or bored is the product of all our sensations, processing, and motor responses, not just the autonomic nervous system.

communicate and where sensory input leads to processing and motor responses without traveling through the CNS. The ENS creates responses specifically in the smooth muscles, glands, and endocrine cells of the digestive tract and allows parts of our digestive system to work without interaction with the brain and spinal cord.

Sometimes associated with our gut feelings, the ENS senses what is happening in the gut, and it plans and executes responses. Our enteric nervous system is not entirely separate from our central nervous system, however. Sensory input that goes to enteric ganglia also goes to our brain and spinal cord, and motor impulses come from our brain and spinal cord to the same tissues as the enteric motor impulses. Whatever we feel from our enteric nervous system is because the ENS also communicates with the CNS by both receiving motor impulses from the CNS based on what's happening in the rest of the body and by sending information back to the brain and spinal cord. Our gut feelings, if we notice them, are the product of our whole nervous system.

PUTTING THE MAPS TOGETHER

We have a variety of ways to look at the nervous system:

- By location: central nervous system, peripheral nervous system, or enteric nervous system
- By function: sensing, processing, and motoring
- By results: somatic, autonomic (including sympathetic and parasympathetic), or enteric

Figure 4.5 shows all three maps together, with arrows to show the possible pathways of communication. When we look at the maps layered in this way, we can see that most of the sensations we receive from tissues throughout our body go into our brain and spinal cord. It is sometimes the case that sensory input from one tissue connects directly to a motor response in that tissue, but more often sensations from many different parts

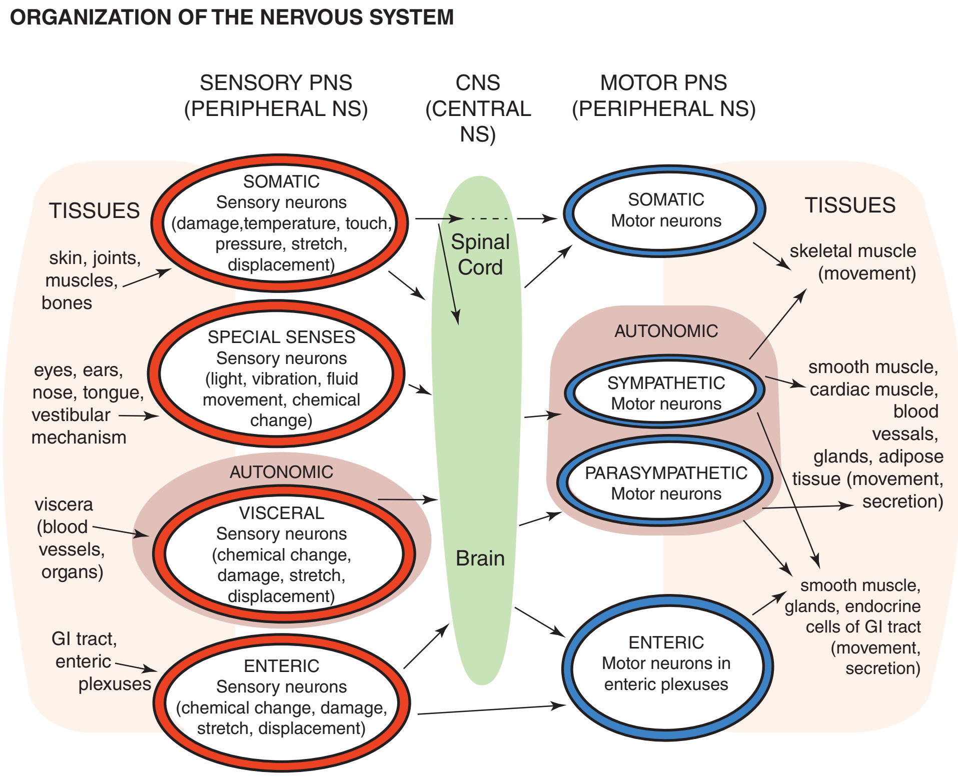

FIGURE 4.5 Layered maps of the nervous system.

of the body (both internally oriented and externally oriented) contribute to a motor response. For example, sensation from a visceral organ (autonomic tissue) might lead to a response in a skeletal muscle. Or sensation from joint capsule ligaments (somatic tissue) might play a part in a parasympathetic response in the viscera.

We can add our own context to the complexity of the communication in the nervous system. Our previous experiences, current emotions, and expectations affect the way we interpret our sensations, our processing, and our conscious or unconscious plans for motor responses. Because our individual history and context affects the choices we make, our habits of thought and movement are unique to each of us and our responses to asana or other movement experiences (or environments or situations) are particular to us as individuals.

MOVEMENT

In previous chapters, we looked at the roles that bones and muscles play in movement: The skeletal system transmits forces through the bones and joints in a variety of articulate and nuanced pathways, and the muscular system generates meticulously calibrated and adaptive movement forces. The nervous system participates with the skeletal and muscular systems by taking sensory input from throughout the body, interpreting and processing those sensations, planning movement responses, and sending coordinated messages through the body to execute those movements. As noted in the muscles chapter, these movements always involve multiple muscles working together, with the proprioceptive feedback of the spindles adjusting the tone of each muscle in the overall pattern. The nervous system is essential to the planning and execution of these patterns in our skeletal muscles.

The motor planning part of processing in the nervous system, the part that involves the recruitment and fine-tuned calibration of many different muscles, is not organized to give us conscious control of individual muscles. We do not have the ability to send a message to a single muscle to engage or to let go. Instead, our motor planning generates patterns of response that will give us the sensory feedback that we expect. That sensory feedback might be about executing a task such as shifting our weight, picking up a cup, or turning a page. When our activities of daily life are within a range of functional ease for our muscles, our sensory feedback might not include sensation (of either effort or stretch) from our muscles at all. A muscle might be working effectively without a noticeable sensation of its engagement as a part of the enormous number of activities that happen in our body without our conscious attention.

CONCLUSION

In a group of people all doing the same asana, each person will have a different experience. What is the role of a yoga teacher in this situation? Is it important for everyone to have the same experience? What if different people need different movements to find safety, for example, or joy?

The incredible responsiveness and adaptability of all the communication systems in our body enable us to continually learn, adjust, and make new choices about how to respond as we continue to encounter new situations on and off the yoga mat.

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5

YOGA AND THE SPINE

As has been stated in previous chapters, this is a book about the practice of yoga viewed through the map of anatomy. This is also a book about anatomy viewed through the map of yoga practice. We could say that this is a book about what both topics share at their root: an inquiry into how life works.

These two maps—yoga and anatomy—can be highly complementary and very powerful when we focus our efforts on improving our physical, mental, and spiritual well-being. Yoga philosophy concerns itself with the nature of universal truth and individual liberation. Human anatomy studies physical bodies to discover structures and functions we all share but express in uniquely individual ways.

No two people—not even identical twins—are exactly alike; therefore, each person's journey toward their own truth will, by definition, be unique to their individual body, circumstances, needs, and values. By focusing on the universal and particular truths of life as the foundation of both yoga and anatomy, we circle back to life's most basic building block: the cell. Starting our examination about anatomy and yoga with a microscopic cell connects us with both form and function. T.K.V. Desikachar, who was, in his day, the leading exponent of therapeutic yoga, was also a structural engineer. He was speaking in both capacities whenever he reminded us: "The form of the practice must serve its function."

YOGA LESSONS FROM A CELL

The most essential concepts in yoga can be derived from observing a cell's form and function. Anatomically, when we understand the basics of a single cell, we can understand the basics of anything made of cells, such as the human body.

Cells are the fundamental building blocks of life, from single-celled organisms to multitrillion-celled animals. Our human body, which is made up of trillions of cells, also plays host to at least an equal number of bacterial cells.[1]

This incredible multitude of cells, in all their complexity and diversity, share the same essential functions. They draw nutrition from their external to their internal environ-

1. It is not such a simple question to ask "How many cells are there in a human body?" If the answer is approximately 60 trillion, only roughly half of those cells would contain human DNA. But, because the human genome consists of only about 25,000 genes, and the combined genomes of all the varieties of bacteria in our bodies is about 500 times larger, we could accurately say that the diversity (if not the volume) of nonhuman genetic material in our bodies far outnumbers our own.

ments, metabolize those raw materials into the energy and chemistry needed for life, and eliminate waste from their internal to their external environments.

A cell is considered to have three divisions: the membrane, the nucleus, and the cytoplasm (figure 5.1). The membrane, which gives the cell form and shape, separates its internal environment, which consists of the cytoplasm and nucleus, from its external environment, which contains the nutrients it requires. A cell needs to know what to let in and what to keep out and what to keep in and what to let out. This is why a cell's membrane is described as being *semipermeable*; in other words, it needs to be both a stable boundary and an open space.

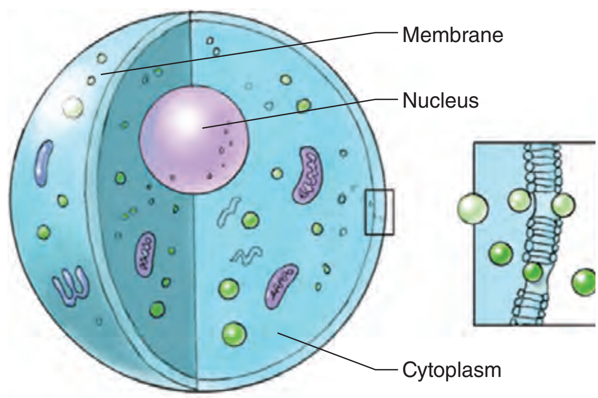


FIGURE 5.1 Our cells' membranes must balance containment (stability) with permeability.

In the language of yoga, the stable boundary is sthira, and the open space is sukha. In Sanskrit, *sthira* can mean firm, hard, solid, compact, strong, unfluctuating, durable, lasting, or permanent. *Sukha* is composed of two roots: *su* meaning good and *kha* meaning space. It means easy, pleasant, agreeable, gentle, and mild. It also refers to a state of well-being, free of obstacles.

All successful living things must balance containment and permeability, rigidity and plasticity, persistence and adaptability, space and boundaries. Successful human-made structures also exhibit a balance of sthira and sukha. For example, a suspension bridge is flexible enough to survive wind and earthquakes, but stable enough to support its load-bearing surfaces. This image also invokes the principles of tension and compression, which are intrinsic to the structure of our spine.

Sukha also means having a good axle hole, implying a space at the center that allows for smooth function. Like a wheel with an axle hole at its center, a person needs to have good, centered space, or functional connections become impossible.

As we will illustrate throughout the next two chapters, these terms will provide a powerful lens through which we can bring into focus key elements of both anatomy and yoga out of a sea of possible details. The ancient people who originated the terms sthira and sukha did not know about cells, but they were skilled observers of living systems, which are of course made from cells. What allows an individual cell to thrive is what allows anything built from cells to thrive: *ingesting*, *metabolizing*, *eliminating*. It makes sense to have broad concepts for those activities, and the ancients gave us *prana*, *agni*, *apana*. These yogic concepts related to the functional activity shared by all life will be explored more deeply in the next chapter, which focuses on breathing.

AS BELOW, SO ABOVE

The idea that the nature of a microcosm may reflect that of a macrocosm (and vice versa) is not a new concept. During this exploration, we focus on the more tangible range beginning at the small end with cellular components and extending to observable individual and social structures. Yoga practice offers a perspective on how we can bring any of our living relationships into a state of balance, and this chapter examines one of nature's most elegant solutions to the contrasting engineering demands of *sthira* and *sukha*: our human spine.

PHYLOGENY: A BRIEF HISTORY OF THE SPINE

What is the spine? Why do we need one? Why is yoga asana and breathing practice so focused on our spine? To answer questions like these, we need to understand the basics of how the central nervous system, with its complex physiological, sensory, and motor functions, evolved over millions of years and became essential to survival.

Imagine a cell floating around in a primordial sea of fluid, surrounded by nutrients ready to be assimilated across its membrane (figure 5.1). Now imagine that the nutrients become less concentrated in some areas and more concentrated in others. The more successful organisms are the ones that develop the ability to reach nutrients by changing their shape. This was probably the first form of locomotion; the pseudopod in figure 5.2 is an example of a simple cell with that ability and how changing shape became a survival method.

FIGURE 5.2 A cell changes shape and extends into a pseudopod.

It is not too difficult to see how moving around became more and more valuable to these organisms, so a pseudopod eventually refined itself into a specialized organ, such as the flagella pictured in this bacterium (figure 5.3).

FIGURE 5.3 Bacterium with flagella.

At that point, rather than passively floating around in their environment, these primitive forms of life were able to actively seek the nutrients necessary to their survival. One benefit of mobility, in addition to being able to seek food, is to avoid becoming food for other organisms. Here we can see a biological foundation for the yogic principles of *raga* and *dvesha* (attraction and repulsion). Seeking the desirable and avoiding the undesirable are fundamental activities of all living things, and evolving life responded to these imperatives with ever more complex adaptations. As an organism's sensitivity and response to its surroundings became more complicated, it reached a point at which these activities required central organization and guidance.

FIGURE 5.4 A platyhelminth worm, with its rudimentary central nervous system.

Figure 5.4 shows a parasitic worm with a flattened body called a *platyhelminth*, and in it we see the development of a rudimentary central nervous system. It exhibits a cluster of primitive nerve cells at the top and two nerve cords running down its length. Worms are invertebrates, but in their descendants, these rudimentary nerve cells evolved into the brain, spinal cord, and the rest of the nervous system. All of these required the corresponding development of a structure that allowed for free movement but was stable enough to protect the vital yet delicate tissues of our central nervous system: a skeletal spine.

In sea creatures such as a fish (figure 5.5), the shape of the spine is consistent with its environment: water surrounding on all sides, exerting an equal amount of mechanical pressure from top to bottom and side to side. As a fish employs its head, tail, and fins to propel itself through the water, the spinal movements are oriented laterally (from side to side).

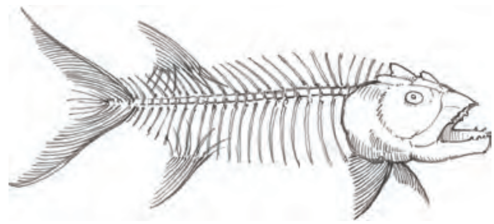


FIGURE 5.5 Fish with a straight spine.

This lateral spinal undulation was preserved even when aquatic creatures made the enormous evolutionary leap to terrestrial life. Figure 5.6 demonstrates that pattern in an amphibious salamander. Even though its limbs (evolved from fins) assist in locomotion, they do not support the weight of its spine off the ground. That development, probably resulting from a need to orient its eyes to ever more distant food or threats, required a dramatic reorientation of its spinal structures.

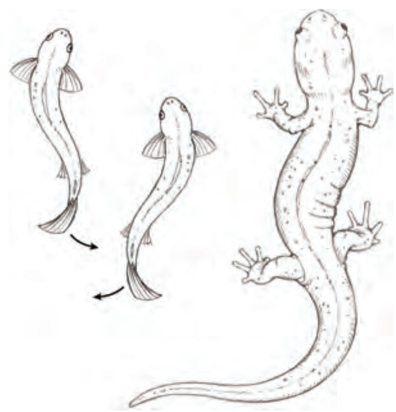


FIGURE 5.6 Lateral movement in both aquatic and amphibious spines.

If a straight spine, such as that of a fish, were supported on four limbs, it would be subjected to gravity's maximum destabilizing force at its weakest point: the center of the span between the two supported ends (figure 5.7). Once raised onto its limbs, the most successful newly terrestrial creatures would be those that arched their spines in response to gravitational stress in order to direct that stress toward the supported ends rather than the unsupported middle. Think of the difference between Greek and Roman architecture. Far more of the Romans' buildings are still standing not so much because they are newer, but because the Romans built more extensively with arches.

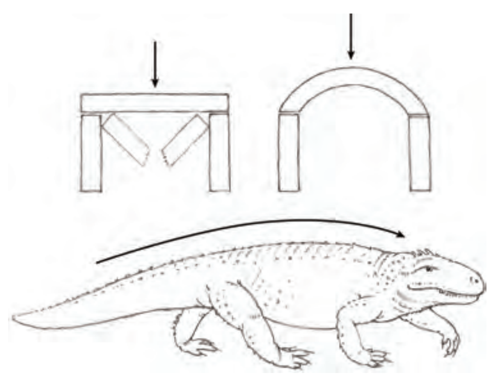


FIGURE 5.7 A supported arch is more stable than a straight line.

The human version of arched architecture is the development of the primary curve of the terrestrial spine—what we know as our thoracic curve. It is primary in the sense that it is the first anteroposterior (front–back) curve to emerge and also in the sense that it is the first curve a human spine exhibits prenatally.

The curve of the neck was the next to evolve. Our fish ancestors had no real necks; their heads and bodies moved as a single unit with gills placed directly behind the brain. The gradual evolutionary migration away from the head of land-based breathing structures allowed for the development of a highly mobile neck that was capable of producing quick, precise, and independent movements of the head and sensory organs, offering an ever-more distant view of the environment, resulting in tremendous survival advantages. This orientation of the cervical region signaled the first development of a secondary, or lordotic, curve in the spine, which can be seen in the cat (figure 5.8).

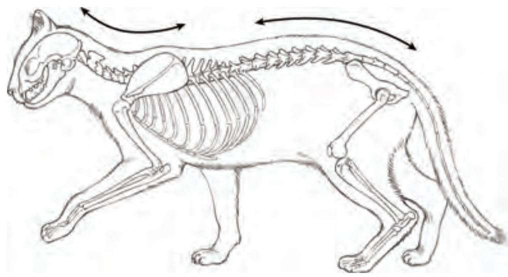


FIGURE 5.8 A feline spinal column exhibiting a primary and secondary curve.

When creatures began to use their forelimbs to interact with their environment, the ability to bear weight on the lower extremities became more necessary, and this signaled the beginning of the uniquely human second lordotic curve—the lumbar. At first, it was just a flattening of the primary curve at the base of the spine in order to allow animals such as the yellow-bellied marmots pictured in figure 5.9 to support their center of gravity above their base of support for longer periods of time.

FIGURE 5.9 Flattening the primary curve to get the forelimbs off the ground.

The presence of a tail also helped in balance, but as our tails gradually disappeared, the shape of our spine had to change to bring our center of gravity fully above our base of support. In our human evolution, our hip, sacral, and leg structures remained stationary in their quadruped relationship to the earth, and our torsos pushed their way up and back, forming our lumbar curve.

Figure 5.10*a* illustrates the difference in shape between a chimpanzee spine and a human spine. Notice the absence of a lumbar curve in the chimp, which is not an issue when climbing or swinging through trees, but when moving across the ground, their high center of gravity requires them to walk on their knuckles (figure 5.10*b*) or, when briefly running on hind legs, throwing their long arms back. Without a lumbar curve, that is the only way they can get their weight over their feet.

A human spine is unique among mammals in that it exhibits a full complement of both primary (thoracic and sacral) and secondary (cervical and lumbar) curves (figure 5.11). Only a true biped (a creature who's primary rather than occasional means of locomotion is on two limbs) requires both pairs of curves. Our tree-swinging and

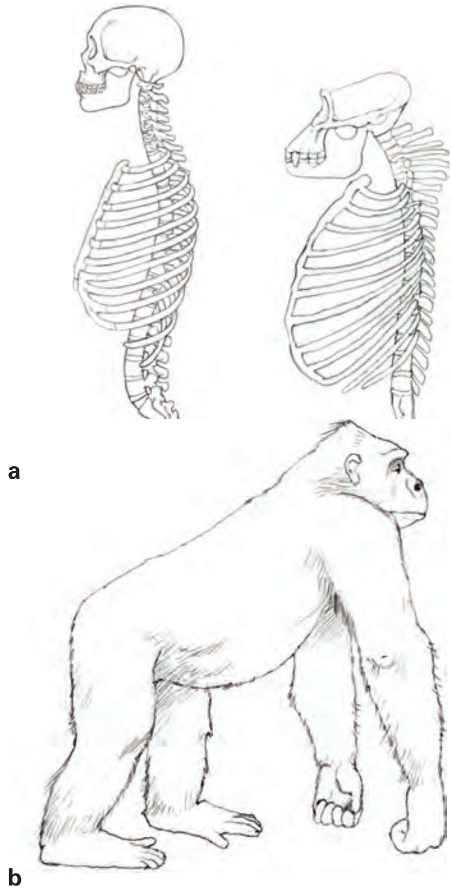


FIGURE 5.10 *(a)* Only humans have lumbar curves, so *(b)* our primate cousins cannot be considered true bipeds.

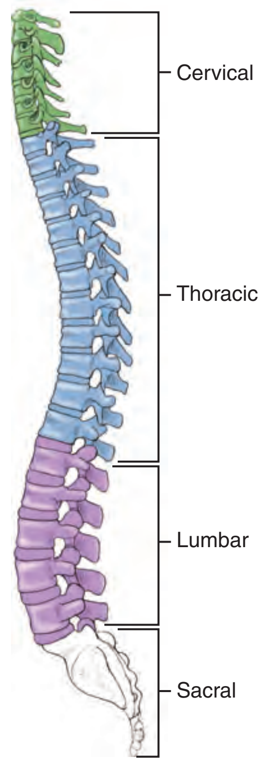


FIGURE 5.11 The curves of our spinal column.

knuckle-walking cousins have some cervical curve but no lumbar curve, which is why they are not considered to be true bipeds.

Viewing our evolution from quadruped to biped in yogic terms, we could say our lower body developed more *sthira* (stability) for weight bearing and locomotion, and our upper body more *sukha* (mobility) for breathing, reaching, and grasping. Another way to describe this differentiation is that our lower bodies move us out into the environment, while our upper bodies bring our environment in to us.

ONTOGENY: AN EVEN BRIEFER HISTORY OF OUR OWN SPINES

After understanding the evolution of our species (phylogeny), it is useful to study the developmental stages experienced by each individual human (ontogeny). Although a developing fetus exhibits—and then loses—certain characteristics that we share with our ancient ancestors (such as gills and a tail) the theory that ontogeny recapitulates phylogeny has long been discredited. There is, however, at least one sense in which this is true: the phylogenetic and ontogenetic similarities in how our spines develop.

Consider how our fetal spine exhibits only a primary curve along its entire length for most of our intrauterine existence (figure 5.12). The first time our spine has cause to move out of that primary curve is when our head negotiates the 90-degree curve of the birth canal, and our neck initially experiences its secondary (lordotic) curve (figure 5.13).

Even if we were not born vaginally, our postural development proceeds from our head downward, with our cervical curve continuing to emerge after we learn to hold up the weight of our head in the first six months of our lives. It then fully forms at around nine months, when we learn to sit upright.

After crawling and creeping like our quadruped ancestors, to bring our weight over our feet we must acquire a lumbar curve. At roughly 12 to 18 months, just as we begin to walk, our lumbar spine straightens out from its primary, kyphotic curve. By around 3 years of age, our lumbar spine begins to develop the lordotic (concave forward) shape, although this is not outwardly visible until 6 to 8 years of age. After about the age of 10, our lumbar curve usually assumes its adult shape (figure 5.14), although the bones of the spine continue to ossify into our 20s and 30s.

FIGURE 5.12 The entire spine exhibiting the primary curve in utero.

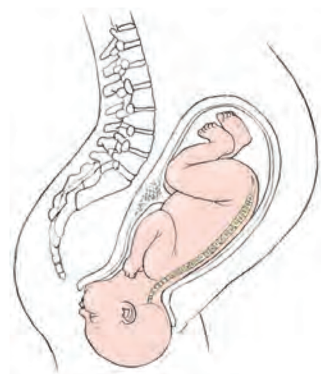


FIGURE 5.13 The first emergence of the secondary curve: negotiating the 90-degree turn from the cervix into the vaginal passage.

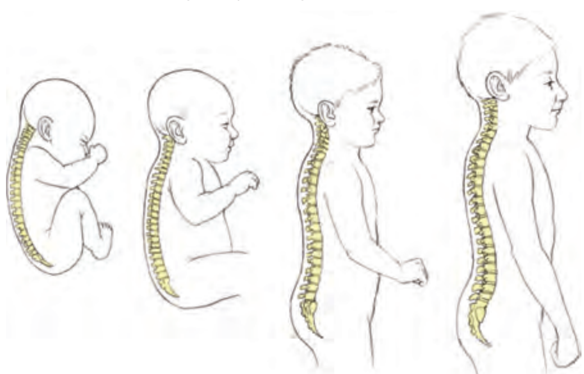


FIGURE 5.14 Development of primary and secondary curves.

STABILITY STARTS WITH GRAVITY

Nature's ability to reconcile conflicting demands is gloriously apparent in the human spine because, as the only true bipeds on the planet, we also seem to be earth's least mechanically stable creatures. From an engineering perspective, we have the smallest base of support, the highest center of gravity, and the brainiest cranium (proportional to our total body weight[2]) of any other mammal. Fortunately, the disadvantage of having a head as heavy as a bowling ball (10-11 pounds or 4.5-5 kilograms) balanced on top of our bodies is offset by the advantage of having that big brain; it can figure out how to make it all work efficiently, and yoga practice can help us sense when our spine and breath are fully supporting our head. Why is this so important? It has been estimated that for every inch (2.5 centimeters) the weight of our skull moves forward of our center line of gravity, an extra 10 pounds of force are loaded into the muscles required to hold it.

Our human form, particularly our spine, exhibits an extraordinary resolution between the contradictory requirements of rigidity and plasticity. The structural balancing of forces of sthira and sukha in our living bodies relates to the principle of *intrinsic equilibrium*, a deep source of indwelling support that can be uncovered through yoga practice.

OUR SPINE IS A NEUTRAL-SEEKING COLUMN

The components of our spinal column acting as a unified whole have evolved to neutralize the combination of forces to which it is constantly subjected by gravity and movement. The 24 vertebrae are bound to each other with intervening zones of cartilaginous discs, capsular joints, and spinal ligaments (shown schematically in blue in figure 5.15). This alternation of bony and soft tissue structure represents a combination of stable and active components: Our vertebrae are the stable structures (sthira), and the active, moving elements (sukha) are our intervertebral discs, facet (capsular) joints, and network of ligaments that connect the arches of adjacent vertebrae (figure 5.16). The *intrinsic equilibrium* of our spinal column can be found in the integration and interaction of these stable and active elements, which are capable of storing and releasing energy in response to gravitational and movement loads placed on them.

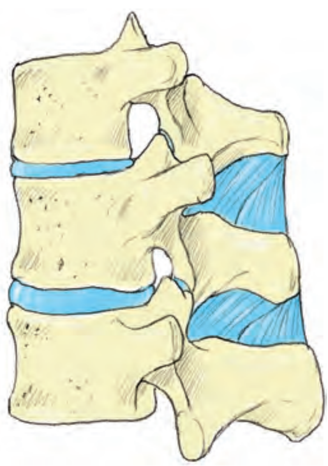


FIGURE 5.15 Alternating zones of hard and soft tissue in our spinal column.

To understand the overall architecture of our spine, it is useful to view it as two separate columns. In the schematic side view in figure 5.17, its front-to-back dimension can be roughly divided in half between a column of vertebral bodies and a column of arches. The anterior column of vertebral bodies deals with weight-bearing, compressive forces, whereas the posterior column of arches deals with tensile forces generated by movement. Within each column, the dynamic

2. More refined than brain–body size ratios, encephalization quotient (EQ) is a relative measure of brain size that is defined as the ratio between the observed to predicted brain mass for an animal of a given size. Among mammals, EQ puts humans in first place, with dolphins, orcas, and chimpanzees right behind. Ravens score quite high, with hippos dead last (Pontarotti 2016).

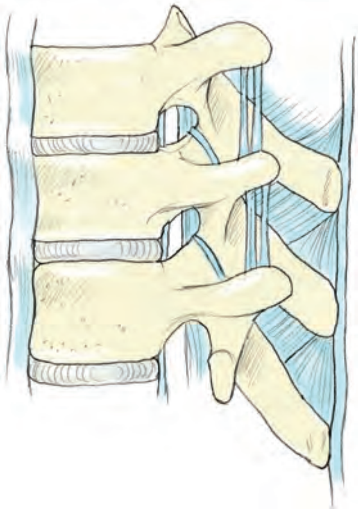


FIGURE 5.16 Ligaments of our spine.

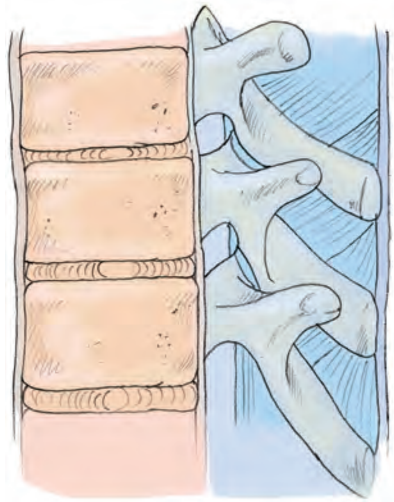


FIGURE 5.17 Side view of our spine divided into an anterior column of vertebral bodies and discs, and a posterior column of arches and processes.

relationship of bone to soft tissue exhibits a balance of sthira and sukha. Our vertebral bodies transmit compressive forces to the discs, which resist compression by pushing back in the opposite direction. The column of arches transmits tension forces to all the attached ligaments (figure 5.18), which resist tensioning by recoiling. In short, the structural elements of our spinal column are involved in an intricate dance that protects our central nervous system by neutralizing the forces of tension and compression.

From the top of the cervical spine to the base of the lumbar spine, individual vertebrae are dramatically different in shape based on the functional demands of the varying regions of our spine (figure 5.19). There are, however, common elements to all vertebral structures, as illustrated by the schematic representation in figure 5.20.

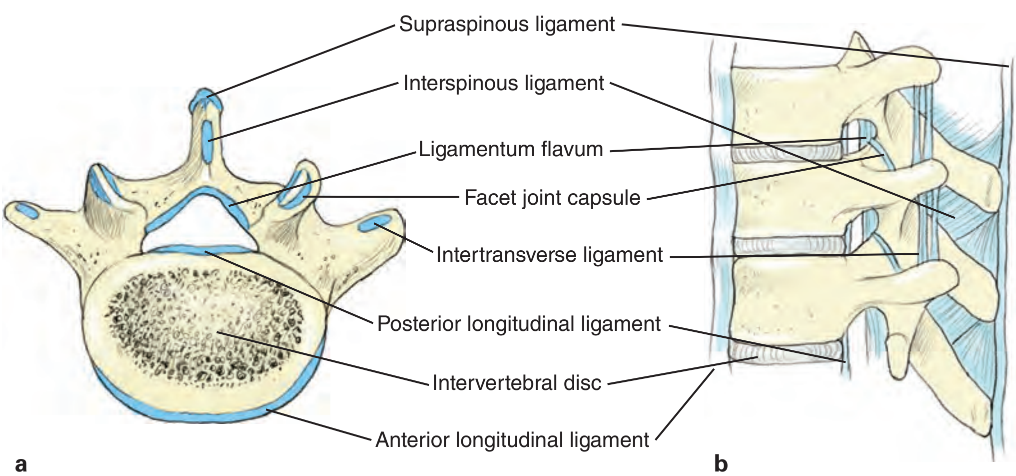


FIGURE 5.18 *(a)* Superior view of spinal ligaments and *(b)* lateral view of spinal ligaments.

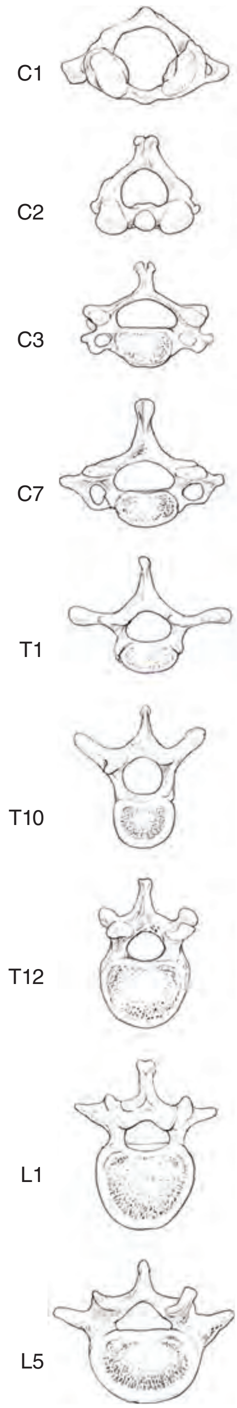


FIGURE 5.19 Form follows function: the changing shape of our vertebrae.

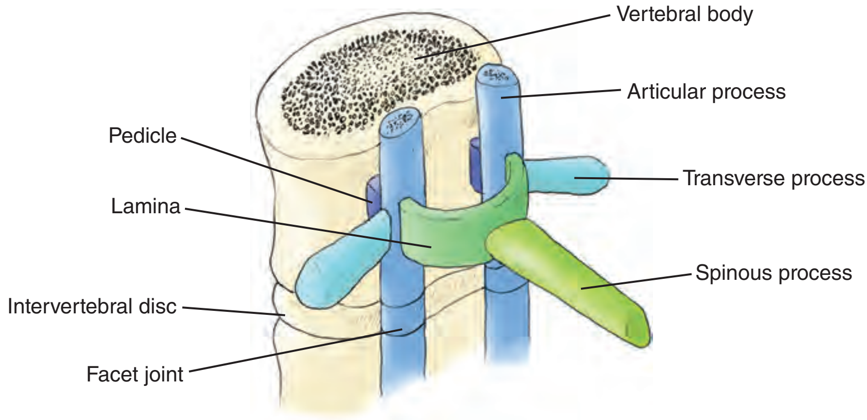


FIGURE 5.20 Common elements of a vertebra's structure.

Discs and Ligaments

Looking deeper, we can see how *sthira* and *sukha* are revealed in the components of an intervertebral disc: the tough, fibrous layers of the annulus fibrosus tightly enclose the soft, spherical nucleus pulposus, the remnants of the notochord, one of the early[3] embryonic origins of the spine. In a healthy disc, the nucleus is completely contained by our annulus fibrosus and our vertebra (see figure 5.21). Our annulus fibrosus is itself contained front and back by our anterior and posterior longitudinal ligaments, with which it is closely bonded (see figure 5.18). This tightly contained arrangement results in a strong tendency for the nucleus to always return to the center of the disc, no matter in which direction our body's movements propel it.

FIGURE 5.21 Our nucleus pulposus is tightly bound by the annulus fibrosus, which contains concentric rings of oblique fibers that alternate their direction in a manner similar to that of the internal and external obliques of our abdominals.

Push and Counterpush

Weight-bearing activities in general, as well as axial rotation (twisting movements), produce axially compressive forces that flatten the nucleus into the annulus, which pushes back, resulting in a decompressive reaction (see figure 5.22).

3. The notochord appears in embryos at three weeks of gestation as a small flexible rod made from cells of the *mesoderm* (middle layer), one of three primary cell layers, formed in the earliest stages of embryonic development. The other two layers are the *endoderm* (inner layer) and the *ectoderm* (outer layer).

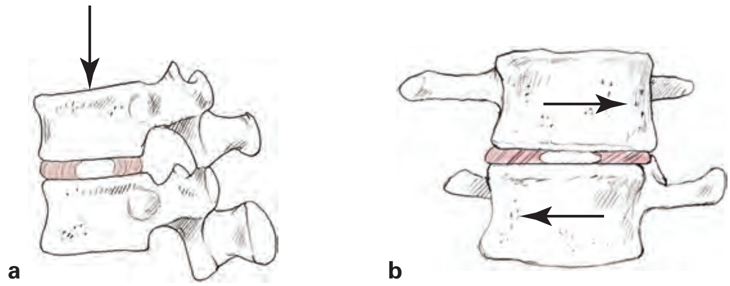


FIGURE 5.22 *(a)* Weight-bearing forces as well as *(b)* twisting produce symmetrical compression (flattening) of the nucleus, which, under pressure from the annulus, returns to its spherical shape, thus decompressing our intervertebral spaces.

If the compressive force is high enough, rather than rupture, the nucleus loses some of its moisture to the porous bone of the vertebral body. When weight is taken off our spine, the hydrophilic (water-loving) nucleus draws the water back in, and the disc returns to its original thickness. That is why, morning stiffness aside, humans are a bit taller right after getting out of bed.

The movements of flexion, extension, and lateral flexion produce asymmetrical movements of the nucleus, but the result is the same. Wherever the edges of the vertebral bodies move toward each other, the nucleus is pushed in the opposite direction to the "open" side, where it meets the counterpush of the annulus, which propels the nucleus toward the center of the disc, encouraging the vertebral bodies to return to neutral (see figure 5.23).

Assisting in this counter-push are the long ligaments that run the entire length of our spine, front and back. The anterior longitudinal ligament runs all the way from the front of our sacrum to the front of our occiput, and it is tightly fixed to the front surface of each intervertebral disc. When it is tensioned during backward bending, not only does it tend to spring our body back to neutral, but the increased tension at its attachment to each disc helps to propel the nucleus posteriorly. The opposite action occurs in the posterior longitudinal ligament, which runs from the back of our sacrum to the back of our occiput, when it is tensioned in a forward bend.

Every movement that produces compression in the anterior column necessarily results in tension forces being applied to the corresponding ligaments attached to the posterior

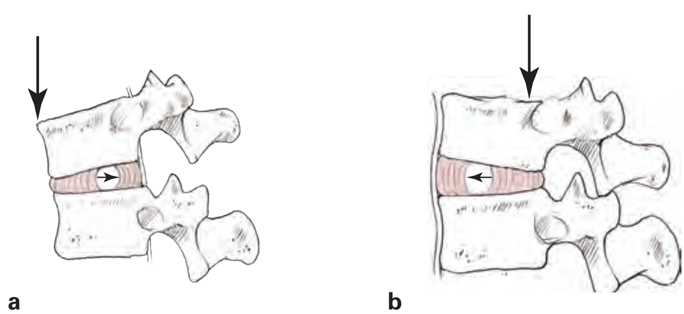


FIGURE 5.23 *(a)* Flexion and *(b)* extension movements produce asymmetrical movements of the nucleus, which, under pressure from the annulus, returns to a central position, thus helping our spine to return to neutral.

column. The recoiling of these ligaments out of their tensioned state adds to other forces of intrinsic equilibrium, all of which combine to return our spine to neutral.

Significantly, this activity occurs in tissues that behave independently of the circulatory, muscular, and voluntary nervous systems. In other words, their actions do not impose an energy demand on these other systems or require conscious intention to operate. However, focused intention is required if we are to discover all the ways in which we habitually interfere with this natural, inborn mechanism of support. This is a powerful, anatomy-based perspective from which to view a key objective of asana practice—the uncovering and removal of obstructions to our natural state.

Unhealthy Discs

Because there is a tremendous amount of pain in the world attributed to damaged or "slipped" intervertebral discs, this is a good place to clarify what happens when the structure of a disc is compromised. Although the phrase is in common use, there is no such thing as a "slipped disc." The annulus fibrosus is firmly anchored to the endplates of the vertebral bodies, so no slippage is *possible* between the two. What actually leads to disc degeneration is that after the age of 25 or so, the fibers of the annulus become less resilient, which can lead to tears and a loss of containment of the nucleus pulposus, usually referred to as herniation or prolapse. Although anterior herniations are possible, the far more common posterior herniation is depicted in figure 5.24.

In figure 5.24*a*, a youthful disc is shown from above, its nucleus fully contained within the intact rings of the annulus. Figure 5.24*b* shows what happens when those rings of fibrocartilage tear and the nucleus leaks out toward, but not beyond, the posterior periphery of the disc, usually referred to as a bulging disc. When the nuclear material pushes out beyond the border of the disc, but is still contained by the posterior longitudinal ligament (figure 5.24*c*),

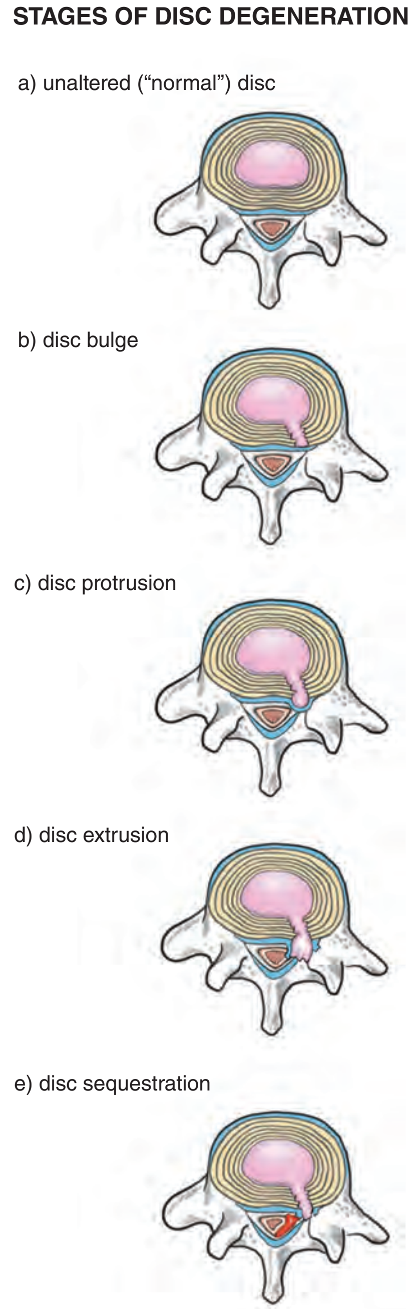


FIGURE 5.24 Classification of disc degeneration: *(a)* normal disc; *(b)* disc bulge; *(c)* disc protrusion; *(d)* disc extrusion; *(e)* disc sequestration.

it is classified as a protruding disc. Once the posterior longitudinal ligament has been breached by the nucleus (figure 5.24*d*), it becomes a disc extrusion. Considered the most severe form of disc degeneration, disc sequestration (figure 5.24*e*) is diagnosed when a fragment of the nucleus has broken free and wanders into spaces through which vital nerves pass.

Understandably, disc sequestration can be associated with alarming neurologic symptoms, such as severe pain, sensorimotor deficits or loss of bowel and bladder control. If these symptoms persist and worsen, immediate surgery is often recommended to prevent potential nerve damage. Research studies have shown that even this most severe form of disc herniation does not cause pain in some people and, in those for whom it does, symptoms often resolve themselves eventually without surgical intervention, after which little or no evidence of the sequestered fragment can be found on MRI. This coincides with studies that show that the more severe the herniation (figure 5.24 *d* and *e*), the more likely the body's natural healing mechanisms will reabsorb the wayward nucleus (Weber 1982).

Several theories have been proposed to explain this phenomenon (Geiss et al. 2007; Marshall, Trethewie, and Curtain 1977; Gertzbein et al. 1975), most of which center on the chemical nature of the nucleus pulposus and how our body's immune system reacts when it breaks free. You may recall that the nucleus is the remnant of the embryonic notochord, and it lives in a completely avascular environment at the center of the disc, where our body's circulatory and immune systems, which developed after the notochord, cannot reach it. Therefore, when our immune system encounters the nucleus pulposus, it registers it as "not self" and mounts an inflammatory attack to eliminate the threat. This reaction produces many of the chemicals associated with pain and inflammation.[4] Along with the physical pressure of the nucleus on the nerve root, it is clear that a good portion of pain that results from an uncontained herniation is caused by our immune system's inflammatory response, which is doing its best to reabsorb the "invader."

What about the less severe forms of disc degeneration (figure 5.24 *b*, *c*, *d*)? Researchers and clinicians are increasingly considering these to be normal wear and tear on a human spine, rather than a disease process. Many of them question whether the word *disease* should even be connected to discussions about degenerating discs or the causes of back pain (Goel 2019).

Multiple studies (Jensen et al. 1994; Boden et al. 1990; Weishaupt et al. 1998; Boos et al. 1995, 2000; Powell et al. 1986; Borenstein et al. 2001; Wiesel et al. 1984; Wood et al. 1995; Jarvik et al. 2001) have replicated a finding that, when middle-aged people with no history of back pain are given MRIs, at least half of them will be found to have bulging, protruding, and extruded discs. Because these are asymptomatic subjects, they did not have a reason to get an MRI, unlike those in enough pain to seek medical attention. It seems the relationship of most back pain to evidence of disc degeneration is merely one of correlation: People with back pain get MRIs, but correlation is not causation. For this reason, it would be valuable to tell a different story about what causes back pain for most people and why yoga practice seems to help them so much. We will pick up this thread in the breathing chapter.

TYPES OF SPINAL MOVEMENT

There are generally thought to be four possible movements of our spine: flexion, extension, axial rotation (twisting), and lateral flexion (side bending). These four movements

4. Inflammation-starting biochemicals, such as prostaglandins, leukotrienes, thromboxane, nitrous oxide, cytokines (IL-1, IL-6, TNFa, and IFNy) as well as white blood cells (macrophage and lymphocytes) have all been found in damaged disc nuclei.

occur more or less spontaneously in the course of daily life: bending over to tie your shoes (flexion; see figure 5.25), reaching for something on a high shelf (extension; see figure 5.25), grabbing a bag in the car seat behind you (axial rotation; see figure 5.26), or reaching your arm into the sleeve of an overcoat (lateral flexion; see figures 5.27 and 5.28). There are, of course, yoga postures that emphasize these movements as well. These illustrations and tables 5.1 to 5.3 offer a detailed breakdown of these ranges of

TABLE 5.1 Spinal Flexion and Extension

	FLEXION		EXTENSION		COMBINED
	Degrees	Average per vertebra	Degrees	Average per vertebra	Degrees
Cervical (C1 to C7)	40°	5.7°	75°	10.7°	115°
Thoracic (T1 to T12)	45°	3.8°	25°	2.0°	70°
Lumbar (L1 to L5)	60°	12.0°	35°	7.0°	95°
Total	145°		135°		280°

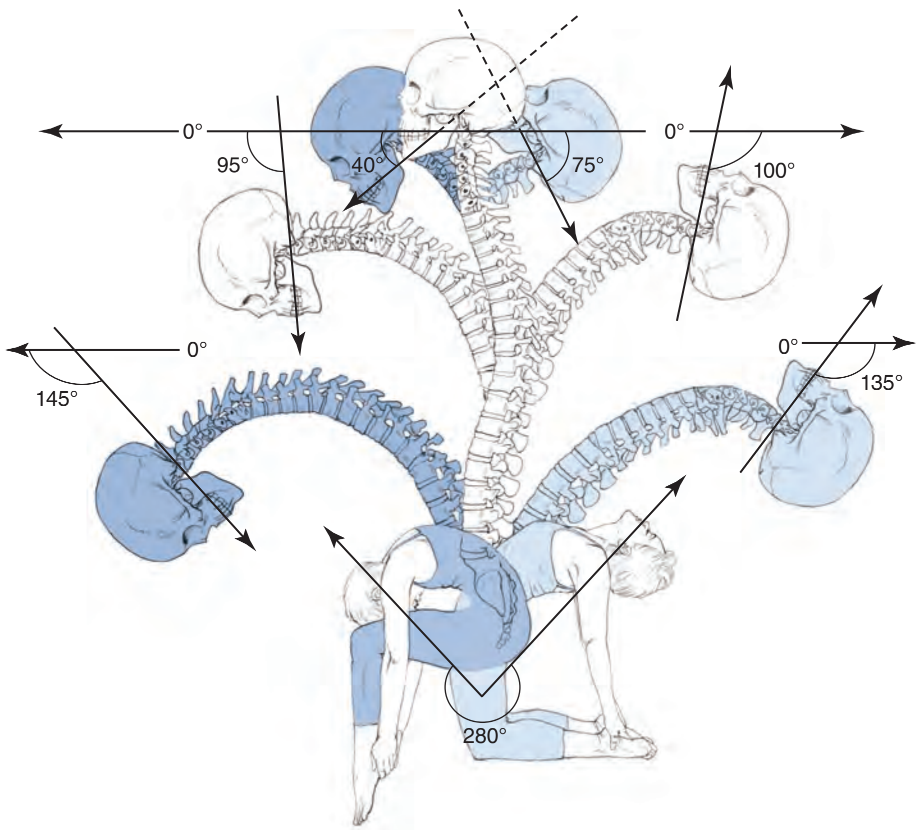


FIGURE 5.25 Average ranges of motion of spinal flexion and extension. Table 5.1 shows the average range of motion (ROM) per vertebra, which is determined by dividing the number of vertebrae in that section by the total ROM of the section. Note that the average ROM per vertebra does not take into account the variations in ROM that exist at every level within each section.

Based on A.J. Kapandji, *Physiology of the Joints,* Vol. 3: The Vertebral Column, Pelvic Girdle and Head, 6th ed. (Elsevier, 2008)

TABLE 5.2 Axial Rotation

	Degrees	Average per vertebra
Cervical (C1 to C7)	75°	10.7
Thoracic (T1 to T12)	35°	2.9
Lumbar (L1 to L5)	5°	1.0
Total	115°	

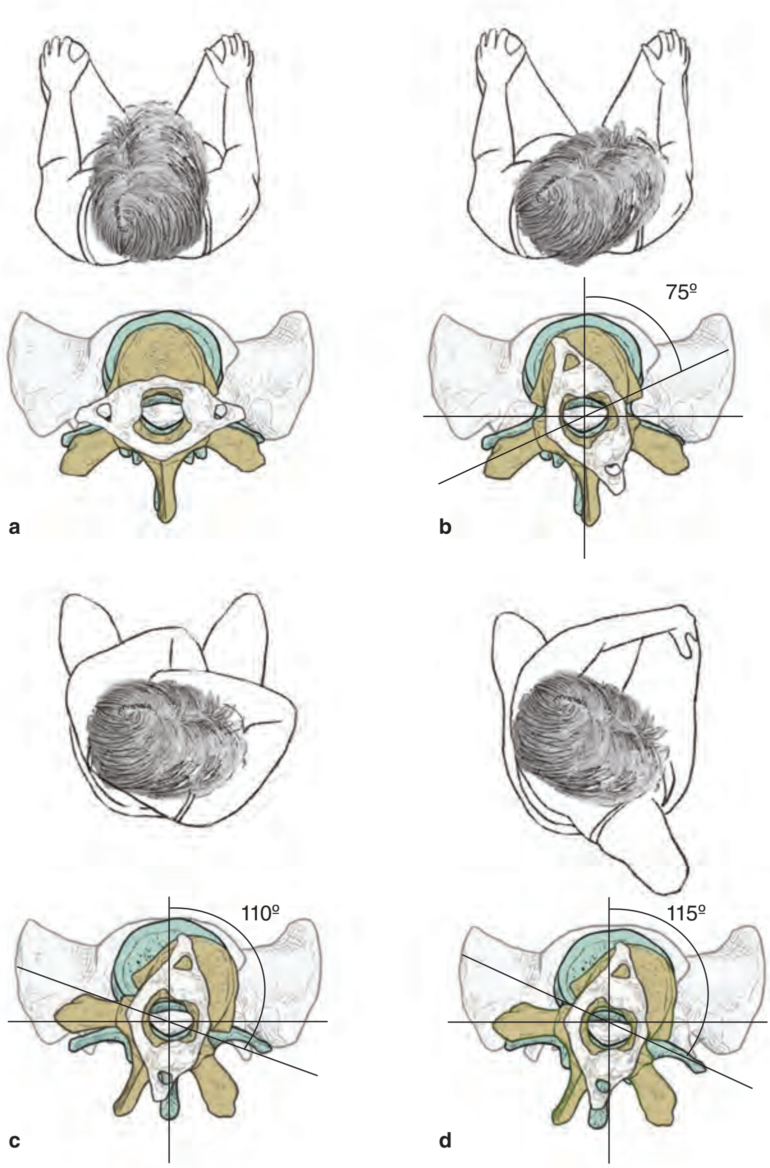


FIGURE 5.26 *(a)* Neutral, 0 degrees axial rotation; *(b)* cervical only, 75 degrees axial rotation; *(c)* cervical plus thoracic, 110 degrees axial rotation; and *(d)* cervical plus thoracic plus lumbar, 115 degrees axial rotation.

motion. Please note that these ranges are averages established by measuring a wide variety of people. Any given individual will exhibit significant variations at both ends of the spectrum of flexibility and in different regions of their spine. The numbers given for degrees of range of motion are approximate as are the angles pictured, with up to five degrees of variation in either direction. Additionally, it is virtually impossible to completely isolate spinal sections or ranges of motion from each other because our spine—and indeed our entire body—moves as a coupled, integrated whole.

For practitioners and teachers of asana, one value in these numbers is to clearly see how unevenly movement in our spine is distributed, which is evident by looking at the average range of motion per vertebra on the combined chart (table 5.4). For example, reading straight across from left to right on the thoracic spine row (T1-T12), you will find four of the five lowest average per vertebra numbers on the chart. To summarize the story told by those numbers, the only thing our spine likes less than flexing, extending, or twisting through its 12 thoracic vertebrae (1.7 to 3.8 average degrees per vertebra) is to twist through its 5 lumbar vertebrae (1.0 average degree per vertebra).

TABLE 5.3 Lateral Flexion

	Degrees	Average per vertebra
Cervical (C1 to C7)	35°	5.0
Thoracic (T1 to T12)	20°	1.7
Lumbar (L1 to L5)	20°	4.0
Total	75°	

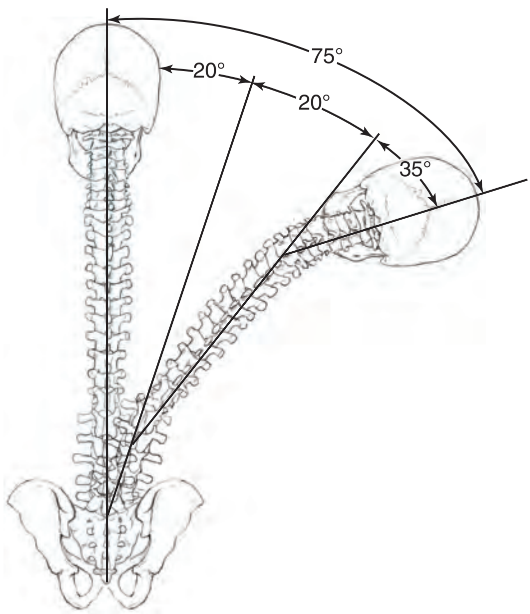


FIGURE 5.27 Spinal ranges of motion of lateral flexion. Note how the 75 degrees of lateral flexion is the movement most evenly distributed throughout the spine.

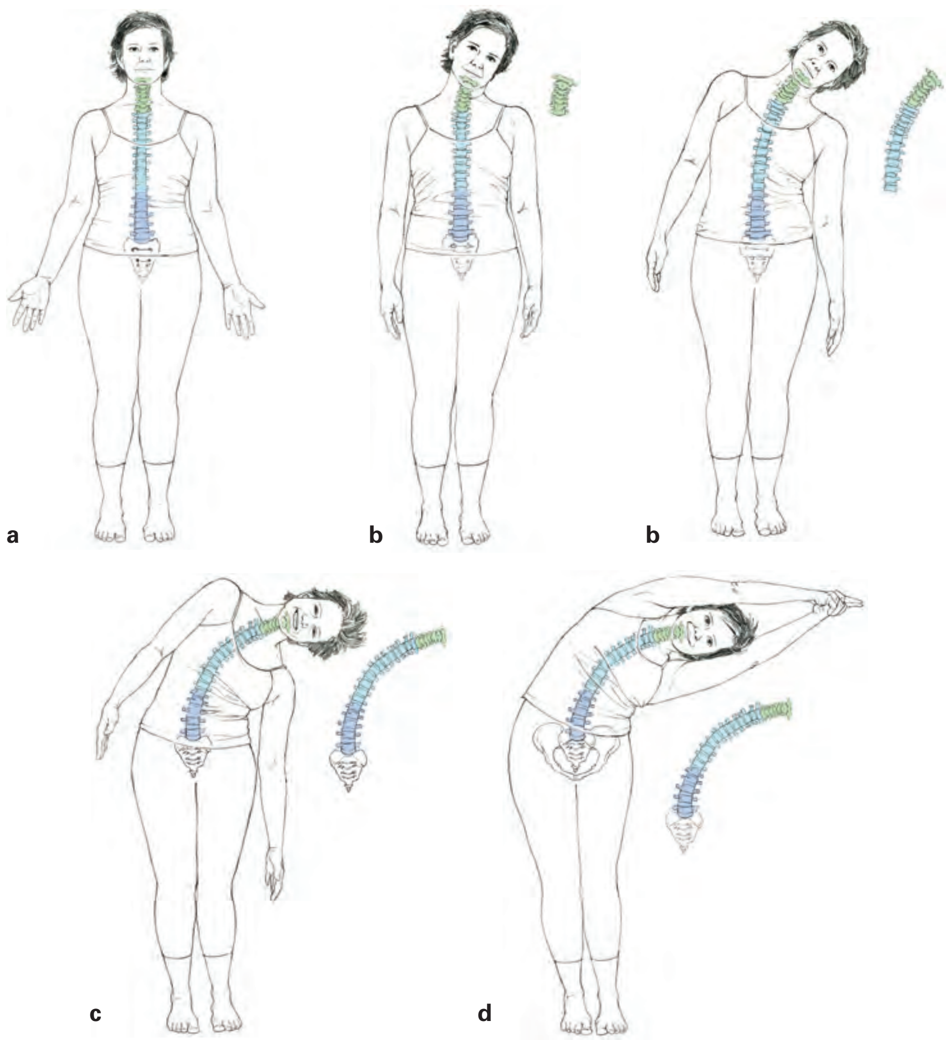


FIGURE 5.28 *(a)* Neutral spine; *(b)* cervical lateral flexion; *(c)* cervical and thoracic lateral flexion; *(d)* cervical, thoracic, and lumbar lateral flexion; and *(e)* lateral flexion and lateral pelvic shift.

Flexion and Extension and Primary and Secondary Curves

The movement of our spine that emphasizes its primary curve is flexion. As discussed previously, the primary curve is mostly present in our thoracic spine, but it is also obvious in the shape of our sacrum. It is no accident that the yoga asana that most commonly exemplifies spinal flexion is called child's pose (see figure 5.29) because it replicates the primary curve of an unborn child.

From a certain perspective, all the curves of our body that are posteriorly convex can be seen as reflections of the primary curve. A simple way to identify all the primary curves is to notice all the curved parts of your body that contact the floor in *savasana*,

TABLE 5.4 Distribution of Flexion, Extension, Axial Rotation, and Lateral Flexion Compared in the Cervical, Thoracic, and Lumbar Spines

	FLEXION		EXTENSION		COMBINED	AXIAL ROTATION		LATERAL FLEXION	
	Degrees	Average per vertebra	Degrees	Average per vertebra		Degrees	Average per vertebra	Degrees	Average per vertebra
Cervical (C1 to C7)	40°	5.7	75°	10.7	115°	75°	7.1	35°	5.0
Thoracic (T1 to T12)	45°	3.8	25°	2.0	70°	35°	2.9	20°	1.7
Lumbar (L1 to L5)	60° 12.0		35°	7.0	95°	5°	1.0	20°	4.0
Total	145°		135°		280°	115°		75°	

or corpse pose (see figure 5.30): the curve of the back of your head, your upper back and scapulae, the backs of your hands, your sacrum, the backs of your thighs, your calves, and your heels. Consequently, the secondary curves are present in all your body parts that curve away from the floor in this position: your cervical and lumbar spine, the backs of your knees, and the space posterior to your Achilles tendons.

Spinal flexion can be defined as an increase in the primary spinal curves and a decrease in the secondary curves. A reversal of this definition defines spinal extension as an increase

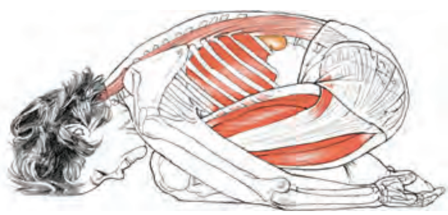


FIGURE 5.29 Child's pose replicates the primary curve of an unborn child.

FIGURE 5.30 In the supine corpse pose, the primary curves of your body (shaded areas) contact the floor.

in the secondary curves and a decrease in the primary curves. Referring to sacral and thoracic curves as primary and referring to lumbar and cervical curves as secondary is a less clinical alternative to the terms kyphotic and lordotic, which are often and indiscriminately replaced with kyphosis and lordosis. This is problematic because the suffix *-osis* turns a description of a normal feature of our spine into a diagnostic term for abnormal or excessive curvature.

As far as movement is concerned, the relationship between the primary and secondary curves can be seen as reciprocal: The more you increase one, the more the other tends to decrease and vice versa. For example, an increase in your thoracic curve tends to produce a decrease in your cervical and lumbar curves. A classic yoga exercise that explores this reciprocal relationship of the primary and secondary curves is cat–cow, or *chakravakasana* (see figure 5.31).

Supported at both ends by your arms and thighs, your spine's curves can move freely in both directions, producing the shape changes of flexion and extension. Although it is common for instructors to teach this movement by telling a student to exhale on spinal flexion and inhale on spinal extension, other perspectives on breath cueing and spinal movement will be examined in the following chapter.

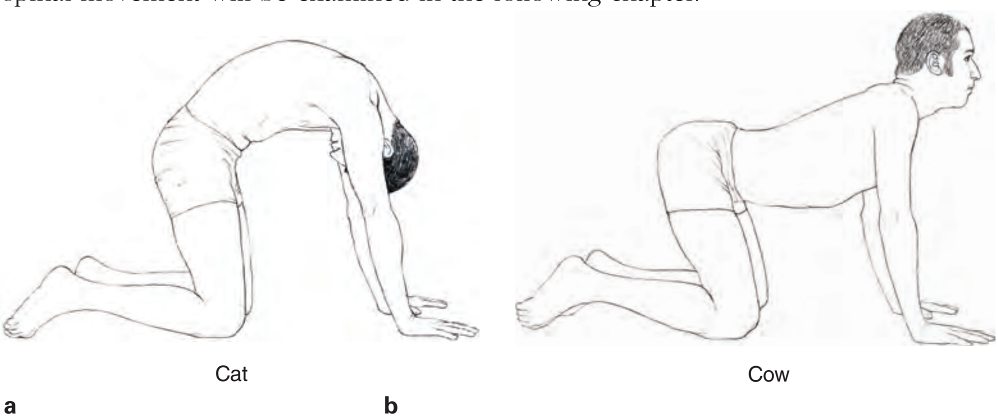


FIGURE 5.31 The cat–cow exercise emphasizes the reciprocal relationship of the *(a)* primary and *(b)* secondary curves.

Time to Move and Breathe

From a comfortable sitting position, try increasing your thoracic curve. Notice if your neck and lower back flatten. Now, try the same movement, initiating flexion from your head. If you drop your head forward, does your chest or lower spine follow? Does something similar occur if you initiate flexion from your lower spine? Notice whether these spinal flexion movements generally tend to create an exhalation or an inhalation.

Going in the opposite direction, try decreasing your thoracic curve. Notice whether your neck and lower back increase their curves. If you try initiating extension with your head or lower spine, are the results the same or different? Did you notice whether these extension movements of the spine tend to create an inhalation or an exhalation?

Next, flip the experiment and, with several breaths, slowly increase the length and depth of your exhalations for several breaths and then your inhalations. Do you notice your spine wanting to move into flexion or extension? If so, which breath encourages which movement?

Spatial Versus Spinal Perspectives in Forward- and Backward-Bending Poses

Spinal flexion is not necessarily the same thing as bending forward, and spinal extension is not necessarily the same thing as bending backward. To avoid confusion, it is important to keep these distinctions clear. Flexion and extension refer to the relationship of the spinal curves to each other, while forward bending and backward bending are terms that refer to movements of our body in space. The terms can, of course, be related, but they are not interchangeable. By way of illustration, consider the following contrasting examples of how two different body types might appear in standard yoga movements.

1. A stiff, sedentary office worker, whose stooped posture doesn't change as his hips move forward and his arms reach overhead in an attempt to do a standing back bend: his spine remains in flexion while his body moves backward in space (figure 5.32*a*).
2. A flexible dancer, who fully extends her spinal curves in the overhead reach and keeps her spine extended as she flexes forward at the hip joints to move into uttanasana (standing forward bend): Her spine remains in extension while her body bends forward in space (figure 5.32*b*).

a b

FIGURE 5.32 *(a)* Flexion moving backward in space, and *(b)* extension moving forward in space.

The ability to distinguish between the changes in the relationship of the spinal curves from movements of the torso in space is a valuable skill. Because both frequently happen at the same time, it can take practice.

Figure 5.33 shows a different orientation to a standing back bend. Here, their secondary curves are kept under control, and their pelvis is kept firmly over their feet. As a result, there is much less movement backward in space, but a greater emphasis on thoracic extension (reduction of the primary curve). Compared to our office worker or dancer, this may not be a dramatic movement spatially, but it may provide a more distributed and safer experience of extension to their thoracic and rib structures while being less disturbing to their breath.

FIGURE 5.33 Standing spinal extension with limited backward spatial movement.

Spatial Versus Spinal Perspectives in Lateral and Twisting Movements

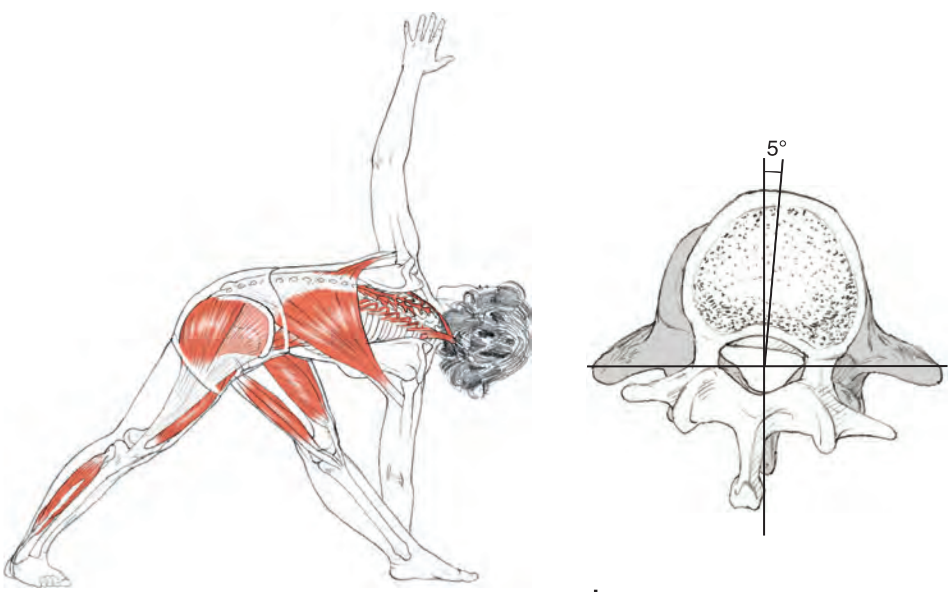
When looking at yoga poses that involve lateral and twisting movements, it is also important to distinguish spatial from spinal perspectives. Trikonasana, or triangle pose, is often referred to as a lateral bend, and this is true insofar as it lengthens the connective tissue pathway that runs along the side of our body (see figure 5.34). However, it is possible to lengthen the lateral line of our body without appreciable lateral flexion of our spine, so again, it must be clear exactly what the term *lateral bend* means.

FIGURE 5.34 Lateral spatial movement with minimal lateral spinal flexion.

In trikonasana, a greater lengthening of the lateral line might result from a wide spacing of our feet and an intention to initiate the movement primarily from our pelvis while maintaining our spine in neutral extension. This asks for a lot of movement from our hip joints, which may or not be indicated for some practitioners (see page 146 for Warrior I). For some people, lateral flexion of their spine can be emphasized by placing their feet closer together. This stabilizes the relationship between their pelvis and thighs, requiring the movement to come more from lateral bending of their spine.

When we look at *parivrtta trikonasana*, the revolved variation of triangle pose (figure 5.35*a*), we can apply the same perspective to the twisting action of our spine. Our lumbar spine is almost entirely incapable of axial rotation (only five degrees; see figures 5.26 and 5.35*b* and table 5.4), which, in this pose, means that it will go wherever the sacrum leads it. Consequently, for our lower spine to twist in the direction of this pose, our

Our thoracolumbar junction is a flexible area that frequently becomes overmobilized because of restrictions elsewhere. In twisting movements, this is because the inferior articular facets of T12 are curved like lumbar vertebrae, so they lock into the superior facets of L1 as if they were another lumbar vertebra, restricting axial rotation. However, the superior articular facets of T12 are flat, and so can slide across each other like the rest of our thoracic vertebrae. Therefore, the T11 and T12 articulations are the first spinal joints above our sacrum that can freely rotate. You can think of this twisting action as occurring between our floating ribs, which, lacking attachments to the front of our rib cage, have greater freedom of movement at their anterior ends.



a b

FIGURE 5.35 *(a)* Parivrtta trikonasana; *(b)* our entire lumbar spine can twist only five degrees around its vertical axis.

pelvis would have to be turning in the same direction. If our pelvis is free to rotate around our hip joints, this pose exhibits a more evenly distributed twist throughout our spine rather than an overloading of T11 and T12—the first two vertebrae above our sacrum that can freely rotate in relation to each other (see figure 5.36). If our lumbar spine fully participates because our pelvis and sacrum are also turning, our rib cage, upper back, neck, and shoulders are also freer, along with the breath.

If the articulation of our hip joints is restricted, our lumbar spine might appear to be moving in the opposite direction of our rib cage and shoulder girdle rotation. When this is the case, most of the twisting originates from T11 to T12 and above. In addition, the twisting of our shoulder girdle and arms around our rib cage can create the illusion that our spine is twisting more than it really is. Our body can indeed be twisting in space, but a careful observation of our spine may reveal that the twisting may not be coming from where you think.

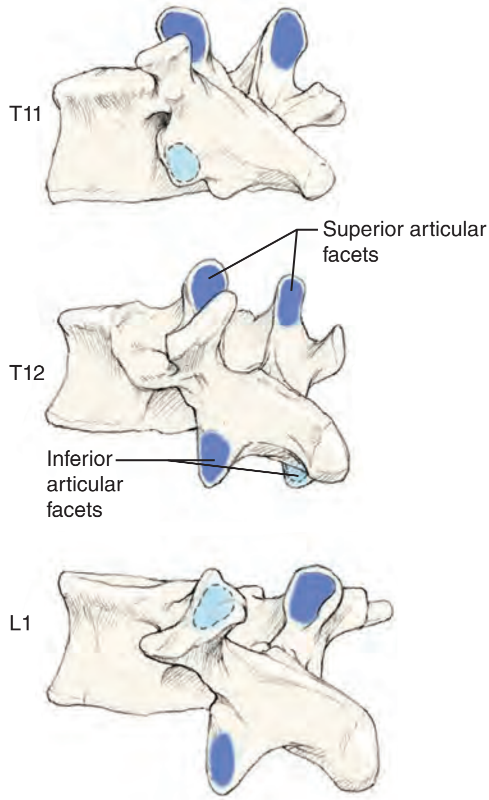


FIGURE 5.36 T12 is a transitional vertebra. (Facets in light blue are hidden from view.)

Axial Extension, Bandhas, and Mahamudra

A fifth spinal movement, axial extension, is defined as a simultaneous reduction of both the primary and secondary curves of our spine (see figure 5.37). In other words, your cervical, thoracic, and lumbar curves are all simultaneously flattened, and the result is that because the distance between your head and your pelvis is increased, you temporarily become a bit taller. Because the primary and secondary curves have a reciprocal relationship, which is expressed in the natural movements of flexion and extension, axial extension is "unnatural" in the sense that it bypasses this reciprocal relationship by reducing all three curves at once. Axial extension generally doesn't happen on its own; it requires conscious effort and training to sort out which muscles need to engage and which need to release and to cultivate the requisite sensory awareness.

The action that produces axial extension involves a shift in the tone and orientation of our breathing structures known as the bandhas. Three of our diaphragms (pelvic, respiratory, and vocal) and their surrounding musculature become more toned (more *sthira*, or stable). As a result, the shape-changing ability of our thoracic and abdominal cavities is more limited in axial extension. The overall effect can be a reduction in volume, but an increase in length and support of breath. The yogic term that describes this state of our spine and breath is *mahamudra,* or "great seal," which always involves axial extension and the bandhas. It is possible to experience mahamudra from many positions, including seated, standing, and supine and in arm support.

A seated gesture named *mahamudra* (figure 5.38) adds a twisting action to axial extension, which drives the breath movements even deeper into the core of our body.[5] It is considered a supreme accomplishment to engage in breath practice with all three bandhas executed correctly in mahamudra because it represents a complete merging of asana and pranayama practice and thus is an important rung on the ladder leading toward the inner four limbs of yoga.[6]

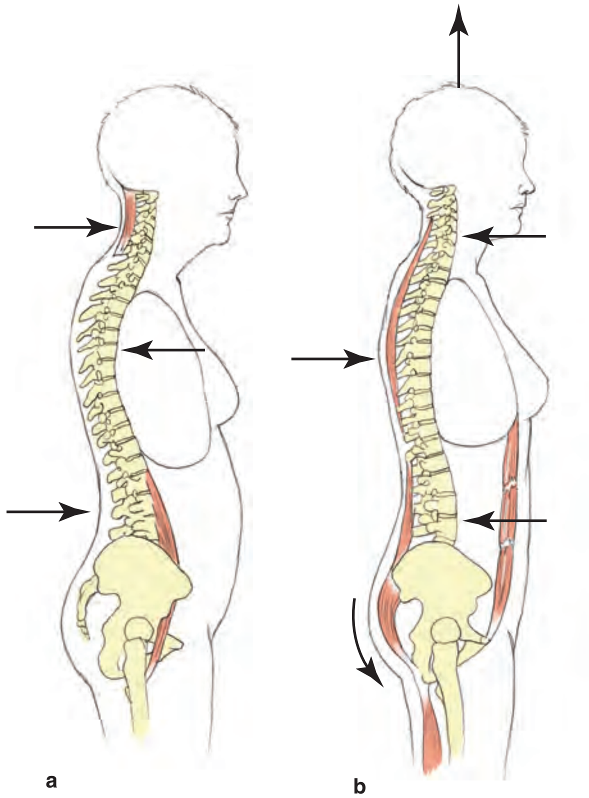


FIGURE 5.37 Axial extension involves a simultaneous reduction of *(a)* the primary and secondary curves, which *(b)* extends our torso beyond its usual height.

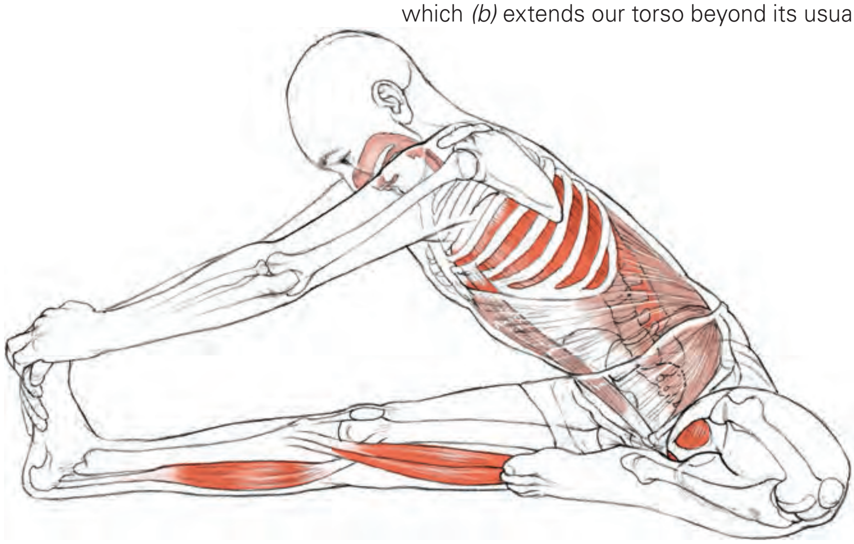


FIGURE 5.38 Mahamudra combines axial extension, a twisting action, and all three bandhas.

5. From a Hatha Yoga perspective, this effect of mahamudra can be associated with the opening of the *sushumna*, the central most important *nadi*, or pranic channel.

6. The first four (outer) limbs of Patanjali's ashtanga (eight-limbed) yoga, also known as raja yoga (the royal path), are the ethical precepts of yama/niyama and the bodily practices of asana/pranayama. They pave the way for the (inner) limbs of pratyahara (sense withdrawal), dharana (concentration), dhyana (meditation), and samadhi (total absorption in the object of meditation).

INTRINSIC EQUILIBRIUM: OUR SPINE, RIB CAGE, PELVIS, AND PRESSURE ZONES

Theoretically, if you were to remove all the muscles that attach to your spine, it would not collapse. Why? Intrinsic equilibrium. This concept explains why our spine is a self-supporting structure and why any movement produces potential energy that helps to return our spine to neutral. The same arrangement exists in our rib cage and pelvis, which, like our spine, are bound together under mechanical tension.[7] Intrinsic equilibrium is also exhibited in the pressure zone differentials between our pelvic, abdominal, and thoracic cavities (see the next chapter).

True to the principles of yoga theory and practice, the most profound change occurs when obstacles are reduced.[8] In the case of intrinsic equilibrium, the indwelling support does not depend on muscular effort. It is derived from relationships between the non-contractile tissues of cartilage, ligament, and bone. Consequently, when this support asserts itself, it is always because an extraneous muscular effort has ceased to obstruct it.

Maintaining an inefficient relationship with gravity requires a constant expenditure of muscular energy to fuel habitual, unconscious exertions of which, for the most part, we are unaware until they produce suffering. Thus the reduction of effort can be associated with a tremendous feeling of relief and liberated energy. It is tempting to mistake the emergence of intrinsic equilibrium for the awakening of a mystical source of energy[9] because its discovery is frequently accompanied by profound, sometimes overwhelming, sensations of increased vitality in our body. To put an anatomical spin on what is otherwise considered to be a mystical topic, yoga practice certainly helps us identify and reduce inefficient muscular effort, which can liberate tremendous stores of our body's intrinsic potential energy and support.

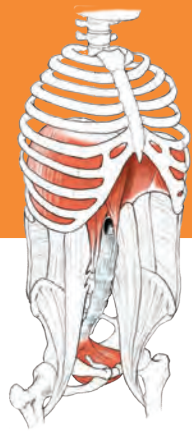
CONCLUSION

As noted in the book's introduction, a healthy relationship between will and surrender is needed in order to honor the true nature of our body in yoga practice. Without this perspective, the deeper, intrinsic support within our system is forever overshadowed by a futile attempt to reproduce through effort what nature has already placed at the core of our body. The next chapter will advance this discussion further by taking a deep dive into the structure and function of breathing as a core element of yoga practice.

7. Surgeons experience this when the sternum is divided for a thoracic procedure, and the two sides of someone's rib cage spring away from each other because the intrinsic energy of the thorax has been released.

8. Patanjali's Yoga Sutra, Kaivalya Pada (4: 2, 3).

9. This is a reference to Kundalini theory. Chapter 6 contains a fuller presentation of these concepts as taught by Sri T. Krishnamacharya.



6

DYNAMICS OF BREATHING

Exploring breath anatomy from a yogic perspective will take us back to a cell (figure 5.1) as a starting point. Chapter 5 proposed that the most essential concepts in yoga can be derived from observing a cell's form and function. From a semipermeable membrane all the way to the intricate, intrinsic equilibrium of a spine, the powerful lens of sthira and sukha help us focus on the key structural details most relevant to the practice of yoga.

Now, as we examine the dynamics of breathing, we turn to the functional activity shared by all life—ingesting, metabolizing, eliminating—and the corresponding yogic concepts *prana, agni,* and *apana.*

PRANA, AGNI, AND APANA

The Sanskrit term *prana* is derived from *pra-*, a prefix meaning "before," and *an*, a verb meaning "to breathe, to blow, and to live." *Prana r*efers to what nourishes a living thing, but it has also come to mean the action that brings in the nourishment. Within this chapter, the term will refer to the functional life processes of a single entity. When capitalized, *Prana* is a more universal term that can be used to designate the manifestation of all generative life force.

The raw materials that enter a living thing must be processed and metabolized, and that faculty is the domain of *agni,*[1] fire. Within our body, agni is associated with the digestive fire, and in general with our ability to metabolize and assimilate anything that can nourish us on any level. The English word "ignite" is derived from agni.

Fire produces ash, and metabolism produces waste. *Apana*, which is derived from *apa*, meaning "away," "off," or "down," refers to the waste that's being eliminated as well as the action of elimination. Essentially, prana is about what brings raw materials into the system, agni is about turning those raw materials into nourishment, and apana is about eliminating whatever is unneeded.

We will address agni in a deeper discussion later in this chapter. For now, we will focus on prana and apana and how these terms relate to breathing.

1. Agni is also a Vedic god who is invoked with the very first word of the world's most ancient surviving religious text, the Rig Veda: *Agnim*.

Human Pathways of Prana and Apana: Nutrition In, Waste Out

Our body's pathways for nutrients and waste are not as simple as those of a cell but not so complex that we can't easily describe them in terms of prana and apana. Figure 6.1 shows a simplified version of our nutritional and waste pathways. It shows how our human system is open at the top and at the bottom to our external environment. We take in prana—solid and liquid nourishment—at the top of the system. These solids and liquids enter our alimentary canal, move through the digestive process, and, after a lot of twists and turns, move down and out as waste matter. This is the only way waste can go because the exits are at the bottom. It is clear that the force of apana, when acting on solid and liquid waste, must move down to get out. The strong association (and translation) of apana as a downward force of elimination is based on this obvious fact.

Prana also enters our bodies in gaseous form: our breath. Like solids and liquids, it enters at the top, where it remains above the diaphragm in our lungs (see figure 6.2), exchanging gases with the capillaries at the alveoli. The waste gases in our lungs need to be expelled, but they get out the same way they came in. Therefore, the force of apana, when acting on respiratory waste gas, must move upward to assist with an exhalation. This should encourage us to take the main translation of *apa* as "away," "off," or "out," because it is clear that apana must be able to operate freely both upward and downward, depending on what type of waste it acts on—downward for solid and liquid and upward for gaseous.

The ability to reverse apana's downward action is a basic and useful skill that can be acquired through yoga practice, but it is not something most people are able to do without training. Accustomed to pushing down to operate our apana, most of us have learned that whenever something needs to be eliminated from our body, we must squeeze in and push down. That explains why, when most beginning students are asked to exhale completely, they tend to activate their breathing muscles as if they are urinating or defecating. After covering the basics of breath anatomy, we will see how cultivating *upward apana* is intimately connected to improving postural support.

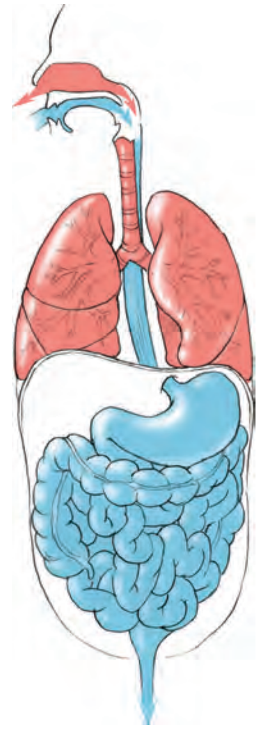


FIGURE 6.1 Prana, in the form of solid and liquid nutrition (food and drink; blue), enter at the top of the system, move downward, and exit as waste—apana—at the bottom. Prana, in the form of gaseous nutrition (air; red), also enters at the top of the system and moves downward, but gaseous waste—apana—must move upward to exit at the top, where it came in.

FIGURE 6.2 The pathway air takes into and out of our body.

From Dukha to Sukha

Generally translated as suffering, *dukha* is derived from *dus*, meaning bad, difficult, or hard, and *kha*, meaning space. Understanding that the experience of suffering originates from a feeling of obstructed space points to both the goal and methods of yoga practice.

Sukha (literally good space) means easy, pleasant, agreeable, gentle. As was mentioned in the previous chapter, sukha also means "having a good axle hole," implying a space at the center that allows for smooth function. From the viewpoint of breath practice, our bodies need to experience good, centered, unobstructed space so our prana and apana can have a healthy reciprocal relationship.[2]

This pranic model points to a fundamental insight of classical yoga practice[3] which seeks to uncover and resolve blockages or obstructions (kleshas[4]) to reduce dukha. When we make more good space, our pranic forces flow freely and restore normal, healthy function. Because exhalation is an act of removing waste from the system, another practical way of applying this insight is that if we take care of the exhalation, the inhalation takes care of itself. If we get rid of the unwanted, we make room for what is needed. Supporting this insight, T.K.V. Desikachar would often say that yoga therapy is 90 percent about waste removal. He was on to something, because physiologically, 70 percent of all waste leaves our bodies in the form of carbon dioxide, and exhaled air holds 100 times more CO_2 than inhaled air.

Being Born to Breath and Gravity

When a fetus is in utero, their mother does the breathing. Her lungs deliver oxygen to her uterus and to their placenta. From there, oxygen travels to their umbilical cord, which takes about half the oxygenated blood to their inferior vena cava while the other half enters their liver. The two sides of their heart are connected, bypassing their lungs, which remain dormant until the child is born. Needless to say, human fetal circulation is very different from ex utero circulation (figure 6.3).

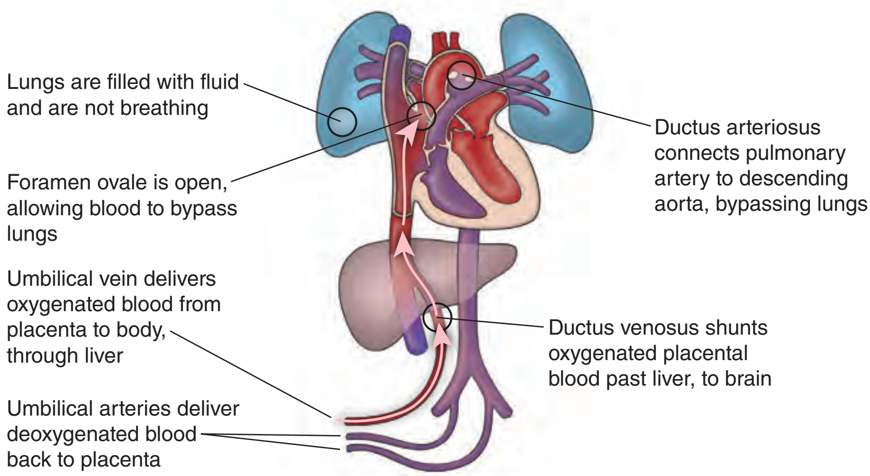


FIGURE 6.3 Fetal circulation bypasses their lungs.

2. This is derived from a definition of pranayama found in *Yoga Yajnavalkya 6:2:* Prana-apana samayogah pranayama iti iritah. "Pranayama is the balanced joining of the in-breath and the out-breath."

3. Patañjali's Yoga Sutra 2.3–2.9.

4. *Klestr* (the root of *klesha*) means that which causes pain or suffering (dukha).

Being born means being severed from their umbilical cord—the lifeline that has sustained a fetus for nine months. Suddenly, and for the first time, the infant needs to engage in actions that ensure continued survival. The very first of these actions declares physical and physiological independence. It is the first breath, and it is the most important and forceful inhalation a human will ever take. That first inhalation must be so forceful because it needs to overcome the initial surface tension of the previously inactive lung tissue. The force required to overcome that tension is three or four times greater than that of a normal inhalation. The initial inflation of an infant's lungs is assisted by the presence of surfactant, a substance that lowers the surface tension of the stiff, newborn lung tissue. Because surfactant is produced very late in intrauterine life, babies who are born prematurely (before 28 weeks of gestation) have a hard time breathing.

The initial inflation of our lungs triggers enormous changes to our entire circulatory system, which has previously been geared toward receiving oxygenated blood from our placenta. That first breath causes a massive surge of blood into our lungs; the right and left sides of our heart to separate into two pumps; and the specialized vessels of fetal circulation to shut down, seal off, and become ligaments that support our abdominal organs.

Another radical reversal that occurs at birth is the sudden experience of body weight in space. Inside the womb, a fetus is cushioned in a supportive, fluid-filled environment. Suddenly, the child's entire universe expands—their limbs and head can move freely, and the baby must be supported in gravity.

Because adults swaddle babies and move them around from place to place, stability and mobility may not seem to be much of an issue early in life. In fact, infants begin to develop their posture immediately after taking their first breath as they begin to nurse. The complex, coordinated action of simultaneously breathing, sucking, and swallowing eventually provides them with the tonic strength to accomplish their first postural skill—supporting the weight of their head. This is no small feat for an infant, considering that an infant's head constitutes one fourth of their overall body length, compared to one eighth for an adult.

Head support involves the coordinated action of many muscles and, as with all weight-bearing skills, a balancing act between mobilization and stabilization. Postural development continues from our head downward until after about a year, when babies begin walking, culminating in the completion of our lumbar curve at about 10 years of age (see chapter 5).

Having a healthy life on Earth requires an integrated relationship between breath and posture, prana and apana, and sthira and sukha. If something goes wrong with one of these functions, it will go wrong with the others. In this light, yoga practice can be viewed as a way of experiencing the integration our body's systems so we spend more time in a state of sukha and less in a state of dukha.

To summarize, from the moment of birth, humans are confronted by breath and gravity, two forces that were not present in utero. To thrive, we need to reconcile those forces as long as we draw breath on this planet.

BREATHING DEFINED: MOVEMENT IN TWO CAVITIES

Breathing is traditionally defined in medical texts as the process of taking air into and expelling it from our lungs. This process—the passage of air into and out of our lungs—is movement; specifically, it is movement in our body's cavities, which we will refer to as shape change. So, for the purposes of this exploration, here's our definition:

Breathing is the shape change of our body's cavities.

The simplified illustration of a human body in figure 6.4 shows that our torso consists of two cavities: thoracic and abdominal. These cavities share properties, and they have important distinctions as well. Both contain vital organs: Our thoracic cavity contains our heart and lungs, and our abdominal cavity contains our stomach, liver, gall bladder, spleen, pancreas, small and large intestines, kidneys, and bladder.

Both cavities open at one end to the external environment—our thoracic at the top and our abdominal at the bottom. Our cavities are both open to and connected to each otherby means of an important shared structure: our diaphragm (see figure 6.12, page 85).

Another important shared property is that both cavities are bound posteriorly by our spine (figure 6.5). The two cavities also share our spine's property of mobility—they change shape. This shape-changing ability is most relevant to breathing; without this movement, our body cannot breathe at all.

Although both our abdominal and thoracic cavities change shape, an important structural difference exists in how they do so.

FIGURE 6.4 Thoracic cavity (yellow), abdominal cavity (blue). These cavities are open at either end to the outside and to each other via openings in our diaphragm.

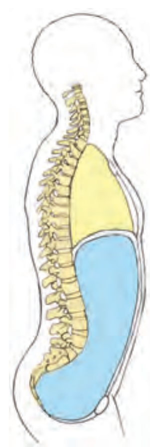


FIGURE 6.5 Our spine is the back of our cavities.

The Water Balloon and the Accordion

Our abdominal cavity changes shape like a flexible, fluid-filled structure such as a water balloon. When you squeeze one end of a water balloon, the other end bulges (figure 6.6). That is because water is noncompressible. Your hand's action only moves the fixed volume of water from one region of the flexible container to another. The same principle applies when the movements of breathing compress our abdominal cavity; a squeeze in one region produces a bulge in another. In the context of breathing, our abdominal cavity changes shape but not volume. In the context of life processes other than breathing, our abdominal cavity does change volume. When you drink a large volume of liquid or eat a big meal, the overall volume of your abdominal cavity increases as a result of expanded abdominal organs (stomach, intestines, and bladder). Any volume increase in our abdominal cavity produces a corresponding decrease in the volume of our thoracic cavity. That is why it can be more difficult to breathe after a big meal, before a big bowel movement, or when pregnant.

In contrast to our abdominal cavity, our thoracic cavity changes both shape *and* volume; it behaves as a flexible gas-filled container, similar to an accordion bellows. When you squeeze an accordion, you create a reduction in the volume of the bellows, and air is forced out. When you pull the bellows open, its volume increases and air is pulled in (figure 6.7). This occurs because the accordion is compressible and expandable, as is air. The same is true of our thoracic cavity, which, unlike our abdominal cavity and its contents, can change its shape and volume for breathing.

Let's now imagine our thoracic and abdominal cavities as an accordion stacked on top of a water balloon. This image gives a sense of the relationship of the two cavities in breathing; movement in one will necessarily result in movement in the other. Recall that during an inhalation (the shape change permitting air to be pushed into our lungs by the planet's atmospheric pressure), our thoracic cavity expands its volume. This pushes downward on our abdominal cavity, which changes shape caused by the movement

FIGURE 6.6 The water balloon changes shape, but not volume.

FIGURE 6.7 The accordion changes shape and volume.

from above. By defining breathing as shape change, it becomes easy to understand what constitutes effective or obstructed breath—it is simply the ability or inability of the structures that define and surround our body's cavities to produce shape change.

The Universe Breathes Us

Volume and pressure are inversely related; when volume increases, pressure decreases, and when volume decreases, pressure increases. Because air always flows toward areas of lower pressure, increasing the volume inside your thoracic cavity will decrease pressure and cause air to flow into it. This is an inhalation.

It is important to note that despite how it feels when you inhale, you do not actually pull air into your body. On the contrary, air is *pushed* into your body by the sea of atmospheric pressure[5] that always surrounds you. This means that the actual force that moves air into your lungs is outside of your body. The energy you expend in breathing produces a shape change that lowers the pressure in your chest cavity and permits the air to be pushed into your body by the weight of the planet's atmosphere. In other words, you create the space, and the universe fills it.

During relaxed, quiet breathing, such as while sleeping, an exhalation is a passive reversal of this process. Your thoracic cavity and lung tissue—which have been stretched open during the inhalation—spring back to their initial volume, pushing the air out and returning them to their previous shapes. This is referred to as a *passive recoil.* Any reduction in the elasticity of these tissues results in a reduction of our body's ability to exhale passively, leading to a host of respiratory problems such as emphysema, pulmonary fibrosis, and COPD[6], which greatly compromise the elasticity of the lung tissue.

In breathing patterns that involve active exhaling, such as blowing out candles, speaking, singing, and performing various yoga exercises, the musculature surrounding the two cavities engages in such a way that our abdominal cavity is pushed upward into our thoracic cavity or our thoracic cavity is pushed downward onto our abdominal cavity or a combination of the two.

Time to Breathe

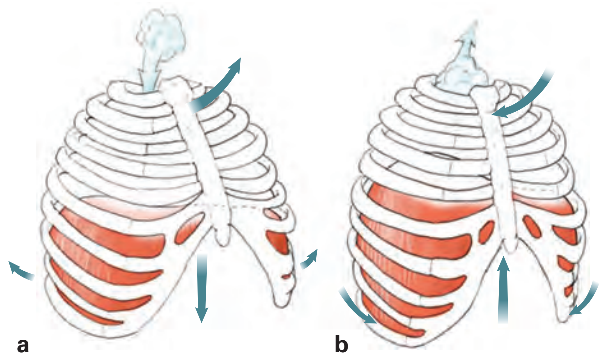
You can easily experience your exhalation as a passive recoil. Take a full inhalation and pause, then simply open your airway and notice how the air leaves your body automatically, with no muscular effort required.

5. At sea level, 14.7 pounds per square inch, or 1.03 kg/cm^2.

6. Chronic obstructive pulmonary disease (COPD) is characterized by long-term breathing problems and poor airflow. It often is associated with emphysema's breakdown of lung structure. Air gets trapped in our lungs, blocking the inflow of breath.

Three-Dimensional Shape Changes of Breathing

Because our lungs occupy a three-dimensional space in our thoracic cavity, when this space changes shape to cause air movement, it does so three dimensionally. Specifically, an inhalation involves your chest cavity increasing its volume from top to bottom, from side to side, and from front to back; an exhalation involves a reduction of volume in those three dimensions (see figure 6.8).



a b

FIGURE 6.8 Three-dimensional thoracic shape changes of *(a)* inhalation and *(b)* exhalation.

Because thoracic shape change is inextricably linked to abdominal shape change, you can say that our abdominal cavity also changes shape (not volume) in three dimensions. It can be squeezed from top to bottom, from side to side, or from front to back (see figure 6.9).

In our living, breathing bodies, this thoracic shape change cannot occur without abdominal shape change. That is why the condition of our abdominal region has such an influence on the quality of our breathing and why the quality of our breathing has a powerful effect on the health of our abdominal organs.

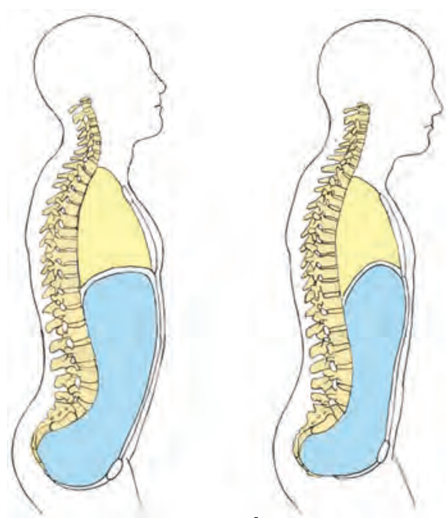


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FIGURE 6.9 Changes in abdominal shape during breathing: *(a)* inhalation and *(b)* exhalation.

EXPANDED DEFINITION OF BREATHING

Based on the information we have so far, here's an expanded definition of breathing:

Breathing, the process of taking air into and expelling it from our lungs, is caused by a three-dimensional shape change in our thoracic and abdominal cavities.

Defining breathing this way explains not only what it is but also how it is done. As a thought experiment, try this: Substitute the term *shape change* for the word *breathing* whenever discussing your breath. For example, "I just had a really good breath" really means "I just had a really good shape change." More important, "I'm having difficulty breathing" really means "I'm having trouble changing the shape of my cavities." This concept has profound practical and therapeutic implications because it tells us where to start looking for the root causes of breath and postural issues, and it can eventually lead us to a deeper understanding of the supporting, shape-changing structure that occupies the back of our body's two primary cavities—our spine (chapter 5).

A key foundation of yoga practice is the insight that spinal movements are an intrinsic component of the shape-changing activity of our cavities (breathing). Later in this chapter, we will examine the anatomical rationale for different ways to coordinate the movements of our spine with the process of inhaling and exhaling.

OUR DIAPHRAGM'S ROLE IN BREATHING: THE SLARA FORMULA

A single muscle, our diaphragm, is able to produce—on its own—the three-dimensional shape changes of breath in both cavities. This is why just about every anatomy book describes our diaphragm as the principal muscle of breathing. Let's add our diaphragm to our shape-change definition of breathing to begin exploring this remarkable muscle:

Our diaphragm is the principal muscle that causes three-dimensional shape change in our thoracic and abdominal cavities.

To understand how our diaphragm causes this much shape change, we will examine its *shape* and *location* in our body, where it is *attached* and what is attached to it (*relations*), and its *action*. Together, this list of our diaphragm's attributes is called the SLARA formula: shape, location, attachments, relations, action.

Shape of Our Diaphragm

The deeply domed shape of our diaphragm (figure 6.10) has evoked many images. Two of the most common are a jellyfish and a parachute (figure 6.11). Our diaphragm's shape is created by the organs it encloses and supports (see Relations of Our Diaphragm). Deprived of its relationship with those organs, its dome would collapse, much like a stocking cap without a head in it. It is also evident that our diaphragm has an asymmetrical double-dome shape; the right dome rises higher than the left because our liver pushes up from below the right dome, and our heart pushes the left dome down from above.

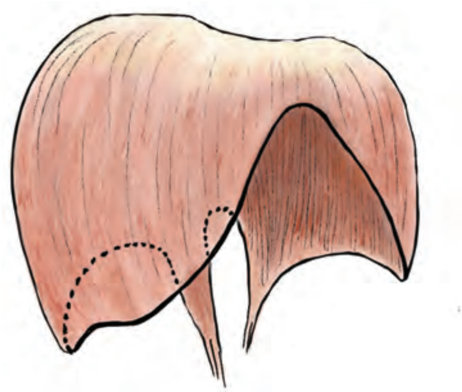

FIGURE 6.10 The shape of our diaphragm.

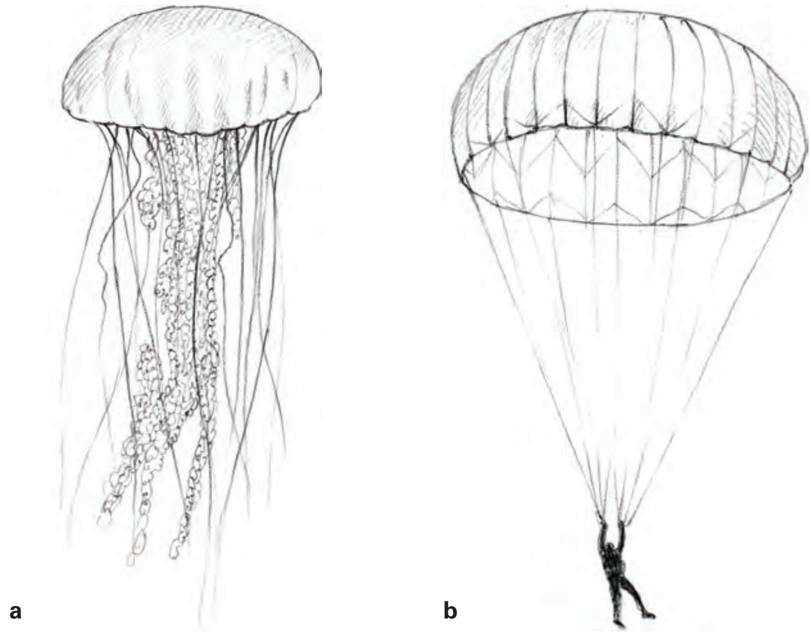

FIGURE 6.11 The shape of our diaphragm reminds many people of *(a)* a jellyfish or *(b)* a parachute.

Location of Our Diaphragm

Our diaphragm divides our torso into our thoracic and abdominal cavities. It is the floor of our thoracic cavity and the roof of our abdominal cavity. Its structure extends through a wide section of our body. *Nipple to navel* is one way to describe its location. More anatomically stated, the uppermost part of our diaphragm reaches the space between our third and fourth ribs, and its lowest fibers attach to the front of our third and second lumbar vertebrae.

Attachments of Our Diaphragm

To avoid confusion as we begin to examine the attachments of our diaphragm's muscular fibers, we will avoid the terms *origin* and *insertion* and simply refer to our diaphragm's lower and upper attachments. A detailed rationale for this choice will follow shortly.

Lower Attachments

The lower edges of our diaphragm's fibers attach at four distinct regions[7] (see figure 6.12):

1. Sternal—The back of the xiphoid process at the bottom of our sternum
2. Costal—The inner costal cartilage surfaces of ribs 6 through 10
3. Arcuate—The arcuate ligament[8] that runs from the 10th rib's cartilage to our lumbar spine, attaching along the way to the floating ribs (11 and 12) and the transverse process and body of L1
4. Lumbar—The crura (Latin for legs) at the front of our lumbar spine, L3 on right and L2 on left

7. Traditional texts list only three regions: sternal, costal, and lumbar. Because the very existence of the arcuate ligament is necessitated by our diaphragm running out of costal surface for attachment below the 10th rib, it makes little sense to include it with the costal attachments.

Visible in figure 6.13 are the central tendon, the three diaphragmatic hiatuses, the arcuate ligament and its attachment points, and the crura (legs) of our diaphragm attaching to the anterior surface of the lumbar spine. The three openings (hiatuses) in our diaphragm are for the venous return from the lower body to our heart: inferior vena cava, esophagus (esophageal hiatus), and arterial supply to our lower body (aortic hiatus). Hiatus is derived from the Latin "hiare," to stand open or yawn.

Upper Attachments

All the muscular fibers of our diaphragm rise upward from their lower attachments (figure 6.14). They eventually arrive at the flattened, horizontal top of the muscle, the central tendon, into which they blend. In essence, our diaphragm connects to itself—its own center, which is fibrous noncontractile tissue. When we discuss the action of our diaphragm, we see that the central tendon's vertical movements within our body are limited by its strong connection to our heart's fibrous pericardium, to which it is inextricably linked, an observation that naturally leads us to the next topic.

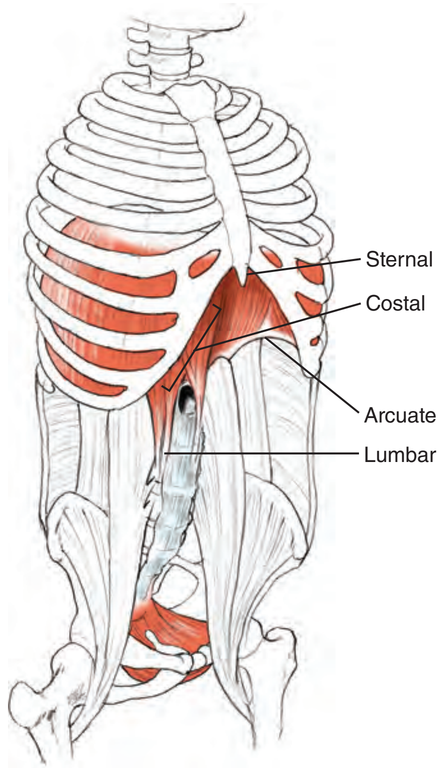

FIGURE 6.12 Location and lower attachments of our diaphragm.

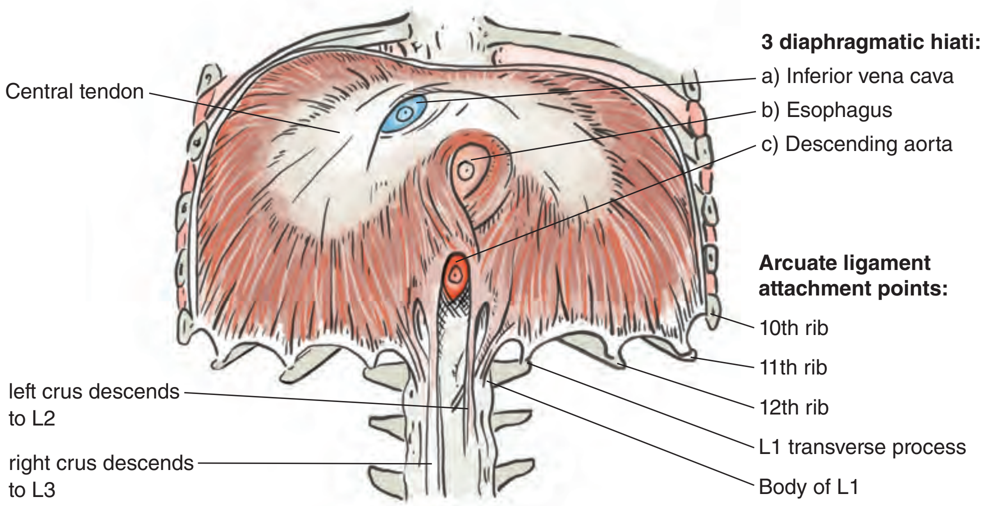

FIGURE 6.13 View of the posterior side of our diaphragm obtained by cutting away the front of our rib cage.

8. Traditional texts label each arc of the arcuate ligament individually. It is much clearer to think of it as a single, long ligament that attaches to the tips of the bony surfaces mentioned. In dissection, when the arcuate ligament is deprived of these attachments, it clearly stretches out into a single, straight ligament.

Relations of Our Diaphragm

So far, we've looked at the structures our diaphragm is attached to. But unlike other muscles, our diaphragm is associated with our thoracic and abdominal organs via their surrounding connective tissues. This is what is meant by the term *organic relations*.

As the prime mover of our thoracic and abdominal cavities, our diaphragm is a place of anchorage for the connective tissue that surrounds our thoracic and abdominal organs. The names of these important structures are easily remembered as the three Ps (figure 6.15):

Pleura, which surrounds our lungs

Pericardium, which surrounds our heart

Peritoneum, which surrounds most of our abdominal organs

Clearly, the shape-changing activity of these cavities has a profound effect on the movements of the organs they contain. Our diaphragm is a fundamental source of these movements, and our viscera are also a source of shape, resistance, and stabilization for our diaphragm. This reciprocal relationship illuminates why the coordinated movements of breath and body promoted by yoga practice can lead to such dramatic improvements in the overall health and functioning of all our body's systems (see Physiological Effects of Breathing).

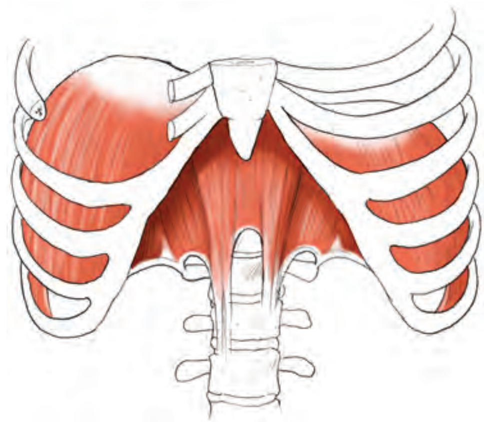

FIGURE 6.14 The muscular fibers of our diaphragm all run vertically from their lower attachments to the central tendon, which is their upper attachment point.

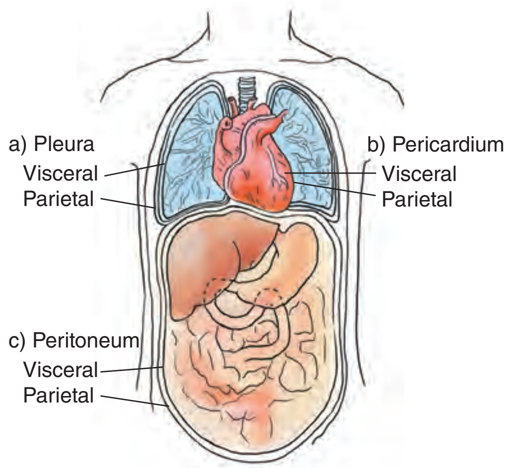

FIGURE 6.15 The visceral relations of our diaphragm are the pleura, pericardium, and peritoneum, each with their parietal (cavity) and visceral (organ) layers.

Physiological Effects of Breathing

Inhaling lowers internal thoracic pressure relative to the external atmosphere and also relative to internal abdominal pressure. This helps accelerate the return of venous blood from below our diaphragm into the right atrium of our heart. Additionally, inhaling lowers the central tendon (to which the pericardium is anchored), thus stretching our heart open to receive the venous return. The hiatus for the inferior vena cava (labeled as one of the three diaphragmatic hiati in figure 6.13) is within the central tendon so the contraction of our diaphragm's muscular fibers does not cause it to constrict the venous flow. By contrast, the esophageal hiatus (also labeled in figure 6.13) is a loop formed by muscular fibers of our diaphragm. It squeezes shut our esophagus during inhalation, preventing stomach acid from being drawn upward. When this mechanism is compromised, a hiatal hernia can occur, in which the lower pressure above our diaphragm draws the top of our stomach upward, resulting in acid reflux (also known as GERD, or gastroesophageal reflux disease), commonly referred to as heartburn because of the location of our esophagus posterior to our heart.

During exhalation and slow, paced breathing, the tone of our vagus nerve is increased, which is linked to parasympathetic messages of relaxation to our viscera. Vagal fibers innervate our heart and our lungs, which regulate heart rate and airway size and volume. There is evidence that our vagus nerve also influences immune function and the secretion of some glands and suppresses inflammation (Gerritsen and Band 2018).

Actions of Our Diaphragm

To fully appreciate the action of our diaphragm in all its three-dimensional complexity of shape, location, attachment, and relations, it is important to remember that the muscular fibers of our diaphragm are oriented primarily along the vertical (up–down) axis of our body (see figure 6.14). Analogies that liken the action of our diaphragm to a piston sliding within a cylinder offer an extremely impoverished, unidimensional view of breathing.

The action of our diaphragm is the fundamental cause of the three-dimensional thoracoabdominal shape changes of breathing. As with all muscles, the contracting fibers of our diaphragm exert a pull at their two attachment points (the central tendon and the base of our rib cage), drawing them toward each other. The observable movement produced by that contraction depends on which region of attachment is stable and which is mobile.

To illustrate this with a different muscle and its action, the psoas major creates hip flexion either by moving our leg toward the front of our spine, as in lying on our back and raising our legs, or by moving the front of our spine toward our legs, as in sit-ups with our legs braced. In both cases, our psoas major is contracting and flexing our hip joint. What differs is which end of the muscle is stable and which is mobile (see Origin and Insertion Fallacy in chapter 3, page 28). A stable torso and moving leg look different from a moving torso and a stable leg, even though the same muscle is acting to produce the movement. (The psoas, of course, does not do this on its own. A lot of other muscles help to stabilize our spine and mobilize our legs in a leg-raising movement, or vice versa for sit-ups.) In a similar way, our diaphragm's main action is to produce an increase in the volume of our thoracic cavity. The appearance of that shape change is different depending on whether our rib cage is stabilized and our abdominal wall is released or if our abdominal wall is held stable while our rib cage is free to move.

Just as you can think of the psoas major as both a leg mover and a trunk mover, you can think of our diaphragm as both a belly bulger and a rib cage lifter (see figure 6.16). Yet, the action of our diaphragm is almost universally associated with a bulging movement in our upper abdomen, commonly referred to as a belly breath or abdominal breath, and confusingly referred to as a diaphragmatic breath. The confusion is compounded by labeling this "diaphragmatic breath" as yogic, proper, or correct breathing.

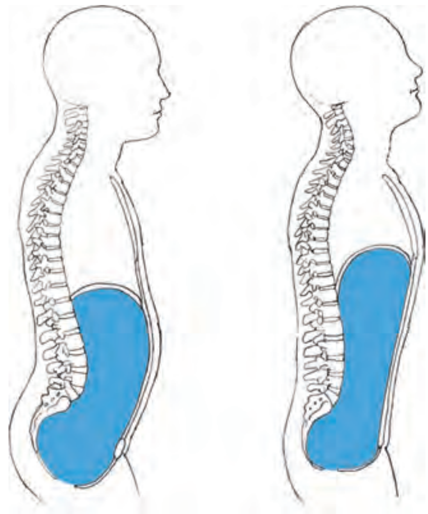

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FIGURE 6.16 Our diaphragm can be *(a)* a belly bulger during a "belly breath" or *(b)* a rib cage lifter during a "chest breath."

The Myth of Diaphragmatic Breathing

It should be clear by now that belly breathing is only one type of diaphragmatic breath—one in which the base of our rib cage (lower attachments) is stable, our abdominal wall is released, and the domes (upper attachments) are mobile (see figure 6.17*a*).

If we reverse these conditions by stabilizing our abdominal wall while releasing our rib cage, a diaphragmatic contraction exerts a lifting action at its lower attachments and an expansion of our rib cage (see figure 6.17*b*). This is usually called a chest breath, which many believe to be caused by the action of muscles other than our diaphragm.

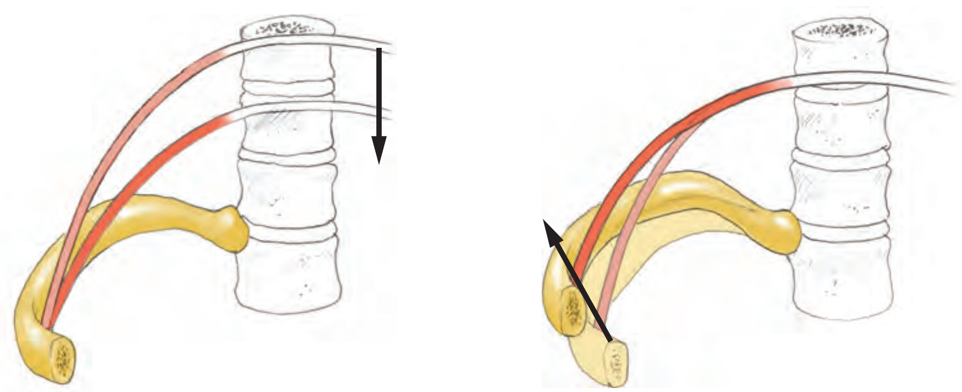

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FIGURE 6.17 *(a)* With our rib cage stable and our abdominal muscles relaxed, our diaphragm's contraction lowers the upper attachments; *(b)* with our rib cage relaxed and the upper attachments stabilized by abdominal action, the contracting diaphragm lifts our rib cage upward.

Chest breathing has gotten a bad reputation because it is associated with stress responses, while belly breathing is lauded for its calming effect on the system. While this may be true for many people, it is not true universally. It is just as possible to take a relaxed, efficient chest breath as it is to take a tense, tightly bound belly breath. In short, the location of breathing's shape change in our body is not a reliable indicator of how beneficial it is, so labeling one location of shape change as healthy and the other unhealthy is not justified. (See Cueing Callout: Exhalations Are Not Always Calming in chapter 7.)

This mistaken idea creates a false dichotomy between diaphragmatic and so-called nondiaphragmatic breathing. Except in cases of paralysis, our diaphragm is *always* used for breathing, so the term *diaphragmatic breathing* is a redundancy that reinforces this dichotomy.[9]

Breathing is what we do with our diaphragm, just as assuredly as walking is what we do with our feet.[10] We don't start a class in gait training by telling students they have been walking improperly and are about to learn foot walking. Yet, breathing students are commonly told they've not been using their diaphragms until they are taught the correct method of belly bulging known as *diaphragmatic breathing*.

The real issue is whether our diaphragm is able to work efficiently, meaning how well it can coordinate with all our other muscles that affect shape change. Yoga practitioners can achieve this more easily if they are not misled by confusing terminology.

STEERING THE ENGINE OF THREE-DIMENSIONAL SHAPE CHANGE

If it were possible to release all the muscular action surrounding our cavities,[11] our diaphragm's action could freely move the lower and upper attachments toward each other and cause both our chest and abdomen to move simultaneously. What tends to obstruct this multidimensional potential is the need to support and move our body's mass in gravity, which causes many of our respiratory stabilizing muscles—which are also postural muscles—to remain active through all phases of breathing, even while we are supine. From this perspective, our postural habits are synonymous with our breathing habits.

The specific patterns we encounter in yoga asana or breathing practice (pranayama) result from the action of accessory muscles—muscles other than our diaphragm—that can change the shape of our cavities. They have the same relationship to our diaphragm as the steering mechanism of a car has to its engine. The engine is the prime mover of a car. All mechanical and electrical movements associated with a car's function are generated by the engine. Similarly, the three-dimensional, thoracoabdominal shape changes of breathing are primarily generated by our diaphragm.

9. Yoga technique includes a version of non-diaphragmatic breathing—*kapalabhati*—which requires our diaphragm to relax so it can be moved by our abdominal viscera powered by rhythmic contractions of our lower abdominal wall.

10. The example of people with paralyzed diaphragms or lacking feet who, with the aid of technology, still manage to breathe and walk are exceptions that prove the rule.

11. The closest one can get to experiencing this (other than in orbit) is in the weightless support of a half-ton of Epsom salts dissolved in the water of a flotation tank or floating in the Dead Sea. It takes a while for the deeply habitual postural action of the muscles to release, but it's possible.

When you drive, the only direct control you exert over the engine is the speed of its spinning. Pushing the gas pedal makes the engine spin faster, and releasing the pedal makes it spin slower. When breathing, the only direct, volitional control you have over your diaphragm is its timing. Within physiological limits, you can control when your diaphragm contracts and, just as your car's gas pedal springs upward to decelerate as you release your foot, when your diaphragm ceases contracting, a passive recoil creates the exhalation.

Everyone knows you don't steer a car with its gas pedal. To channel the power of the engine in a particular direction, you need the transmission, brakes, steering, and suspension. In the same way, you don't "steer" your breathing with your diaphragm. To control the power of your breath and steer it in specific directions, you need the assistance of accessory muscles.

From the standpoint of this engine analogy, the notion of improving your breath function by training or strengthening your diaphragm is flawed. After all, you don't become a better driver by learning how to work only the gas pedal. Most of the skills you acquire in driver training have to do with coordinating the acceleration of the car with steering, braking, and awareness of your surroundings. Likewise, breath training is accessory muscle training. Only when all the musculature of your body is coordinated and integrated with the action of your diaphragm can breathing be efficient and effective.

The notion that diaphragmatic action is limited to abdominal bulging (belly breathing) is as inaccurate as asserting that an engine is capable of only moving the car forward and that something other than the engine governs reverse movement. Just as this mistake results from not understanding the relationship of the car's engine to its transmission, the corresponding breathing error results from not understanding our diaphragm's relationship to rib cage movement and to our accessory muscles.

Challenging Traditional Labeling of Origin and Insertion

Confusion about the action of our diaphragm may be caused by the mislabeling of its origin and insertion in anatomy texts, which has resulted in a kinesiological confusion about which end of the muscle is stable and which is mobile when our diaphragm's fibers contract.[10]

Traditional texts refer to our diaphragm's lower attachments as the muscle's origin, and the central tendon as the insertion. On closer scrutiny, this categorization breaks down. To find your diaphragm's lower attachments (see figure 6.12), place your fingertips at the base of your sternum, where you can usually touch the tip of your xiphoid process. You can then sweep your fingers around the edges of your costal cartilage, and from there around your back to the region of the floating ribs, which will lead you to the top of your lumbar spine.

At every point of contact you just traced on your body, your fingertips were as little as .25 inch (0.6 cm) and no more than one 1.5 inches (3.8 cm) away from either the sternal, costal, arcuate, or lumbar attachments of your diaphragm. Your fingers were on the *surface* of your body, not near its core, and neither were the attachments you just traced.

10. It is always tricky to use the word *contract* when referring to the action of our diaphragm because the word also means "to get smaller," which can create cognitive dissonance due to the fact that our diaphragm's contraction makes our rib cage bigger (increases its internal volume).

Can your fingers get close to your diaphragm's upper attachments at the central tendon? Not really, because it is at the *core* of your body, which is why describing this structure as *central* is apt, and why using a term for the central tendon that is usually reserved for distal structures (insertion) is confusing. Clearly, the lower attachments of your diaphragm are more distal than the upper.

Lower Fibers Have Mobile Attachments

The lower (distal) muscular fibers of our diaphragm all attach to flexible cartilage and ligament, and have considerable potential for movement, assuming our rib cage is not overly stabilized. The xiphoid process is continuous with the springy and flexible costal cartilage, which creates the many joints that attach the ribs to the sternum, and are among the more than 100 joints comprising our rib cage articulations. The arcuate ligament is a long, ropy band that attaches to the tips of the floating ribs. The front surface of the lumbar spine is covered with the anterior longitudinal ligament, which is anchored to the anterior surfaces of the cartilaginous intervertebral discs as well as the anterior surfaces of the lumbar vertebrae.

Upper Fibers: Central Tendon and Domes

The center of our diaphragm and our heart have never been apart, both having origins outside our thoracic cavity in our embryonic development. At this early stage, the future central tendon is called the transverse septum, and it moves together with the heart into our thoracic cavity during the inward folding of an embryo's structure in the fourth week in utero. Once in place, the muscular tissue of our diaphragm grows toward the central tendon from the interior surface of our abdominal wall, which further justifies its labeling as our diaphragm's origin.

Because of its firm anchoring to the pericardium and the rest of the circulatory system, the central tendon has limited ability to move vertically within our thoracic cavity (0.5 to 1 in., 1.2 to 2.5 cm). However, the domes that rise on either side of the central tendon are more mobile (averaging 1 to 2 in. or 3 to 5 cm, or 2.5 to 3 in. or 7 to 8 cm in well-conditioned athletes and yogis). The domes have the ability to strongly push downward on our abdominal viscera, and this mostly accounts for observed bulging of the upper abdomen, commonly referred to as a belly breath.

Conclusion

Because traditional texts have historically reversed the structural labeling of origin and insertion of the diaphragm by describing distal structures (lower attachments) as the origin and proximal structures (upper attachments at the central tendon) as the insertion, and because of the assumption that muscular insertions are mobile and muscular origins are stable, the belly-bulging action of the diaphragm has been termed "diaphragmatic" breathing.

ACCESSORY MUSCLES OF RESPIRATION

Although there is general agreement that our diaphragm is our principal muscle of breathing, there are varied and sometimes contradictory ways of categorizing the other muscles that participate in breathing. For example, many myographic studies of the intercostal muscles yield conflicting results, probably caused by variances in anatomy and breathing habits. By restating our definition of breathing, we can define as accessory any muscle *other than our diaphragm* that can cause a shape change in our cavities. Under certain circumstances, this could apply to just about any muscle in our body,[12] which in itself reveals the full-body complexity of breathing, but also calls for a more specific definition.

For the sake of clarity, we will not categorize our accessory muscles as either inhaling or exhaling,[13] but as muscles with attachments and orientation of action that can lead to either an increase or decrease of thoracic volume (figures 6.18 and 6.19). This is an anatomical versus a kinesiological distinction necessitated by the observation that many

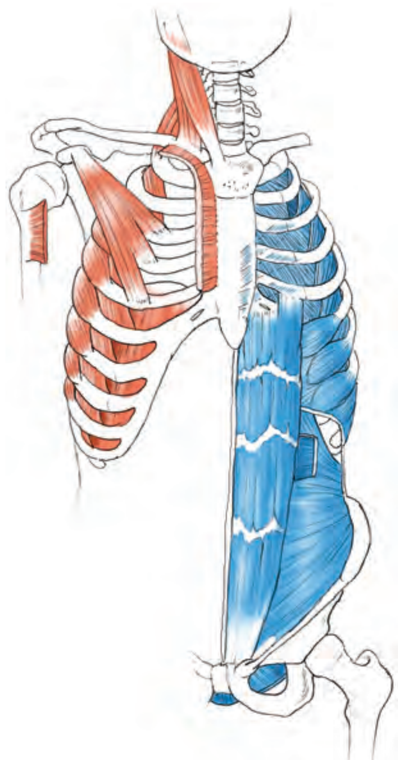


FIGURE 6.18 Some of our accessory muscles of respiration: Blue muscles act to reduce thoracic volume, while red muscles help to increase thoracic volume.

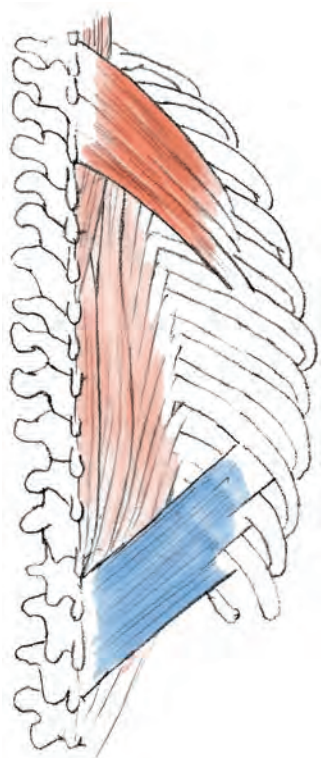


FIGURE 6.19 The serratus posterior muscles: Superior (red) assist thoracic volume increase; inferior (blue) assist thoracic volume reduction.

12. Consider the fact that our arms and legs can induce shape change in our cavities through a variety of pushing and pulling actions against external surfaces and resistance.

13. To indicate these are commonly used, but are not quite accurate terms, "inhaling muscles" and "exhaling muscles" will be used in quotes to indicate they are "so called."

so-called exhaling muscles can be quite active during the act of inhaling, and vice versa. There are accessory muscles that can accomplish these volume changes directly, and there are muscles that require the stabilizing action of other muscles to become accessory to breathing. This will become clear in the section, Analyzing Breathing Patterns.

Abdominal and Thoracic Accessory Muscles

Our abdominal cavity and its musculature can be imagined as a water balloon surrounded on all sides by elastic fibers running in all directions (figure 6.20). This includes the musculature on the top of the water balloon: our diaphragm (which is not accessory).

In concert with diaphragmatic contractions, the shortening and lengthening of these fibers produce the infinitely variable shape changes associated with respiration. As the tone of our diaphragm increases during inhalation, the tone of some abdominal muscles must decrease to allow our diaphragm to move. If you contract all your abdominal muscles at once and try to inhale, you'll notice that it's quite difficult because you've created resistance to your abdomen's ability to change shape in the vertical (top-down) dimension. Additionally, because the upper attachments of our abdominal muscles attach directly to the lower border of our rib cage, their engagement directly affects the ability of our thoracic cavity to expand in the transverse (side-to-side) and sagittal (front-to-back) dimensions (see figure 6.8).

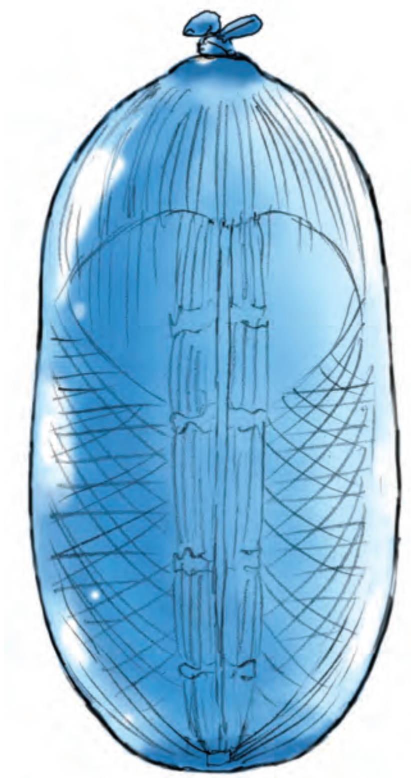


FIGURE 6.20 The shape changing of our abdominal cavity (similar to a water balloon) is modulated by many layers of muscle running in all directions.

The abdominal muscles that have the most direct effect on breathing are the ones that attach at the same place as our diaphragm: the transversus abdominis. This deepest layer of our upper abdominal wall arises from the costal cartilage at the base of our rib cage's inner surface. The horizontal fibers of the transversus abdominis are interdigitated (interwoven) at right angles with those of our diaphragm, whose fibers ascend vertically (see figure 6.21). This makes the transversus abdominis a direct antagonist to our diaphragm's action of expanding our rib cage. The same layer of horizontal fibers extends this action upward into the posterior thoracic wall as the transversus thoracis, a depressor of our sternum.

The other layers of our abdominal wall have similar counterparts in our thoracic cavity. Our external obliques turn into our external intercostals, and our internal obliques turn into our internal intercostals (see figure 6.22). Of all these thoracoabdominal layers of muscle, only our external intercostals are capable of increasing thoracic volume. All the others produce a reduction of thoracic volume, either by depressing our rib cage or resisting the downward movement of our diaphragm.

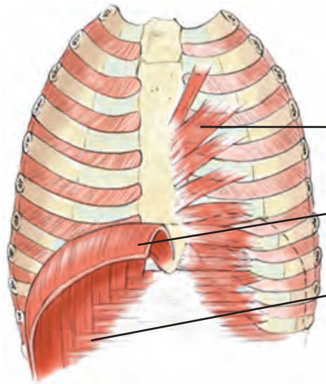


FIGURE 6.21 Posterior view of our chest wall, showing the interdigitated origins of our diaphragm and transversus abdominis forming perfect right angles with each other. This is clearly an agonist–antagonist, inhalation–exhalation muscle pairing that structurally underlies the yogic concepts of prana and apana.

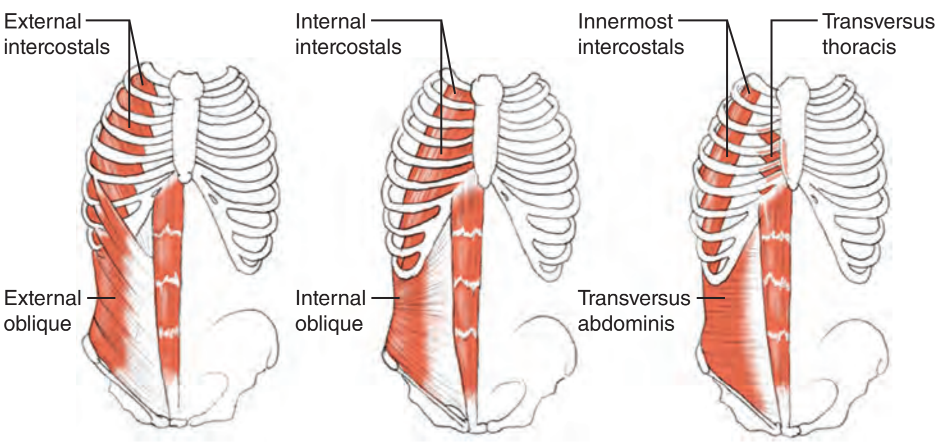


FIGURE 6.22 The continuity of our abdominal and intercostal layers shows how *(a)* our external obliques turn into our external intercostals, *(b)* our internal obliques turn into our internal intercostals, and *(c)* our transversus abdominis turns into our transversus thoracis in the front and our innermost intercostals in the back.

Movement of Our Rib Cage and Action of the Intercostals

Without a clear idea of how our rib cage moves, the action of our intercostals cannot be understood. As has already been mentioned, our rib cage increases and decreases its volume in all three dimensions: vertical, horizontal, and sagittal. This is frequently compared to the movements of a bucket handle (figure 6.23*a*) and a pump handle (figure 6.23*b*). In figure 6.7, the image of an accordion was used to illustrate the volume change of our thoracic cavity. Both these images are helpful but limited because they can lead to the erroneous assumption that, like the folds of an accordion, the ribs move toward and away from each other during respiration. This is not the case because our

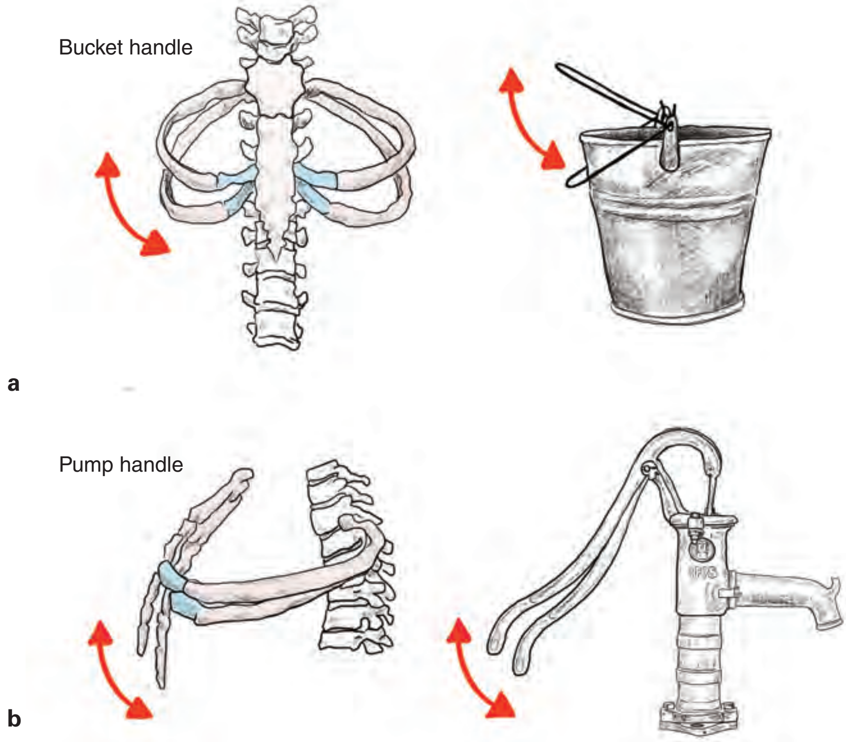


FIGURE 6.23 Rib movements *(a)* in the vertical and horizontal dimensions represented as bucket handles and *(b)* in the sagittal and vertical dimensions represented by a pump handle.

intercostal spaces remain constant through all phases of breathing. Rather, our ribs slide in relation to each other while maintaining their distance. This is why the oblique (slanted) orientation of our intercostal muscles can assist in one or another direction of this sliding (figure 6.24). The red dotted line is straight in the neutral position (figure 6.24*b*), then misaligns because of the sliding of our ribs in relation to each other during thoracic volume reduction (figure 6.24*a*) and increase (figure 6.24*c*). Our intercostals that are shortening in each phase are shown in red, and our intercostals that must lengthen are shown in blue.

This provides insight into a major factor that can contribute to breathing (shape-changing) difficulties; the amount of work our "inhaling muscles" must do to increase thoracic volume depends directly on the ability of our muscles that decrease thoracic volume to release the resistance they impose on the act of breathing. This links to another profound observation of T.K.V. Desikachar: "If you take care of the exhale, the inhale takes care of itself."

Other Accessory Muscles

Some neck, chest, and shoulder girdle muscles can increase the volume of our rib cage by lifting it from above (see figure 6.25), but they are far less effective at doing this than our diaphragm, which raises our rib cage from below and our external intercostals, which lift our rib cage from within the intercostal spaces.

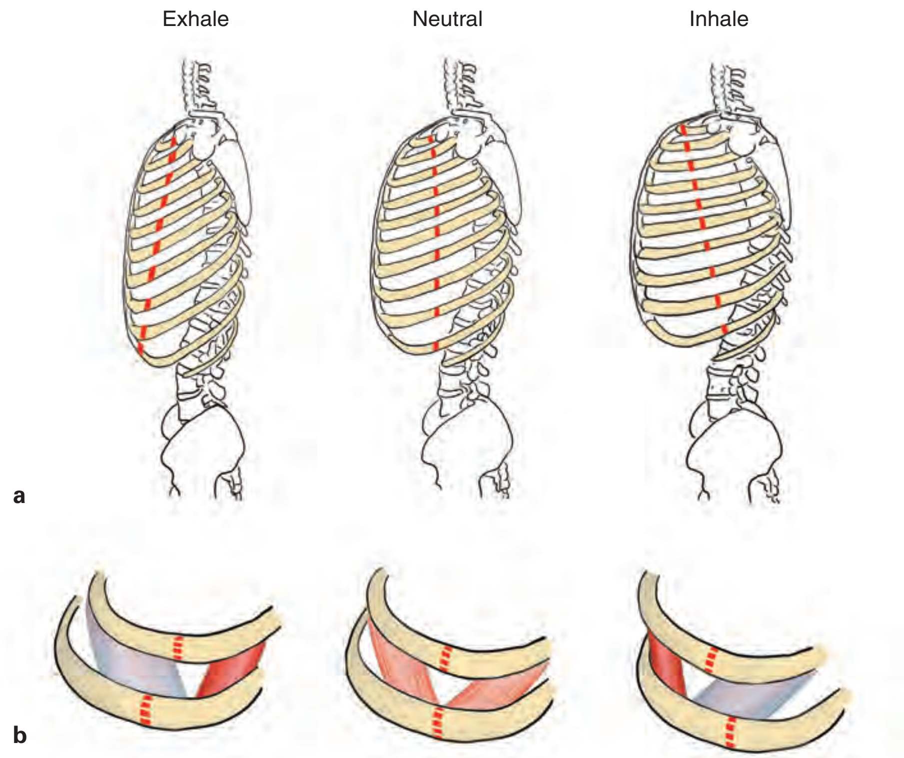


FIGURE 6.24 Sliding action of our ribs assisted by intercostals illustrated by misalignment of a red dotted line. Thoracic volume reduction assisted by *(a)* internal intercostals and *(b)* thoracic volume increase assisted by *(c)* external intercostals.

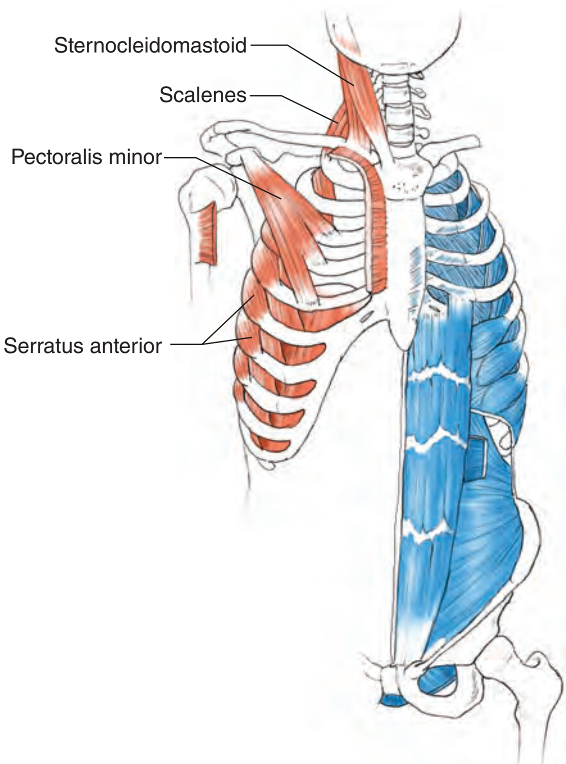


FIGURE 6.25 Neck, chest, and shoulder muscles that can act as accessory to breathing. Our sternocleidomastoid can lift our clavicle and sternum. Our scalenes can lift ribs 1 and 2. Our pectoralis minor can lift ribs 3, 4, and 5. Our serratus anterior can lift ribs 1 through 8 or 9.

The usual role of these muscles is not respiration, and their location and attachments do not provide lifting leverage on our rib cage (especially the sternocleidomastoid and scalenes, which can lift only our collarbones, sternum, and first two ribs). As mobilizers of our head, neck, and shoulder girdle, they are usually stable proximally (toward the core of our body) and mobile distally (toward the periphery of our body). For these muscles to expand our rib cage, this relationship must be reversed; for the proximal origins to be mobilized, the distal insertions must first be stabilized by yet more muscles (specifically our posterior neck muscles, levator scapulae, rhomboids, and trapezius, among others), many of which can be visibly tense in people who have breathing disorders.[14] All these factors make these the least efficient of our accessory muscles, and considering the degree of muscular stabilization that inhaling with these muscles requires, the net payoff in oxygenation can make it a poor energy investment. That is why improved breathing is observable as decreased tension in the accessory mechanism, which happens when our diaphragm, with its enormously efficient shape-changing ability, can operate unencumbered.

ANALYZING BREATHING PATTERNS

No simple formula can capture the complexity and subtlety of the infinite variations available to our breathing mechanism. For the sake of simplicity, we will analyze the muscular actions that produce three distinctly different breathing patterns, while being mindful that these patterns will be expressed differently by each individual.

Belly breathing is an example of how “exhaling muscles” can be active in shaping a specific type of inhalation. Because our diaphragm is both a rib cage lifter and belly bulger, for our diaphragm’s action to show mainly in our abdomen, its costal (lower) attachments must be stabilized by the muscles that pull our rib cage downward: the internal intercostals, the transversus thoracis, and others (see figures 6.18, 6.20, and 6.23). Additionally, our abdominal wall must be able to yield to the forward and downward movement of the organs generated by the descent of the domes of our diaphragm. In short, belly breathing mobilizes the upper attachments of our diaphragm by stabilizing its lower attachments and releasing our abdominal wall.

Chest breathing mobilizes the lower attachments of our diaphragm by stabilizing its upper attachments and engaging our abdominal wall. This is another example of how a specific type of inhalation can be shaped with “exhaling muscles,” but in the opposite pattern of a belly breath. In a chest breath, the central tendon (upper attachments) of our diaphragm is stabilized by the lower abdominal muscles and possibly our pelvic floor.

Cueing Callout

Although a common cue when teaching belly breathing is “expand your belly,” no volume change is involved when our breath manifests as abdominal shape change. A more accurate (albeit less attractive) word is *bulge*. “Breathe into your belly” is not wrong, but “inflate your belly,” which implies air is entering our abdomen, is. Also, *belly* and *abdomen* should not be replaced with *stomach*.

14. People with emphysema, desperate for breath, will often elevate their shoulder girdle to give more leverage to their accessory breathing efforts.

Note that in both the chest and belly breaths, our diaphragm (engine) does the only thing it knows how to do: increase thoracic volume by drawing its attachments toward each other. Our accessory muscles (steering) direct that shape change by stabilizing one region and releasing another.

Kapalabhati (from *kapala* meaning "skull," and *bhati* meaning "light" or "shine") is a cleansing technique (*kriya*) that strongly activates the upward movement of apana. This action is generated by rhythmic contractions of our deep lower abdominals and pelvic floor (figure 6.26), which produce partial, active exhalations followed by partial, passive inhalations.

While both belly breathing and chest breathing are examples of how "exhaling muscles" can be active in shaping a specific type of inhalation, kapalabhati is the opposite: An exhaling action is facilitated by engaging the "inhaling muscles." For the lower abdominal contractions to move our viscera freely upward, the base of our rib cage needs to be lifted and held open by the "inhaling muscles" such as our external intercostals, serratus posterior, and levatores costarum, which remain active throughout the exercise. Unlike the belly breath, in which our abdominal wall is released and our diaphragm is active, kapalabhati requires the opposite: an active abdominal wall and a released diaphragm. One could say this is a form of non-diaphragmatic breathing; although our diaphragm is in motion, it is being moved by other muscles.

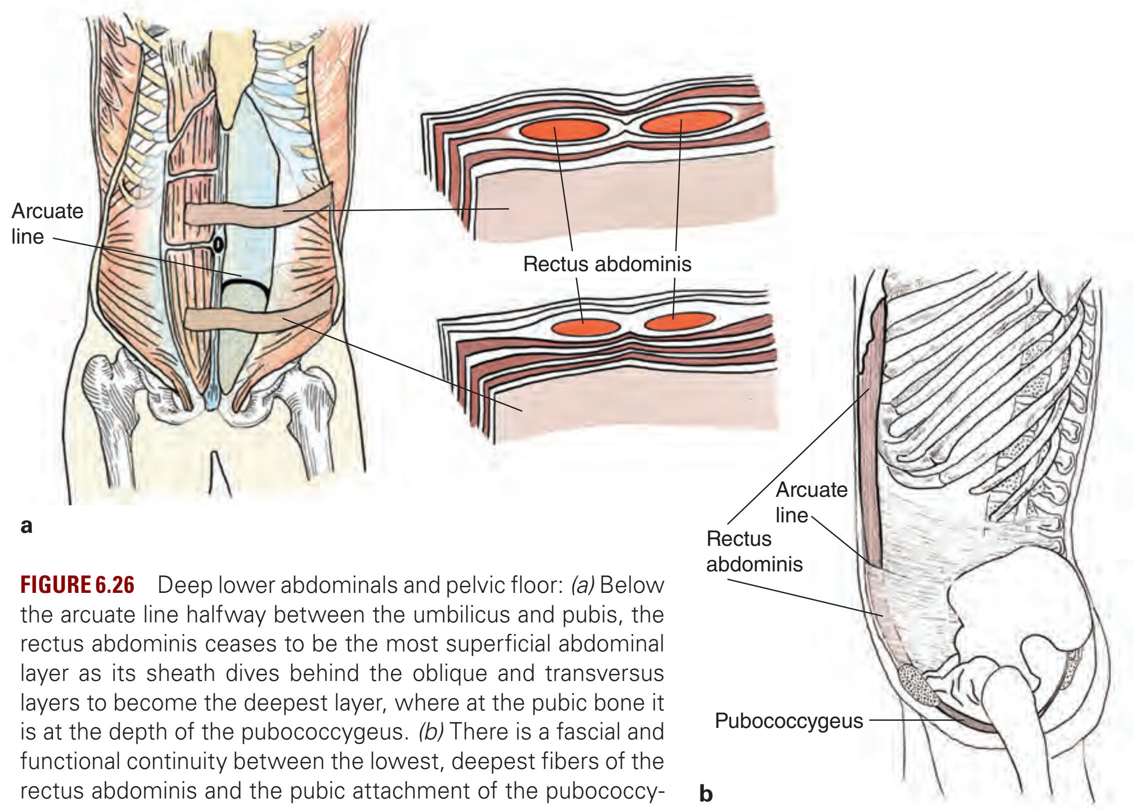


FIGURE 6.26 Deep lower abdominals and pelvic floor: *(a)* Below the arcuate line halfway between the umbilicus and pubis, the rectus abdominis ceases to be the most superficial abdominal layer as its sheath dives behind the oblique and transversus layers to become the deepest layer, where at the pubic bone it is at the depth of the pubococcygeus. *(b)* There is a fascial and functional continuity between the lowest, deepest fibers of the rectus abdominis and the pubic attachment of the pubococcygeus (pelvic diaphragm).

OTHER DIAPHRAGMS

Along with the respiratory diaphragm, breath movement involves the action of other muscular diaphragms. Of interest to yoga practitioners are the coordinated actions of our pelvic and vocal diaphragms.

Pelvic Diaphragms

Mula bandha, or root lock (*mula* meaning "firmly fixed" or "root," and *bandha* meaning "binding," "bonding," or "tying"), is a lifting action produced in the pelvic floor muscles (figure 6.27), including the lower fibers of our deep abdominal layers (figure 6.26*b*). Mula bandha is an action that moves apana upward and stabilizes the upper attachments of our diaphragm. Activating this bandha produces an upward shift in our abdominal contents that requires the base of our rib cage to make space by "flying upward." This lifting action is referred to as *uddiyana bandha*, or flying upward lock. Mula bandha and uddiyana bandha are in fact, the bottom and top of the same single gesture. Uddiyana is the space toward which mula rises; mula is the support upon which uddiyana roots to rise.[15]

The more superficial muscular fibers of our perineum, which are not efficient lifters of our pelvic floor, need not be involved in mula bandha. They also contain our anal and urethral sphincters (figure 6.28), which are associated with the downward movement of apana (elimination of solid and liquid waste), as shown in figure 6.1. Intentionally engaging the external anal sphincter during breath practice is not part of mula bandha but is a separate action known as *ashwini mudra*.[16]

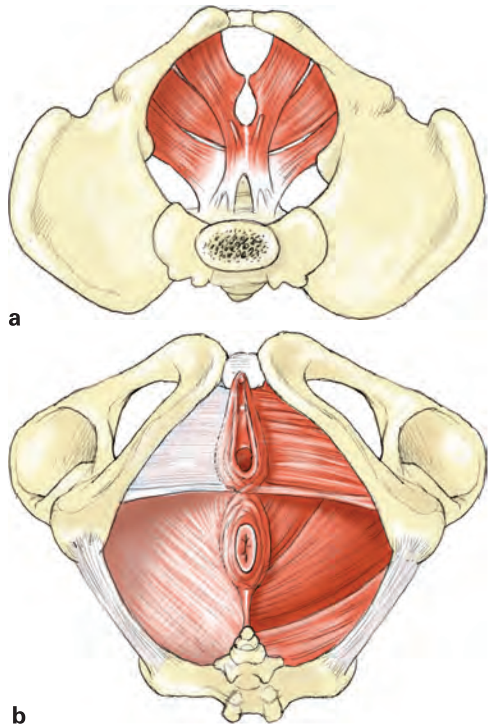


FIGURE 6.27 *(a)* The deepest muscles of our pelvic diaphragm, from above; *(b)* our pelvic floor from below, showing the orientation of superficial and deeper layers. The more superficial the layer, the more it runs from side to side (ischia to ischia); the deeper the layer, the more it runs front to back (pubic symphysis to coccyx).

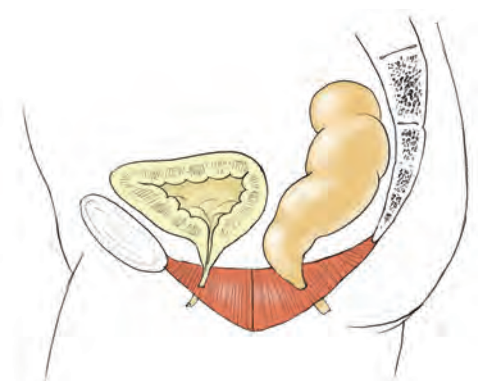


FIGURE 6.28 The action of our more superficial perineal fibers are associated with the anal and urogenital sphincters.

15. The evocative cue "root to rise" was most likely inspired by Irene Dowd's highly influential *Taking Root to Fly: Seven Articles on Functional Anatomy*, originally published in 1981.

16. *Ashwin* means "horse," an association derived from the impressive sight of equine defecation.

Vocal Diaphragm

The gateway to our respiratory passages is our glottis, shown in figure 6.29, which is not a structure, but a space between the vocal folds (cords). Regulating this space in various ways based on what we are doing with our breath, voice, and posture is a natural part of our development. Yoga training can help us become conscious of these habits by intentionally regulating (and un-regulating) the airway.

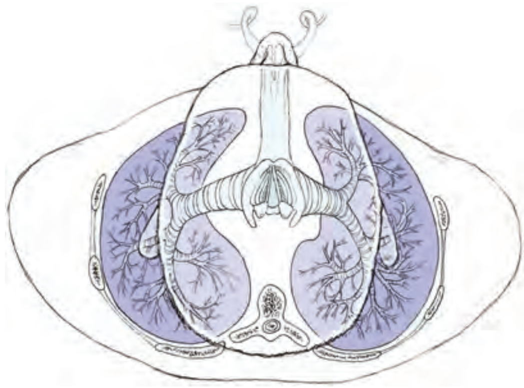


FIGURE 6.29 The pathway of air into and out of our lungs, showing the location of our vocal folds.

When at rest, the muscles that control our vocal cords can be relaxed so that our glottis is being neither restricted nor enlarged (see figure 6.30*a*). This occurs in sleep and in the more restful, restorative practices in yoga.

When inhaling quickly between phrases of speech or singing, or doing breathing exercises that involve deep, rapid movements of breath, such as kapalabhati or bhastrika

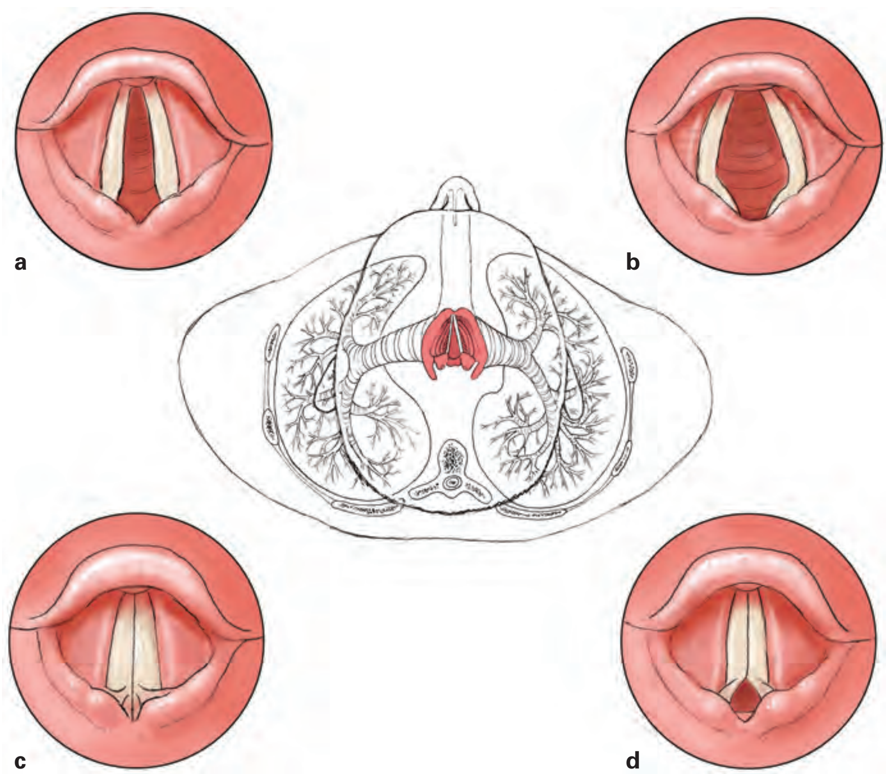


FIGURE 6.30 Position and location of vocal folds: *(a)* relaxed position, *(b)* maximally opened for forced respiration, *(c)* closed for speaking (phonation), *(d)* slightly opened for whispered speech (or ujjayi).

(*bhastra* means "bellows"), the muscles that pull our vocal folds apart (abduction) contract to create a wider passage for the movement of larger volumes of air (see figure 6.30*b*). When chanting, singing, or speaking, our vocal folds are drawn together (adduction), which causes them to vibrate as the exhaled air is forced across them. This vibration is termed *phonation* (see figure 6.30*c*).

When the exercises call for long, deep, slow breaths, our glottis can be partially closed, with only a small opening at the back of the cords (see figure 6.30*d*). This is the same action that creates whispered speech; in yoga it is one way to create a gentle, quiet *ujjayi*, "the victorious breath" (*ud* meaning "to flow out" and *jaya* meaning "victory" or "triumph"). Stronger, louder versions of ujjayi that can create more postural support in our body will recruit some of the throat muscles above our glottis, as we will explore in the next section.

NOSE BREATHING VERSUS MOUTH BREATHING

There are compelling anatomical reasons why nose breathing is often cited as being healthier than mouth breathing. Various studies use different definitions of nose and mouth breathing. Some researchers label the breath based on where the inhalation occurs (i.e. inhaling through the nose and exhaling through the mouth is still considered to be nose breathing, while the reverse is called mouth breathing). Most yoga sources accept both inhaling and exhaling through our nose as nose breathing.

Air inhaled through our nose is warmed, filtered, moistened, and spun into a coherent vortex by a shell-shaped system of bones, vessels, and tissue within the nasal passageways called the turbinates, also known as nasal conchae, which is Latin for "shell." *Turbinate* also refers to a shell shaped like a spinning top or inverted cone (figure 6.31). Although our illustration depicts these structures symmetrically, this is seldom the case in actual bodies. As with spines, most people exhibit some degree of asymmetry in these structures, the most common being deviation in our septum, which makes one nostril more structurally open than the other.

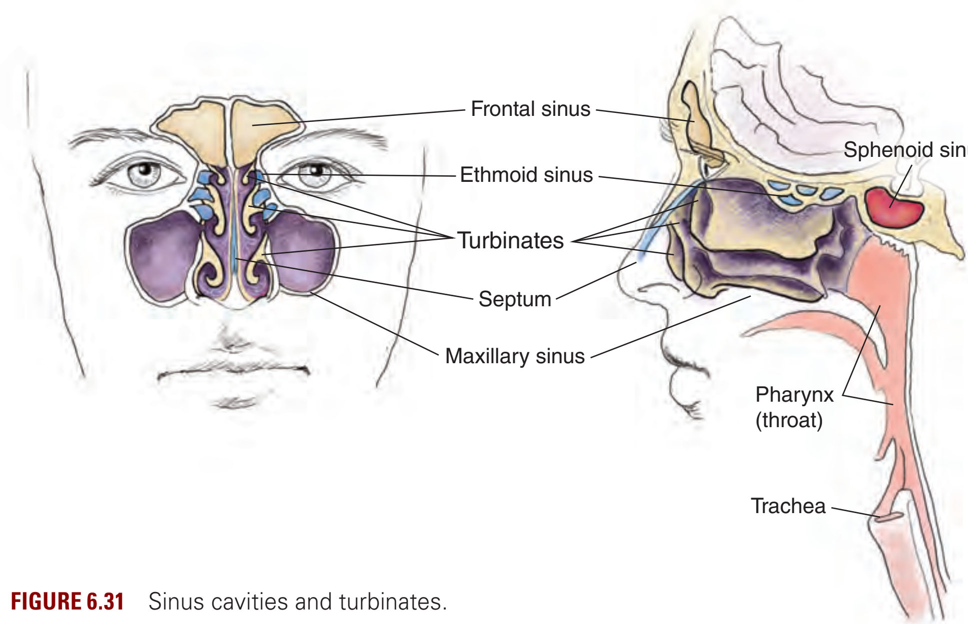


FIGURE 6.31 Sinus cavities and turbinates.

Within our nasal sinuses is secreted the important vasodilator nitric oxide, which relaxes the smooth muscle of blood vessels, causing them to widen.[17] This increases blood flow and lowers blood pressure. Compared to mouth breathing, nose breathing transports more nitric oxide (and its benefits) to our lungs and bloodstream (Lundberg et al. 1996). Mouth breathing delivers a greater quantity of air to our lungs; nose breathing delivers better quality.

THE BANDHAS

All three diaphragms (pelvic, respiratory, and vocal) come together with ujjayi in yoga movements that are coordinated with inhaling and exhaling. In addition to giving more length and texture to our breath, the valve of ujjayi creates a kind of back pressure throughout our abdominal and thoracic cavities. This pressure can protect our spine during the long, slow flexion and extension movements that occur in the breath-synchronized flowing practice of *vinyasa* (arrangement or placement), such as during sun salutations. In yogic terms, these coordinated actions of our diaphragms (bandhas) create more sthira (stability) in our body, protecting it from injury by redistributing mechanical stress.

Figure 6.32 shows a mechanical analysis of a body entering into a forward bend from two perspectives. In figure 6.32*a*, we see a torso moving without breath support. Because

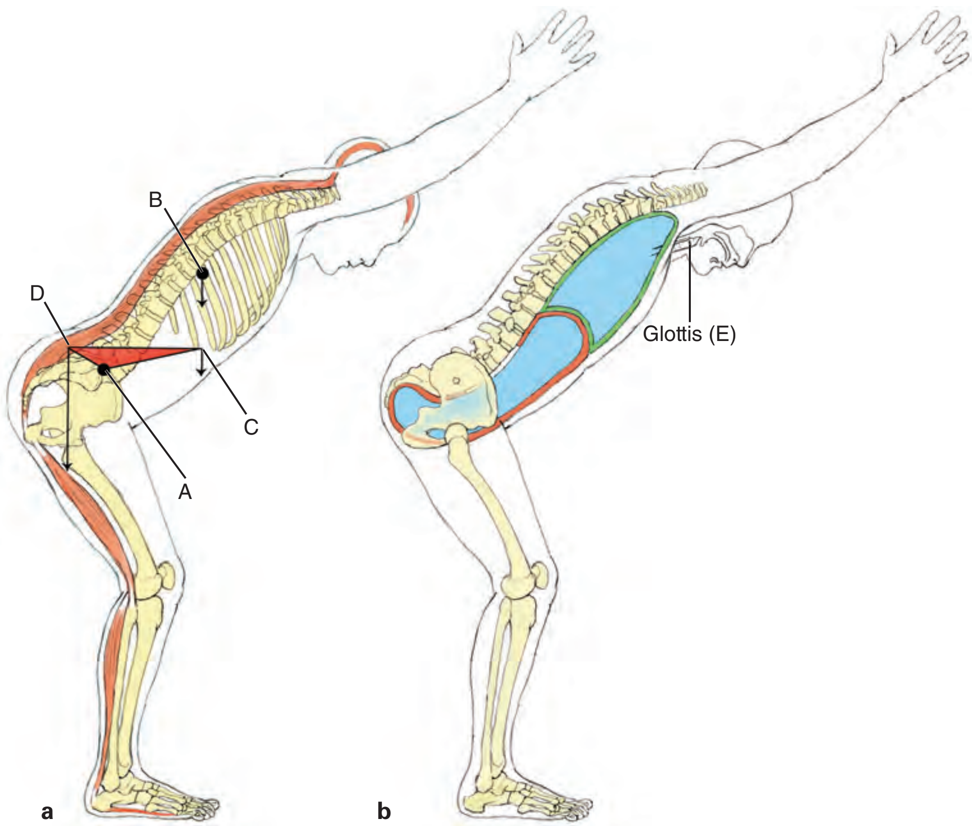


FIGURE 6.32 Supporting our spine *(a)* without our breath and *(b)* with our breath.

17. The discovery of nitric oxide as a signaling molecule in the cardiovascular system was so important that it won the 1998 Nobel Prize in Physiology or Medicine for Robert F. Furchgott, Louis J. Ignarro, and Ferid Murad.

the breathing musculature surrounding the cavities is not engaged, there is no single center of gravity to the shape, and a partial center of gravity (B) is acting on the long arm of a lever (C), of which the fulcrum point (A) is within the vulnerable lumbosacral junction. The weight of our torso is being controlled by the posterior musculature, which compressively acts on the short end of the lever (D). Our body instinctively resents this extremely poor leverage, and that's why we tend to hold or "valve" our breath in situations like this to avoid irritating our spinal structures.

Figure 6.32*b* pictures the same movement employing the glottal valve of ujjayi (E), which automatically engages our breathing musculature. This creates support along the entire anterior surface of our spine because it rests on the stabilized body cavities. Our body now has a single center of gravity, which is being supported safely by our pelvis and legs. This is what is commonly referred to as frontal support.

An additional effect of moving and supporting our body through this kind of resistance is the creation of heat in the system. These practices are referred to as *brhmana*,[18] which implies heat, expansion, and the development of power and strength as well as the ability to withstand stress. Brhmana is also associated with inhaling, nourishment, prana, and the chest region.

When releasing our body into more horizontal, restorative practices, it is important to notice whether you can disengage any bandha and glottal constriction associated with vertical postural support. This relaxing side of yoga embodies the quality of *langhana*,[19] which is connected with coolness, condensation, relaxation, and release as well as the development of sensitivity and inward focus. Langhana is also associated with exhaling, elimination, apana, and our abdominal region. (See Cueing Callout: Brhmana and Langhana Describe *Experiences*, not *Practices* in chapter 7.) The role of the bandhas in pranayama practice will be addressed at the end of this chapter.

BREATH CUEING AND SPINAL MOVEMENT: A THREE-DIMENSIONAL PERSPECTIVE

Figures 6.8, 6.23, and 6.24 showed some of the three-dimensional thoracic shape changes that create inhaling and exhaling. Figure 6.33 depicts how exhaling decreases and inhaling increases the front-to-back dimension of our thoracic cavity. In figure 6.33*b*, the upper arrow shows the inhalation lifting our sternum and front attachments of the ribs via the "pump handle" action. As indicated by the lower two arrows, an inhalation moves our sternum farther away from the front of

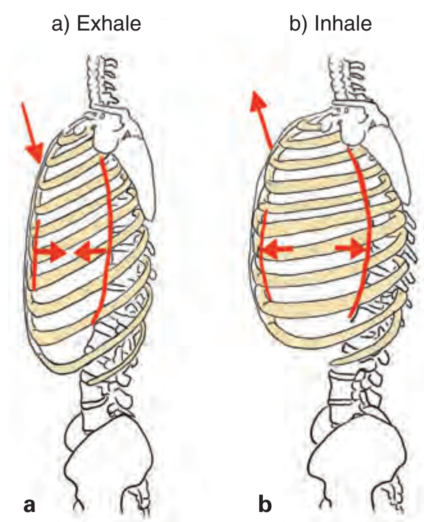


FIGURE 6.33 Side view of *(a)* thoracic shape change during exhalation and decreased thoracic flexion and *(b)* thoracic shape change during inhalation and increased thoracic flexion.

18. From *brh*, meaning "to make big or fat or strong," "increase," "expand." In ayurveda, brhmana treatments nourish, heat, and increase the bulk of our body.

19. From *laghu* or *laghaya* meaning "to make light," "lessen," "diminish." Ayurvedic treatments that seek to reduce, promote elimination, cleanse, and lighten our body are said to be langhana.

our spine, but it also moves our thoracic spine away from our sternum. In other words, inhaling involves a slight *flexion* of our spine to increase thoracic volume. The opposite occurs with the exhalation (figure 6.33*a*), when our thoracic volume decreases and our spine reduces its primary curve toward *extension*.

This observation leads to a challenging inquiry for yoga practitioners and teachers who have been trained to always cue inhaling on spinal *extension* and exhaling on spinal *flexion*.

Returning to the example of cat–cow (cakravakasana; figure 6.34), we can see that these cues have no anatomical basis and are merely a result of giving preference to the breath dynamics of the front of our body over the back. Everything in our body, including our breath, is three dimensional. While it is true that the opening of the front of our body is part of an inhalation (figure 6.34*a*), adding spinal extension to that movement actually *closes* the back of our body. Conversely, performing spinal flexion on an exhalation produces a closing, condensing action in the front of our body, but it also *opens* the back of our body.

Figure 6.34*b* depicts the opposite scenario in which the breath cueing gives preference to the dynamics of our back body. Many beginning students, if not directed away from this in favor of the "correct" pattern, will naturally prefer it, perhaps because they are relating their inhaling action to the region where 60 percent of lung capacity resides—the back—or connecting their exhaling action to what their thoracic spine prefers—extension—as was pointed out in figure 6.33*b*.

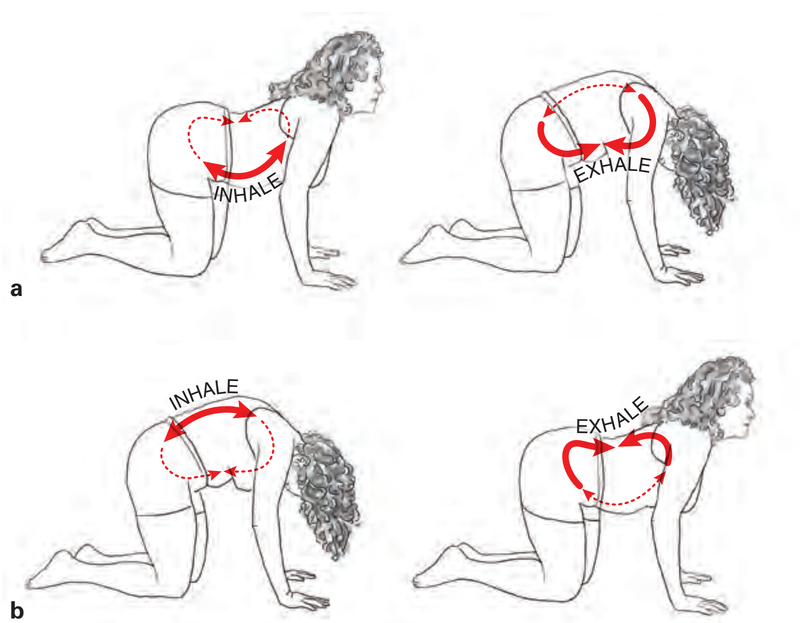


FIGURE 6.34 Focus on breath in the cat–cow movements of flexion and extension: *(a)* front-body breathing; *(b)* back-body breathing.

Time to Breathe and Move: An Inquiry About Habits

Try the cat–cow movements using both breathing patterns depicted in figure 6.34 and see what you notice. Does one version feel noticeably easier or harder than the other? If so, why? Does something about your body's structure account for what you felt, or was it caused by habitual patterns of breath and movement based on training you've received or certain ideas about your body?

If breath and spinal movements were entering into areas that usually don't breathe or move, what did that feel like? Was it pleasant or unpleasant, confusing or clarifying, upsetting or calming? Was it difficult to recognize differences? There is no wrong answer to an inquiry like this, even if your response is utter confusion. T.K.V. Desikachar famously said, "The recognition of confusion is itself a form of clarity."

On the other hand, the nonrecognition of confusion—when you don't know what you don't know—is always a problem waiting to happen. In Patañjali's *Yoga Sutras*, this is known as *avidya* (ignorance), which is identified as the root cause of all the obstacles (*klesha*) we seek to overcome through yoga practice.

INTRINSIC EQUILIBRIUM REVISITED: PRESSURE ZONES

Intrinsic equilibrium refers to several important mechanisms that combine to make our human torso a self-supporting structure with an inherent tendency to generate upward support. The neutral-seeking spinal component of intrinsic equilibrium was discussed in chapter 5, when we saw how our spine's intervertebral discs are constantly pushing our vertebral bodies apart—an action countered by the ligaments that bind together the components of our spine's posterior column. This combined push–pull of forces makes our entire spinal column a springy structure whose tissues are constantly storing and releasing energy.

We also pointed out that the other bony components of our torso—our rib cage and pelvis—share this characteristic with our spine: Their parts are also knit together under mechanical tension, like coiled springs restrained by elastic bands. When our sternum is divided for thoracic surgery, the curved, springlike ribs straighten out a bit and the two halves spring open. They need to be pushed back together to be closed up again. At the front of our pelvis, the two pubic rami are joined at our pubic symphysis, a pressurized joint that would also spring open if severed.[20]

Perhaps the most important of these mechanisms of support can be found in the shape-changing, visceral components of our torso. A pressure differential exists between our lower abdomen (highest pressure), our upper abdomen (middle pressure), and our thoracic cavity (lowest pressure). Because energy always migrates from a region of higher pressure toward a region of lower pressure, this means that the lower and upper abdominal contents are constantly migrating upward toward our thoracic space (figure 6.35).

20. The hormone relaxin, present in pregnancy, softens the ligaments that hold the bones of the pelvis together so they can open for childbirth. Usually, they reknit afterward.

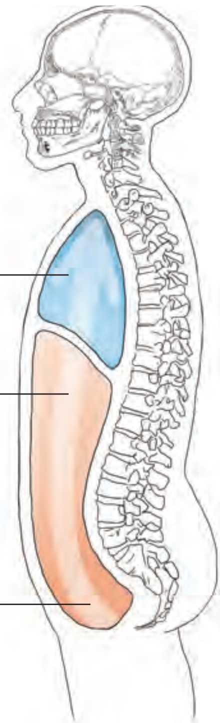


FIGURE 6.35 Pressure zones of our torso.

Of the many functions of our diaphragm, one is to prevent our abdominal viscera from entering our thoracic space.[21] All of these features of our body operate independently of muscle contraction—in fact, it is the unconscious, habitual activity of our postural and breathing musculature that obstructs the experience of intrinsic equilibrium. So, establishing an upright relationship to gravity, in the deepest sense, is less about exerting the correct muscular effort than it is about discovering and releasing the habitual muscular effort obstructing the natural tendency of our body to be intrinsically supported from within.

AGNI: AN ORIGIN STORY FOR YOGA?

At the very beginning of this chapter, the process of digestion and assimilation was said to be the domain of agni, a term for fire, which was worshipped in ancient times as a deity. The extreme importance of fire to our ancestors provides a vital clue to the prehistoric origins of yoga.

Although not exactly synonymous with a leisure activity, yoga does require a certain amount of free time to pursue within a society in which division of labor exists. Time free from what? From surviving in a world in which all your waking hours and bodily energy are devoted to chasing, gathering, chewing and digesting your food, or running away from a hungry creature that is faster, bigger, and stronger than you[22] and wants to turn you into their food.

21. When a lobe of our lung is removed (lobectomy), our diaphragm and abdominal organs are drawn upward by the lower pressure within our thoracic cavity to fill the extra space.

22. This is the same raga and dvesha activity that was noted in our cells in chapter 5.

Pain, Emotions, and Breath

In chapter 5, the idea that degenerating discs are responsible for the most common forms of back pain was questioned. Is there an alternative story to explain such a widespread source of suffering and disability? Back pain leads millions of people to seek medical diagnosis, MRIs, medication, surgery, and rehabilitation, and it costs the world economy hundreds of billions of dollars in treatment and lost wages every year (Gaskin and Richard 2011).

One view, which is supported by a significant amount of clinical and research evidence (Sarno 1977), suggests that many forms of chronic pain may not be caused by body structures being injured or "broken" in any way, but is more likely rooted in the mind's defense mechanism against unconscious mental stress and emotions (Rashbaum and Sarno 2003).

The theory proposes that suppressing our emotions involves a process that causes physical pain and other symptoms through the action of the autonomic nervous system, which can decrease blood flow to muscles, nerves, and tendons. This results in oxygen deprivation (ischemia) and metabolic waste accumulation in the affected tissues, which can be extremely painful.

For an illustration of ischemia, consider the previous inquiry involving the cat–cow movements and breath. If you tried it, there's a chance that some of your body's tissues were being asked to lengthen when they are accustomed to being shortened or to engage when they usually are lax or to slide longer where they are habitually held short. When our muscles, nerves, tendons, and connective tissues cannot freely lengthen, engage, or slide in response to our movement and breath, they can become deprived of oxygen (ischemic), and the result can be pain, sometimes quite severe and possibly chronic.

For many people, a pain episode is what led them to yoga practice, where the path to a more pain-free body may be as simple as learning how to move, breathe, and focus their attention in the present so they can safely acknowledge what they are feeling. In those moments of clarity, it is possible to realize the difference between holding ourselves together and being held up by a source of support arising from deep within—what we call *intrinsic equilibrium*.

At its origin, yoga largely involved sitting still, which needed to be sufficiently valued by the tribe so that they were willing to share some of the food they had worked quite hard to hunt and gather. This made division of labor necessary. This line of reasoning leads to the conclusion that until pre-humans started using fire to cook their food by day and repel their predators by night, they would not have lost their big bellies, grown their big brains, come out of the trees, and learned to be more sociable while sitting still around fires. If the early Vedas prove nothing else, it's that the earliest technologies for transformation were forged by the innumerable hours spent by generations sitting around the communal fires that quite made them human.[23]

Given this inextricable link between our use of fire and our humanity, it is unsurprising that the earliest Vedic worship was so focused on agni as a deity, and the earliest known breath practices describe an inner offering of prana and apana to each other, and both to agni.

PRANAYAMA, PRANA, APANA, SUSHUMNA, AND KUNDALINI

Compound Sanskrit terms are understood by dividing them into and translating their roots, a process that is open to much interpretation. Pranayama is a good example because it is commonly divided into two terms familiar to yoga students: *prana* (breath, life force) and *yama* (the act of restraining, curbing, checking). This interpretation leads to the common translation of pranayama as "breath control." However, there is a long second "a" in pranayama, which renders the roots as *prana* and *ayama* (stretching, extending). Going further, it is not unreasonable to view the prefix "a" as a negation or reversal of whatever follows, as in avidya (non-knowledge, ignorance) or ahimsa (non-harming), the first of Patañjali's five yamas. Thus, unobstructing of prana as a definition and goal of pranayama is not far fetched and adds dimension to the practice. Because our breathing can be under both voluntary and autonomic control at different times, a full understanding of the topic must embrace not only the control of our breath, but also the times when we are controlled by our breathing.

Two ancient, related references to pranayama practice can be found in the *Yoga Yajñavalkya* and the *Bhagavad Gita*. Yajñavalkya defines pranayama[24] as the "balanced joining (samayogah) of the in-breath and the out-breath (prana apana)." In related techniques of pranayama, this is accomplished by manipulating the accessory muscles of breathing in such a way that the act of inhalation is experienced as a shape change that descends from our nose toward our solar plexus.[25]

For exhalation, our abdominal and pelvic floor musculature create the sensation of an ascending movement toward our solar plexus region (figure 6.36). In this context, the practice of bandha makes sense because it helps unite downward prana and upward apana.

Additionally, when our bandhas are being employed in pranayama practice, they impart a stability to the shape-changing motions of our cavities, reducing the grosser expression of our breath in favor of deeper, more subtle spaces in

FIGURE 6.36 Offering prana (top arrow) to apana (bottom arrow) and both to agni (red dot).

Illustration based on photo of T. Krishnamachrya in Mulabandhasana, used with permission.

23. Richard Wrangham's brilliant book *Catching Fire: How Cooking Made Us Human* details all the evidence for dating the human use of fire all the way back to the transition between Homo Habilis and Homo Erectus roughly 2 million years ago, not the Erectus–Sapiens transition of 400,000 years ago as was previously thought (2009).

24. "Pranapana samayogah pranayamah iti iritah."

25. This is the opposite of the ubiquitous three-part, bottom-to-top, full yogic breath taught by the majority of yoga traditions, also known as dirga swasam. When T.K.V. Desikachar first began teaching his top-to-bottom technique more widely, he acquired the nickname "the yogi who breathes upside down."

our system. In breath practice, the word *deep* is most often understood as "very intense or extreme" and is used to encourage maximal shape change and transport of air. However, the very first dictionary definition of *deep* is "extending or situated far from the outer edge or surface." Therefore, deep breathing can also mean "deep within, subtle, hidden from the surface." In the energetic anatomy of yoga, the deepest space in which prana can move—the central channel—is called *sushumna*.

The passage from the *Bhagavad Gita* more explicitly refers to the joining of prana and apana as an offering or sacrifice (juhvati).[26] According to Krishna, who is imparting yogic wisdom to Arjuna, these ancient yogis offered "as sacrifice the outgoing breath in the incoming breath, while some offer the incoming breath into the outgoing breath. Some arduously practice **prāṇāyāma** and restrain the incoming and outgoing breaths, purely absorbed in the regulation of the life-energy." A later passage states, "all knowers of this sacrifice are cleansed of their impurities." In a masterful integration of these teachings, and adding Patañjali's insight that ignorance (avidya) is the root cause of our sufferings (klesha), Desikachar's father, Professor T. Krishnamacharya re-contextualized a key element of hatha yoga imagery: the coiled serpent sleeping at the entrance to the path of liberation (sushumna), *kundalini*.

To a scholar highly trained in logic like Krishnamacharya, the notion that energy could be dormant would be rejected as contradictory.[27] The further claim that this dormant energy constitutes a second, more "spiritual" form of prana that needs to be awakened to realize one's full potential would also be dismissed.

Yet, Krishnamacharya insisted that the experiences reported by yogis from time immemorial of an intense, ascending energy being unleashed into a central channel are undeniably real. This, he would point out, is nothing more than prana itself being liberated from its bondage to ignorance—symbolized by *kundalini*—which represents the inertia of a mind troubled by avidya. In this view, kundalini is not a dormant spiritual energy to be awakened, it is an obstacle to be removed because it blocks the entrance to sushumna, the path of liberation (figure 6.37.)

To be cleansed of the impurity of avidya requires the heavy and dark kundalini to be lifted upward toward the heat and light of agni. Purification through heat, known as *tapas*, is another key element in Patañjali's formulation of yoga practice.[28] Expressed in terms of breath mechanics, this practice uses the upward action of the exhalation (apana) to lift the kundalini toward the solar plexus, where agni is burning. The downward action of the inhalation (prana) directs the heat of agni into the kundalini to consume it (figure 6.38*a*). This also illuminates a key reason why the action of inversion (viparita karani) is so highly regarded from a breathing perspective; when the action of gravity is reversed, the kundalini falls into the now upward burning heat of agni (figure 6.38*b*).

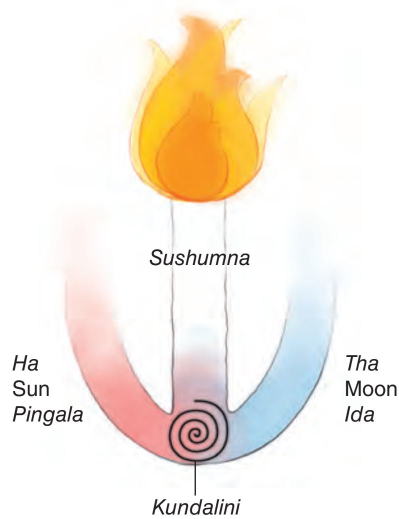


FIGURE 6.37 Kundalini blocking the entrance to sushumna.

26. apāne juhvati prāṇaṁ prāṇe 'pānaṁ tathāpare - prāṇāpāna-gatī ruddhvā prāṇāyāma-parāyaṇāḥ. Bhagavad Gita, Chapter Four, Verse 29

27. Logic has been described as the art of noncontradictory identification. Krishnamacharya is reported to have earned two advanced degrees in Nyaya–Indian logic.

28. Yoga Sutra of Patañjali: Sadhana Pada 2.1: Tapaswadhyayaishvarapranidhanani kriyayogah.

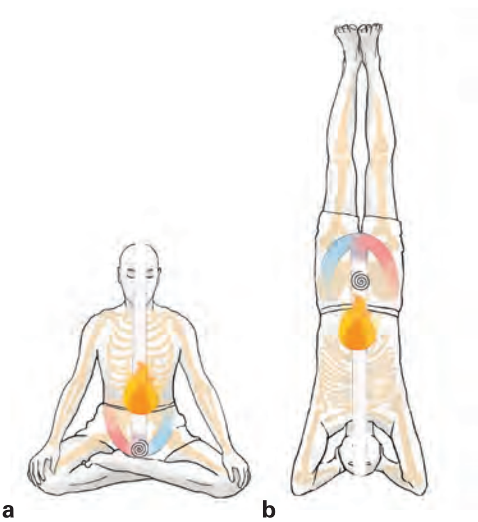


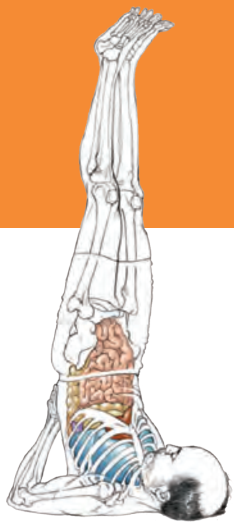
FIGURE 6.38 Breath as the inner offering of kundalini to agni, *(a)* seated and *(b)* with the assistance of gravity in inversion.

In this light, the ultimate purpose of breath practice is to accomplish an inner sacrifice in which prana and apana are offered to each other and both are offered to the flame of agni. This creates an altar upon which the obstacles that cause our sufferings may be offered.[29]

CONCLUSION

The view that our body's deepest, most efficient anatomical support derives from an intrinsic equilibrium is consistently in harmony with the perspective on yoga practice offered by Krishnamacharya and Patañjali. Namely, that which is essential to our health, freedom, and clarity is not missing, but may be obstructed. Therefore, we achieve yoga by identifying and removing the klesha (afflictions) from our system. Hearkening back to Patañjali's definition of kriya yoga presented in the introduction (swadhyaya as discernment between tapas, or the things we can change, and isvara pranidhana, or the things we cannot change), we can now see how beautifully these teachings link to the idea that our breath—both voluntary and autonomic—is the best and most intimately accessible teacher of the deepest principles of yoga.

29. Many yoga students will recognize this idea as being reminiscent of the well-known Shanti Mantra taken from *Brihadaranyaka Upanishad 1.2.28*. It is widely used as a prayer at Indian gatherings of all kinds: "From ignorance, lead me to truth; From darkness, lead me to light; From death, lead me to immortality; Om peace, peace, peace."



7

INSIDE THE ASANA

One simple definition of *asana* is that it is a pose, a shape you make with your body as part of a yoga practice. A more traditional definition of asana is that it is a seat, a position to sit in for meditation. Some yoga traditions have only a few official asana, while other traditions freely adopt shapes and sequences from other movement practices.[1]

A useful description of asana that Amy uses is "a container for an experience." Asana is a form that we inhabit for a moment, a shape that we move into and out of, a place where we might choose to pause and pay attention differently in the continuously flowing movement of life. From this perspective, an asana is not an exercise for strengthening or stretching a particular muscle or muscle group, although it might have that effect.

Each asana is a whole-body event during which we can witness how things arise, how they are sustained, and how they dissolve or are transformed. We can see how we are affected by the experience of moving into the pose, being in the pose, and moving out of the pose, and how that might affect other places in our lives where we meet change. As long as we are in the matrix of space and time, we are never actually still but are constantly moving and meeting those places of change. As Laban noted, "Each bodily movement is embedded in a chain of infinite happenings from which we distinguish only the immediate preceding steps and, occasionally, those which immediately follow" (1966, 54).

Individual asana are part of a yoga practice that goes beyond a single movement or moment in time. We might describe a practice as the attentive repetition of a pattern of movement, breath, and thought. Some practices might focus more on movement (as in asana), some more on thought (as in meditation), some more on breath (as in pranayama). In the end, all these aspects—movement, breath, thought—are different approaches to examining our experiences as individuals.

The word *practice* sometimes is associated with mastery, the idea that we might practice a skill until we have become adept enough to somehow demonstrate that mastery. That is not the idea we are offering; instead, we are suggesting that asana practice could be an inquiry and exploration that changes and adapts as we change. Our context—our age, gender and race; our culture and language; our family patterns and social expectations; our formal and informal educational experiences—it all has an impact on how we make meaning of our experiences and on how we experience our practice.

1. Excellent research is being done on the history of asana. If you are interested in further details, you might look into Mallinson, Singleton, and colleagues at the South Asian Section of the University of London.

EFFECTS OF ASANA

Certain qualities (stimulating, calming, grounding, cleansing, balancing) are often attributed to asana. Asana are often described as helpful for a wide range of conditions (diabetes, high blood pressure, constipation) or categorized as safe or dangerous for certain body parts (knees, sacroiliac joints, neck, spine). This book reflects the way we (the authors) teach; we don't characterize asana in that way and won't say what effect an asana will have on your body.

We do believe that physical movement of all kinds, including asana, always affect physical and psychoemotional states. We also believe that your context—your individual circumstances, previous experiences, assumptions, and goals—affect your experience of the asana and that the effect of the asana depends on what you bring to it, whether consciously or unconsciously.

Just as we can't specify the experience all participants will have in an asana, we also can't say that they will feel safe or unsafe in a particular asana, in a yoga class or in any space. While we might hope to create a safe space for exploration, we recognize that people are negotiating all kinds of situations of safety and danger.

Stating specific effects of asana similarly implies that there is an experience everyone should be having and carries with it the implication that if you are not having that experience, you might be doing the asana incorrectly. With the idea that asana is a container for experience, we propose instead that you approach each asana as an inquiry and see what experiences arise for you.

There's No Such Thing as a Dangerous Asana

There really aren't dangerous asana (or safe asana), just dangerous (or safe) ways of doing them. Any asana can be done safely or dangerously depending on how it's taught, how it's modified, the student's experience and skill, and the movement potential of each person.

ALIGNMENT FOR ASANA

Along with the effects of asana, it is common in some approaches to talk about the rules of alignment for doing a pose safely and correctly. We don't offer these standardized alignment instructions for several reasons:

- *Alignment is relational. Alignment* is a relational term, not an absolute concept that exists without reference to something else. It describes a relationship with something, so we have to ask "Alignment with what?" You can align yourself ideologically with a principle or a political party or a school of thought or a teacher, or physically with an object or a landmark or another person. We can't simply be aligned but must be aligned *with* something. So a statement such as, "Find the correct alignment of your leg" is incomplete until we know what we are aligning the leg with.
- *There are many kinds of alignment.* In a movement practice, you can find alignment from a variety of anatomical or physiological perspectives. You might align yourself

according to how your organs feel, to the pathways of your nerves, to how you feel your blood moving most clearly, or to seek a sensation of stretch in your muscles. You might also align yourself according to energetic or emotional criteria: what feels safe or comfortable, where you feel the flow of energy in your nadis or chakras, or simply what feels right. The perspective you choose depends on the style of yoga you are practicing or your point of focus at the moment. There's no right answer, just the question of whether it suits your needs at the moment.

- *No single alignment instruction will work for every person's body.* Standardized alignment instructions are often offered as ways to safely do an asana. One single instruction cannot cover all the ways that people can move into and out of an asana, and what is a helpful instruction for one person might be what injures someone else if it's based on the assumption that our bodies are all the same. The basic shape of our bones and orientation of our joints is mostly determined by our genetic inheritance and early development and does not substantially change after adolescence.

As an example, consider factors that might influence the ease or difficulty you may experience in two asana: hanumanasana (figure 7.1*a*) and upavistha konasana (figure 7.1*b*).

FIGURE 7.1 *(a)* Hanumanasana; *(b)* upavistha konasana.

How do you experience these asana if you focus on what's happening in your hip joints? Do you feel like your hips move easily into these positions, or is it challenging? Many factors can account for the answers to these questions, but significant factors can be seen in figure 7.2.

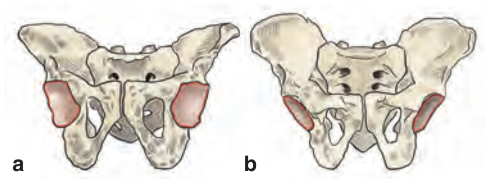


FIGURE 7.2 Comparison of orientation of the hip sockets.

Notice how in the pelvis in figure 7.2*a*, the hip sockets (acetabula) are more upwardly oriented to the front, while in figure 7.2b, they are more downwardly oriented to the side. The differences in the shape of the bones affect the range of movement in the hip joints and might make the asana shown in figure 7.1 feel easier or more difficult. Additionally, here are observed differences in the degree of spiral in human femurs that would also have an influence on the functional range of motion of the hip joints (figure 7.3).

None of the bones are normal because, despite what we may learn from artistic or photographic representations of human anatomy, there is no single normal structure to be found. All of them are normal because the variations in structure depicted were normal for the people who possessed them. We are all different in this and in an infinite number of other ways, but not because we differ from a theoretical "normal" anatomy. Difference is the norm. This is why Leslie likes to say, "Asana don't have alignment; people have alignment."

Sometimes an alignment cue that is interpreted as a way to do the asana *safely* is actually simply a guideline for doing an asana *correctly*, meaning according to the rules of a particular style or approach to yoga. For example, the instruction to "have your front knee bent to 90 degrees and over your ankle" in virabhadrasana does not guarantee the safety of your knee. Your knee joint can potentially have balanced joint space and a clear pathway of weight in its full range of movement (and can potentially be injured at 90 degrees and over your ankle). What has an impact on the safety of the knee joint is what's happening along the whole pathway from the foot to the spine, not simply the angle of the knee or its position in space. The instructions for performing an asana correctly arise from specific approaches to yoga, each with its own perspectives and goals for practice.

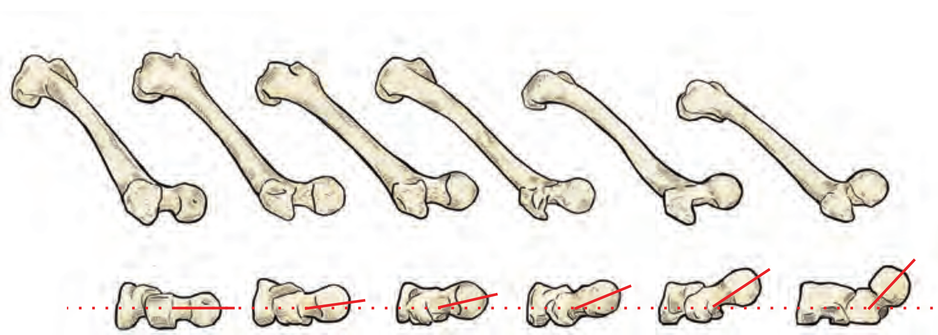


FIGURE 7.3 Differences in femur spiral and length and angle of the femoral neck. Which of these bones is normal? None of them, and all of them.

DIFFERENT GUIDELINES FOR ASANA IN DIFFERENT STYLES

If you have the opportunity to study different styles of yoga, you might notice that several asana are common to many styles of yoga yet look and are taught very differently. There are many schools of yoga, and they have various approaches to asana and a wide range of ideas about what is correct or incorrect in an asana.

The same pose can be used to explore different aspects of movement, which might change the appearance of the pose. In parsvottanasana, for example, one style of yoga might focus on spinal flexion (like bringing your forehead to your knee), while another focuses on hip flexion and a long spine (and bringing your nose to your shin). From an anatomical perspective, neither of these approaches to the asana is better or more anatomically safe or sound. In either version, the pose can be done in a way that supports steadiness and ease (sthira and suhka) or in a way that could lead to injury.

This is not to say that there is no wrong way to do the pose. If you are practicing a style of yoga that calls for a long spine, rounding your spine into flexion won't be correct for doing that version of the pose. It doesn't make it unsafe, just incorrect. How we do a pose does make a difference, but right or wrong is based on what works for each person's body and goals, rather than an absolute idea of the perfect asana.

Cueing Callout: Brhmana and Langhana Describe *Experiences*, not *Practices*

Many asana and pranayama practices are traditionally categorized as being either brhmana or langhana. Asana that involve back bending and breathing ratios that favor the length of the inhalation are typically referred to as brhmana, while forward-bending asana and extended exhalations are considered langhana. This overly simplistic view overlooks a crucial fact: brhmana and langhana are *descriptions of experiences* an individual can have in relation to certain practices, not the practices themselves. In other words, asana and pranayama exercises do not have intrinsic effects apart from the person performing them. This principle is often stated as "Doing an asana is not like taking a pill," but even medicines do not have a reliably consistent effect on individuals, so how could a yoga technique? It is quite possible for someone to be calmed by a back bend or aroused to anxiety by a forward bend. As useful as these generalizations may be as a starting point for inquiry, they should never be taken as prescriptive or proscriptive rules.

INDIVIDUAL ADAPTATIONS IN ASANA

Your choices about how to move through an asana depend on your starting condition. For example, if I have open shoulders, then I might think about internally rotating my humerus relative to my scapula, while my neighbor with less mobility in the glenohumeral joint is rolling their arms open as much as they can. Both actions could be functional in adho mukha svanasana (downward-facing dog pose) because the point of the asana (on a body level) is not to "do it right" by some external standard, but to find the relationship between all the parts of your body that will let the experience of the asana resonate throughout your whole body—cells, tissues, fluids, and organs.

The ways you initiate a movement have a tremendous impact on the quality of your movement. With practice and skillful observation, you might be able to tell from the initiation how the movement might travel through your body and the effect it might have on your tissues. An understanding of what you are activating to move into an asana can help you understand the nature of the asana and the effect it has on you. If you find yourself in an asana having to attend to myriad alignment "corrections," try reconsidering the steps you took to get there in the first place, and see whether starting differently helps you arrive in a different place.

An asana is not just a final arrangement of your limbs and spine, but includes the full process of coming into that arrangement. If we look at the process rather than the final product, we are able to develop variations that increase or decrease the challenge of the pose without feeling that we aren't actually doing the asana until we get our head to our knee, our hands to the floor, or some other concrete goal. It is possible to adapt practice to the individual so that we each can find a unique embodiment of the asana. A famous quote from T. Krishnamacharya sums up this principle: "The very essence of yoga is that the practice must be adapted to the individual, not the other way around."(T.K.V. Desikachar quoting his father, 1992)

Cueing Callout: Exhalations Are Not Always Calming

It's a common instruction to focus on exhaling in order to find calm because physiologically our heart rate slows and our blood pressure drops with our exhalation, sometimes called the "relaxation response." While the relaxation response does indicate a kind of lowering of tone in the cardiovascular system, the experience of these changes in heart rate and blood pressure might actually produce anxiety as an emotional response in someone because of a previous experience. There's no guarantee that a particular breathing pattern, no matter what physiological response it creates, will create a specific emotional response.

The same is also true of any movement: back bending is often described as stimulating, and forward folding as calming. The physiological responses caused by these movements are real, but the way the responses are processed by a person having the experience depends on many more variables than their physiology. Some people actually find forward bends alarming and back bends soothing. We can't generalize about the emotional effects of movement with any accuracy because those effects depend on a person's individual context.

If yoga is going to become more inclusive and more responsive to experiences of trauma, oppression, and discrimination, teachers need to become even more aware of their own assumptions that everyone will have the same experience in an asana or breathing practice.

ASANA ANALYSIS

If we respect these individual differences, how then can we possibly analyze the anatomy of an asana? In the remaining chapters of the book, that is precisely what we have chosen to do, using the lens of anatomy and kinesiology.

Because we believe asana is more of a process than a final product, in the creation of this text it was a challenge to decide which moments to photograph and which parts of the anatomy to focus on. For the purposes of this book, we tried to find the moments that capture what we felt were recognizable aspects of commonly practiced asana and then analyze them from the perspective of someone's musculoskeletal system and breathing mechanism. In each asana we chose a starting position and then determined the skeletal joint actions and muscular actions that could give rise to the asana from that starting position.

It was also a challenge to know what to say about the actions in the joints and muscles for each asana. Each body is unique. Each body has different ways of engaging with the support of gravity. Each body has different habits and patterns for recruiting muscles. Two people can use different muscles to create the same joint action in an asana, and then have completely different sensations. We also each have our own way to distinguish between sensations of stretching and lengthening, working and holding, or pain and release. How we distinguish and describe those sensations will shape what our experience is in an asana.

With all these challenges in mind, we started from the base of support for each pose, and then used a series of questions to analyze the actions in bones and joints, then in the muscles.

Starting Positions and the Base of Support

Your base of support is the parts of your body that are on the ground and through which weight-bearing forces are transmitted down to the earth, resulting in supporting energy generated upward into your body.[2]

The poses in this book are arranged by a starting position determined by the base of support. Any asana can arise from a variety of starting positions; we have used what we think are the simplest entry points for each pose:

Standing—Supported on the soles of your feet (chapter 8, page 121)

Sitting—Supported on the base of your pelvis (chapter 9, page 175)

Kneeling—Supported on your knees, shins, and tops of your feet (chapter 10, page 213)

Supine—Supported on the back surface of your body (chapter 11, page 233)

Prone—Supported on the front surface of your body (chapter 12, page 259)

Arm support—Supported (at least partially) on your upper limbs (chapter 13, page 271)

Skeletal Joint Analysis

After identifying the base of support for the asana, we analyze movement in the skeletal joints, asking the following questions:

In Your Axial Skeleton

What is your spine doing?

Is your spine maintaining a shape and moving through space, or is it articulating?

If your spine is articulating, what is the joint action?

If your spine is not articulating and is moving through space, what is articulating?

2. A possible orientation for alignment cues could be based on the idea that the dual forces of gravity and support can organize our movement rather than a relationship to some ideal form or shape.

In Your Appendicular Skeleton

What joint is your focal joint (the point of focus)?

Is your focal joint articulating or moving through space or both?

If your focal joint is articulating, what is the joint action?

If your focal joint is moving through space, what is articulating?

Please note, because the images are moments isolated from a full phrase of movement, there is no way to know the sequence in which the movements were made. The order in which things are listed is not an indication of what sequence is best, appropriate, or most effective. There is no single correct way to get into or out of these poses, and each choice you make will give rise to a different experience.

Muscular Analysis

Once it is clear what the main joint actions are, then we can consider the muscles. This is a more complex process because we must take into account the relationship to gravity and other major points of resistance to determine which muscles to include as possibly being involved. To narrow the choice of muscles to focus on, we ask the following questions:

In Articulating Joints

What is your joint action? What causes your joint action?

Does your joint action go with gravity so that the weight of your body or your limbs creates the joint action? If so, we're looking for eccentric muscle actions to modulate the pull of gravity.

Does your joint action involve lifting the weight of your body or your limbs away from the floor or moving against another kind of resistance? If this is the case, we're looking for concentric muscle actions to overcome the pull of gravity.

What About Isometric Contractions?

An understandable question concerning muscle analysis is "Because the poses are all static, why wouldn't all our muscles just be doing isometric contractions?" Although the final shape of an asana can appear before your eyes on the pages of a book, in real life, bodies do not just materialize into a pose out of a vacuum. That is why we are describing how to come into the pose from a starting position, rather than how to be in the pose.

The idea that you can ever be without movement is an illusion. On the most fundamental level, the three-dimensional actions of your breathing structures never cease for very long. For the purposes of communicating in this two-dimensional medium, we might refer to a final position, but this is just a snapshot in a never-ending progression of movement.

In Joints That Aren't Articulating but Are Instead Maintaining a Position

Are there outside forces, such as the pull of gravity or the action of another body part, that would pull your joint away from that position if nothing were active? If so, then even though there is no change in your joint, changing muscle actions may be necessary to maintain your position as it moves through space.

INFORMATION FOR EACH POSE

With an occasional variation, each pose description includes the following sections:

Name—Each asana is presented with its Sanskrit name and its translated English name. Additionally, descriptive text is added to clarify the meaning or context of the pose's name.

Skeletal joint actions—The main joints that are involved in the process of moving into the asana are identified according to their actions (flexion, extension, adduction, abduction, rotation, and so on).

Muscular actions—Muscles that create the listed joint actions are identified by the kind of contraction (concentric, eccentric, or isometric), their name, and their general actions. In a few cases we list muscles that are lengthening (or "also lengthening") but are not necessarily active to distinguish them from muscles that are actively in an eccentric contraction. For some people, these muscles will have the sensation of stretching early in the movement, but for others there will be no sensation of stretching until much farther in the range of motion.

Notes—Ideas about things to notice, potentially unhelpful patterns, and other jumping-off points for your own explorations. The perspective that we generally work from in making suggestions about alignment is based on the Body-Mind Centering ideas discussed in the chapter on the skeletal system—finding balanced joint space and a clear pathway of weight through the bones and joints.

Breathing inquiry—Specific opportunities for noticing the interrelationship between the asana and your breathing will be presented in the form of questions.

Drawings—The asana images in this book are based on photographs of models that were taken during several sessions (figure 7.4). Some of the perspectives are unusual because they were shot from below using a large plexiglass sheet or from above using a ladder.

The photos were used as reference for the anatomical illustrator, who posed her skeleton in the various positions and sketched the bones by hand. Because a model skeleton doesn't move like a living human being, and because the skeleton's proportions did not match our models, we needed many rounds of corrections to have the positions of the bones actually match the bodies in the poses. Then the muscles and other structures were added using computer software, and several more rounds of corrections and adjustments were made to produce the final images.

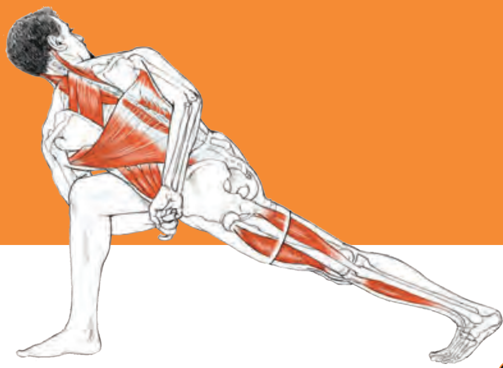
FIGURE 7.4 *Yoga Anatomy* photo shoot at The Breathing Project in New York City. Leslie Kaminoff (far left) supervises as the photographer, Lydia Mann, shoots Derek's bakasana from below the plexiglass sheet. Janet and Elizabeth stabilize the ladders. The final artwork from the resulting photo is on page 282.

The labeling of the structures in each drawing and the various arrows and other indicators were added last. Muscles are sometimes labeled in the drawings for reference purposes and may not be active in that particular asana. If you find a muscle in the text that is not labeled on the accompanying drawing, use the muscle index on page 323 to find an illustration of that muscle.

CONCLUSION

While we might choose different aspects of a pose to focus on, the asana itself is a composite of all the possible points of focus, and the whole experience is greater than the sum of its parts. Because yoga practice is fundamentally experiential, the information in this book is intended to be an inspiration to explore your own body. Perhaps you will understand more clearly something you've experienced as a result of reviewing this material. On the other hand, an anatomic detail may capture your interest and move you to investigate it through a pose that is being depicted.

In either case, this book will have served its purpose if it supports you in these explorations. Please take these ideas as a launching point for inquiry, discussion, and exploration, rather than as the final word on how to achieve the pose. And then, once you've found your own way in, try it the opposite way. Try this, then try that, then see what you notice.



8

STANDING POSES

When you stand, you bear weight on the only structures in your body that have specifically evolved to hold you upright in a human stance—your feet. The architecture of your feet, along with their musculature, shows nature's unmatched ability to reconcile and neutralize opposing forces.

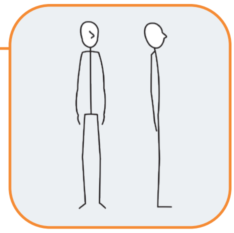
These amazing structures are massively overengineered for the way most people use them in the civilized world. Stiff shoes and paved surfaces teach our feet to be passive and inarticulate. Fortunately, yoga exercises are usually done barefoot, and much attention can be given to restoring the strength and resilience of your foot and lower leg.

In a yoga practice, early lessons sometimes center on the simple act of standing upright—something humans do from the time they are about a year old. If you can feel your weight releasing into the three points of contact between each foot and the earth, you may be able to feel the support the earth offers back to you through the action of your foot's arches and the muscles that control them.

Release and support, giving and receiving, strength and flexibility—these are all ways of interpreting *sthira sukham asanam,* Patañjali's fundamental description of asana in chapter 2 of the *Yoga Sutras*. T.K.V. Desikachar's translation sums it up well when he defines *sthira* as "alertness without tension" and *sukha* as "relaxation without dullness" (YS 2:46 *The Heart of Yoga, Revised Edition* 1995, page 180). The fundamental lessons we learn from standing postures can illuminate our practice of other asana.

Of all the starting points, standing positions have the highest center of gravity. And the energy required to organize that center and stabilize it over the support of your feet is needed in all the standing postures.

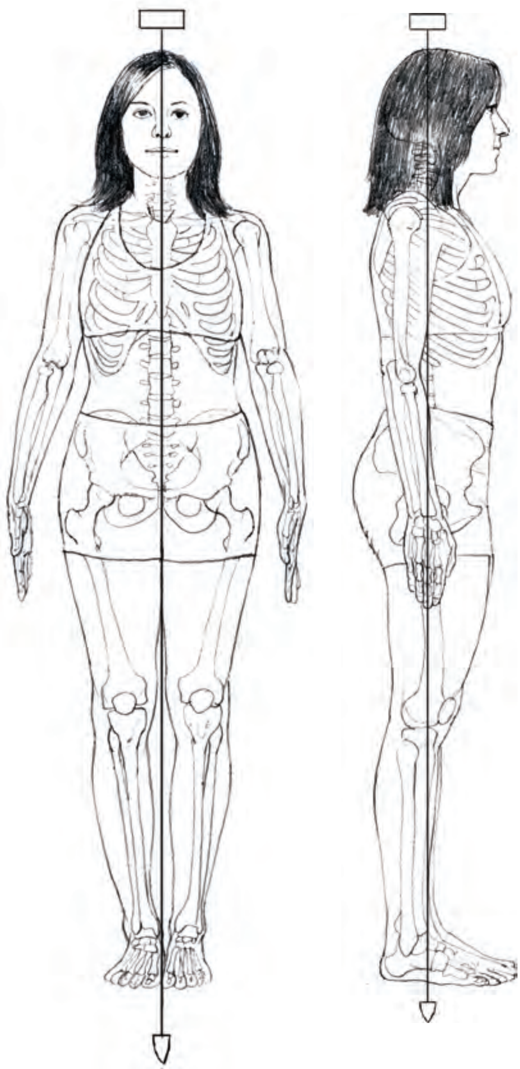
TADASANA



Mountain Pose

tah-DAHS-anna
tada = mountain

The name of this pose evokes many images that relate to a stable, rooted base of support and a crown that reaches for the heavens.



Nonmuscular support and padding for your foot: the fat pads (yellow) and plantar fascia (blue). The muscles of your foot occupy the space between the plantar fascia and the bones.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Neutral extension or mild axial extension	Neutral extension, forearm pronation	Hip adduction and neutral extension, knee neutral extension, ankle dorsiflexion

Notes

Nothing lasting can be built on a shaky foundation. This may be why tadasana is considered by many yoga traditions to be the starting point of asana practice. This pose is almost identical to the anatomical position, which is a starting reference point for the study of movement and anatomy. The only positional difference between the two shapes is that in tadasana, your forearms are pronated: The palms of your hands are facing the sides of your thighs rather than forward.

Conceptually, however, the two could not be further apart because bodies depicted in the neutral anatomical position exist as abstractions floating in a gravity-free conceptual space, while a real-life person in tadasana actively stands and breathes on a planet with gravity. A variety of muscles in your torso engage in a combination of concentric and eccentric contractions to maintain the curves of your spine in a dynamic relationship with the pull of gravity. In each person, a different combination of flexors and extensors are active in various types and degrees of contractions to maintain the postural support needed.

Cueing Callout: Neutral Is Not Natural

A common suggestion in yoga classes is to do something naturally or organically—for example "Let your arms fall naturally to your sides," "Find the natural curves of your spine," or "Feel your breath organically move your spine."

We cannot determine what a natural movement is without the context of an individual's movement history. Certainly, there are many ideas about what a *neutral* body position is: how curved your lumbar spine should be, whether your legs are parallel or not, where your shoulders should sit on your rib cage, how close together your feet are, and so on. But what's considered neutral in one circumstance might be quite different in another. A basic standing position in ballet is quite different from the starting place for tai chi, the stance that is functional for skiing isn't necessarily helpful in a vinyasa class, and what's considered a most basic asana, tadasana (mountain pose), is taught in different ways in different styles of yoga.

What feels *natural* is not usually neutral, though. Natural is instead what is most familiar, practiced, and habitual. The more often we do a movement and the more time we spend in a position, the less sensation we receive from it because of how the nervous system adapts to repetition. This adaptation in the nervous system is a terrific way of being efficient with our attention and means that the things we've already learned to do, we don't need to keep noticing and attending to.

The things we do most often feel the most familiar, become less noticeable, and start to feel like the most natural or organic way to do something. It doesn't matter if this pattern is incredibly inefficient or wildly asymmetrical; we can adapt and normalize almost any position with enough time and repetition. (And what is an inefficient position for one person might perfectly suit another person's individual structure, preferences, practices, or profession.)

Any supposedly neutral position might feel unnatural to a student if it is very different from what the student is accustomed to doing. Something doesn't feel natural to someone until it becomes familiar, which can certainly happen with repetition and practice, but it might initially take a lot of attention and effort. And it might feel the opposite of natural or organic.

(*continued*)

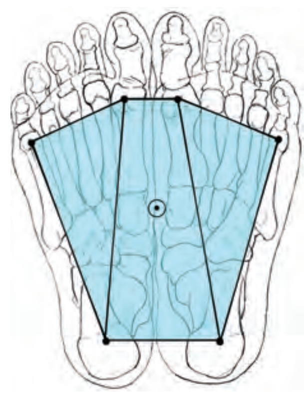
Tadasana (*continued*)

This upright body position is also unique to humans, who regularly use this bipedal stance. Humans have the smallest base of support, the highest center of gravity, and (proportionately) the heaviest brain balancing atop it all.

The base of support of this pose—your feet—offers a beautiful image of how the forces of yielding and support operate in the human system. The essential structure of your foot can be represented by a triangle. The three points of the triangle are the three places where your foot's structure will rest on a supporting surface: your heel, the distal end of your first metatarsal, and the distal end of your fifth metatarsal.[1] The lines connecting these points represent three of your arches, which offer postural support: the medial longitudinal arch, the lateral longitudinal arch, and the transverse (metatarsal) arch. There is also a fourth arch, called the medial transverse arch (or the tarsal arch), across your tarsal bones from the navicular to the cuboid.

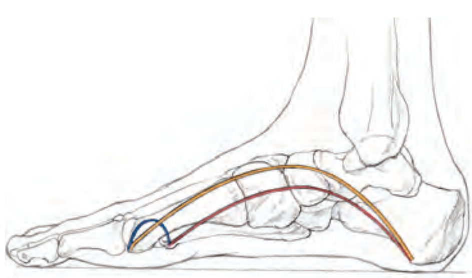
These arches help to distribute forces through your feet: When the pathways for weight distribution through your arches are clear, the weight of your whole body can travel through the relatively small bones in your arches to the ground without stressing individual bones. The many bones and joints in your arches can adapt to uneven and unstable surfaces while still transferring forces, which offers resilience and a dynamic kind of balance to our body. (The arches of your feet can also engage with the support of your pelvic floor, lower abdomen, rib cage, cervical spine, and the crown of your head to support this resilience and balance.)

From underneath, the two triangles of your feet can be joined to show the size and shape of the base of support for tadasana. If, when standing, body weight is equally distributed between all three points in both feet, a plumb line passing through your body's center of gravity would fall through the center of this base. The many layers of muscles (see the top figure on page 125) combine to create movement of the 28 bones (26 major bones and 2 sesamoid bones) of your foot, which makes it an incredibly adaptable structure able to move you smoothly over uneven terrain.



Triangles represent the three points of support of each foot.

Your foot has evolved over millions of years in a world with no roads or sidewalks. If you live in a place where the adaptability of your foot is no longer needed during locomotion, the deeper muscles that support your arches can become less active, eventually leaving only



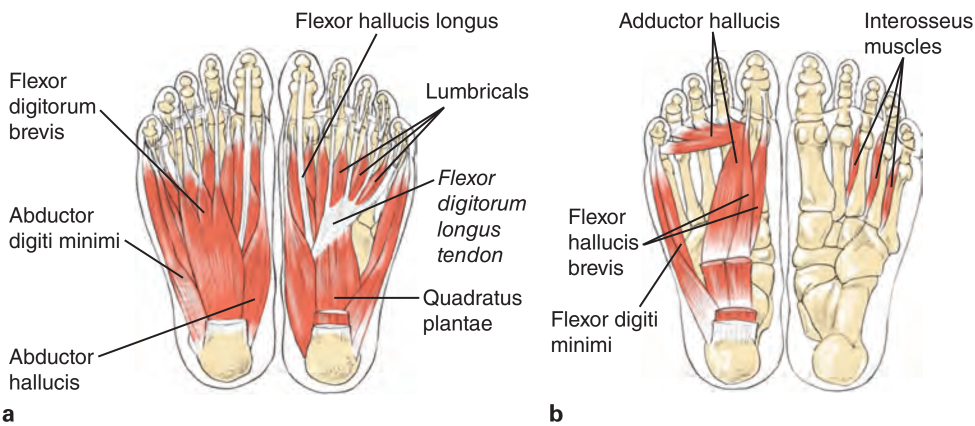
Three of the arches of the foot.

The plantar fascia, the most superficial layer of support for your foot. The less that your arch support muscles participate in standing and walking, the more pressure is put on your plantar fascia, which can result in plantar fasciitis and heel spurs.

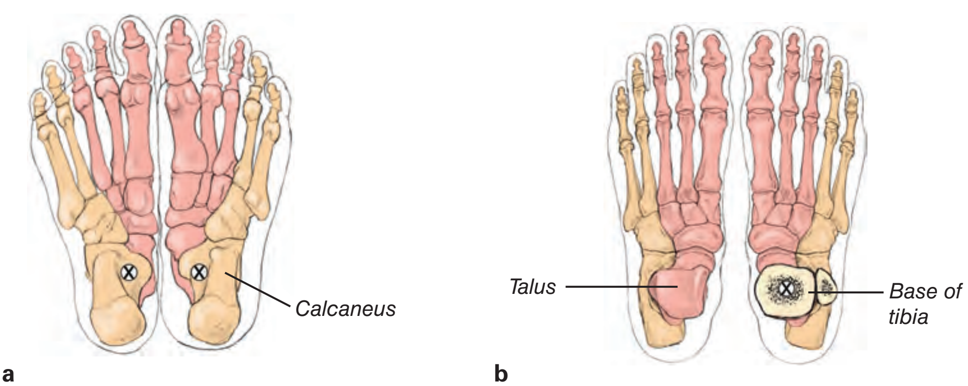
1 Much asana cueing refers to "the four corners of your foot," and a case could be made for your heel having an inner and outer edge. Nevertheless, your calcaneus is not square and does not have corners; its inferior surface is curved, so there will always be a single point that is the apex of its contact with the earth.

the superficial, nonmuscular plantar fascia responsible for supporting the transfer of forces through your foot. The stress this lack of muscular activity places on your plantar fascia can lead to plantar fasciitis and heel spurs, which can in turn be alleviated by focused strengthening of the musculature of arch support.

The practice of standing postures in general, and tadasana in particular, is one of the best ways to restore the natural vitality, strength, and adaptability of your feet. Once your foundation is improved, it is much easier to put the rest of your house in order.



Layers of musculature: (*a*) most superficial and (*b*) deepest.



Foot bones from (*a*) below and (*b*) above. The *X* marks the point where the weight of your body transfers through your tibia to your talus bone, and from there to your calcaneus.

Breathing Inquiry

Tadasana is an excellent position for observing the difference and similarity between the muscles you use for postural support and the muscles that create shape change in your abdominal and thoracic cavities. When there is clear support from your feet, legs, and spine, do you notice more mobility in your rib cage and shoulder girdle that allows the movement of your breath?

Is your breathing in tadasana directly affected by how much muscular effort is used to reposition the curves of your spine and pelvis? If you encourage more axial extension of your spine, do you notice more bandha action being engaged? Does that action increase the resistance to the free flow of shape change in the cavities (breath)?

(*continued*)

Cueing Callout: Do You Really Mean to *Tuck Your Tail*?

It is common to hear the cue “tuck your tail” in asana class, but what does that actually mean? If you ask different teachers, each one might be looking for a different action. Like many alignment cues that name body parts, “tucking your tail” isn’t actually a single specific kinesiological action and can refer to a variety of movements (unlike flexing your elbow, for example, which means a single specific action).

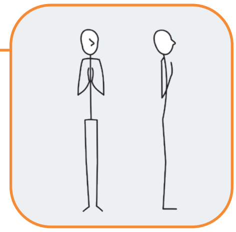
The instruction to “tuck your tail” could be referring to three distinct actions:

1. Sacrococcygeal flexion, which is movement between your coccyx and your sacrum created by the muscles of your pelvic floor.
2. Counternutation of your sacroiliac joints, which is movement between your sacrum and your pelvic halves.
3. Posterior tilting of your pelvis, which also flexes your lumbar spine and extends your hip joints.

Each of these movements can be done separately or they can happen simultaneously. Each of them will move your tail forward, but only sacrococcygeal flexion involves just your coccyx articulating with another bone. Counternutation and posterior tilting might indeed carry your tail forward in space, but it will happen as a consequence of other joints articulating. When suggesting an adjustment from a landmark that isn’t directly articulating with the place you are looking to change, you can end up affecting everything between the cueing landmark and the destination. While there are certainly times when it’s useful to engage a whole kinetic chain of bones, joints, and muscles, there are also times when using a faraway cueing landmark can recruit more muscles than necessary, resulting in something other than the desired result.

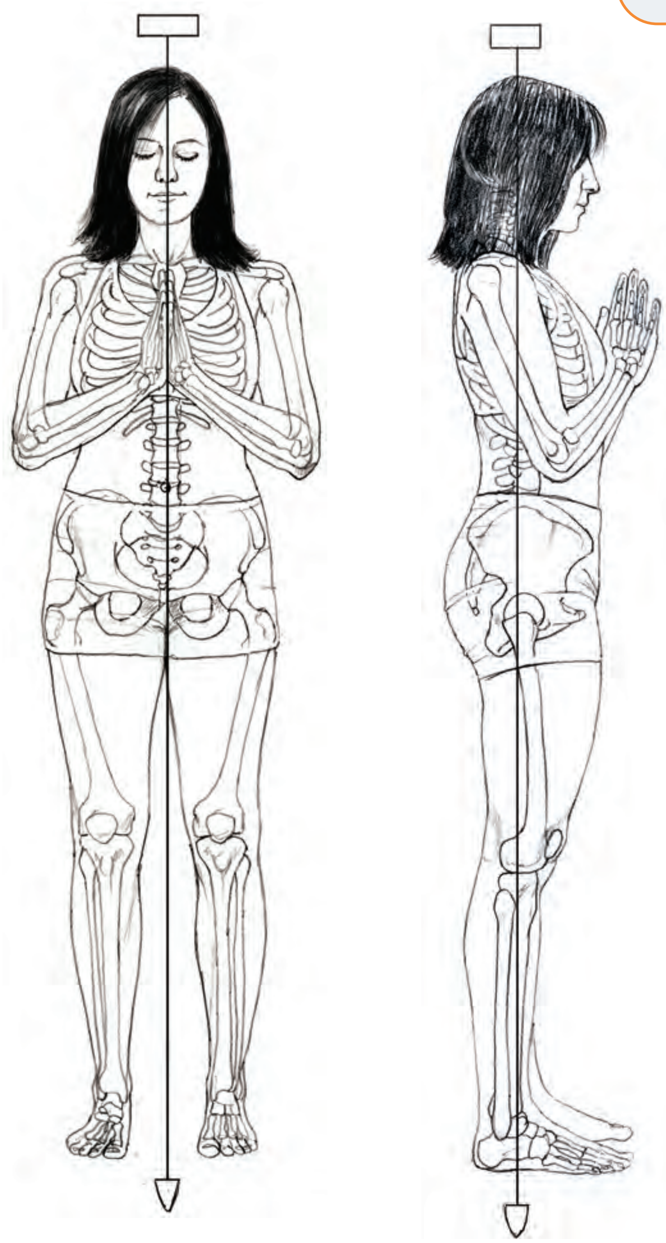
The cue to “tuck the tailbone” is an example of a cue that might have unintended effects: If you use tailbone tucking to change something like the curve of your lumbar spine (in the lower back), you might also recruit more of the muscles between your tail and your lumbar spine than you need to. This could interfere with the movement of your hip joints, for example, because much of your hips’ musculature is between your tail and your lower back. It’s always worth considering the bigger picture when you offer an instruction that has many possible effects.

SAMASTHITI



Equal Standing, Prayer Pose

sama = same, equal; *sthiti* = to establish, to stand



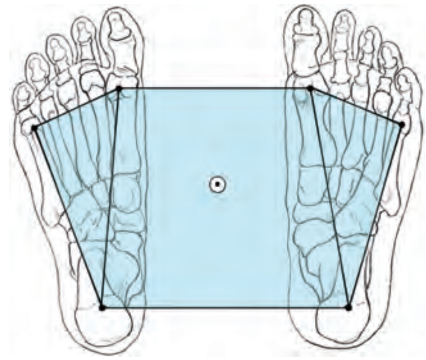
(*continued*)

Samasthiti *(continued)*

Notes

Samasthiti has a wider base than tadasana because your feet are placed with the heels under your sit bones (or wider) rather than as close to each other as possible. As a consequence, some people who initiate standing poses from this base (as opposed to tadasana) experience a wider, more stable base of support.

Additionally, your head is often lowered and your hands are in namaste (prayer) position. This is typical of the starting point of a sun salutation, a vinyasa that is used by many systems of hatha yoga to connect asana into a flowing sequence.



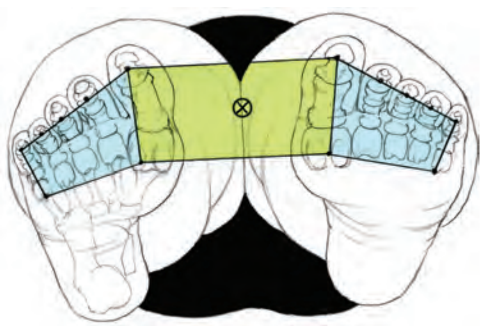
Base of support for samasthiti. The circled dot marks where your center line of gravity falls.

Breathing Inquiry

Spend a few breaths in tadasana and then in samasthiti. Do you notice a difference in how you experience these two gestures? Notice where your focus goes, where your breath settles. Does one feel more like a backward bend or a forward bend? Does one feel more stable or secure, open or vulnerable?

Terminology Note

In the Ashtanga tradition of Sri K. Pattabhi Jois, the term *samasthiti* refers to what is here described as *tadasana*. In the teaching tradition of Sri T. Krishnamacharya and his son, T.K.V. Desikachar, the term *tadasana* refers to a standing pose with your arms overhead, balancing on the balls of your feet (the base of which is depicted in the illustration).

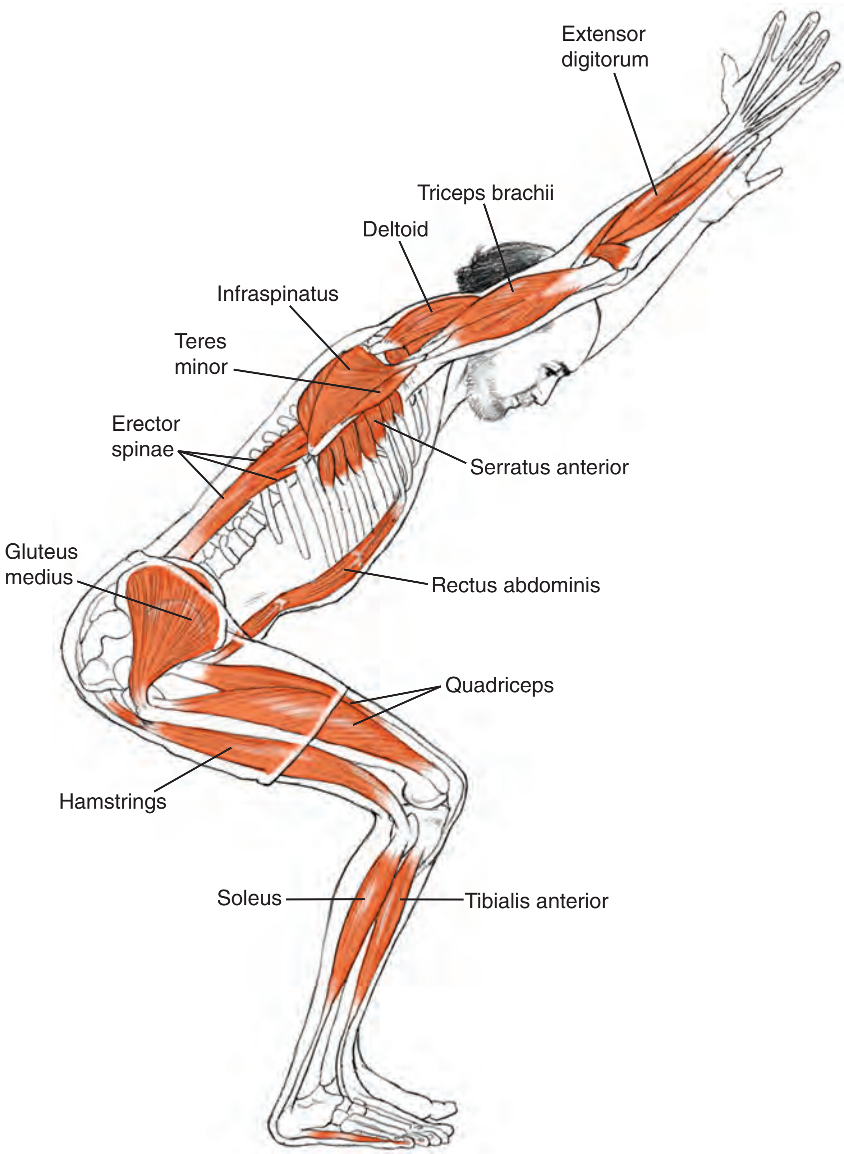


Here the weight is balanced on the balls of your feet. The *X* marks where the center line of gravity falls.

UTKATASANA

Chair Pose, Awkward Pose

OOT-kah-TAHS-anna
utkata = awkward



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Utkatasana *(continued)*

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Axial extension	Scapular upward rotation, abduction, and elevation; shoulder joint flexion; elbow extension	Hip flexion, knee flexion, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	
To maintain alignment of spine: Intertransversarii, interspinalis, transversospinalis, erector spinae	**To prevent anterior tilt of pelvis and overextension of lumbar spine:** Psoas minor, abdominal muscles
Upper limbs	
CONCENTRIC CONTRACTION	
To upwardly rotate, abduct, and elevate scapula: Upper trapezius, serratus anterior **To stabilize and flex shoulder joint:** Rotator cuff, coracobrachialis, pectoralis major and minor, anterior deltoid, biceps brachii (short head)	**To extend elbow:** Anconeus, triceps brachii
Lower limbs	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To resist tendency to widen knee (abduct at hip): Gracilis, adductor longus and brevis	**To allow hip and knee flexion and ankle dorsiflexion without collapsing into gravity:** Gluteus maximus, medius, and minimus; hamstrings at hip joint; vastii; soleus; intrinsic muscles of foot

Notes

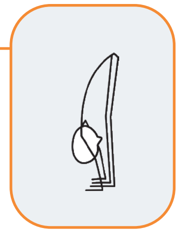
Utkatasana can be an interesting pose for exploring a balance between effort and release because gravity is what pulls us into the pose, and the major activity is avoiding going too far rather than working to go farther. While the muscles of your back need to be active to keep you from falling too far forward, some of your back muscles also need to lengthen to allow your arms to lift overhead.

Letting go into gravity can cause you to overly arch your lumbar spine or overly flex your hips. Drawing your sit bones forward or lifting your pubic bones can prevent tipping your pelvis too far forward, but too much of those actions can also pull your spine into flexion, rather than maintaining your neutral curves.

Breathing Inquiry

Maintaining axial extension (which minimizes breathing shape change) while engaging the largest, most oxygen-hungry muscles of your body presents an interesting challenge to your breath. Can you find an efficient balance between effort and breath that allows you to stay in this pose for an extended time?

UTTANASANA



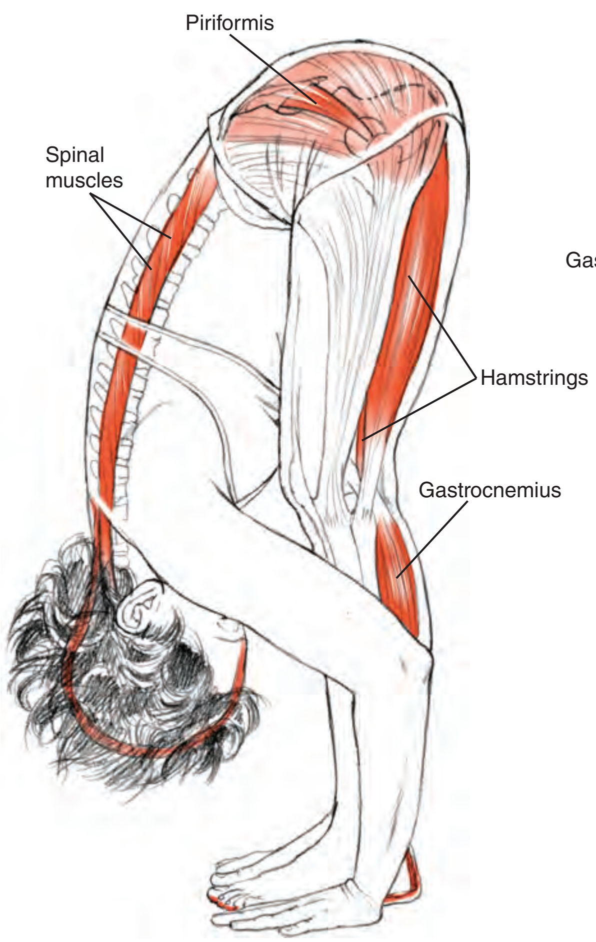
Standing Forward Bend

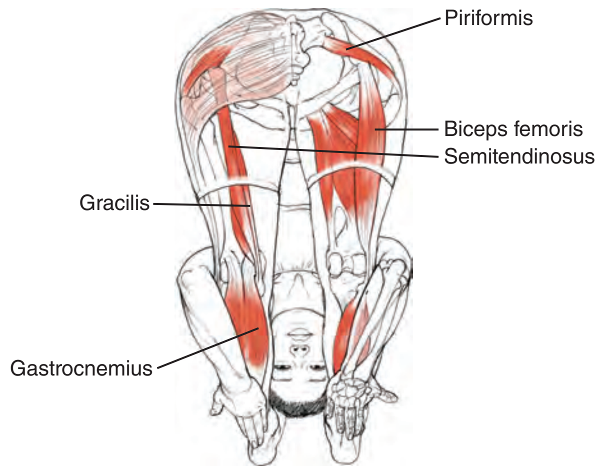
OOT-tan-AHS-anna

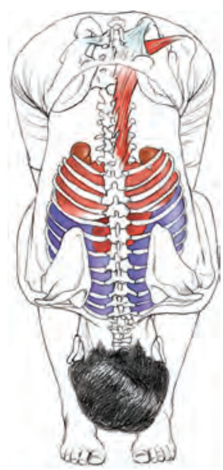
uttana = spread out, stretched

Terminology Note

In current use, uttanasana refers exclusively to the downward-facing (adho mukha) version of the pose depicted here. But because *uttana-asana* translates only as "spread out," it can also refer to back bend from standing in which the hands clasp the lower leg from behind. This was catalogued by Krishnamacharya as "tiryangamukha[2] uttanasana" in his monumental 1934 work *Yoga Makaranda*.







(*continued*)

2 tiryaganuka: the breadth of the back part of the altar

Uttanasana *(continued)*

SKELETAL JOINT ACTIONS

Spine	Lower limbs
Mild flexion	Hip flexion, knee extension

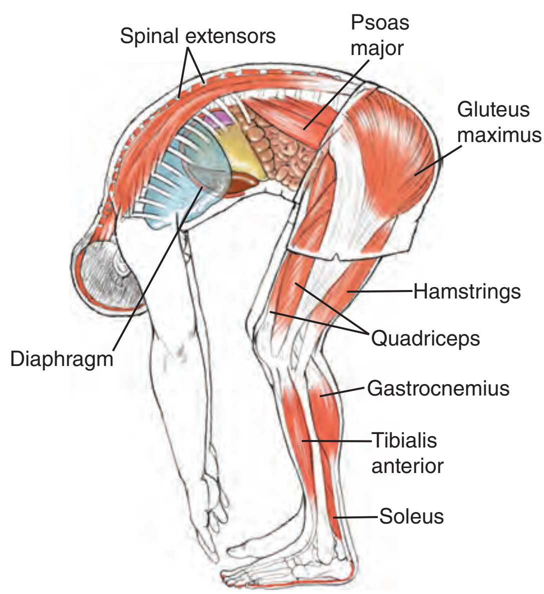
SELECTED MUSCULAR ACTIONS

Spine		
LENGTHENING		
Spinal muscles		
Lower limbs		
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**ALSO LENGTHENING**
To maintain knee extension: Articularis genu, vastii	**To maintain balance:** Intrinsic and extrinsic muscles of foot and lower leg	Hamstrings, gluteus medius and minimus (posterior fibers), gluteus maximus, piriformis, adductor magnus, soleus, gastrocnemius

Notes

The less your hips flex in this pose, the more spinal flexion there is.

Habitual shortness in the muscles of the back of your legs, pelvis, and torso can reveal places of excess effort. In this pose, gravity can do the work of moving you deeper into the pose. People experiencing resistance to this shape from the backs of their legs sometimes pull themselves down by using their muscles of hip flexion, which can then create habitual shortness and congestion in the front of their hip joints. A more efficient choice might be to release your knees, find softness in your hip joints, and allow your spine to release into gravity. After your spine has released, gradually extending your legs might then lead to a more well-distributed lengthening along the entire back line of your body.

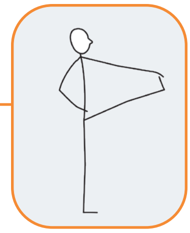


If your hamstrings are habitually short, slightly bending your knees helps release your spine.

Breathing Inquiry

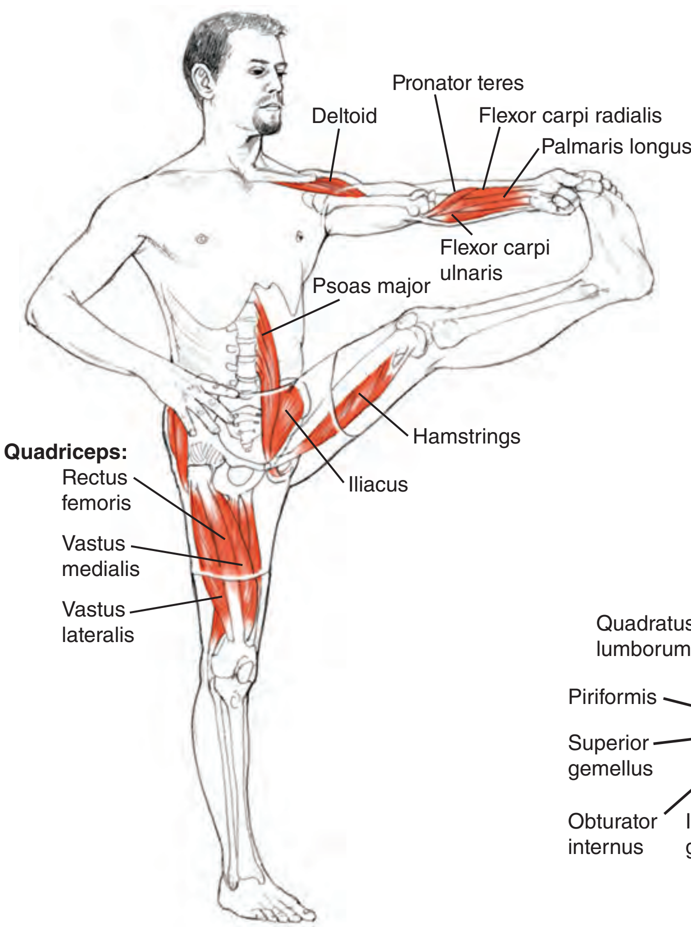
Do you experience the deep hip and spinal flexion of this pose combining to compress your abdomen, possibly restricting its ability to move with your breath? Do you experience this pose as an inversion in which gravity moves the center of your diaphragm cranially (toward your head)? Can you find more freedom for your breath in the back and sides of your rib cage?

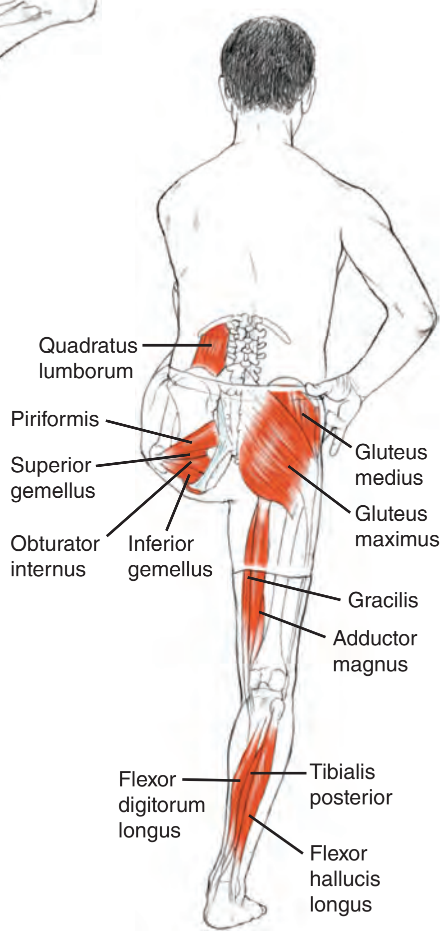
UTTHITA HASTA PADANGUSTHASANA



Extended Hand–Toe Pose

oo-TEE-tah HA-sta pad-an-goosh-TAHS-anna
utthita = extended; *hasta* = hand; *pada* = foot; *angusta* = big toe





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Utthita Hasta Padangusthasana *(continued)*

SKELETAL JOINT ACTIONS

Spine	Upper limbs: Lifted arm	Lower limbs: Standing leg	Lower limbs: Lifted leg
Neutral spine, level pelvis	Shoulder joint flexion and slight adduction, elbow extension, finger flexion	Neutral hip extension, neutral knee extension	Hip flexion and slight adduction to midline, neutral knee extension, neutral ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine

	CONCENTRIC CONTRACTION
To calibrate concentric and eccentric contractions to maintain neutral alignment of spine: Spinal extensors and flexors	**To counter rotation in torso from pull of arm:** Rotatores, transversospinalis, external and internal obliques

Upper limbs

Lifted arm

CONCENTRIC CONTRACTION	
To stabilize, flex, and slightly adduct shoulder joint: Rotator cuff, coracobrachialis, pectoralis minor, anterior deltoid, biceps brachii (short head)	**To grasp big toe:** Flexors of hand and fingers

Lower limbs

Standing leg: CONCENTRIC CONTRACTION	Standing leg: ECCENTRIC CONTRACTION	Lifted leg: CONCENTRIC CONTRACTION	Lifted leg: LENGTHENING
To keep knee in neutral extension and balance on single leg: Articularis genu, quadriceps, hamstrings, intrinsic and extrinsic muscles of foot and lower leg	**To allow lateral shift of pelvis over standing foot for balance and to keep pelvis level:** Gluteus medius and minimus, piriformis, superior and inferior gemellus, tensor fasciae latae	**To flex hip and slightly adduct leg toward midline:** Psoas major, iliacus, rectus femoris, pectineus, adductor brevis and longus	Gluteus maximus, hamstrings, gastrocnemius, soleus

Notes

Habitual shortness in the muscles of the back of your lifted leg can cause spinal flexion by pulling on your pelvis and tipping it posteriorly. This can also lead to hip extension or knee flexion in your standing leg. Another choice could be to bend your knee in your lifted leg and find neutral curves in your spine, neutral extension in your standing hip, and knee extension in your standing leg. Weakness in your hip flexors of your lifted leg can also cause muscles in your torso to attempt to help with lifting your leg, which can result in the elevation of your hip on the side of your lifting leg.

The abductors of your standing leg are working eccentrically in this asana. Weakness or habitual shortness in these muscles might also cause the hip of your lifted leg to elevate, or the rotators of that leg might try to stabilize your pelvis, which then rotates your pelvis either internally or externally on your standing leg, rather than your pelvis staying level and facing forward. The more strength and adaptability you have in your feet and ankles, the more options you may have for finding balance on your standing leg.

Breathing Inquiry

If, while maintaining this balancing pose, there isn't enough support in the muscles of your legs, you might notice that the stabilizing action in your abdominal muscles, combined with the bracing action of your arms, can create an overall reduction of breath capacity. Can you find a way to identify and release extraneous muscular tension without compromising your balance or breathing?

Cueing Callout: Lock or Don't Lock Your Knee

The cue "lock your knee" can mean different things, depending on the teacher and the style of yoga you practice. For some, locking your knee means to hyperextend your knee joint (also called back locking). For others, locking your knee means to engage as much as possible around your knee joint to make it as strong and stable as possible without hyperextending. To add to the potential confusion, a *physiological lock* happens in extension of your knee joint when your femoral heads rotate slightly on top of the tibia to find the most congruence between your bones.

In terms of the functionality of your knee joint when bearing weight in extension (as when standing on a straight leg), consider the following:

- The physiological lock in your knee helps the bones line up with each other for the clearest pathway of weight.
- Hyperextending your knee inhibits the physiological lock, potentially puts more pressure on the ligaments of your knee, allows standing without much muscular activity in your legs, and usually encourages an anterior tilt of your pelvis.
- Although engaging the muscles around your knee might protect it or make it more stable, engaging the muscles around your knee as much as possible might create problematic patterns of overuse in those leg muscles.

It's worth asking a teacher (or, if you are the teacher, asking yourself) about the intent behind an instruction to lock your knee. Is there another, clearer way to communicate the cue?

UTTHITA HASTA PADANGUSTHASANA VARIATION

With Spine Flexed

Notes

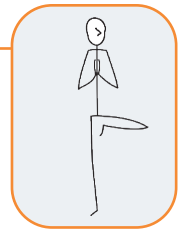
In this variation on utthita hasta padangusthasana, your lifted leg is parallel to the floor and your head comes to your knee. Lowering your head to your knee radically changes the center of gravity of this shape, which can make the balance much more challenging. For those who are accustomed to going to their extreme range of motion, this pose is a valuable exploration of precision in placement.

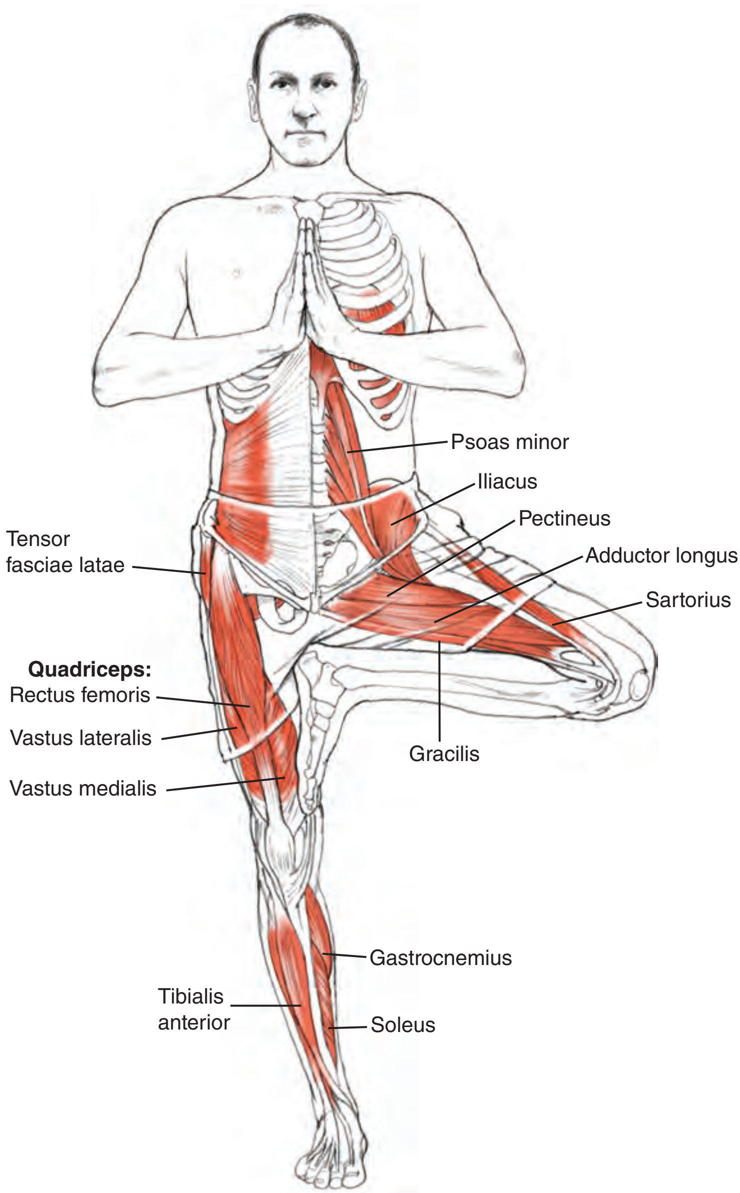
In this shape, less length is required in the back of your leg, but much more mobility is required in the muscles of your back. For your spine to flex so deeply, your spinal muscles must lengthen a great deal while your abdomen softens. This is an excellent pose for exploring how any habitual holding patterns in your abdomen can be released and how balance might be found in the support of your pelvic floor rather than by engaging your abdominals and the muscles of your lower back and posterior rib cage.

VRKSASANA

Tree Pose

vrik-SHAHS-anna
vrksa = tree





(*continued*)

Vrksasana *(continued)*

SKELETAL JOINT ACTIONS

		Lower limbs	
Spine	**Upper limbs**	**Standing leg**	**Lifted leg**
Neutral spine, level pelvis	Slight shoulder joint flexion and adduction; elbow flexion; forearm pronation; wrist, hand, and finger extension	Neutral hip extension, neutral knee extension	Hip flexion, external rotation, and abduction; knee flexion; ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine			
To calibrate concentric and eccentric contractions to maintain neutral alignment of spine: Spinal extensors and flexors			
Lower limbs			
Standing leg		**Lifted leg**	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**CONCENTRIC CONTRACTION**	**LENGTHENING**
To keep knee in neutral extension and balance on single leg: Articularis genu, quadriceps, hamstrings, intrinsic and extrinsic muscles of foot and lower leg	**To allow lateral shift of pelvis over standing foot for balance and to keep pelvis level:** Gluteus medius and minimus, piriformis, obturator internus, superior and inferior gemellus, tensor fasciae latae	**To flex hip:** Iliacus, psoas major **To externally rotate leg and open it to side:** Gluteus maximus, gluteus medius and minimus (posterior fibers), piriformis, obturator internus and externus, superior and inferior gemellus, quadratus femoris **To press foot into standing leg:** Adductor magnus and minimus	Pectineus, adductor longus and brevis, gracilis

Notes

As in the previous pose, the abductors on your standing leg are working eccentrically; if they are weak or habitually short, the hip of your lifted leg might hike up or the rotators might try to stabilize your pelvis and cause your pelvis to rotate on your standing leg rather than staying level and facing forward.

The more strength and adaptability you have in your feet and ankles, the more options you have for finding balance on your standing leg.

The action of your lifted leg, with your knee drawn up and out to the side, is actually a complex movement muscularly. Your hip flexors are active in lifting your knee, but with external rotation and abduction, your hip extensor muscles also become involved. Then, in order to press your foot into your standing leg while keeping your knee out to the side (and without tipping your pelvis forward), your hip joint needs to adduct without flexing. Of course, the higher on your standing leg your foot is, the less it is necessary to press your foot in because the weight of your leg helps to hold your foot in place. However, if it is necessary to use the adductors to press your foot into your standing leg, it is important to find adductors that are more posterior and are still adductors. Anterior adductors, which are also hip flexors, might tip your pelvis forward and internally rotate your lifted leg at the same time they are trying to adduct and press your foot into your standing leg.

Breathing Inquiry

Compare your experience in this pose to the variation of vrksasana (page 137) with your arms elevated and utthita hasta padangusthasana (page 133). Can you notice a difference in your upper body's freedom to participate in respiratory movements while maintaining balance between these poses?

VRKSASANA VARIATION

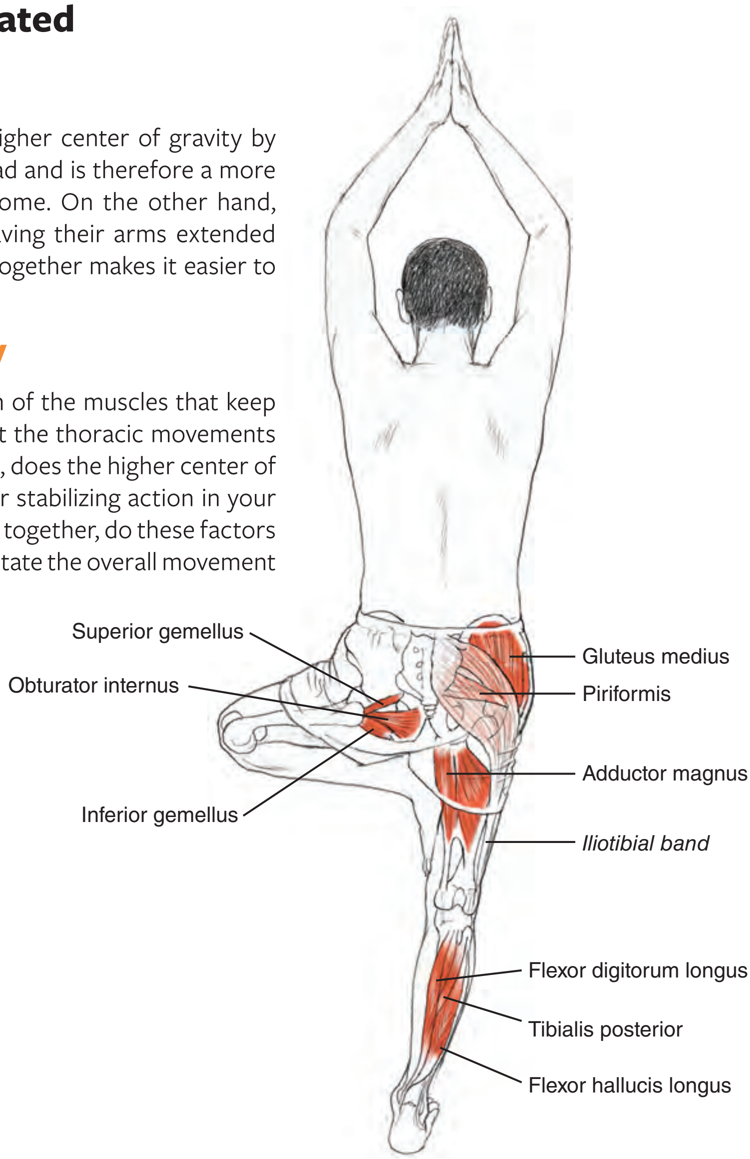
With Arms Elevated

Notes

This variation creates a higher center of gravity by placing your arms overhead and is therefore a more challenging balance for some. On the other hand, some people find that having their arms extended and pressing their palms together makes it easier to balance.

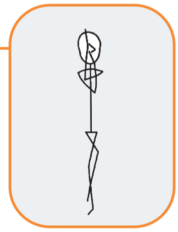
Breathing Inquiry

Does the stabilizing action of the muscles that keep your arms overhead affect the thoracic movements of your breath? In addition, does the higher center of gravity produce a stronger stabilizing action in your abdominal muscles? Taken together, do these factors combine to reduce or facilitate the overall movement of your diaphragm?



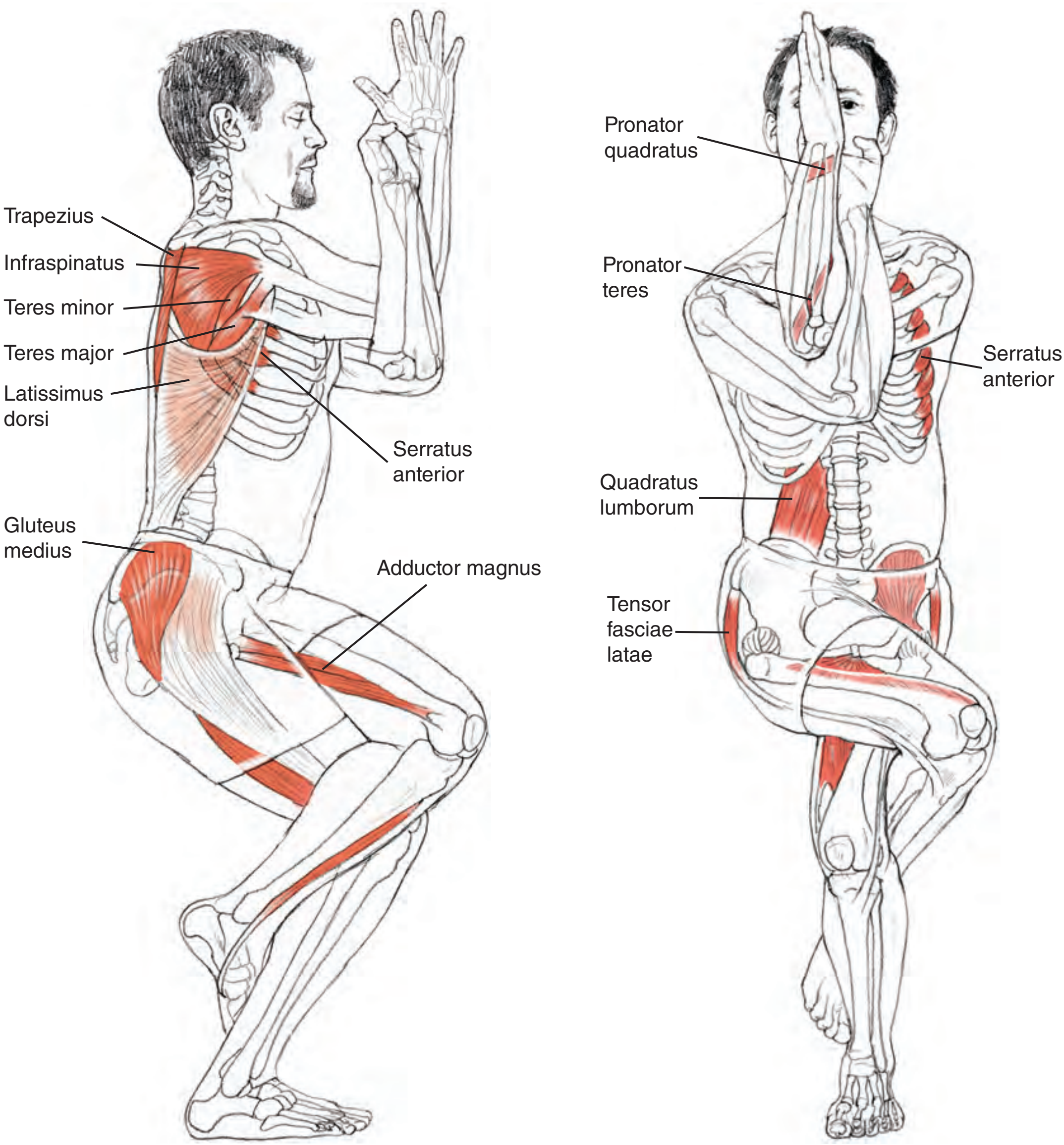
GARUDASANA

Eagle Pose



gah-rue-DAHS-anna

garuda = a fierce bird of prey; the vehicle (vahana) of the Hindu god Vishnu, usually described as an eagle but sometimes as a hawk or kite



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Neutral spine or flexion	Scapular abduction and upward rotation, shoulder joint flexion and adduction, elbow flexion, forearm pronation	Hip flexion, internal rotation, and adduction; knee flexion and internal rotation (of tibia); ankle dorsiflexion; lifted-foot pronation

SELECTED MUSCULAR ACTIONS

Spine
To calibrate concentric and eccentric contractions to maintain neutral alignment of spine: Spinal extensors and flexors

Upper limbs	
CONCENTRIC CONTRACTION	**LENGTHENING**
To abduct and upwardly rotate scapula: Serratus anterior **To stabilize, flex, and adduct shoulder joint:** Rotator cuff, coracobrachialis, pectoralis major and minor, anterior deltoid, biceps brachii (short head) **To flex elbow:** Biceps brachii, brachialis **To pronate forearm:** Pronator quadratus and teres	Rhomboids, middle and lower trapezius, latissimus dorsi

Lower limbs			
Standing leg		**Lifted leg**	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**CONCENTRIC CONTRACTION**	**LENGTHENING**
To adduct and inwardly rotate hip: Pectineus, adductor brevis and longus	**To allow hip and knee flexion and ankle dorsiflexion without collapsing into gravity:** Gluteus maximus, medius, and minimus; hamstrings at hip joint; vastii; soleus; intrinsic muscles of foot **To allow lateral shift of pelvis over standing foot and to maintain balance by actively lengthening:** Gluteus medius and minimus, piriformis, obturator internus, superior and inferior gemellus	**To flex, adduct, and internally rotate hip:** Psoas major, iliacus, pectineus, adductor brevis and longus, gracilis **To flex and internally rotate knee:** Popliteus, gracilis, medial hamstrings **To pronate foot:** Peroneals, extensor digitorum longus	Gluteus maximus, gluteus medius and minimus (posterior fibers), piriformis, obturator internus, superior and inferior gemellus

(continued)

Notes

To achieve the full entwining of your legs, both your standing leg and your lifted leg need to flex at your hips and knees. This position of hip flexion with internal rotation and adduction is challenging for many people, and the action of adduction with internal rotation especially lengthens the muscles of your outer hip. Restriction along the outside of your thigh can also come from shortness in the muscles that attach near the top of your iliotibial (IT) band.

This position can be challenging for your knees. If your hips don't perform the actions of adduction and internal rotation, your knees may be forced to compensate and possibly overrotate. Paying attention to internally rotating the tibia can help prevent this overmobilization of your knee.

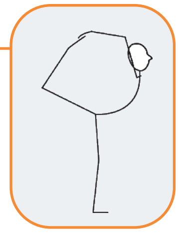
This action (internal rotation and adduction) in your legs is generally stabilizing for your sacroiliac (SI) joint because it encourages your pelvic halves to move together in the front, which can bring congruence to the edges of your SI joint on the anterior surfaces of your sacrum and ilium.

Breathing Inquiry

How does your breath feel if you allow your scapulae to both abduct and rotate upwardly? What if your scapulae are pulled down and together? Does that inhibit the movement of your rib cage or diaphragm?

From the standpoint of shape, center of gravity, and breathing, this is the most compacted of the one-legged balancing postures. Does the entwining of your arms compress the front of your rib cage? Is there freedom for your breath to move toward the posterior portion of your rib cage?

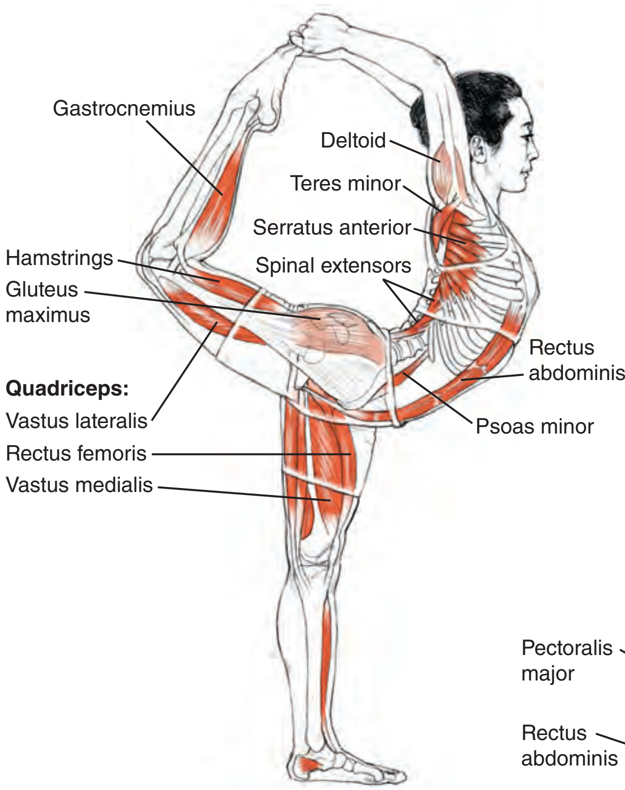
NATARAJASANA

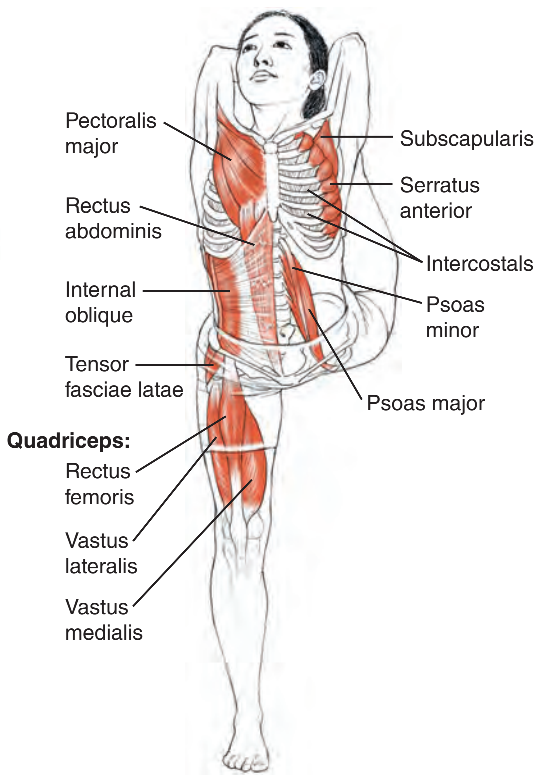


King of the Dancers Pose

not-ah-raj-AHS-anna

nata = dancer; *raja* = king





(*continued*)

Natarajasana *(continued)*

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Standing leg	Lower limbs: Lifted leg
Extension	Scapular upward rotation, abduction, and elevation; shoulder joint flexion, adduction, and external rotation; forearm supination; hand and finger flexion	Hip flexion, neutral knee extension	Hip extension and slight adduction to midline, knee flexion, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To extend spine: Spinal extensors	**To prevent hyperextension at lumbar spine:** Psoas minor, abdominal muscles

Upper limbs

CONCENTRIC CONTRACTION	LENGTHENING
To abduct, upwardly rotate, and elevate scapula: Serratus anterior, upper trapezius **To stabilize, flex, and adduct shoulder joint:** Rotator cuff, coracobrachialis, pectoralis major (upper fibers), anterior deltoid, biceps brachii (short head) **To rotate forearm and grasp foot:** Supinator and flexors of hand and fingers	Rhomboids, latissimus dorsi, pectoralis major (lower fibers), pectoralis minor

Lower limbs

Standing leg: CONCENTRIC CONTRACTION	Standing leg: ECCENTRIC CONTRACTION	Lifted leg: CONCENTRIC CONTRACTION	Lifted leg: LENGTHENING
To keep knee in neutral extension and balance on single leg: Articularis genu, quadriceps, hamstrings, intrinsic and extrinsic muscles of foot and lower leg	**To allow lateral shift:** Gluteus medius and minimus, piriformis, obturator internus, superior and inferior gemellus, tensor fasciae latae **To allow anterior tilt of pelvis without falling forward:** Hamstrings, gluteus maximus	**To create hip extension and knee flexion to enter pose:** Hamstrings **To create hip extension, internal rotation, and adduction:** Adductor magnus **To create hip extension:** Gluteus maximus **To extend knee and increase hip extension against resistance of hand grasping foot:** Vastii	Iliacus, psoas major, rectus femoris

Notes

Scapular mobility is important in this full-arm version, both for getting your arms into position without overmobilizing your shoulder joints and for mobility in the extension of your thoracic spine.

It can be a challenge to keep your lifted leg adducted and internally rotated at your hip joint in this asana. Although you might find more hip extension through external rotation at your hip joint, this involves the risk of overmobilizing your SI joint or overextending your lumbar spine.

As in dhanurasana (page 264), the additional resistance created by the hands grasping your foot can put pressure in vulnerable spots such as your knee and lower back.

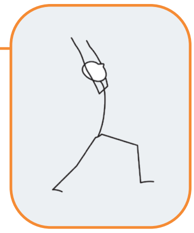
Breathing Inquiry

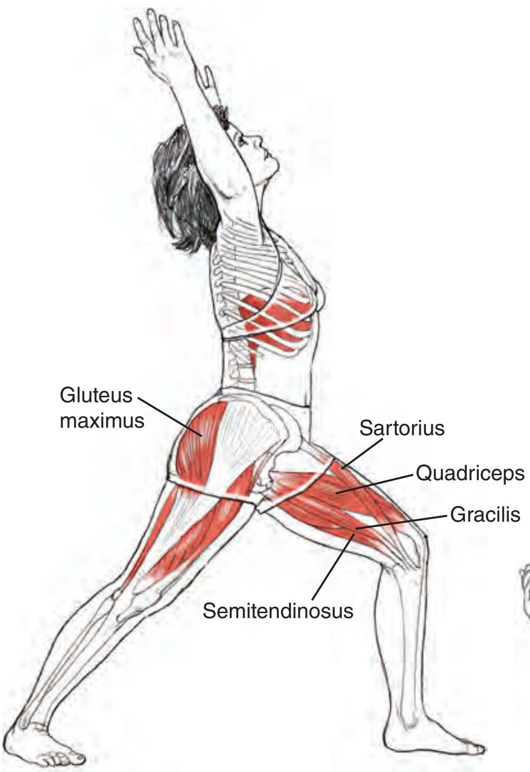
In this pose, is the movement of your diaphragm inhibited or facilitated by the deep spinal extension? Can you find the support in the deeper, intrinsic muscles of your spine that reduces the effort needed from the superficial muscles of your back and torso? Does this make more movement available for your breath?

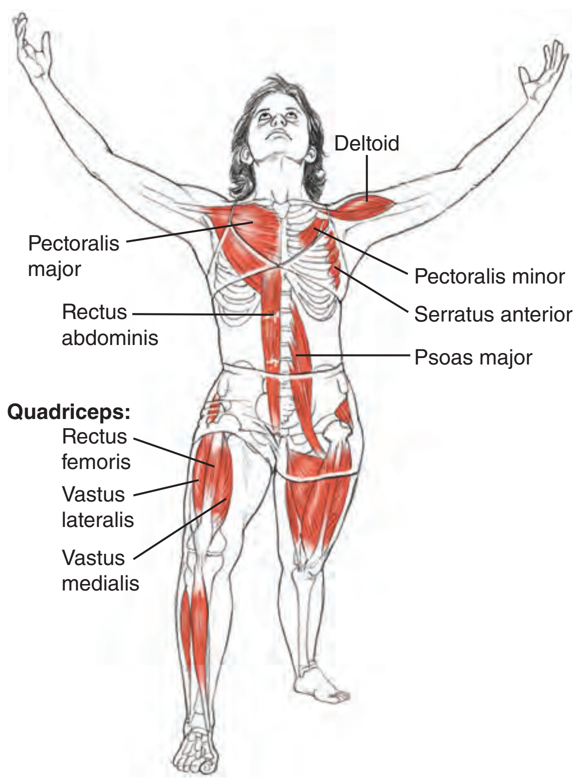
VIRABHADRASANA I

Warrior I

veer-ah-bah-DRAHS-anna
Virabhadra = the name of a fierce mythical warrior







SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs	
		Front leg	Back leg
Extension, slight rotation for chest to face forward, pelvis level	Scapular abduction and upward rotation, shoulder joint abduction and external rotation, slight elbow flexion, forearm supination	SI joint nutation, hip flexion, knee flexion, ankle dorsiflexion	SI joint counternutation, hip extension and adduction, knee extension, ankle dorsiflexion and foot supination at heel and pronation at forefoot

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To extend spine: Spinal extensors **To rotate chest forward:** Internal oblique (front-leg side); external oblique (back-leg side)	**To prevent hyperextension at lumbar spine:** Psoas minor, abdominal muscles **To support weight of head as neck extends:** Rectus capitis, longus capitis and colli, verticalis, scalenes

Upper limbs	
CONCENTRIC CONTRACTION	
To abduct and upwardly rotate scapula: Serratus anterior **To supinate forearm:** Supinator	**To stabilize and abduct shoulder joint:** Rotator cuff, biceps brachii (long head), middle deltoid

Lower limbs			
Front leg		Back leg	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION	CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To resist tendency to widen knee (abduct at hip): Gracilis, adductor longus and brevis	**To allow hip and knee flexion and ankle dorsiflexion without collapsing into gravity:** Gluteus maximus, hamstrings at hip joint, vastii, soleus, intrinsic and extrinsic muscles of foot **To level and center pelvis over feet and to maintain balance side to side (the narrower the stance, the more active and long these muscles need to be):** Gluteus medius and minimus, piriformis, superior and inferior gemellus	**To extend hip:** Hamstrings at hip joint, gluteus medius (posterior fibers), adductor magnus, gluteus maximus **To extend knee:** Articularis genu, vastii **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	**To allow outer ankle to lengthen without collapsing inner knee or inner foot:** Peroneals

(continued)

Virabhadrasana I (*continued*)

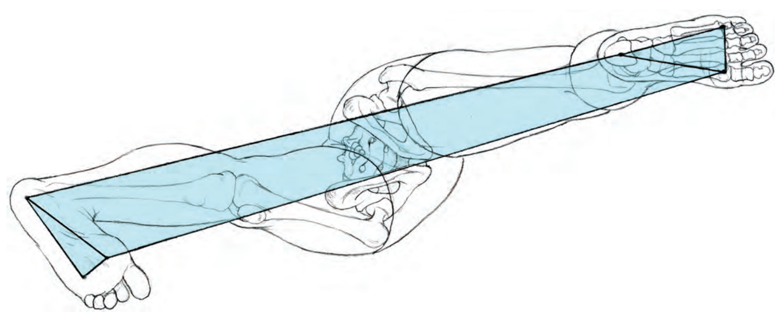
Notes

In warrior I, warrior II (page 150), and other lunging poses, the weight of your body (in relation to gravity) creates the flexion at your knee and hip of your front leg. The muscles of your front leg are eccentrically contracting, which means they are active as they lengthen to keep your ankle, knee, and hip joints from moving too far into flexion. The abductors in your front leg also need to be active eccentrically to level and orient your pelvis to your front leg and to maintain balance. If they are habitually shortened, they can pull your front knee too far to the side or twist your pelvis out of alignment. In general, muscles become fatigued more quickly when they are close to their maximum working length, so it can take time to build stamina in these positions.

Many things are said about the amount of external or internal rotation of your back leg in warrior I. What is consistently true is that your back leg is extended and to some degree adducted (in comparison to warrior II, in which your back leg is extended and abducted). We suggest that your back leg be organized from the arches of your foot upward, and that the bones of your foreleg, thigh, and pelvis orient themselves to create a clear pathway from the three points of your foot to your spine. If your back leg is organized in this way, the amount of internal or external rotation in the hip joint will vary from person to person, but the joint spaces can remain balanced so your back leg can support the weight of your torso. This can also redistribute some of the effort of this position away from your front leg.

In your back foot, your subtalar joint and the joints between your tarsals and metatarsals need to articulate so that the back part of your foot supinates (so your calcaneus can clearly connect to the floor) and your forefoot pronates (so your toes can clearly connect to the floor). If your foot doesn't articulate in this way, your outer ankle can be overmobilized and weakened.

The amount of rotation needed in your spine depends on how articulate your SI joints and hip joints are. The less mobile your lower limbs are, the more rotation is needed in your spine to orient your chest forward.



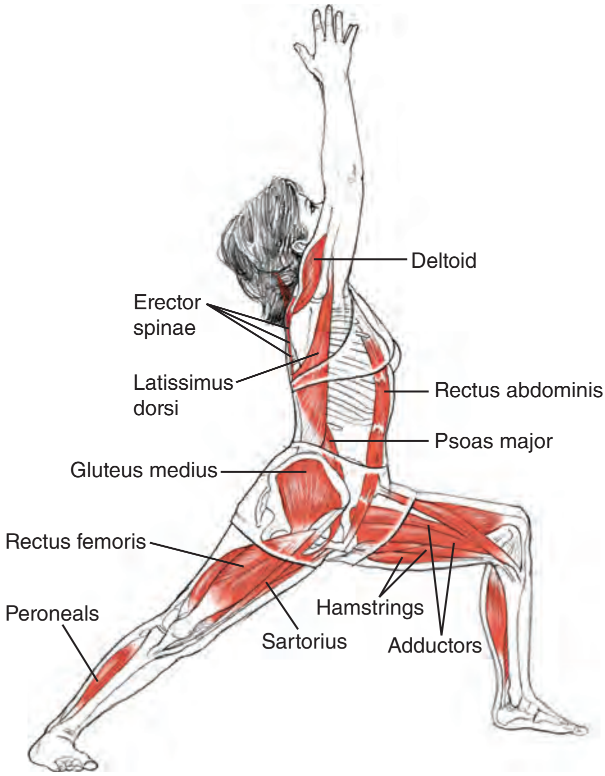
A wide base of support can make it easier to balance.

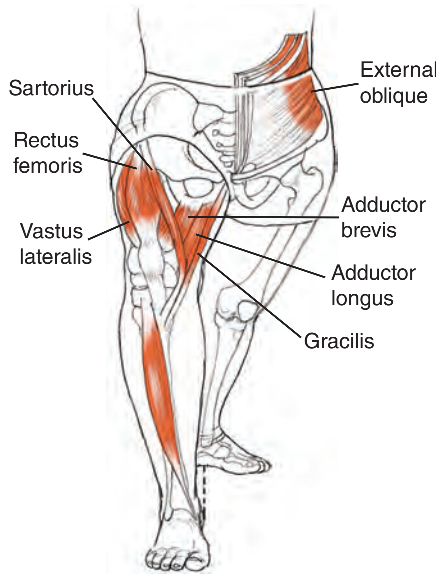
Breathing Inquiry

Can you experience your lower body as both articulate and strong, providing enough support (sthira) for your breath to move freely in your upper body (sukha)? Can you view the challenges of the lunging position in these warrior poses as an interesting way to explore your breath mechanics?

VIRABHADRASANA I VARIATION

With Longer Stance

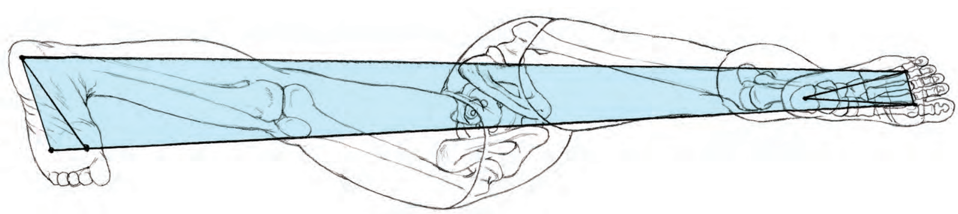




Notes

Different arrangements of your feet can affect where you experience the challenges of this pose. The shorter stance (from front to back) requires less mobility from your pelvis, so the support of your legs might feel more accessible. The width of the base can make your balance easier, but the higher center of gravity in the shorter pose might make your balance feel more precarious.

The shape of this pose with a longer, narrower stance has a lower center of gravity, so it might be easier for you to balance. However, the longer, narrower base of support may challenge your balance because your adductors have to be effective at a greater length. The extended stance also requires more mobility in your SI joints, hips, knees, ankles, and feet and requires the muscles that resist flexion in your hips and knees to all work at a greater length, which can make the pose feel less stable or at least less sustainable.



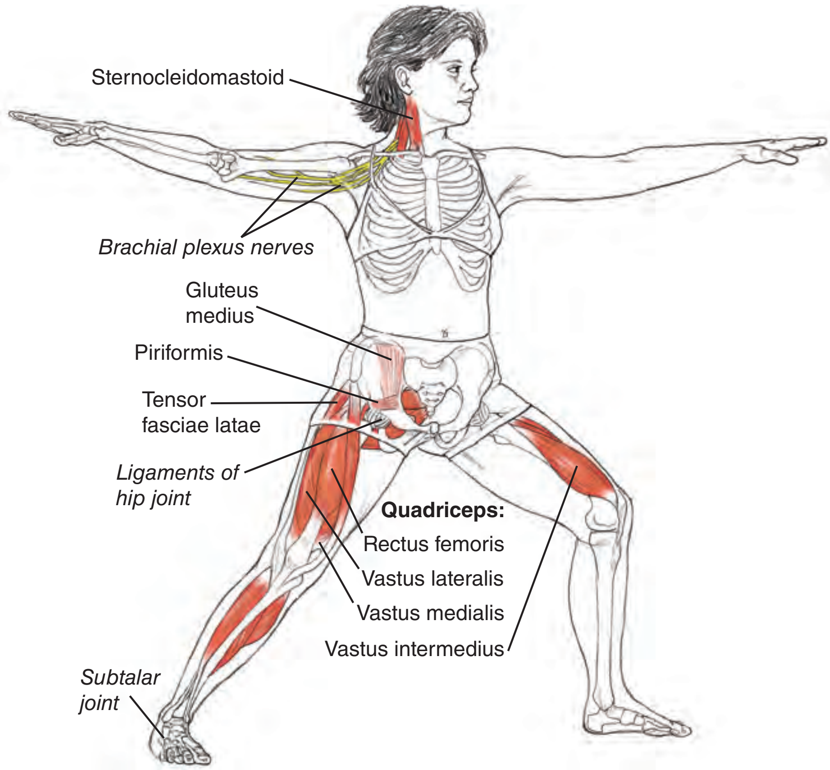
Long, narrow stance.

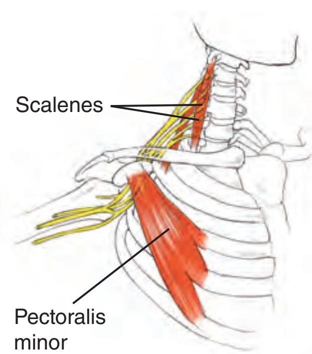
VIRABHADRASANA II

Warrior II

veer-ah-bah-DRAHS-anna

Virabhadra = the name of a fierce mythical warrior





Brachial plexus.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Front leg	Lower limbs: Back leg
Neutral spine, slight rotation for chest to orient to side, head rotated to face front leg, pelvis level	Scapular abduction, shoulder joint abduction and external rotation, forearm pronation	SI joint nutation, hip flexion and abduction, knee flexion, ankle dorsiflexion	SI joint counternutation, hip extension and abduction, knee extension, ankle dorsiflexion, foot supination at heel and pronation at forefoot

SELECTED MUSCULAR ACTIONS

Spine

ALTERNATING CONCENTRIC AND ECCENTRIC CONTRACTIONS	CONCENTRIC CONTRACTION
To maintain neutral alignment of spine: Spinal extensors and flexors	**To rotate chest to side:** External oblique (front-leg side); internal oblique (back-leg side) **To rotate head toward front leg:** Rectus capitis posterior, obliquus capitis inferior, longus capitis and colli, splenius capitis (front-leg side); sternocleidomastoid, upper trapezius (back-leg side)

Upper limbs

CONCENTRIC CONTRACTION	LENGTHENING
To abduct scapula: Serratus anterior **To stabilize and abduct shoulder joint:** Rotator cuff, biceps brachii (long head), deltoid **To pronate forearm:** Pronator quadratus and teres	Pectoralis major and minor (particularly in back arm)

Lower limbs

Front leg: CONCENTRIC CONTRACTION	Front leg: ECCENTRIC CONTRACTION	Back leg: CONCENTRIC CONTRACTION	Back leg: ECCENTRIC CONTRACTION
To abduct hip: Gluteus medius and minimus	**To abduct hip and allow hip flexion without collapsing into gravity:** Gluteus maximus, piriformis, obturator externus, superior and inferior gemellus **To allow hip and knee flexion and ankle dorsiflexion without collapsing into gravity:** Hamstrings at hip joint, vastii, soleus, intrinsic and extrinsic muscles of foot	**To extend and abduct hip:** Gluteus medius and minimus, hamstrings at hip joint, piriformis, obturator externus, superior and inferior gemellus **To extend knee:** Articularis genu, vastii **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	**To support inner knee:** Gracilis **To allow outer ankle to lengthen without collapsing inner knee or inner foot:** Peroneals

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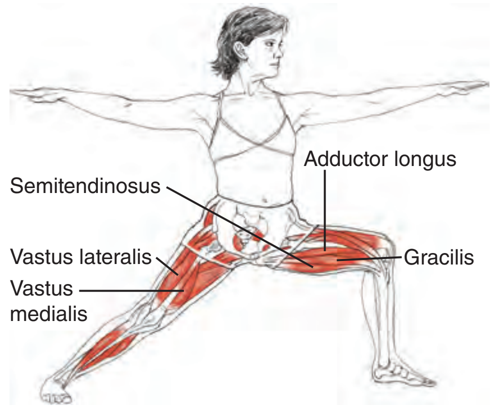
Notes



Virabhadrasana II with longer stance.

As in warrior I (page 146), the action of flexion in the front hip and knee is eccentric in relationship to the pull of gravity. Unlike warrior I, however, the abductors of your front leg are working concentrically to abduct your hip. Because your foot is on the ground, this is a proximal action that has the effect of rotating your pelvis open to the side.

In your back leg, simultaneous hip extension and abduction can be challenging. Articulation of your pelvis and sacrum at your SI joint can take some of the pressure of these actions away from the ligaments and capsule of your hip joint.

Like warrior I, a variety of opinions exists about how much external rotation is needed in your back hip joint. The amount of rotation depends on several factors and could best arise from the action of your foot and whole leg, rather than being an isolated hip joint action.

The more mobility there is in the SI joint and hip joint of your front leg, the less spinal rotation is needed to turn your chest to face the side.

If your chest is not clearly facing sideways, spreading your arms can put pressure on your brachial plexus (the web of nerves that extend into your arm), which travels from the side of your cervical spine under your collarbone into your arm. Keeping your arms in line with the sides of your torso helps to prevent this compression, which can result in sensations of numbness or tingling in your arms.

Breathing Inquiry

In your warrior poses, do you notice how your lower body needs to be both articulate and strong to allow your breath to move freely? Compared to virabhadrasana I, do you experience more or less ease in the movement of your breath in virabhadrasana II because of the difference in how much your pelvis and spine are twisting? Does this leg position require more or less effort? Where do you feel more ease in your breath?

Cueing Callout: To Square or Not to Square the Pelvis

A common cue taught in virabhadrasana I and II is to "square your pelvis" either to the front or to the side. If your pelvis is treated as a single unit (without allowing for movement in your sacroiliac joints), squaring your pelvis requires accommodating all the movement in the joints of your hips, knees, and feet, which often leads to overmobilization in some (or all) of these joints.

If we allow that some movement in your SI joints is functional, then it becomes possible for some of the action of facing forward to come from the movement of each pelvic half in relation to your sacrum. In this case, your hips won't be symmetrical but can be generally oriented forward.

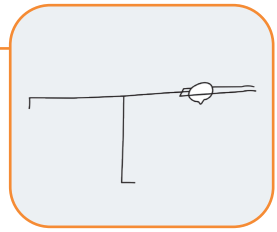
If the joints of your lower limbs (feet to SI joints) don't contribute to the movement, then the facing-forward (or sideways, in virabhadrasana II) action might be pushed into your lumbar spine. Or you might ask your ribs to turn too much in relation to your thoracic spine or ask all of the movement to happen in your shoulder joints.

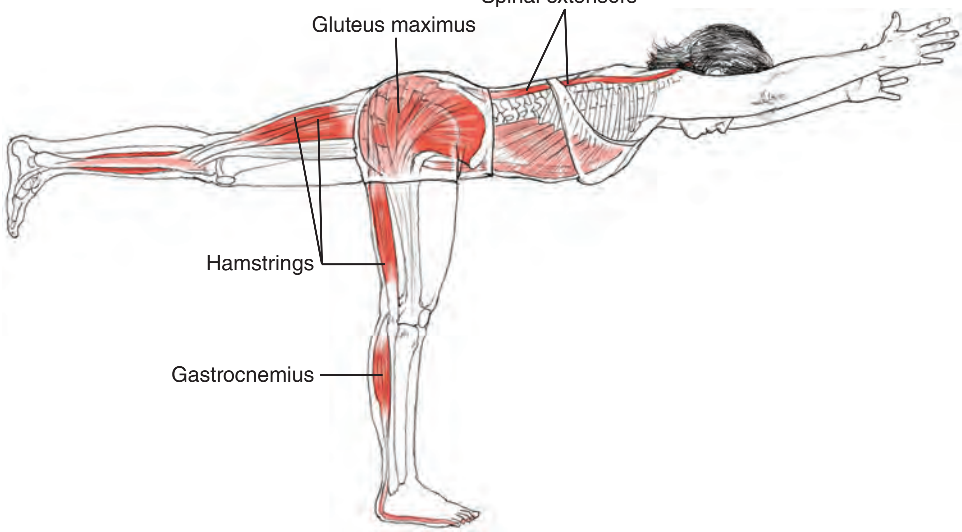
Learning how the movement of facing forward or facing sideways is distributed through your spine, pelvis, and legs can be a different exploration for each person. Using a cue such as "square your pelvis" might invite people to focus on only one part of their bodies rather than finding how their whole body is involved in the asana.

VIRABHADRASANA III

Warrior III

veer-ah-bah-DRAHS-anna
Virabhadra = the name of a fierce mythical warrior





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Standing leg	Lower limbs: Lifted leg
Neutral spine or axial extension	Scapular upward rotation, abduction, and elevation; shoulder joint abduction; elbow extension	SI joint nutation, hip flexion and adduction, knee extension, ankle dorsiflexion	SI joint counternutation, neutral hip extension and rotation, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	
To maintain alignment of spine: Intertransversarii, interspinalis, transversospinalis, erector spinae	**To prevent anterior tilt of pelvis and overextension of lumbar spine:** Psoas minor, abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	
To upwardly rotate, abduct, and elevate scapula: Upper trapezius, serratus anterior **To stabilize and flex shoulder joint:** Rotator cuff, coracobrachialis, pectoralis major and minor, middle deltoid, biceps brachii (short head)	**To extend elbow:** Anconeus, triceps brachii

(*continued*)

Virabhadrasana III *(continued)*

Lower limbs		
Standing leg		Lifted leg
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION	CONCENTRIC CONTRACTION
To keep knee in neutral extension and balance on single leg: Articularis genu, quadriceps, intrinsic and extrinsic muscles of foot and lower leg	**To control hip flexion:** Hamstrings **To allow lateral shift of pelvis over standing foot for balance and to keep pelvis level:** Gluteus medius and minimus, piriformis, superior and inferior gemellus	**To maintain neutral hip extension and rotation:** Hamstrings, adductor magnus, gluteus maximus

Notes

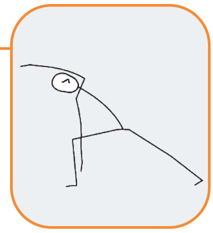
Because gravity draws the unsupported side of your pelvis toward the floor, keeping your pelvis level in this action requires your standing leg abductors to lengthen while they are active. If your abductors shorten instead, they tilt your pelvis so that the hip of your lifted leg moves away from the floor.

It can be challenging to keep your lifted leg parallel. This calls on muscles that are extensors and internal rotators to balance the action of muscles that are both hip extensors and external rotators.

Breathing Inquiry

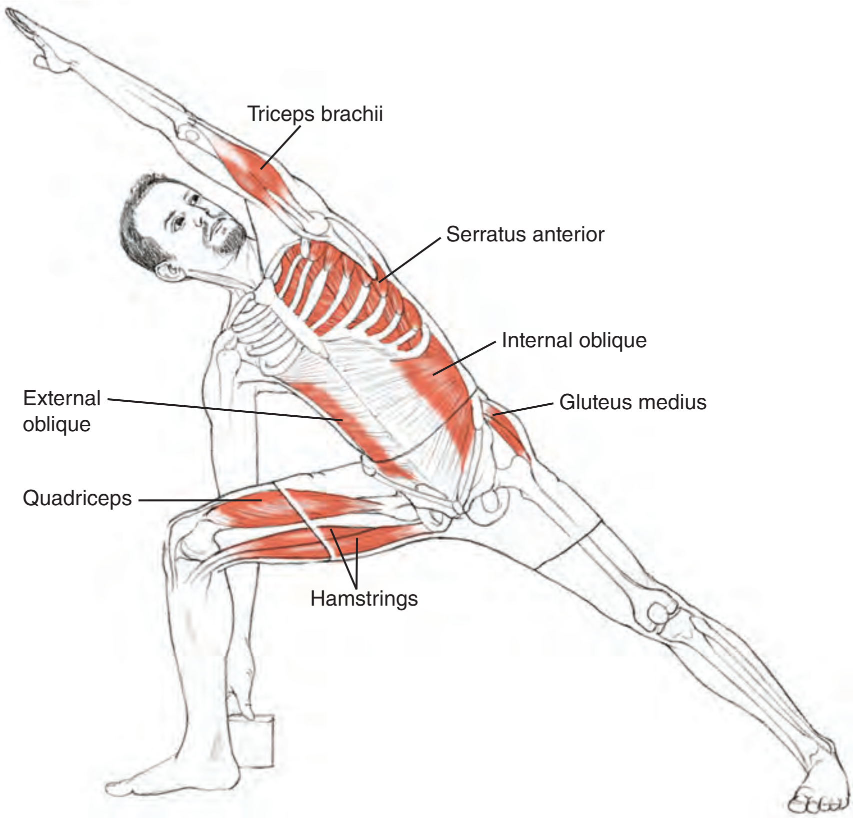
Much like in utkatasana (page 129), the combined actions of this pose (especially with your arms overhead) can engage some of the larger muscle groups of your torso. Can you feel the superficial layers of muscle in your back working to maintain spinal alignment? Are they affecting the movement of your rib cage and making your breathing more challenging? Can you find more ease in your breath by working more efficiently in the deeper muscles that support your spine?

UTTHITA PARSVAKONASANA



Extended Side Angle Pose

oo-TEE-tah parsh-vah-cone-AHS-anna
utthita = extended; *parsva* = side, flank; *kona* = angle



SKELETAL JOINT ACTIONS

	Upper limbs		Lower limbs	
Spine	**Upper arm**	**Lower arm**	**Front leg**	**Back leg**
Neutral spine or slight lateral flexion, slight rotation for chest to orient to side, head rotated to face upper arm	Scapular upward rotation, abduction, and elevation; shoulder joint abduction and external rotation; elbow extension; forearm pronation	Shoulder joint abduction, forearm pronation, wrist dorsiflexion	SI joint nutation, hip flexion and abduction, knee flexion, ankle dorsiflexion	SI joint counternutation, hip extension and abduction, knee extension, ankle dorsiflexion, foot supination at heel and pronation at forefoot

(*continued*)

Utthita Parsvakonasana *(continued)*

SELECTED MUSCULAR ACTIONS

Spine			
CONCENTRIC CONTRACTION		ECCENTRIC CONTRACTION	
To rotate chest to side: Internal oblique (back-leg side); external oblique (front-leg side) **To rotate head toward ceiling:** Rectus capitis posterior, obliquus capitis inferior, longus capitis and colli, splenius capitis (back-leg side); sternocleidomastoid, upper trapezius (front-leg side)		**To resist side bending into gravity:** Quadratus lumborum, latissimus dorsi, spinal muscles (back-leg side)	
Upper limbs			
Upper arm			
CONCENTRIC CONTRACTION		LENGTHENING	
To upwardly rotate, abduct, and elevate scapula: Serratus anterior **To extend elbow:** Triceps brachii, anconeus		**To extend arm to overhead without falling into gravity:** Rotator cuff, teres major, latissimus dorsi	
Lower limbs			
Front leg		**Back leg**	
CONCENTRIC CONTRACTION	LENGTHENING	CONCENTRIC CONTRACTION	LENGTHENING
To abduct hip: Gluteus medius and minimus, piriformis, obturator externus, superior and inferior gemellus	**To allow hip and knee flexion and ankle dorsiflexion without collapsing into gravity:** Gluteus maximus, hamstrings at hip joint, vastii, soleus, intrinsic and extrinsic muscles of foot	**To extend and abduct hip:** Gluteus medius and minimus, hamstrings at hip joint, piriformis, obturator externus, superior and inferior gemellus **To extend knee:** Articularis genu, vastii **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	**To support inner knee:** Gracilis **To allow outer ankle to lengthen without collapsing inner knee or inner foot:** Peroneals

Notes

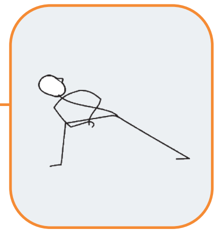
Your legs in this pose are performing the same actions as in warrior II (page 150), and similar muscle groups are active. In this pose, however, the weight of your torso falls more over your front leg, which may need to find additional strength, length, and stamina.

While the position of your upper arm alongside your head is similar to that of your arms in utkatasana (page 129) and virabhadrasana III (page 153), different muscles are required to maintain your arm position in this pose because of your different relationship to gravity. The action is also more eccentric than concentric, again because of the relationship of the weight of your arm to gravity.

Breathing Inquiry

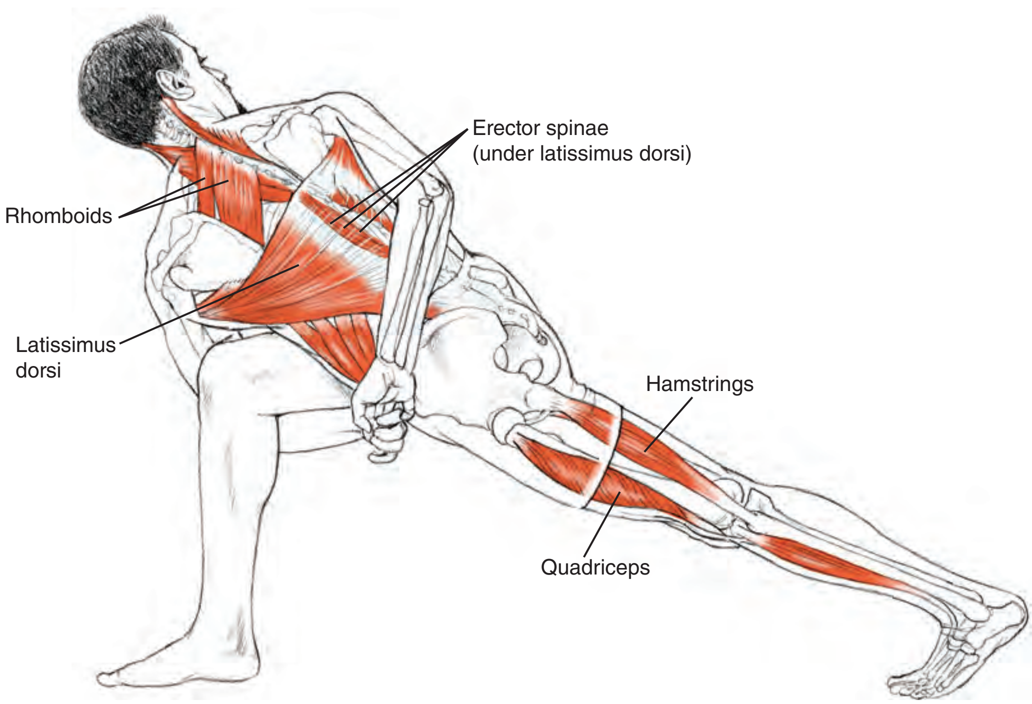
Even though the upper side of your breathing mechanism receives a strong lengthening action in this shape, can you feel your breath on the lower side of your body, where the dome of your diaphragm is moved cranially (toward the head) by the force of gravity acting on the abdominal organs? Can you feel how your breath action in this position provides an asymmetrical challenge to the diaphragm and all the organs attaching to it?

PARIVRTTA BADDHA PARSVAKONASANA



Revolved Side Angle Pose

par-ee-vrit-tah BAH-dah parsh-vah-cone-AHS-anna
parivrtta = twist, revolve; *baddha* = bound; *parsva* = side, flank; *kona* = angle



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Front leg	Lower limbs: Back leg
Axial rotation	Scapular downward rotation and abduction (moving toward adduction); shoulder joint internal rotation, extension, and adduction; elbow extension; forearm pronation; hand and finger flexion	SI joint nutation, hip flexion, knee flexion, ankle Dorsiflexion	SI joint counternutation, hip extension and adduction, knee extension, ankle dorsiflexion, toe flexion

(continued)

Parivrtta Baddha Parsvakonasana *(continued)*

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To rotate spine toward front leg: Erector spinae, internal oblique (front-leg side); transversospinalis, rotatores, external oblique (back-leg side) **To resist flexion caused by action of arms:** Spinal extensors	**To balance rotation around axis:** Transversospinalis, rotatores, external oblique (front-leg side); erector spinae, internal oblique (back-leg side)

Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION OR OTHER LENGTHENING**
To stabilize humeral head: Rotator cuff **To internally rotate shoulder joint and prevent protraction:** Subscapularis, anterior deltoid **To extend arm back:** Teres major, posterior deltoid, latissimus dorsi **To extend shoulder joint and elbow:** Triceps brachii **To grasp:** Flexors of fingers and hand	Upper trapezius, pectoralis major and minor, serratus anterior, coracobrachialis

Lower limbs			
Front leg		**Back leg**	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**CONCENTRIC CONTRACTION**	**LENGTHENING**
To resist tendency to widen knee (abduct at hip): Gracilis, adductor longus and brevis	**To allow hip and knee flexion and ankle dorsiflexion without collapsing into gravity:** Gluteus maximus, hamstrings at hip joint, vastii, soleus, intrinsic and extrinsic muscles of foot **To level and center pelvis over feet and to maintain balance side to side (the narrower the stance, the more active and long these muscles need to be):** Gluteus medius and minimus, piriformis, superior and inferior gemellus	**To extend hip:** Hamstrings at hip joint, gluteus medius (posterior fibers), adductor magnus, gluteus maximus **To extend knee:** Articularis genu, vastii	Soleus, gastrocnemius

Notes

In a spinal rotation around the axis of your spine (without side bending, flexing, or extending), the groups of muscles that are concentrically contracting on one side of your body are eccentrically contracting on the opposite side. This means that one layer of your abdominals is concentrically contracting while the layer above or below is eccentrically contracting. This layering allows for a finely tuned modulation of spinal actions and balance in the whole circumference of your torso.

Binding your arms (wrapping them around your body and clasping them together) in any position has a strong effect on your shoulder girdle and your spine. The anterior–inferior part of your glenohumeral joint capsule is the most vulnerable to dislocation, and the binding of your arms in internal rotation and extension can put pressure on this part of your joint capsule, especially if the rest of your shoulder girdle is limited in its mobility. (This caution applies to binding in general because it allows for more leverage or force to be directed into a joint.)

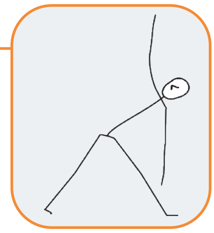
In the process of coming into the bind, both your scapulae and arms abduct and then adduct. The adduction of your scapulae is usually the final step. If your scapulae have been depressed (pulled down your back) in addition to their other joint actions, their mobility is compromised.

Another compensation that happens if your shoulder girdle is restricted and can't mobilize is that spinal flexion happens instead. Flexion combined with rotation can leave the joints of your spine vulnerable to overmobilization. It is possible to combine the leverage of your bound arms with pressure against your leg to force your spine past an appropriate range of motion.

Breathing Inquiry

If your lower body can more effectively create a base in this pose, does it bring more ease to your balance, your breathing? Here, your upper body is firmly bound in rotation against the resistance of your lower body, so there can be significant resistance to the movements of your diaphragm, abdomen, and rib cage, while the strong action in the large muscles of your legs are at the same time demanding more oxygen. Can you find a balanced efficiency of effort that leads to both firmness and ease in the pose?

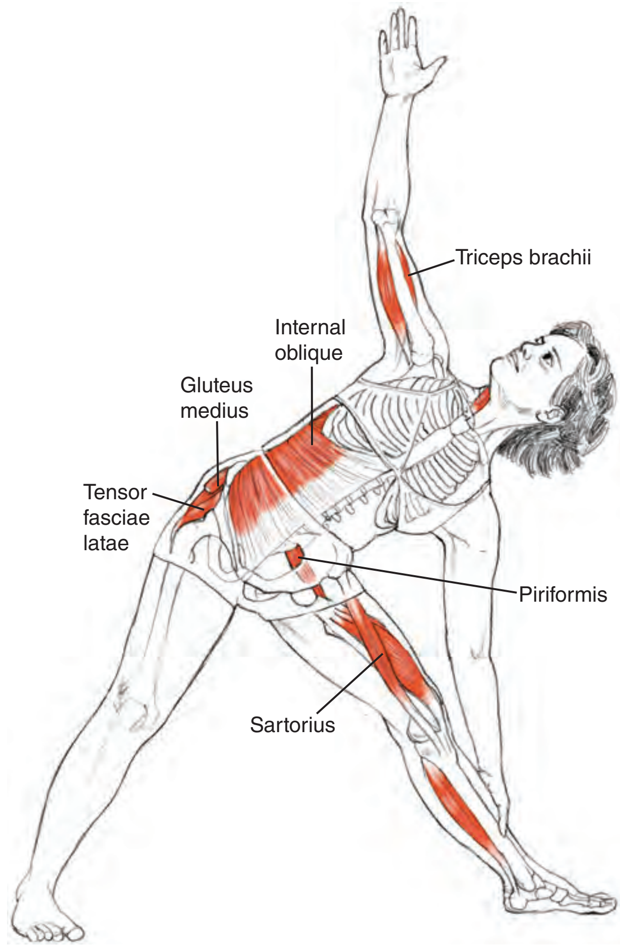
UTTHITA TRIKONASANA



Extended Triangle Pose

oo-TEE-tah trik-cone-AHS-anna

utthita = extended; *tri* = three; *kona* = angle



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs	
		Front leg	Back leg
Neutral spine, slight rotation for chest to orient to side, head rotated on axis to face upward	Scapular abduction, shoulder joint abduction and external rotation, neutral forearm	SI joint nutation, hip flexion and abduction, knee extension, slight ankle plantar flexion	SI joint counternutation, hip extension and adduction, knee extension, ankle dorsiflexion, foot supination at heel and pronation at forefoot

SELECTED MUSCULAR ACTIONS

Spine		
ALTERNATING CONCENTRIC AND ECCENTRIC CONTRACTIONS	**CONCENTRIC CONTRACTION**	**ECCENTRIC CONTRACTION**
To maintain neutral alignment of spine: Spinal extensors and flexors	**To rotate chest to side:** Internal oblique (back-leg side); external oblique (front-leg side) **To rotate head toward ceiling:** Rectus capitis posterior, obliquus capitis inferior, longus capitis and colli, splenius capitis (back-leg side); sternocleidomastoid, upper trapezius (front-leg side)	**To resist side bending into gravity:** Quadratus lumborum, latissimus dorsi, spinal muscles (back-leg side)

Upper limbs	
CONCENTRIC CONTRACTION	
To abduct scapula: Serratus anterior	**To stabilize and abduct shoulder joint:** Rotator cuff, biceps brachii (long head), deltoid

Lower limbs			
Front leg		**Back leg**	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**CONCENTRIC CONTRACTION**	**ECCENTRIC CONTRACTION**
To abduct hip: Gluteus medius and minimus **To extend knee:** Articularis genu, vastii	**To abduct hip and allow hip flexion without collapsing into gravity:** Gluteus maximus, piriformis, obturator externus, superior and inferior gemellus **To allow hip flexion without collapsing into gravity:** Hamstrings at hip joint **To maintain integrity of foot without collapsing:** Intrinsic and extrinsic muscles of foot	**To extend hip:** Hamstrings at hip joint **To extend knee:** Articularis genu, vastii **To support inner knee:** Gracilis **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	**To maintain extension of hip while adducting:** Piriformis, obturator externus, superior and inferior gemellus **To allow hip to abduct:** Gluteus medius and minimus **To allow outer ankle to lengthen without collapsing inner knee or inner foot:** Peroneals

(continued)

Notes

In utthita trikonasana, as in utthita parsvakonasana (page 155), the weight of your torso falls mostly over your front leg. Because the front knee is extended, the action in this pose is shifted from the eccentric contraction of the quadriceps to keep your knee from bending too deeply (as in utthita parsvakonasana) to the balance of actions around the joint that create a clear pathway of support without hyperextending your knee.

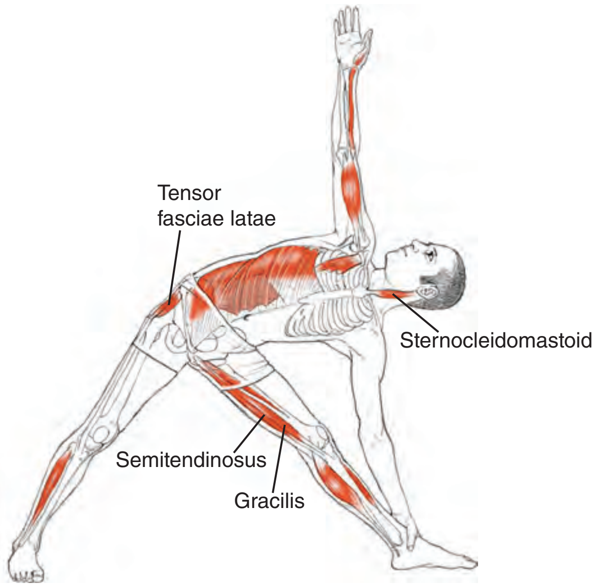
Pain or pressure in your front knee can be a result of lack of mobility in your hip joints and pelvis; whether the lack of movement in your hip joint is from short adductor muscles or another cause, the next place the movement can travel is your inner knee. Sensations from within your knee (or any joint) are important signals to stop what you're doing and adjust your action or position.

In your back leg, the muscles that cross the side of your pelvis, outer hip, and outer knee need to be actively lengthening (eccentrically contracting) to allow your pelvis to tilt sideways (adduct) over your leg. If these muscles cannot lengthen, your pelvis does not move as much, and your spine side bends. On the other hand, if these muscles are not active at all, the weight of your torso can sink into gravity and put pressure in your outer hip or ankle joints.

Does your spine rotate in utthita trikonasana? This pose is taught many ways, and good reasons exist for each perspective. In general, the more articulated your SI joints, pelvic halves, and hip joints, the less rotation is needed in your spine for your chest to face sideways. For example, if your front leg has habitually short adductors and flexors, your pelvis may rotate to the floor, and your spine has to counterrotate more to open your chest. Rotating your spine can accommodate a variety of obstacles in your legs. As in all the poses, maintaining balanced overall joint space is far more important than achieving a particular range of motion in just one or two joints.

UTTHITA TRIKONASANA VARIATION

With Longer Stance

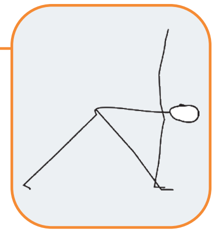


Notes

In some approaches to yoga, your feet are placed much farther apart than in others. The variety of leg positions affects which joints need more mobility and which muscles have to work at longer or shorter ranges.

When your feet are placed farther apart, your front leg muscles have to work at a greater length, but the muscles of the outer hip of your back leg work at a shorter length. It may be easier to keep your spine from side bending when your feet are farther apart. On the other hand, your pelvis may rotate toward the floor less when your feet are closer together. There is no anatomically correct distance for placing your feet in utthita trikonasana; each distance provides different information about the relationship between your torso and legs.

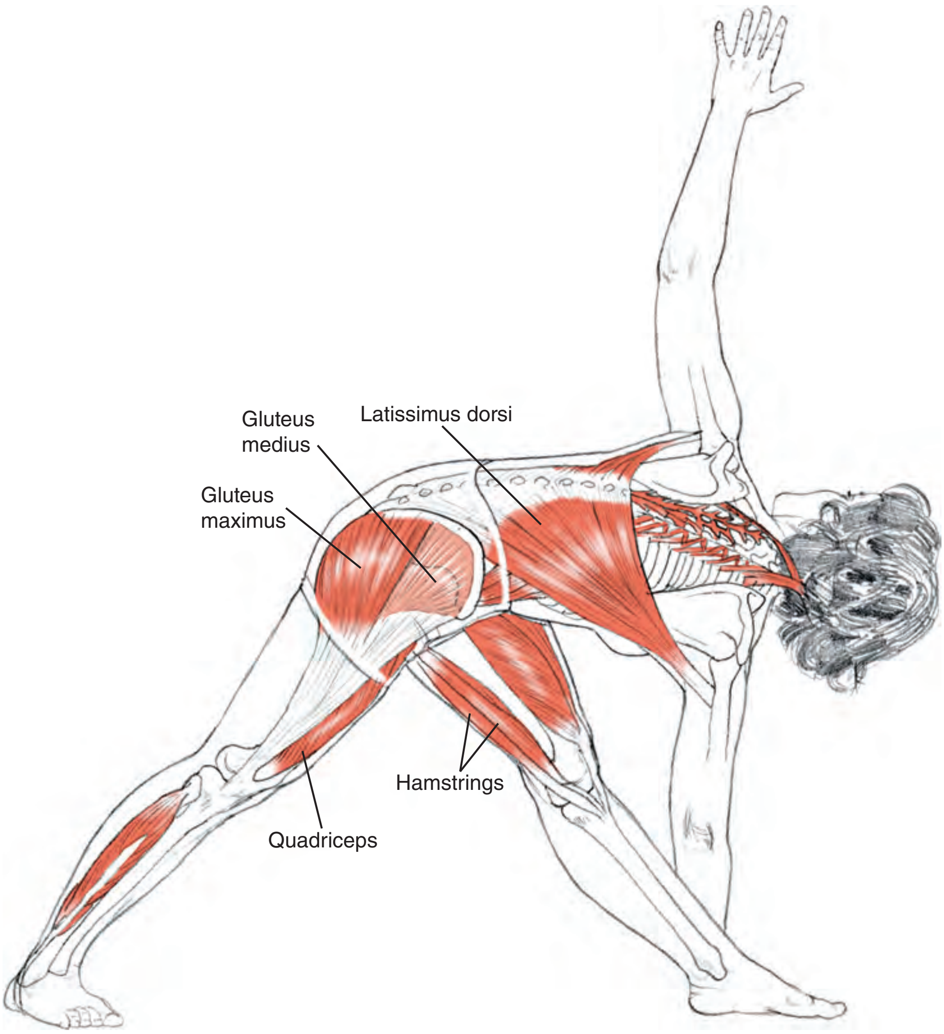
PARIVRTTA TRIKONASANA



Revolved Triangle Pose

par-ee-vrit-tah trik-cone-AHS-anna

parivrtta = to turn around, revolve; *tri* = three; *kona* = angle



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Front leg	Lower limbs: Back leg
Axial rotation	Scapular abduction, shoulder joint abduction and external rotation, neutral forearm	Hip flexion, knee extension, slight ankle plantar flexion	Mild hip flexion, knee extension, ankle dorsiflexion, foot supination at heel and pronation at forefoot

SELECTED MUSCULAR ACTIONS

Spine

ALTERNATING CONCENTRIC AND ECCENTRIC CONTRACTIONS	CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To maintain neutral alignment of spine: Spinal extensors and flexors	**To rotate spine toward front leg:** Erector spinae, internal oblique (front-leg side); transversospinalis, rotatores, external oblique (back-leg side)	**To balance rotation around axis:** Transversospinalis, rotatores, external oblique (front-leg side); erector spinae, internal oblique (back-leg side)

Upper limbs

CONCENTRIC CONTRACTION	
To abduct scapula: Serratus anterior	**To stabilize and abduct shoulder joint:** Rotator cuff, biceps brachii (long head), deltoid

Lower limbs

Front leg: CONCENTRIC CONTRACTION	Front leg: ECCENTRIC CONTRACTION	Back leg: CONCENTRIC CONTRACTION	Back leg: ECCENTRIC CONTRACTION	Back leg: ALSO LENGTHENING
To extend knee: Articularis genu, vastii	**To allow hip flexion:** Hamstrings at hip joint, gluteus maximus **To level and center pelvis over feet and to maintain balance side to side:** Gluteus medius and minimus, piriformis, superior and inferior gemellus, intrinsic and extrinsic muscles of foot	**To extend knee:** Articularis genu, vastii **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	**To allow hip flexion without dropping back leg forward:** Hamstrings at hip joint, gluteus medius (posterior fibers), adductor magnus, gluteus maximus **To allow outer ankle to lengthen without collapsing inner knee or inner foot:** Peroneals	Soleus, gastrocnemius

(continued)

Parivrtta Trikonasana *(continued)*

Notes

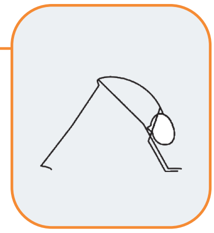
The spinal rotation in this pose requires the muscles on the outsides of your hip joints to be very long, and because of the narrowness of the base, the same muscles are actively modulating their actions to keep you from falling side to side. This eccentric action of lengthening while stabilizing for balance can make this pose feel precarious.

If your legs and pelvis do not have the mobility to flex and rotate as much as needed, your spine may flex to compensate. Rotating your spine when it is in a flexed position can leave the joints along the back of your spine vulnerable to overmobilizing. It is important in this pose to respect the range of motion available in your spine and to avoid using the pressure of your hand on the floor or against your leg to force movement.

Breathing Inquiry

Can you sense how the mobility of your pelvic structures determines how stable a base you can provide for your balance and breathing? If you lack mobility in your pelvis, does it result in your upper body being held stiffly in rotation against the resistance of your lower body, creating resistance to the movements of your diaphragm, abdomen, and rib cage?

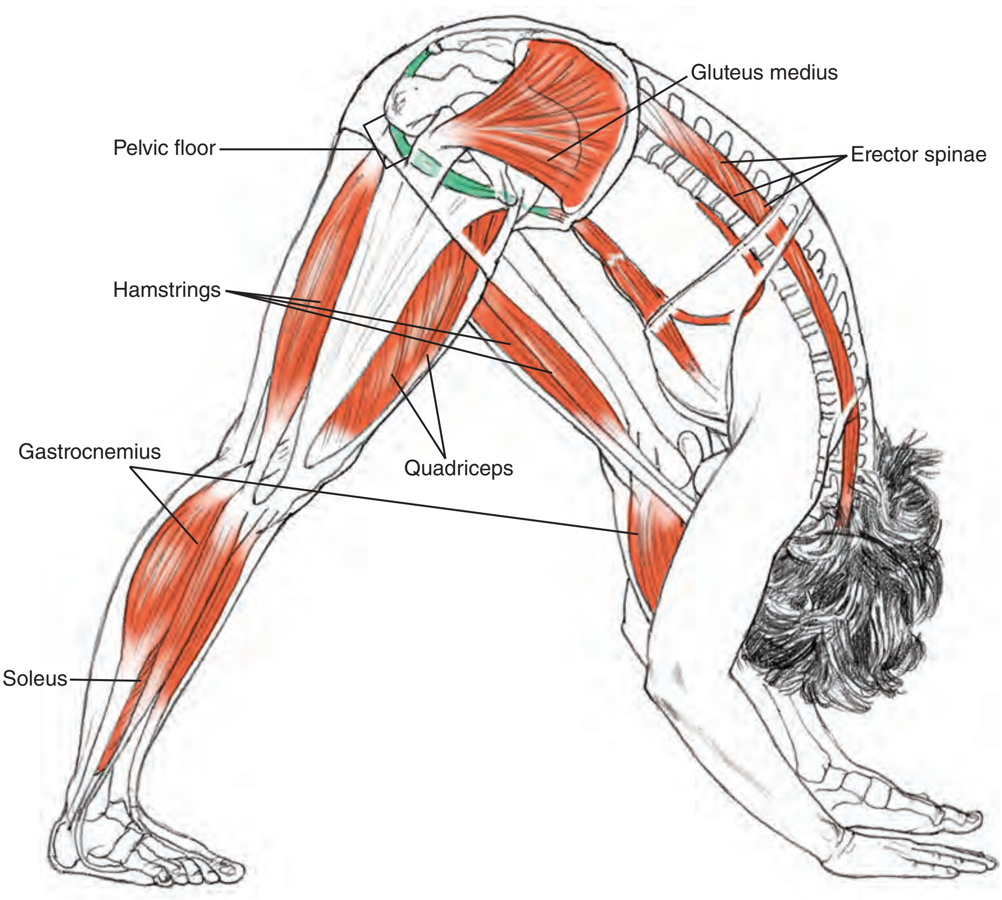
PARSVOTTANASANA



Intense Side Spreading

parsh-voh-tahn-AHS-anna

parsva = side, flank; *ut* = intense; *tan* = to spread



(continued)

Parsvottanasana *(continued)*

SKELETAL JOINT ACTIONS

	Lower limbs	
Spine	**Front leg**	**Back leg**
Mild flexion	Hip flexion, knee extension, slight ankle plantar flexion	Mild hip flexion, knee extension, ankle dorsiflexion, foot supination at heel and pronation at forefoot

SELECTED MUSCULAR ACTIONS

Spine
ECCENTRIC CONTRACTION
Erector spinae

Lower limbs				
Front leg		**Back leg**		
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**CONCENTRIC CONTRACTION**	**ECCENTRIC CONTRACTION**	**ALSO LENGTHENING**
To extend knee: Articularis genu, vastii	**To allow hip flexion:** Hamstrings at hip joint, gluteus maximus **To level and center pelvis over feet and to maintain balance side to side:** Gluteus medius and minimus, piriformis, superior and inferior gemellus, intrinsic and extrinsic muscles of foot	**To extend knee:** Articularis genu, vastii **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	**To allow hip flexion without dropping back leg forward:** Hamstrings at hip joint, gluteus medius (posterior fibers), adductor magnus, gluteus maximus **To allow outer ankle to lengthen without collapsing inner knee or inner foot:** Peroneals	Soleus, gastrocnemius

Notes

The leg actions in parsvottanasana are almost the same as in utthita trikonasana (page 160), and this pose can be a challenge to balance in for the same reason as in that pose—the narrowness of the base and the need for your outer hip muscles to be both long and active. Additionally, if you are accustomed to using your eyes to help you balance, this position with your head rolled forward might present an interesting challenge.

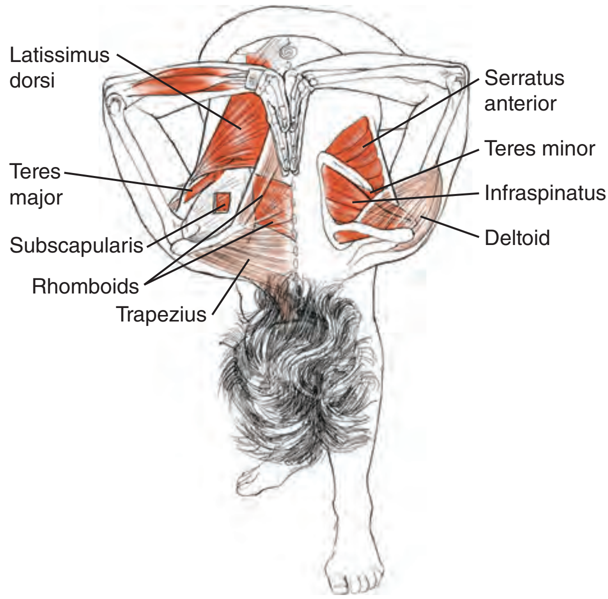
This forward-bending action is more intense in the muscles of the back of your front leg than in uttanasana because of the asymmetry of the pose: Your back leg's position directs the flexion more specifically into the hip joint of your front leg, and the mobility in your spine is less able to compensate for a lack of range in your leg. (This is seen in an even more extreme form in hanumanasana on page 207.)

PARSVOTTANASANA VARIATION
With Arms in Reverse Namaskar

Notes

This arm position can be incorporated into a variety of asana. It requires a fair amount of mobility in your shoulder girdle, and if your scapulae are not able to move easily on your rib cage, bringing your hands into this position may direct excessive pressure into your shoulder joints or wrists.

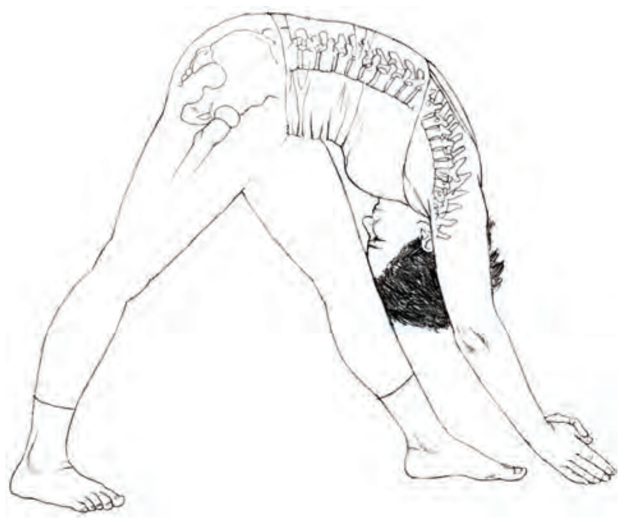
Bringing your arms into this position generally involves abducting your scapulae and spreading them away from your spine before the final actions of adducting and moving your scapulae toward your spine. This final movement of adduction is much more challenging if your spine is flexed or if your scapulae are depressed and pulled down your back.



PARSVOTTANASANA VARIATION
With Spine Flexed

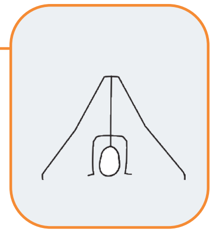
Notes

In this variation on parsvottanasana, the intention is to bring your forehead to your knee rather than along your shin. To execute this action, your spine must flex very deeply, and there is less hip flexion than in the previous version. This action can be surprisingly difficult if you are accustomed to forward bending using hip flexion rather than spinal flexion.



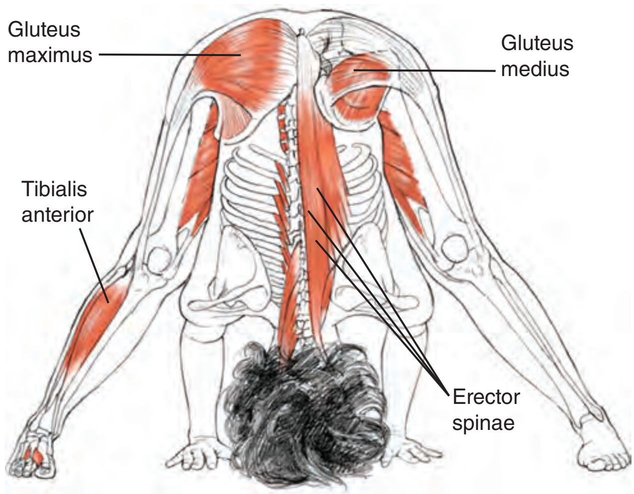
Your shoulder joints are also more fully flexed, bringing them higher overhead, and adducted to bring your palms together. Rather than resting your palms on the floor, try reaching your fingertips out along the floor, sliding your little fingers away from your foot. Because your hands are not on the floor to either side of your foot, balancing in this pose can be more challenging, although you might find a clearer sense of midline with your hands pressed together.

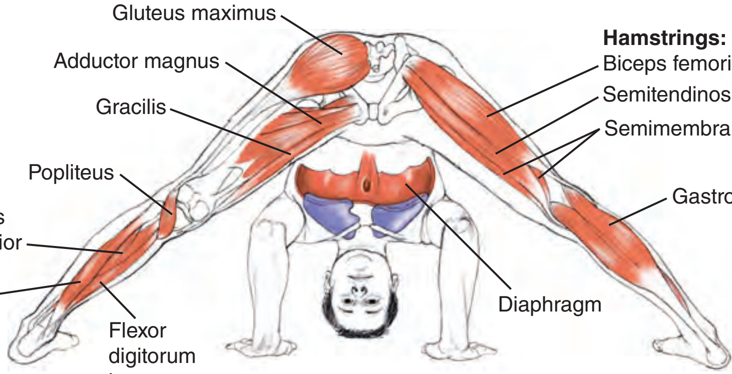
PRASARITA PADOTTANASANA



Wide-Stance Forward Bend

pra-sa-REE-tah pah-doh-tahn-AHS-anna
prasarita = spread, expanded; *pada* = foot; *ut* = intense; *tan* = to spread out





SKELETAL JOINT ACTIONS

Spine	Lower limbs
Mild flexion	Hip flexion and abduction, knee extension, ankle dorsiflexion, foot supination at heel and pronation at forefoot

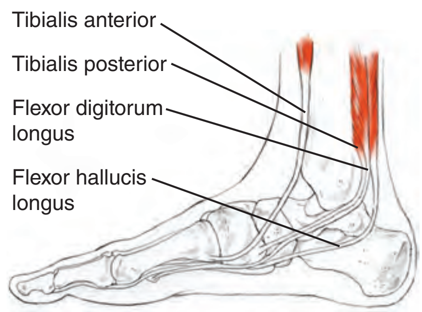
SELECTED MUSCULAR ACTIONS

Spine	
LENGTHENING	
Spinal muscles	
Lower limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION OR OTHER LENGTHENING**
To extend knee: Articularis genu, vastii **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	Hamstrings, especially medial hamstrings (semitendinosus and semimembranosus), adductor magnus and minimus, gracilis

Notes

This pose is often described as a stretch for the adductors, or the muscles of your inner legs. In fact, when your legs are wide apart and your body is folded forward (hip abduction and flexion), some muscles of your adductor group are not lengthened at all. This is because some adductors are also hip flexors and are not at their greatest length until your hip joints are both abducted and extended. An example is when you're standing upright with your legs wide apart (unless when standing you exhibit the common pattern of tipping your pelvis forward, which would undo your hip extension).

When your stance is wide, your feet need to be both strong and mobile. This is so you can ground through your outer feet without overmobilizing your outer ankles or collapsing your inner ankles.



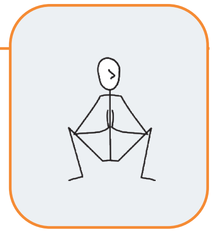
Extrinsic muscles of arch support, medial ankle.

Breathing Inquiry

Many people experience this wide-stance forward bend as the safest, most accessible inversion in all of yoga practice. It provides mild traction and release to your spine while reversing the usual action of your breath. Do you notice a quality of firmness in your legs that creates support while also allowing your pelvis to freely rotate forward at your hip joints? Does that result in a more relaxed torso and inverted breath?

While hanging upside down, do you notice how your diaphragm is pulled cranially (toward your head) by gravity, thus favoring the exhalation? While inhaling, can you tune in to how your diaphragm pushes the weight of your abdominal organs caudally (toward your tail) against gravity while at the same time mobilizing the costovertebral joints in your thoracic spine? All these altered muscular actions can help you to normalize circulation in both the muscles and organs that are subjected to the usual stresses of upright weight-bearing.

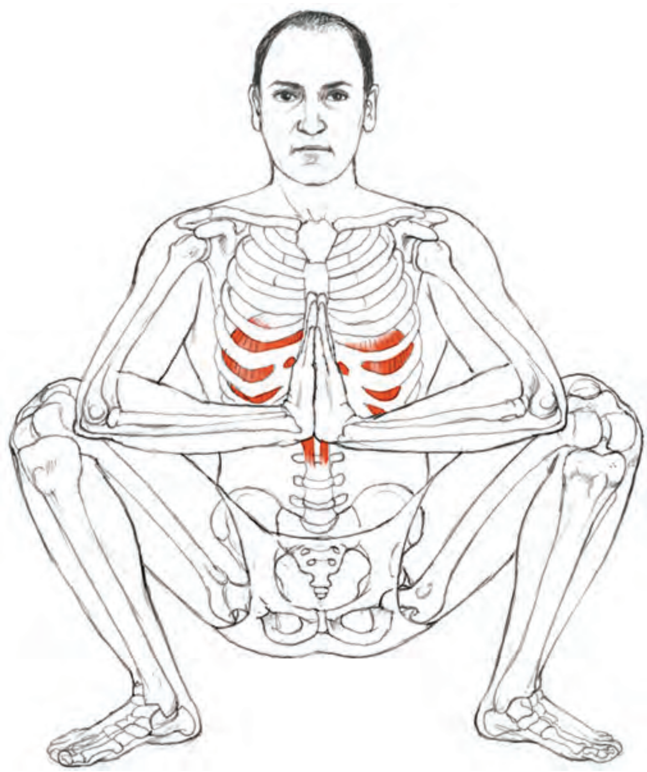
MALASANA OR UPAVESASANA

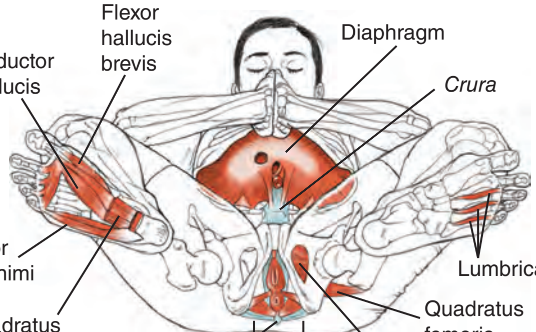


Squat, Garland Pose, Sitting-Down Pose

mal-AHS-anna
mala = wreath, garland
oop-pah-ve-SHAHS-anna
upavesa = sitting down, seat

In many parts of the world, this is not considered to be an asana; it is simply how people sit in the absence of chairs. The more one sits in chairs, the more this becomes a necessary asana.





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Axial extension	Slight shoulder joint flexion; elbow flexion; forearm pronation; wrist, hand, and finger extension	SI joint nutation; hip flexion, external rotation, and abduction; knee flexion; ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To maintain arches of foot without inhibiting dorsiflexion of ankle: Intrinsic muscles of foot	**To allow hip flexion and support external rotation:** Gluteus maximus, piriformis, superior and inferior gemellus, obturator internus **To allow hip and knee flexion and ankle dorsiflexion:** Hamstrings at hip joint, vastii, soleus

Notes

Some people can easily engage their pelvic floor in this position, where it works synergistically to respond to the movement of the inhalation and to initiate the exhalation. Gravity does the work of lowering your body toward the floor, and the muscles of your legs are active to prevent collapsing completely into the joints. This is especially important in your hip joints, because if the weight of your upper body falls passively into your hip joints it may make your pelvic floor less accessible.

The inability to dorsiflex your ankles deeply enough to keep your heels on the floor can be caused by shortness in the back of your ankles and lower legs; however, restriction can also be in the front of your ankles. A modification is available by using support under your heels, but it's important to also find the activity of the intrinsic muscles of your feet, which stabilize your arches, allow deeper flexion in your ankles, and support the bones of your feet and knee joints. Look for the tendons on the front of your ankles popping out; this is a sign that deeper support is yet to be found. See if you can allow gravity to create the flexion, and focus on using your intrinsic muscles to maintain integrity.

Breathing Inquiry

This pose, with your palms together and elbows propped against your inner thighs, offers you an opportunity to powerfully lengthen all three curves of your spine (axial extension). Can you feel a relationship between axial extension and all three bandhas? See if you can sense a connection between the deep support in the arches of your feet and the lifting action of your pelvic floor and lower abdominal muscles (mula bandha). The bracing of your elbows against your knees allows for a strong lengthening of your thoracic spine and lifting of the base of your rib cage and the lower attachments of your respiratory diaphragm (uddiyana bandha). The action of jalandhara bandha, which lifts your sternum to meet your chin as your cervical curve flattens, completes the action of axial extension. With those actions of your spine and breath, what breathing shape change is still available? With all the usual movements of breath stabilized, perhaps you can notice an unusual pattern of breath arising deep in the core of your system.

9

SITTING POSES

For many people in the industrialized world, sitting on a piece of furniture is the body position in which they spend most of their waking hours. What shoes are to your feet, chairs, car seats, and couches are to your legs and lower spine. In yoga practice, just as our bare feet can develop a new relationship with the ground through the practice of standing asana, your legs and pelvis can develop a new relationship with the earth by directly being the base of support in sitting postures.

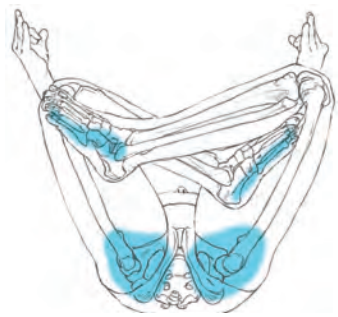
The asana depicted in this chapter are either sitting positions themselves or are entered into from sitting. Practicing some of these positions also has an association with more advanced practices. The word *asana*, in fact, can be literally translated as "seat," and from a certain perspective, all of asana practice can be viewed as a methodical way of freeing your spine, limbs, and breathing so that you can spend extended time in a seated position. With practice, sitting can be a fairly stable upright body position in which the distractions of dealing with gravity and balance can be minimized, thus freeing your attention for the contemplative work of meditative practices.

Note: Blue shaded areas indicate places of contact with the floor.

SUKHASANA

Easy Posture

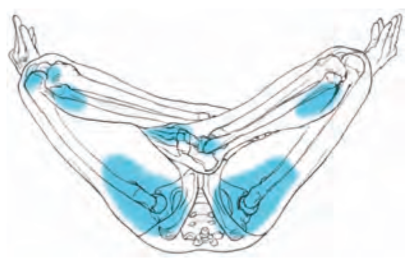
suk-HAS-anna
sukha = comfortable, gentle, agreeable



SIDDHASANA

Adept's Posture

sid-DHAS-anna
siddha = accomplished, fulfilled, perfected; a sage, an adept



SVASTIKASANA

Auspicious Posture

sva-steek-AHS-anna
svastik = lucky, auspicious

PADMASANA

Lotus Posture

pod-MAHS-anna
padma = lotus

MULABANDHASANA

Pose of the Root Lock

moola-ban-DHAS-anna
mula = root, foundation, bottom; *bandha* = binding, tying a bond

(*continued*)

COMMON SKELETAL JOINT ACTIONS (FOR FIVE PREVIOUS POSES)

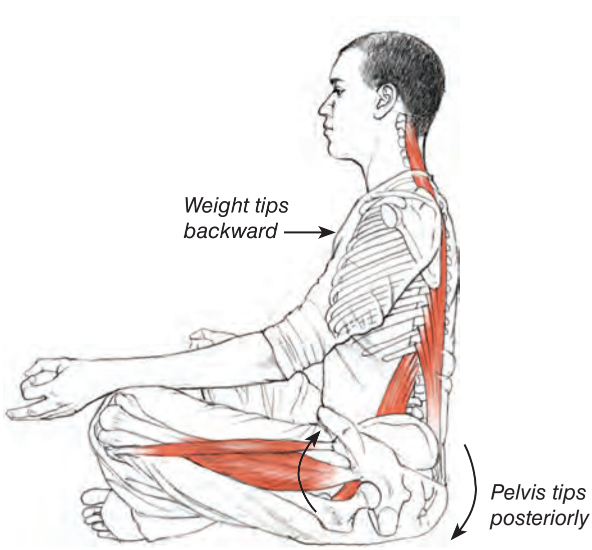
Spine	Lower limbs
Neutral or axial extension	Hip flexion, knee flexion

Notes

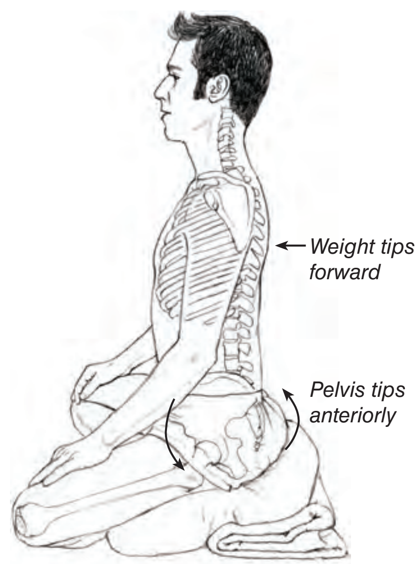
One goal of these seated poses is sthira and sukha—steadiness and ease. If your pelvis and legs are arranged in a way that clearly supports your spine, your spine can provide a clear pathway for weight distribution, and it can maintain balance so that gravity does not pull you forward or backward. Your spine can then support your skull, and your spine and skull can together support and protect your brain and spinal cord. When your spine is supported efficiently by your pelvis and legs, your ribs are also free to move with your breath rather than becoming part of the supporting mechanism of sitting.

One thing to observe is whether your knees are higher or lower than your hips. As in all asana, there is no single correct choice for every person; depending on your body, having your knees higher or lower will have different effects on your spine and your breath. Because the muscles of your back (and the rest of your torso) are always active to some degree in any vertical position, finding the position that feels most supportive will be a question of balancing muscular activity throughout your body without overworking any one area. (If sitting is unfamiliar, any length of time in a position might feel tiring, whether it's an appropriate choice for your body or not.)

Knees higher than your hip joints: Sitting with your legs crossed in such a way that your knees are higher than your hip joints can be helpful if you don't have a lot of external rotation or abduction in your hip joints (that is, if your knees don't open to the sides very easily). For you, crossing your legs so your knees are higher than your hips can allow the weight of the thigh bones to settle deeply into your hip sockets and down into your ischial tuberosities (sit bones).



Sitting with the knees above the hips can posteriorly rotate the pelvis and exaggerate primary curves.



Sitting with the hips above the knees can anteriorly tip the pelvis and exaggerate secondary curves.

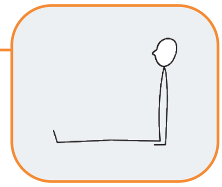
Having your knees higher than your hips isn't helpful if it tips your pelvis posteriorly and rounds your spine into flexion. To come to vertical from this tipped back position, it is necessary to engage the muscles of your spine or to contract your hip flexors to pull your pelvis and spine forward or both. If the muscles of your spine have to work extra hard to overcome a limited range of movement in your pelvis and lower back, it can quickly tire those muscles or lead to overuse of the muscles of the front of your hips (which don't necessarily have to be involved in sitting).

Knees lower than your hip joints: Elevating the seat by sitting on a blanket or block makes it possible for your knees to be lower than your hips. This might prevent your pelvis from tipping back and make it easier to maintain the lumbar curve of your spine, which helps weight travel more efficiently through your spine into your pelvis.

When your knees are out to the side and lower than your pelvis, though, they might also pull your pelvis so it tips in front of your sit bones. This anterior tilt can emphasize extension in your spine, particularly in your lumbar curve, and then the muscles of your back might overwork to prevent falling forward.

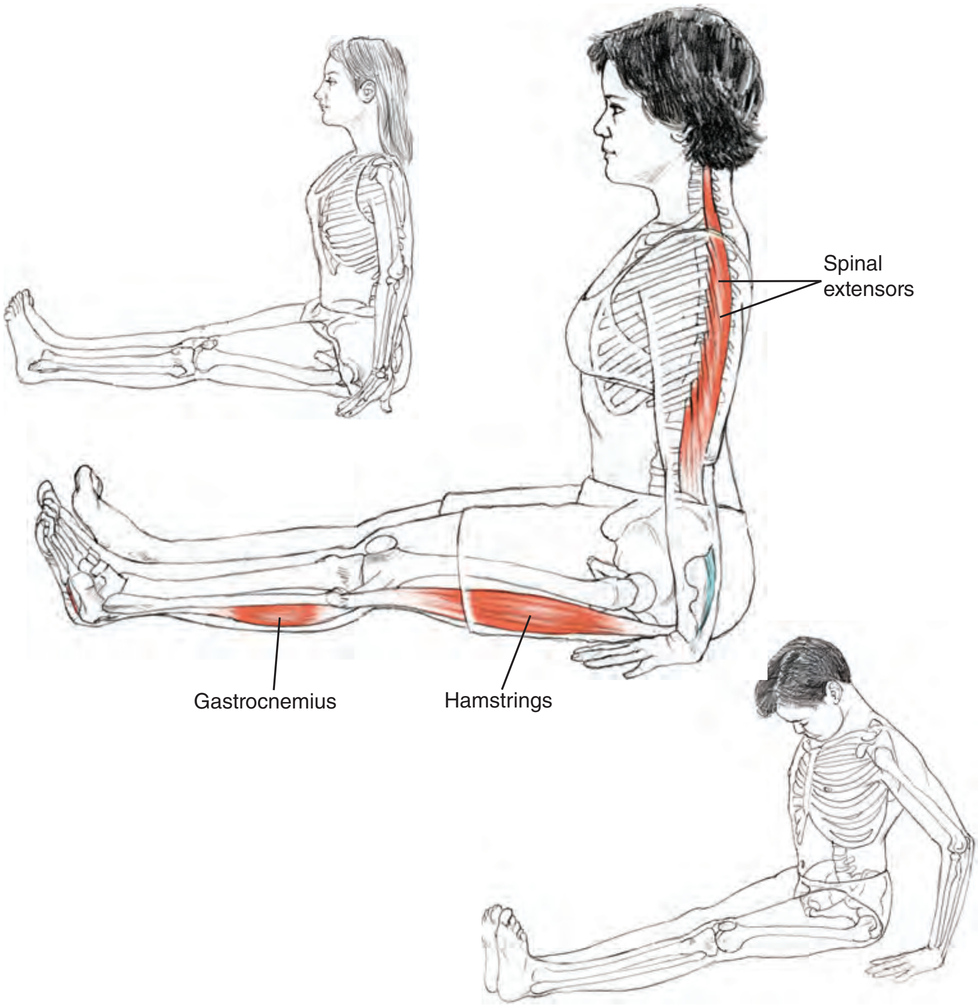
One goal could be to find the leg position that allows the weight to fall most clearly from your spine through your pelvis into your sit bones and the support of the floor, regardless of how high or low your knees are relative to your pelvis. For some people, this involves raising their seat a great deal or even sitting on a chair for ease in their spine until more mobility can be cultivated in their pelvis and legs. In a well-supported seated asana, the intrinsic equilibrium of your pelvis, spine, and breathing mechanism supports your body, and the energy that has been liberated from postural effort can be focused on deeper processes, such as breathing or meditation.

DANDASANA



Staff Pose

dan-DAHS-anna
danda = stick, staff



Arm and torso proportions: short, neutral, and long.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Neutral or axial extension	Neutral scapula, shoulder joint adduction, elbow extension, wrist dorsiflexion	Hip flexion, adduction and rotation to parallel, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
To calibrate concentric and eccentric contractions to maintain neutral alignment of spine: Spinal extensors and flexors	
Upper limbs	
CONCENTRIC CONTRACTION	
To resist adduction of scapula resulting from push of arm: Serratus anterior	**To extend elbow:** Triceps brachii
Lower limbs	
CONCENTRIC CONTRACTION	
To flex hip: Iliacus **To adduct and internally rotate leg:** Pectineus, adductor magnus	**To extend knee:** Articularis genu, vastii

Notes

Dandasana is often considered a basic pose because the instructions are simple: sit with your spine in neutral and your legs extended in parallel. The simplicity of the instructions, however, does not mean it is at all easy, and sometimes coming to a neutral position involves a great deal of activity to move away from habitual patterns and asymmetries (see Cueing Callout: Neutral Is Not Natural, page 123). In this asana, maintaining a neutral position of your spine with 90 degrees of flexion in your hip joints might reveal habitual holding in your legs, over- and underactive parts of your spine, and the ways that patterns in your spine and legs affect each other.

One common example of this is how shortness in the muscles of your legs might pull your pelvis into a posterior tilt and thus your spine into flexion. This might then lead to overusing the flexors of your hip joints or the muscles of your lower back to try to bring your spine erect. Another example is how shortness in your buttocks and outer hip muscles might pull your legs into external rotation, which then means the muscles of your inner legs are called on to maintain a parallel position.

The activity in your legs is an excellent example of the way that a neutral position is not effortless. Even if there is no pulling from the buttocks or outer hip muscles, the pull of gravity tends to roll your legs open, so some activity of internal rotation is needed to keep your legs parallel. (It's possible that with regular practice, this activation of the internal rotators of your legs becomes habitual and unnoticeable. This doesn't mean, however, that the activation is not happening, only that you no longer notice it.)

Because differences exist in arm-to-body proportions, not everyone can use their arms to help create the neutral spinal extension in dandasana. On the other hand, what appear to be different arm-to-body proportions can sometimes be the result of habitually elevating or depressing your scapulae on the rib cage. In addition, if your spine is unable to extend into a vertical position because of habitual shortness in your hips and legs, your arms may also seem too long.

Breathing Inquiry

In one version of this pose, this is a straight-legged opportunity to breathe into an axially extended spine (mahamudra). Can you sense all three bandhas being employed? If so, can you take 10 smooth, even breaths while maintaining the bandhas with your spine in axial extension? If not, what gets in the way?

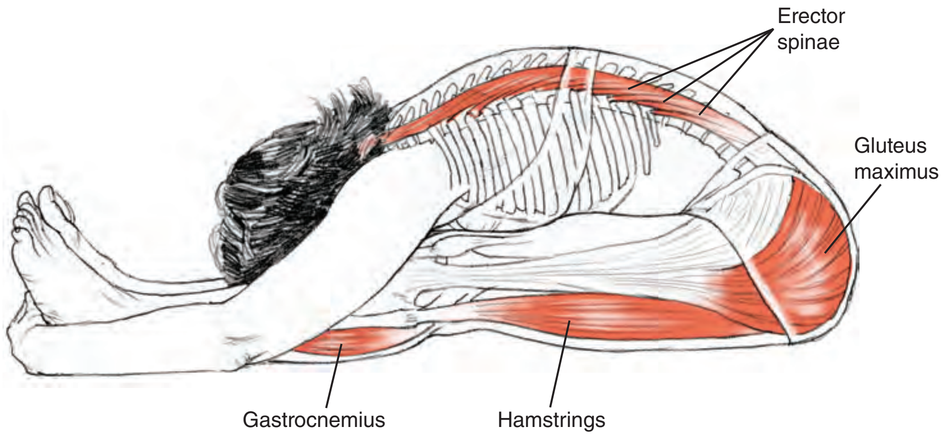
PASCHIMOTTANASANA

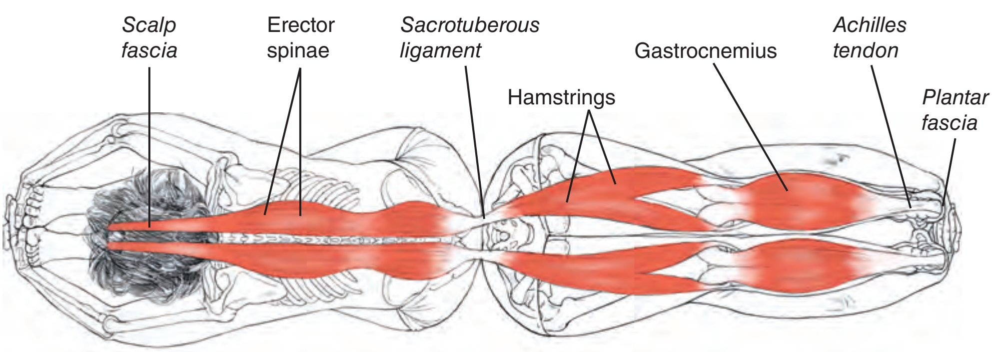
West (Back) Spreading

POS-chee-moh-tan-AHS-anna

pascha = behind, after, later, westward; *uttana* = intense spreading

The back of your body is referred to as *west* because of the traditional practice of facing the rising sun when performing morning worship. Compare this asana with purvottanasana, which spreads open the front of your body (*purva* = in front, before, eastward).





The back line of your body is a continuous network of muscle and fascia that extends from the soles of your feet (plantar fascia) to your scalp fascia and the ridge of your brow.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Mild flexion	Scapular abduction and upward rotation, shoulder joint flexion and adduction, elbow extension	Sacroiliac (SI) joint nutation, hip flexion and adduction, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
ECCENTRIC CONTRACTION	
To distribute flexion through length of spine: Spinal extensors	
Upper limbs	
LENGTHENING	
Rhomboids, lower trapezius, latissimus dorsi	
Lower limbs	
CONCENTRIC CONTRACTION	LENGTHENING
To maintain knee extension: Articularis genu, vastii **To adduct and internally rotate:** Pectineus, adductor longus and brevis	Hamstrings, gluteus medius and minimus (posterior fibers), gluteus maximus, piriformis, adductor magnus, soleus, gastrocnemius

Notes

As with many poses, this forward bend can be taught with the focus in different places. In general, as the name suggests, paschimottanasana is about opening or spreading your back body, but one teacher might emphasize the flexion of your spine, another the lengthening of the back of your legs, another the balance of action in your legs and spine. None of these points of focus are anatomically better than the others; what is safe and appropriate depends on the person doing the asana and their current situation.

In this pose, gravity could do the main work of moving you deeper into the forward bend, and we could say that little muscular activity is needed. As the extensors of your spine lengthen, however, they can also actively distribute the action of flexion along the length of your spine so that one part is not flexing excessively. If there is a lot of habitual shortness in the back of your legs and pelvis, however, hip flexion can be restricted, and the weight of your torso would fall behind your legs in such a way that gravity doesn't actually help in the pose. In this case, your hip flexors and abdominal muscles might be called on to pull your body forward, which can create a sense of congestion in the front of your hip joints. In this case, elevating your seat with folded blankets or other support under your sit bones could let gravity draw your upper body more passively forward. Bending your knees can also allow your spine to come forward more easily. In this case, the backs of your legs still lengthen, but in a potentially less stressful way. Or you might engage the backs of your legs slightly to take some of the lengthening action out of your legs and redirect it into the flexion of your spine.

As in the previous pose, dandasana, your legs in this position are neither rotated internally nor externally. If you have a habit of using your buttocks and legs in a way that pulls your legs into external rotation, you need to engage the muscles of internal rotation to maintain the parallel position of your legs.

(*continued*)

Cueing Callout: Where Should You Feel the Stretch?

You might be told in an asana to feel a stretch in your hamstrings or back or some other particular place. But different people might feel a stretch in different places or not feel a stretch at all, even in the same asana. If you feel a stretching sensation close to your joints or at the points of attachment of a muscle, this might indicate that your tendons and connective tissue are being stressed and potentially damaged. You might try to direct the sensation along the whole length of a muscle (rather than at its attachment points), even if it means moving less deeply into the asana. You also might try doing the asana in a way that doesn't seek a stretching sensation at all and notice whether other sensations arise.

Breathing Inquiry

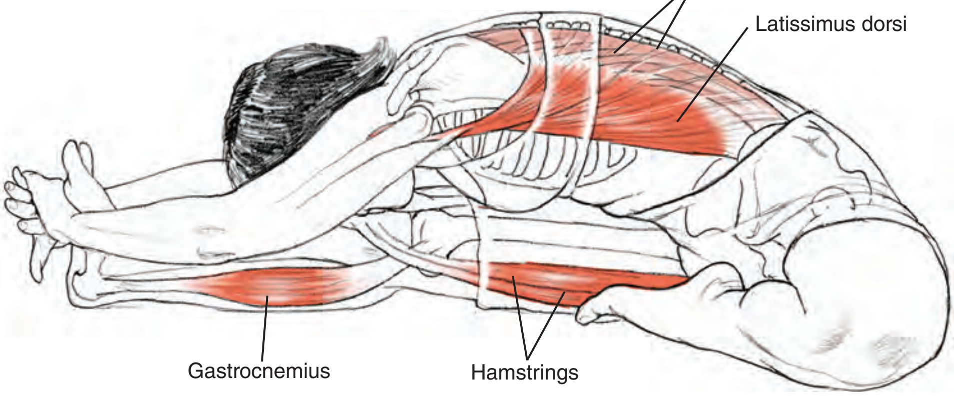
As in uttanasana (page 131), the standing version of this pose, do deep hip flexion and spinal flexion combine to compress the front of your body and restrict the ability of your abdomen to move with your breath? Is it possible to encourage more freedom in your rib cage to bring more ease to your breath in this position?

See whether your breath can be helpful while moving into this pose. One idea to explore is to use the action of your exhalation, initiated with your lower abdominal muscles, to deepen flexion at your pelvis and hips and use the action of your inhalation to assist in mobilizing your rib cage.

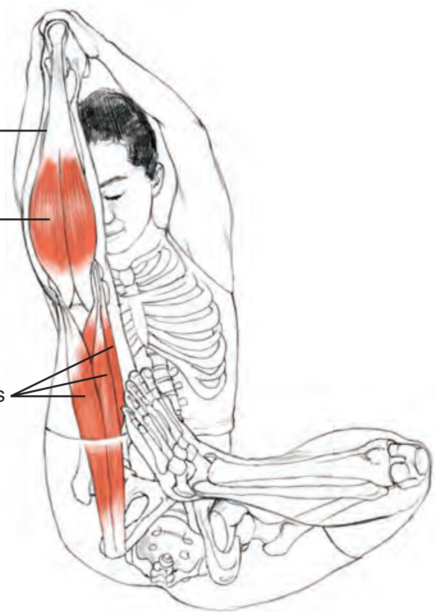
JANU SIRSASANA

Head-to-Knee Pose

JAH-new shear-SHAHS-anna
janu = knee; *shiras* = to touch with the head



The entire back line of your extended-leg side can be lengthened, from the sole of your foot to the scalp fascia.



(*continued*)

Janu Sirsasana *(continued)*

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Extended leg	Lower limbs: Flexed leg
Mild flexion, rotation of chest toward extended leg	Scapular abduction and upward rotation, shoulder joint flexion and adduction, elbow extension	SI joint nutation, hip flexion, knee extension, ankle dorsiflexion	SI joint nutation; hip flexion, external rotation, and abduction; knee flexion; ankle plantar flexion; foot supination

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To rotate chest toward leg: Internal oblique (extended-leg side); external oblique, rotatores, multifidi (flexed-leg side)	**To facilitate rotation and distribute flexion through length of spine by lengthening eccentrically:** External oblique, rotatores, multifidi (extended-leg side); internal oblique (flexed-leg side)

Upper limbs

CONCENTRIC CONTRACTION	LENGTHENING
To upwardly rotate scapula: Serratus anterior **To flex and adduct arm:** Anterior deltoid, pectoralis major **To extend elbow:** Triceps brachii	Rhomboids, lower trapezius, latissimus dorsi

Lower limbs

Extended leg: CONCENTRIC CONTRACTION	Extended leg: LENGTHENING	Flexed leg: CONCENTRIC CONTRACTION	Flexed leg: LENGTHENING
To maintain knee extension: Articularis genu, vastii **To adduct and internally rotate:** Pectineus, adductor longus and brevis	Hamstrings, gluteus medius and minimus (posterior fibers), gluteus maximus, piriformis, adductor magnus, soleus, gastrocnemius	**To externally rotate and abduct hip:** Obturator internus and externus, quadratus femoris, piriformis, superior and inferior gemellus **To externally rotate and flex hip and knee:** Sartorius **To flex knee:** Hamstrings	Adductor magnus, longus, and brevis

Notes

Everyone has a preference for habitually turning to one side or using one side of their body (our *sidedness*). No one's body is perfectly symmetrical, nor are their patterns of movement. In janu sirsasana, sidedness shows up as a difference in sensation between the right and left sides of your body: in the muscles of your back and neck, around your SI joints, in your legs, in the reach of your arms for the foot. This might lead us to say we have an easy side and a hard side, or a good side and a bad side. Another way to look at it would be to notice that each side has its challenges and its strengths and to recognize that they can balance each other without being symmetrical.

Your SI joint on the side of your flexed leg and the vertebrae of your spine all play a role in turning your spine to face your extended leg. When your SI joint is less mobile, your spine will have to articulate more, and when your spine is less mobile, your SI joint will have to move more.

Because of the asymmetrical position of your legs (with one foot levering into the other leg) and the pulling action of your arms, it's particularly easy in this pose (as with other bound poses where the hands are wrapping around one part of the body and clasping each other) to direct a lot of force through your joints. A little movement in a lot of places will give you the most range of motion without demanding too much movement in any single joint. To find this distribution of movement through your joints, it is important to identify which of your joints move most easily (and encourage them to do less) and which joints move less easily (and encourage them to do more). In janu sirsasana, too much force can be directed to your SI joints, especially if your spinal rotation is restricted by the actions in your spine or shoulder girdle. Alternately, too much force can be directed into parts of your spine that are habitually mobile if your SI joints aren't allowed to move at all.

Lack of movement in your SI joint or your hip joint of the flexed leg can lead to excessive torque in your bent-leg knee joint, which can contribute to the meniscus tears frequently reported to happen in this pose. Your hip joint executes a combination of abduction, external rotation, and flexion on your flexed-leg side, and if that movement isn't available in your hip joint, moving into the pose can pull your femur into following the movement of your pelvis in a way that directs too much force into your knee joint.

Breathing Inquiry

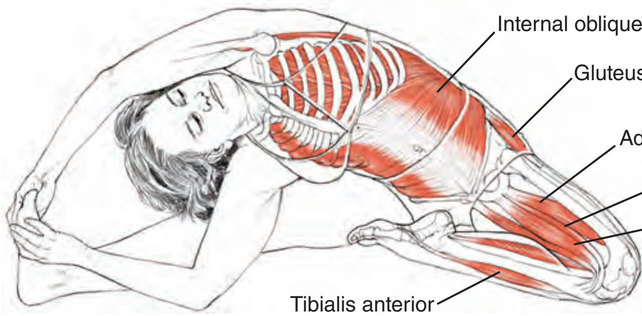
Your breath can be helpful while moving into this pose. Try exploring how the action of your exhalation can deepen the flexion at your pelvis and how emphasizing the action of your inhalation can assist in mobilizing your upper spine. This especially occurs if your exhalation is initiated with your lower abdominal muscles and your inhalation is directed toward your rib cage.

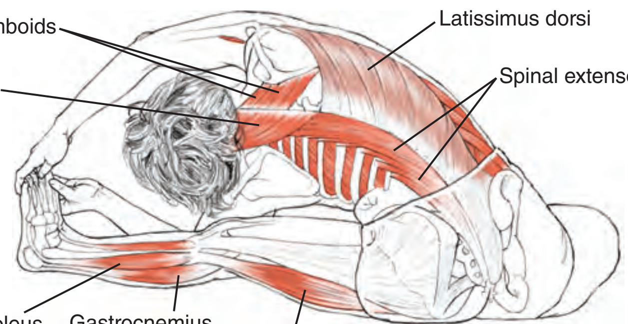
What happens if you experiment with the opposite pattern of breath just to create a contrast? Try exhaling by compressing your chest and inhaling into your belly region. Notice the effect on the asana compared to the first suggestions.

PARIVRTTA JANU SIRSASANA

Revolved Head-to-Knee Pose

par-ee-vrt-tah JAH-new shear-SHAHS-anna
parivrtta = turning, rolling; *janu* = knee; *shiras* = to touch with the head





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Extended leg	Lower limbs: Flexed leg
Lateral flexion, rotation away from extended leg	Scapular abduction, upward rotation, and elevation; shoulder joint abduction; elbow extension; forearm supination	Hip flexion and abduction, knee extension, ankle dorsiflexion	Hip flexion, external rotation, and abduction; knee flexion; ankle plantar flexion; foot supination

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To rotate chest to side: Internal oblique (flexed-leg side); external oblique (extended-leg side) **To rotate head toward ceiling:** Rectus capitis posterior, obliquus capitis inferior, longus capitis and colli, splenius capitis (flexed-leg side); sternocleidomastoid, upper trapezius (extended-leg side)	**To modulate side bending into gravity:** Quadratus lumborum, latissimus dorsi, spinal muscles (flexed-leg side)

<table>
<tr><th colspan="4">Upper limbs</th></tr>
<tr><th colspan="2">CONCENTRIC CONTRACTION</th><th colspan="2">ECCENTRIC CONTRACTION</th></tr>
<tr><td colspan="2">To upwardly rotate, abduct, and elevate scapula:
Serratus anterior
To extend elbow:
Triceps brachii, anconeus</td><td colspan="2">To extend arm to overhead without falling into gravity:
Rotator cuff, teres major, latissimus dorsi</td></tr>
<tr><th colspan="4">Lower limbs</th></tr>
<tr><th colspan="2">Extended leg</th><th colspan="2">Flexed leg</th></tr>
<tr><th>CONCENTRIC CONTRACTION</th><th>LENGTHENING</th><th>CONCENTRIC CONTRACTION</th><th>LENGTHENING</th></tr>
<tr><td>To maintain knee extension:
Articularis genu, vastii
To adduct and internally rotate:
Pectineus, adductor longus and brevis</td><td>Hamstrings, gluteus medius and minimus (posterior fibers), gluteus maximus, piriformis, adductor magnus, soleus, gastrocnemius</td><td>To externally rotate hip:
Obturator internus and externus, quadratus femoris, piriformis, superior and inferior gemellus
To externally rotate and flex hip and knee:
Sartorius
To flex knee:
Hamstrings</td><td>Adductor magnus, longus, and brevis</td></tr>
</table>

Notes

Although your legs in this pose are the same as in janu sirsasana (page 185), the action in your spine is different. Instead of rotating toward your extended leg, the rotation is away from your leg, and instead of forward flexion in your spine, there is lateral flexion.

It can be a challenge in this asana to maintain lateral flexion without rolling forward toward your extended leg for a variety of reasons. The three dimensionality of the action in the vertebrae, the pull of gravity, habitual patterns in your spinal muscles, or a habit of pulling down your scapula can each contribute to rolling toward your leg during this side-bending action.

The action of your arms in this pose—lifting overhead and joining in the lateral flexion of your spine—requires a great deal of mobility in your shoulder girdle and can reveal restrictions in your shoulder joints and scapula that might not show up in other movements. All the muscles that are used to pull down the scapula must lengthen for your arms to be overhead and for your spine to laterally bend.

In this pose, when your sit bones stay on the floor, the action of side bending is focused on your spine. If the sit bone of your flexed leg is allowed to lift off the floor, the action of side bending moves farther into the hip joint of your extended leg and the lengthening of the back of that leg.

Breathing Inquiry

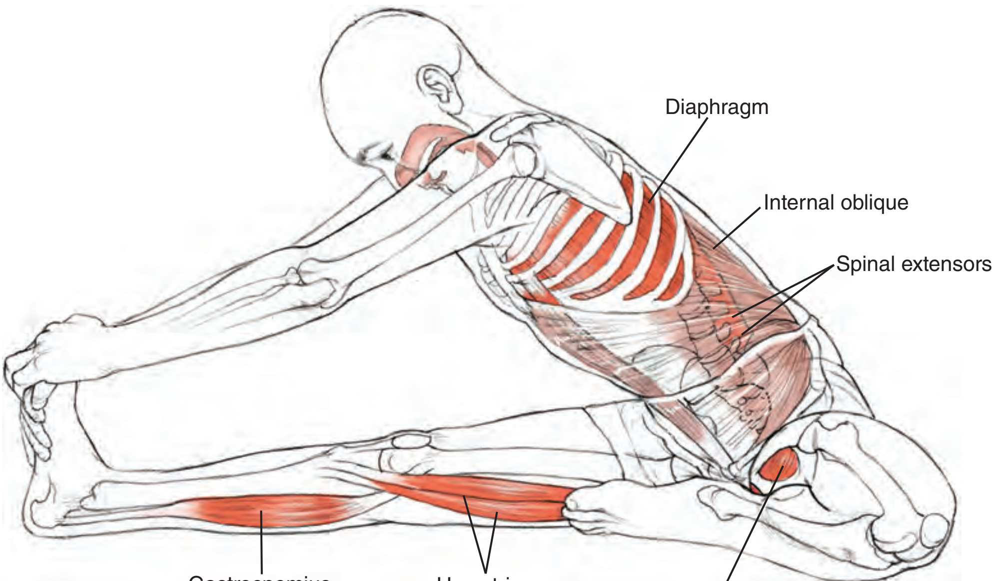
Structurally, the upper side of this pose is more expanded, and your rib cage is more open, but the lower dome of your diaphragm is more mobile, and your lower lung's tissue is more compliant. Where in this pose do you feel compressed, and where do you feel expanded? How can the shape changes of breathing expand what is compressed and condense what is opened?

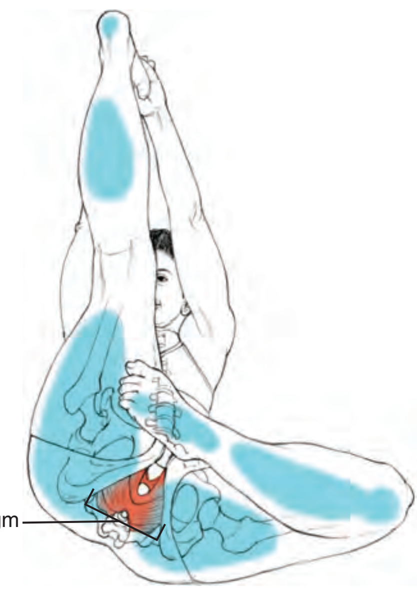
MAHAMUDRA

The Great Seal

ma-ha-MOO-dra

maha = great, mighty, strong; *mudra* = sealing, shutting, closing





Blue shaded areas show the base of support.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Extended leg	Lower limbs: Flexed leg
Axial extension, rotation of chest toward extended leg	Scapular abduction and upward rotation, shoulder joint flexion and adduction, elbow extension	SI joint nutation, hip flexion, knee extension, ankle dorsiflexion	SI joint nutation; hip flexion, external rotation, and abduction; knee flexion; ankle plantar flexion; foot supination

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To rotate chest to face leg and distribute axial extension: Internal oblique (extended-leg side); external oblique, rotatores, multifidi (flexed-leg side)	**To balance weight of head:** Posterior suboccipitals **To facilitate rotation and distribute axial extension through length of spine by lengthening eccentrically:** External oblique, rotatores, multifidi (extended-leg side); internal oblique (flexed-leg side)

Notes

The base of mahamudra is similar to janu sirsasana (page 185), which it resembles, and the actions in your arms and legs are the same. However, the main action of your spine in this pose is strong axial spinal extension rather than spinal flexion. One way of thinking about this position is that it combines a forward bend (flexion of your lumbar and cervical spine), a backward bend (extension of your thoracic spine), and a twist (rotation of your spine and your pelvis toward your extended leg).

Breathing Inquiry

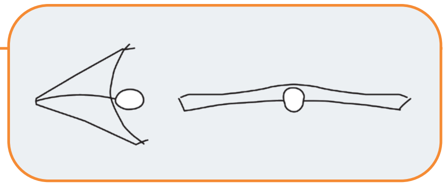
If you attempt to execute this pose by engaging all three bandhas, it is considered to be the ultimate test of your breath's resilience because the action created by mahamudra drives all the normal respiratory movements out of the periphery of your body's cavities. This occurs because engaging the bandhas in this position strongly stabilizes the action in your pelvic floor and abdominal muscles, immobilizes your costovertebral joints through holding your rib cage in a lifted position along with thoracic twisting, and lifts your sternum toward your chin. All in all, your body is forced to find another, unusual way to breathe.

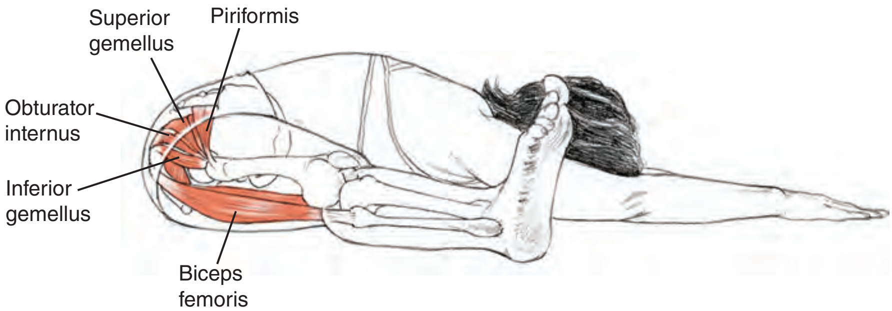
When all your usual, visible, external breath movements have been stabilized, can something deep in the core of your system mobilize through a new pathway? Perhaps that pathway is what is commonly referred to in yogic literature as *susumna*—the central channel.

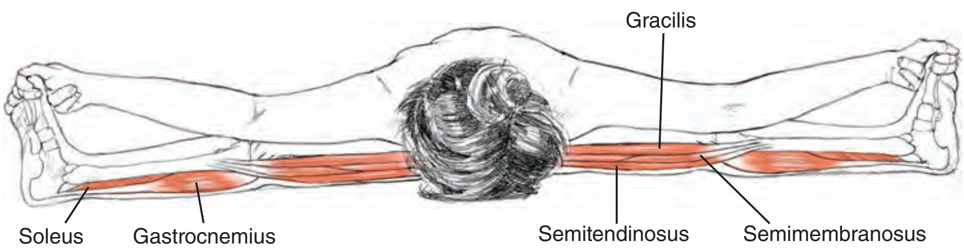
UPAVISTHA KONASANA

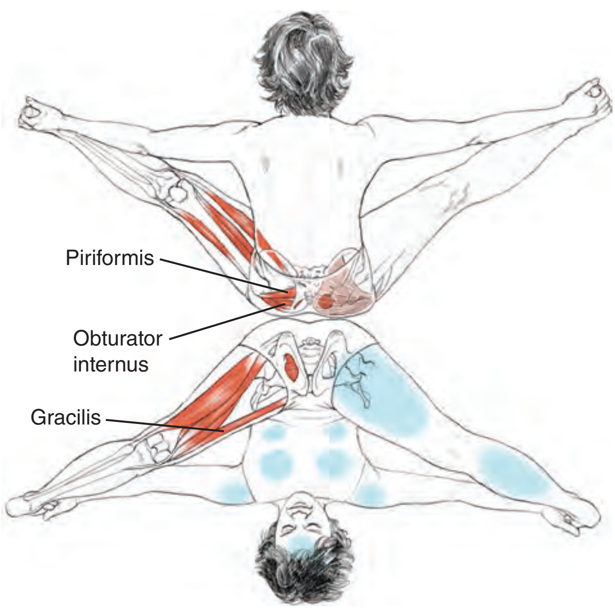
Seated Wide-Angle Pose

oo-pah-VEESH-tah cone-AHS-anna
upavistha = seated; *kona* = angle









SKELETAL JOINT ACTIONS

Spine	Lower limbs
Mild flexion moving toward axial extension	SI joint nutation, hip abduction and flexion, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine
ECCENTRIC CONTRACTION
To distribute flexion through length of spine: Spinal extensors

Lower limbs	
ECCENTRIC CONTRACTION	ALSO LENGTHENING
To abduct leg while folding forward in hip joint: Gluteus medius and minimus, piriformis, superior and inferior gemellus, obturator internus **To modulate forward bend:** Semitendinosus, semimembranosus (medial hamstrings)	Gracilis

Notes

In many forward-bending poses, including this one, coming forward might be accomplished with spinal flexion. As more movement happens in your hip joints, however, less flexion happens in your spine, and as the pose deepens, your spine flattens to the floor and moves toward axial extension. So the muscles of your spine might move through being lengthened and then actively engage to help "flatten your back."

If your sit bones release from the floor, the action is more in your hip joints and back of your legs. If your sit bones stay grounded, the action is more in your spine and potentially your SI joints as the top of your sacrum nods forward while leaving your iliac bones behind (nutation).

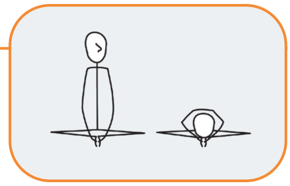
The starting position of your legs is sometimes described as external rotation, but if your feet point up to the ceiling, there is no external rotation in your hip joints. The action is abduction of your legs at your hip joint and then flexion with the movement forward of your spine.

If your legs roll inward with the forward movement of your spine, there could be a holding pattern in your outer hips that pulls your legs along with the forward bend. This might create pressure in your inner knees. Bending your knees or going less far forward might help distribute the action through your legs, pelvis, and spine.

Breathing Inquiry

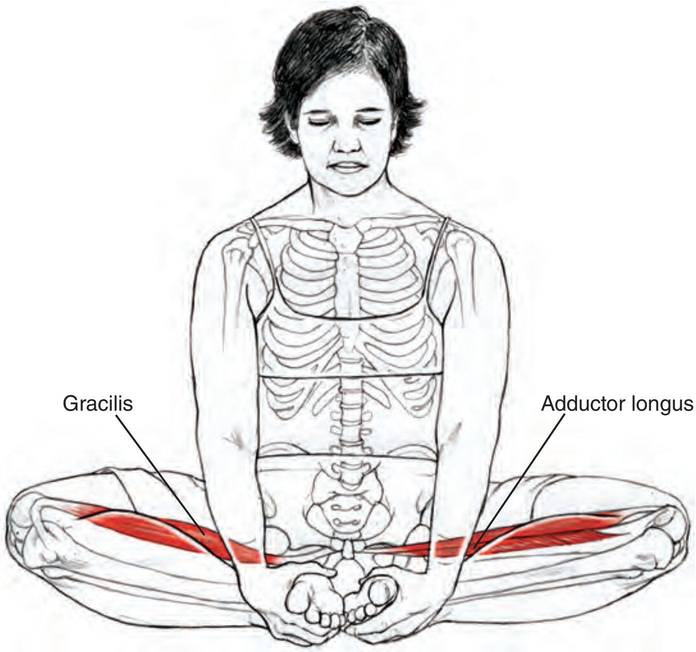
Can the act of gradually lengthening your spine in this pose be assisted by your breath? See whether your exhalation, if initiated in your lower abdomen, can help anchor your sit bones and ground the backs of your thighs. See whether your inhalation, if initiated in your upper chest, can help to lengthen your spine. In short, what do you experience when you think of your exhalation grounding your posture's lower half, and your inhalation lengthening your posture's upper half?

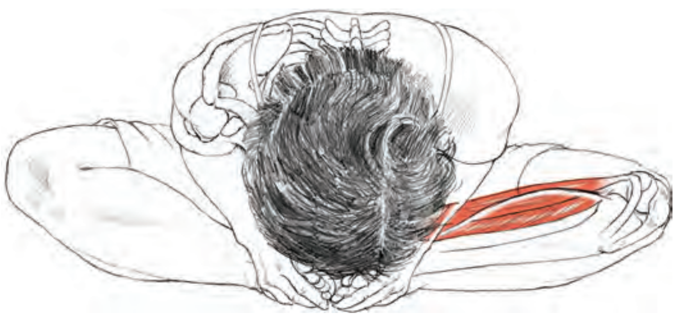
BADDHA KONASANA



Bound-Angle Pose

BAH-dah cone-AHS-anna
baddha = bound; *kona* = angle





SKELETAL JOINT ACTIONS

Spine	Lower limbs
Mild flexion moving toward axial extension	SI joint nutation; hip flexion, external rotation, and adduction; knee flexion; ankle dorsiflexion; foot supination

SELECTED MUSCULAR ACTIONS

Spine	
ECCENTRIC CONTRACTION	
To distribute flexion through length of spine: Spinal extensors	

Lower limbs	
ECCENTRIC CONTRACTION	**ALSO LENGTHENING**
To externally rotate hip: Obturator internus and externus, quadratus femoris, piriformis, superior and inferior gemellus	Adductor magnus, longus, and brevis; gracilis

Notes

As in paschimottanasana (page 182), if the intention is to get your head down to the floor, the action is more spinal (flexion) than pelvic (SI and hip joints). If the intention is to get your navel to your feet, the forward action will be more focused in your hips and pelvis, and your spine will move toward extension.

Depending on how close your feet are to your pelvis, different external rotators are activated to assist with rotating your legs out, and different adductors are lengthened. It can be valuable to work with your feet at different distances from your pelvis to experience the lengthening of different muscles.

Baddha konasana can be challenging for your knees. The supination of your feet (soles toward the ceiling) causes a rotation of your tibia that, combined with knee flexion, diminishes your knee ligaments' role in supporting the integrity of your knees. If your hips are not very mobile and your legs are pushed into this pose, the lower leg torque can travel too much into your knee joints. One way to protect them is to evert your feet (press the outer edges into the floor) to activate the muscles of your outer ankle, which, via fascial connections, can stabilize the lateral ligaments of your knees and help to keep them from twisting too much.

Cueing Callout: There's No Joint Action Called *Hip Opening*

Hip opening is not a joint action, although many asana (like baddha konasana) are called "hip openers." While the term *hip opening* is often used to describe a movement at the hip joint, it is not actually a specific joint action. Because the joint is three dimensional, when there's movement in the hip joint (or any joint), there is always a part that could be called opening and a part that could be called closing. For example, when the hip extends, the front of the joint could be said to be opening and the back of the joint closing. When the hip joint flexes, the front is closing and the back is opening. There's no opening movement in the hip joint that doesn't involve the other side closing unless you pull the bones directly away from each other, which would dislocate the joint!

(*continued*)

Baddha Konasana *(continued)*

Breathing Inquiry

How does your breath move when your intention is to bring your head to the floor with a more rounded spine? How does this compare to when the intention is to bring your navel toward your feet by holding your spine straighter and moving forward from your pelvis? Alternatively, where does the movement into the pose initiate when you focus your breath in the back of your lungs compared to centering your breath in your abdomen?

BADDHA KONASANA VARIATION

SUPTA BADDHA KONASANA

Reclining Bound-Angle Pose

supta = resting, lain down to sleep; *baddha* = bound; *kona* = angle

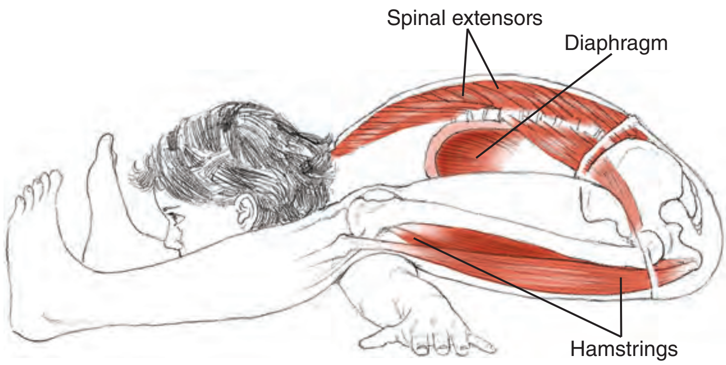
Notes

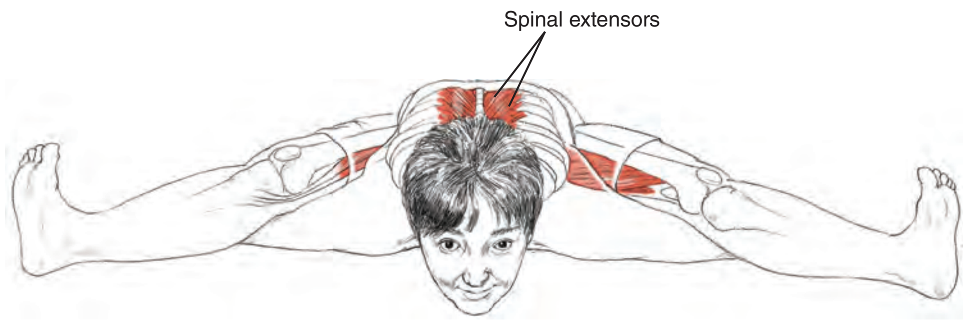
This potentially more restful variation of baddha konasana supports your spine in neutral alignment or very mild extension to gently open up the breathing. It is a commonly used restorative posture, and with the use of props such as bolsters, blankets, straps, and cushions, it can be modified in a variety of ways.

KURMASANA

Turtle Pose

koor-MAHS-anna
kurma = tortoise, turtle





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical extension, thoracic and lumbar flexion moving toward extension	Scapular downward rotation and abduction, shoulder joint abduction and internal rotation, elbow extension, forearm pronation	SI joint nutation, hip flexion and abduction, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend spine against resistance of position of leg and arm: Spinal extensors	**To resist hyperextending cervical spine:** Neck flexors

Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To internally rotate and protect shoulder joint: Rotator cuff (especially subscapularis) **To adduct scapula once arm is under leg:** Rhomboids, trapezius **To press arm against leg:** Posterior deltoid	**To resist hyperextension in elbow:** Biceps brachii

Lower limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend knee over arm: Articularis genu, vastii **To adduct and internally rotate leg:** Pectineus, adductor longus and brevis	**To press leg into arm while modulating forward bend:** Gluteus medius and minimus, piriformis, superior and inferior gemellus, obturator internus, hamstrings

Notes

To prepare for this pose, your spine flexes, your scapulae abduct, your hips flex and abduct, and your knees flex. Once your arms are in position under your legs, the actions that deepen the pose are the reverse of the preparatory ones: spinal extension, scapular adduction, hip extension and adduction, and knee extension. This opposition of actions in your spine and scapulae means that muscles in your back are asked to contract from a very lengthened position, one of the more challenging positions from which to concentrically contract a muscle.

Because your arms are bound under your legs, the action can potentially be forced into vulnerable spots. Your spine could overflex in the lumbar or thoracic regions, or the backs of your legs could overmobilize at their attachment on your sit bones.

Breathing Inquiry

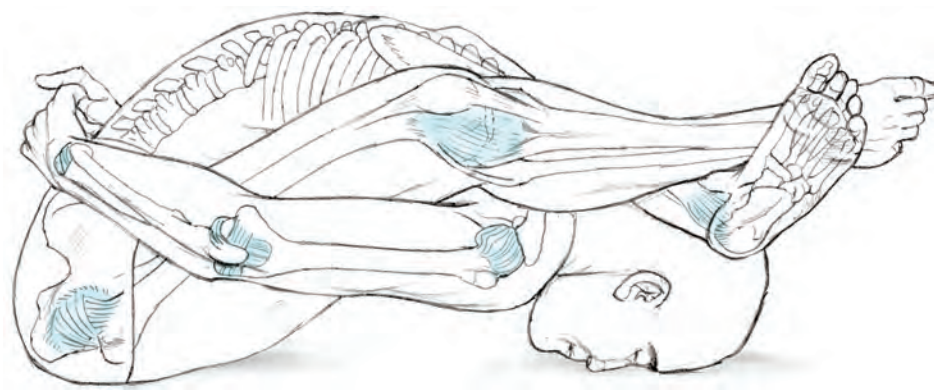
Your diaphragm can receive considerable compression when entering into this position. If you notice that, what can help reestablish the breathing spaces in your abdominal and thoracic cavities? How does your breathing affect how you position your spine?

KURMASANA VARIATION

SUPTA KURMASANA

Reclining Turtle Pose

supta = reclining; *kurma* = tortoise, turtle



Joint capsules are shaded in blue.

Notes

This pose can be intense or of great ease. With your arms and legs bound, little work is needed to maintain the position if enough range of motion exists in all the joints of your body to enter the pose. If the action is not distributed through all your joints, this pose has the potential for directing too much force into your spine, your SI joints, and, with the arms bound in this position, the fronts of your shoulder joints. (Your rotator cuff is working to both internally rotate your humerus and protect your joint from protraction.) The more freedom there is in your scapulae gliding on your rib cage, the less force is directed into your glenohumeral joints and their capsules.

The bound position of your legs behind your skull and cervical spine creates potential stress in this area, too, possibly overstretching the back of your neck or overworking your cervical muscles against the push of your legs. If there isn't enough mobility in the rest of your spine, your cervical spine might have to overflex to be able to position your legs behind your head, and your legs might then pull forward on your head in a way that is hard on your neck.

Breathing Inquiry

Once locked into this bound pose, do your abdominal muscles have much to do? Maybe they can be released for belly breaths. This might be a good choice because excessive thoracic action during loaded trunk flexion may stress an already flexed upper spine.

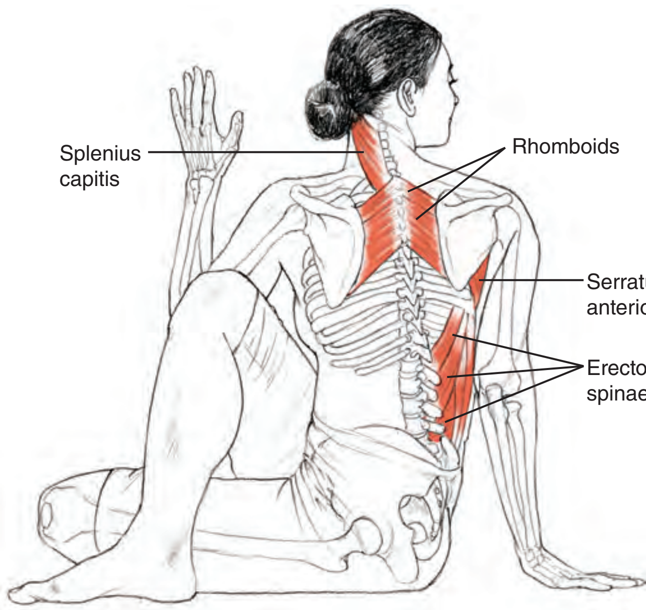
ARDHA MATSYENDRASANA

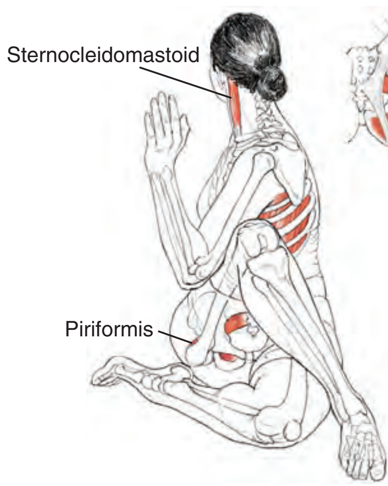
Half Lord of the Fishes Pose

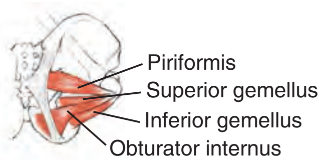
ARD-hah MOTS-yen-DRAHS-anna

ardha = half; *matsya* = fish; *indra* = ruler, lord

Sage Matsyendra was a renowned teacher of yoga who, according to legend, developed this pose.







(*continued*)

Ardha Matsyendrasana *(continued)*

SKELETAL JOINT ACTIONS

Spine	Upper limbs: Front arm (contralateral to top leg)	Upper limbs: Back arm	Lower limbs: Top leg	Lower limbs: Bottom leg
Rotation toward top leg	Shoulder joint abduction, elbow flexion	Shoulder joint extension, elbow extension, wrist dorsiflexion	Hip flexion and adduction, knee flexion, foot on floor	Hip flexion, external rotation, and adduction; knee flexion; ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION	LENGTHENING
To maintain extension against pressure of arm: Spinal extensors **To rotate spine toward leg:** Internal oblique, erector spinae, splenius capitis (top-leg side); external oblique, rotatores, multifidi (bottom-leg side) **To turn head:** Sternocleidomastoid (bottom-leg side)	External oblique, rotatores, multifidi, sternocleidomastoid (top-leg side); internal oblique, erector spinae, splenius capitis, latissimus dorsi (bottom-leg side)

Upper limbs

Front arm (contralateral to top leg): CONCENTRIC CONTRACTION	Back arm: CONCENTRIC CONTRACTION
To stabilize humeral head: Rotator cuff **To maintain placement of scapula on rib cage and resist abduction of this scapula:** Rhomboids **To extend arm against leg:** Posterior deltoid **To flex elbow:** Biceps brachii	**To stabilize humeral head:** Rotator cuff **To maintain placement of scapula on rib cage and resist adduction of this scapula:** Serratus anterior **To extend shoulder joint and elbow:** Triceps brachii

Lower limbs

Top leg: CONCENTRIC CONTRACTION	Top leg: LENGTHENING	Bottom leg: CONCENTRIC CONTRACTION	Bottom leg: LENGTHENING
To flex and adduct leg: Adductor longus and brevis, pectineus	Piriformis; superior and inferior gemellus; obturator internus and externus; quadratus femoris; gluteus maximus, medius, and minimus	**To externally rotate hip:** Obturator internus and externus, quadratus femoris, piriformis, superior and inferior gemellus **To externally rotate and flex hip and knee:** Sartorius **To flex knee:** Hamstrings **To flex and adduct leg:** Adductor longus and brevis	Gluteus medius and minimus

Notes

Rotation is most functionally distributed throughout your spine when it is in neutral extension (all four curves are present). In this asana, beginning from a neutral spine might be one of the greatest challenges because the actions in your legs might pull your pelvis into a posterior tilt and your lumbar spine into flexion. When your lower spine is pulled into flexion by your pelvis, your thoracic spine might be flattened into extension in an effort to sit up vertically. This can disrupt the distribution of rotation through your spine because flexion in your lumbar spine can allow overmobilizing in rotation, while extension in your thoracic spine inhibits rotation there. Muscularly, all parts of your torso contribute to this twist—both right and left sides of your front and both right and left sides of your back, at different layers of muscle.

The twisting action of this pose can happen mostly in your shoulder girdle, rather than your spine, by emphasizing the movement of your scapulae and allowing them to adduct (the back one) and abduct (the front one). To emphasize spinal action, try rotating without using your arms; after finding what's possible in your spine, the leverage of your arms can come in later. (Overuse of your arms can direct too much force into vulnerable parts of your spine, particularly T11 and T12 for some people.) Another factor that contributes to the intensity of the spinal twisting action of this pose is the arrangement of your legs, which greatly limits rotational movements in your pelvis and, in fact, counterrotates your pelvis away from the rotation of your spine.

Breathing Inquiry

Ardha matsyendrasana provides an opportunity to explore the basic dynamics of your breath as they relate to the principles of brhmana and langhana, prana and apana, and sthira and sukha.

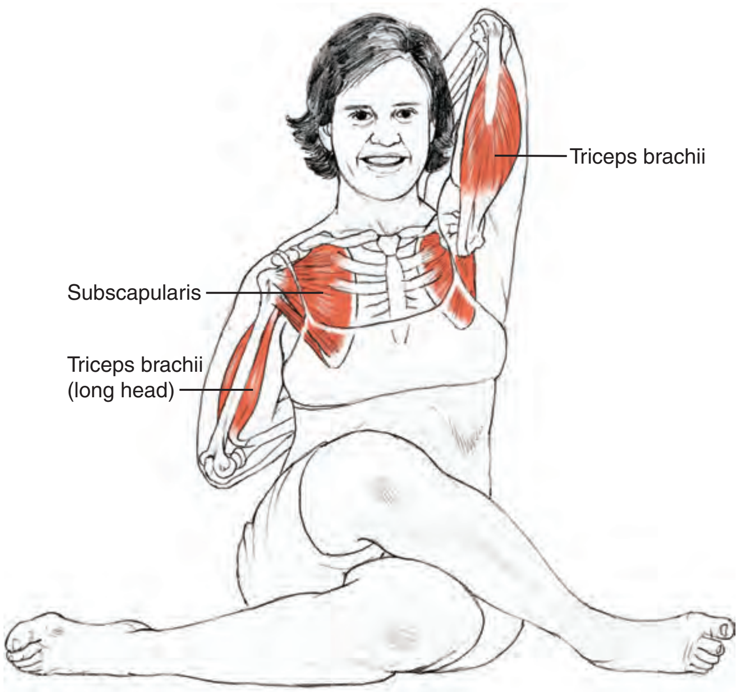
Your lower body is the stable base of this pose, and a langhana (belly breathing) pattern can help to release tension in your lower abdomen, hip joints, and pelvic floor. Does this approach to breathing coincide with your experience of apana flowing downward in your system, into the earth?

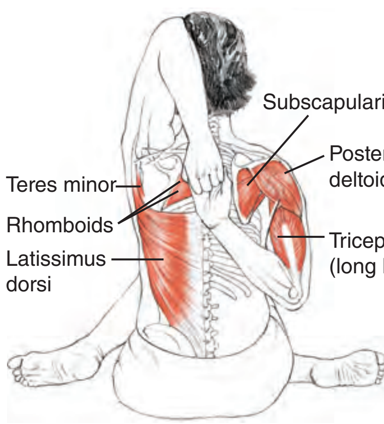
Your upper body is the mobile, supported aspect of the pose, and a brhmana (chest breath) can be accomplished here by simply stabilizing your abdominal wall on the initiation of your inhalation. This can shift your diaphragm's action into your rib cage and costovertebral articulations. Does this intensify a deeper rotational release in your thoracic spine? Does using your lower abdominal muscles to drive your exhalation upward and outward from your body seem related to the upward movement of apana or the downward grounding of your pelvis?

GOMUKHASANA

Cow-Faced Pose

go-moo-KAHS-anna
go = cow; *mukha* = face





SKELETAL JOINT ACTIONS

	Upper limbs		
Spine	Top arm	Bottom arm	Lower limbs
Neutral spine with slight extension in thoracic spine	Scapular upward rotation, elevation, and adduction; shoulder joint external rotation and flexion; elbow flexion; forearm supination	Scapular downward rotation, adduction, and depression; shoulder joint internal rotation and extension; elbow flexion; forearm pronation	Hip flexion, external rotation, and adduction; knee flexion

SELECTED MUSCULAR ACTIONS

Spine			
To calibrate concentric and eccentric contractions and to maintain neutral alignment of spine: Spinal extensors and flexors			
Upper limbs			
Top arm		**Bottom arm**	
CONCENTRIC CONTRACTION	**LENGTHENING**	**CONCENTRIC CONTRACTION**	**LENGTHENING**
To upwardly rotate scapula: Serratus anterior **To adduct scapula:** Rhomboids **To externally rotate shoulder joint:** Infraspinatus, teres minor **To flex arm overhead:** Anterior deltoid **To pronate forearm:** Pronator teres	Triceps brachii, latissimus dorsi, teres major, pectoralis minor	**To downwardly rotate and adduct scapula:** Lower trapezius, rhomboids **To internally rotate shoulder joint:** Subscapularis **To internally rotate and extend shoulder joint:** Teres major, latissimus dorsi **To extend arm:** Triceps brachii (long head), posterior deltoid **To flex elbow:** Biceps brachii **To supinate forearm:** Supinators	Biceps brachii (long head), pectoralis major, serratus anterior, upper trapezius
Lower limbs			
CONCENTRIC CONTRACTION		**LENGTHENING**	
To externally rotate hip: Obturator internus and externus, quadratus femoris, piriformis, superior and inferior gemellus **To externally rotate and flex hip and knee:** Sartorius **To flex knee:** Hamstrings **To flex and adduct leg:** Adductor longus and brevis		Gluteus medius and minimus	

(continued)

Notes

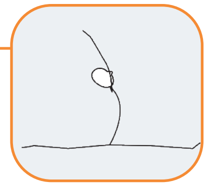
Making sure that your scapula can move freely in this pose can keep your arm position from putting too much pressure on your shoulder joint itself. One way to do this is to focus on the upward and downward rotation of your scapula before pulling them together in the back (adduction). If you have a pattern of "pulling your shoulders down your back," adducting your scapula (drawing them toward your spine) might inhibit the upward or downward rotation needed. If this rotation of your scapula doesn't happen, there can be too much movement in your glenohumeral joint, causing damage to your joint capsule or impingements in your muscle tendons.

If your hip joints are not sufficiently mobile, excessive torque can be transmitted to your knee joints for the same reasons as in janu sirsasana (see page 185).

Breathing Inquiry

Releasing your abdominal wall and directing your breath into your lower abdomen may help your pelvic floor and hip joints release. Try restraining your lower abdomen during the first part of your inhalation and see whether that directs your breath into your thoracic region. What effect does that have on what you are experiencing in your shoulder structures?

HANUMANASANA

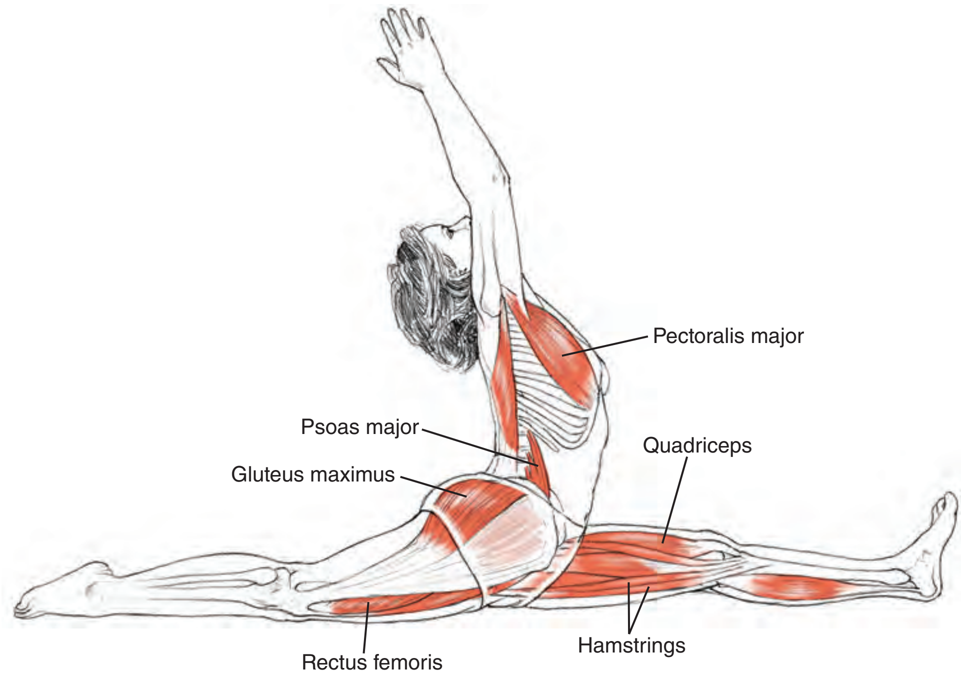


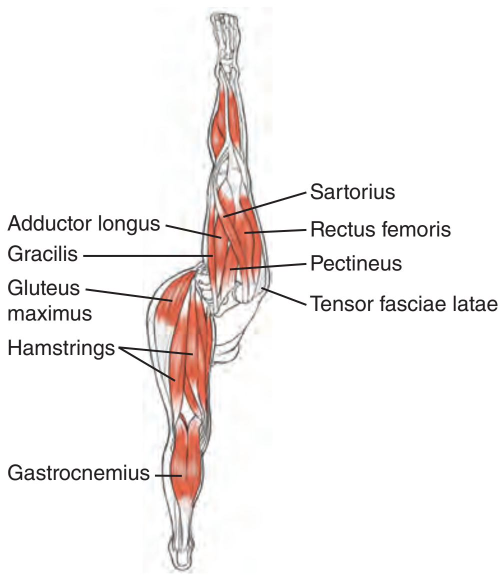
Monkey Pose

ha-new-mahn-AHS-anna

hanumat = having large jaws; a monkey chief

Hanuman was the semidivine chief of an army of monkeys who served the god Rama. As told in the Hindu epic *Ramayana* through the oral tradition, Hanuman once jumped in a single stride the distance between Southern India and (Sri) Lanka. This split-leg pose mimics his famous leap.





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Hanumanasana *(continued)*

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Front leg	Lower limbs: Back leg
Extension	Scapular upward rotation, abduction, and elevation; shoulder joint flexion and adduction; elbow extension	SI joint nutation; hip flexion, internal rotation, and adduction; knee extension; ankle dorsiflexion	SI joint counternutation; hip extension, internal rotation, and adduction; knee extension; ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To extend spine: Spinal extensors	**To allow spinal extension (back bending) without falling into gravity:** Psoas minor, abdominal muscles, longus colli, verticalis, suprahyoid and infrahyoid muscles

Upper limbs

CONCENTRIC CONTRACTION	LENGTHENING
To abduct, upwardly rotate, and elevate scapula: Serratus anterior, upper trapezius **To stabilize, flex, and adduct shoulder joint:** Rotator cuff, coracobrachialis, pectoralis major (upper fibers), anterior deltoid, biceps brachii (short head)	Rhomboids, latissimus dorsi, pectoralis major (lower fibers), pectoralis minor

Lower limbs

Front leg: CONCENTRIC CONTRACTION	Front leg: ECCENTRIC CONTRACTION	Back leg: ECCENTRIC CONTRACTION
To maintain knee extension: Articularis genu, vastii **To adduct and internally rotate:** Pectineus, adductor longus and brevis	**To resist overarticulating in front hip joint and to maintain internal rotation and adduction:** Hamstrings, gluteus medius and minimus (posterior fibers), gluteus maximus, piriformis, adductor magnus, soleus, gastrocnemius	**To resist overextension of hip while maintaining adduction and internal rotation:** Psoas major, iliacus, rectus femoris, sartorius, pectineus, adductor longus and brevis, gracilis, tensor fasciae latae

Notes

In this extreme pose, the forward-bending action in your front leg and pelvic half is countered by the backward-bending action in your back leg and pelvic half. Your spine can then be challenged to seek balance between those two opposing actions.

In a symmetrical forward bend such as paschimottanasana (page 182), part of the action of forward bending comes from your spine as well as your lower limbs. Similarly, in a back bend such as urdhva dhanurasana (page 298), the backward-bending action comes from your lower limbs and spine together. In hanumanasana, however, the fact that your two legs and pelvic halves are performing opposite actions means that the forward-bending and backward-bending actions are directed almost totally into your legs and SI joints, making both aspects more intense.

Because there is generally more range of motion for your hip joint in flexion than in extension, the movement of your back leg usually has a greater effect on your spine in this pose, and extending your spine (rather than flexing it over the front leg) is generally more effortful. Because the action in each leg is limited by your opposite leg, this is a kind of bound pose; forces aren't dispersed into space so much as directed into potentially vulnerable areas.

The presence of gravity means that it isn't necessary to concentrically contract any muscles to pull your body into this position. Instead, the weight of your body itself deepens the action. To do the pose in a way that distributes forces away from vulnerable areas, though, we can't simply release into gravity.

If hanumanasana is done actively, with attention to the eccentric actions of the lengthening muscles, the mobilization of the pose can be distributed over several joints; a little movement in a lot of places can safely distribute the force. This requires awareness of your own tendencies toward places you hold or let go so that you can stabilize the very mobile spots and mobilize the fixed areas.

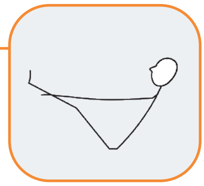
A final note about having your legs in neutral rotation: While the position of your legs is neutral in terms of internal and external rotation, actively internally rotating is needed to maintain this neutral position, especially in your back leg. (As noted previously, a neutral position in your joint is not always the position with the least muscular effort, depending on the actions of gravity and the other limbs. Maintaining a neutral position can often be a vigorous action muscularly.)

In this pose, letting your back leg externally rotate can make it easier to get closer to the floor. Letting your back leg roll out, however, can put twisting pressure into your lumbar spine and the SI joint of your back leg and into your back knee. It also puts more pressure into the adductors of your back leg, and as a result, your inner leg can be both overworked and over-lengthened, while the front of your thigh doesn't get as much lengthening as it could. It takes a different kind of discipline to resist the impulse to go as low as possible and to use props (blocks and blankets) as necessary to maintain the integrity of your pose.

Breathing Inquiry

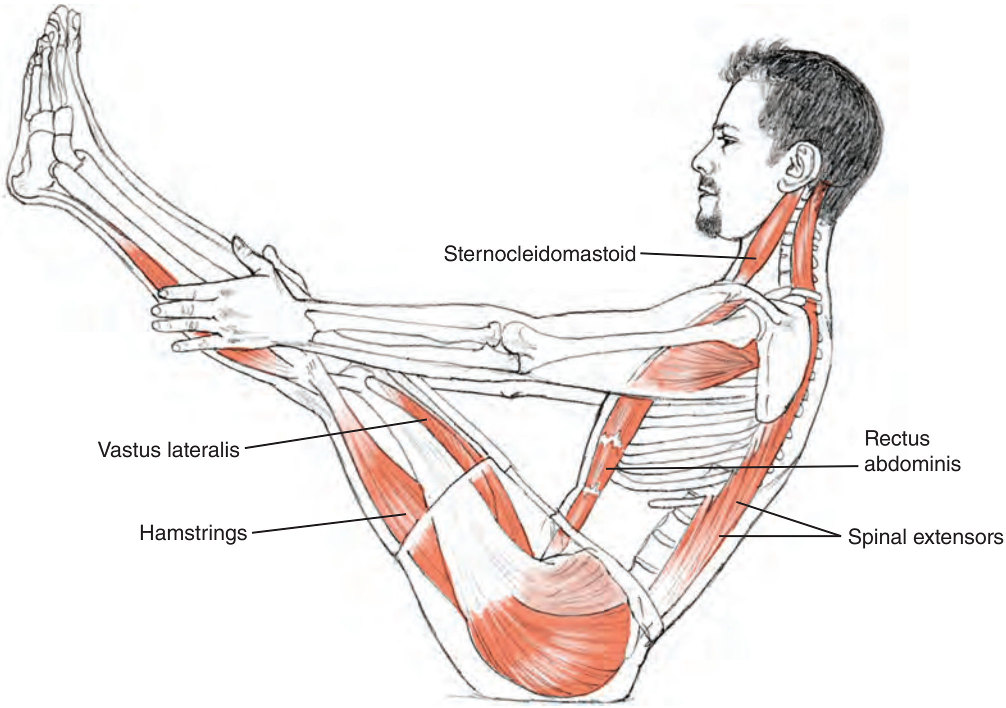
An interesting perspective is that you will know you're doing this pose more effectively when you can breathe more freely. Until all the flexion, extension, and rotational forces have been balanced and your spine can extend easily, your breathing is more likely to be labored and rough. Try experimenting with the use of props so you can work in a gradual way that doesn't excessively disturb the rhythm of your breath.

NAVASANA



Boat Pose

nah-VAHS-anna
nava = boat



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Neutral spine	Shoulder joint flexion	Hip flexion and adduction, knee extension

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To maintain neutral curves of spine: Spinal extensors	**To maintain neutral spine against pull of gravity and resist hyperextension of lumbar spine:** Psoas major (upper fibers), abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	
To hold scapula on rib cage: Serratus anterior, rhomboids **To flex shoulder joint:** Coracobrachialis, anterior deltoid	**To extend elbow:** Triceps brachii, anconeus

Lower limbs	
CONCENTRIC CONTRACTION	
To flex hip: Psoas major, iliacus, rectus femoris **To maintain knee extension:** Articularis genu, vastii	**To adduct and internally rotate:** Pectineus, gracilis, adductor longus and brevis

Notes

In this pose, the challenge is not the position itself so much as its relationship to gravity. If it were rotated 45 degrees, it would be the work of sitting vertically in dandasana (which can certainly present its own challenges; see page 180).

Ideally, your weight in this pose is distributed between your sit bones and your tailbone. All your weight should not fall on your sacrum. If dandasana is a challenge because of shortness in the backs of your legs, that same shortness will makes it a challenge to support navasana with your legs straight. In this case, bending your knees so that your spine can remain neutral is a good option.

This asana is often said to work the abdominal muscles. Although this is true, your abdominal muscles do not pull your body into this pose—rather, they are helping your upper body resist gravity so it does not fall back. The action that holds your body in this position is hip flexion.

Just as bending your knees makes this pose easier by shortening the length of the lower lever arm, extending your arms overhead makes it more difficult by lengthening your upper lever arm.

Navasana variation.

Breathing Inquiry

Maintaining stability and balance in this pose can make your breath feel restrained and focused. Notice where your breath is (and is not) able to move while in this pose. As an experiment, attempt to do navasana while taking deep belly breaths. Does that affect your ability to maintain this shape?

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10

KNEELING POSES

When kneeling, your body's weight is on your knees, shins, and tops of your feet. Kneeling brings the center of gravity closer to the ground than standing, but farther from the ground than sitting with your sit bones directly on the floor. Developmentally, kneeling (both kneel-sitting and kneel-standing) is an important transitional place for babies learning to move from sitting to standing.

Historically, this position is associated with lowering oneself in the sense of meekness or worship. This probably evolved from the fact that when kneeling, a person is more vulnerable than when standing, especially if their head is bowed.

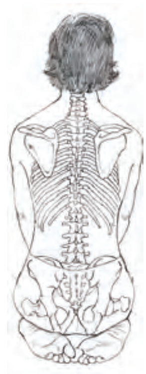
Kneeling can also be a posture of relaxed alertness that is associated with strength and readiness, as seen in vajrasana and virasana (page 214). In martial arts, kneeling is used as a waiting position that is easier than cross-legged sitting for quickly getting from the floor to standing, and in the practice of aikido they also train to do throws from kneeling.

In asana, kneeling poses are often used to help mobilize the hip joints. When the mobility of the feet and lower legs is removed from your base of support, attention can be focused on the actions in the hip joints, pelvic halves, and pelvic floor. Kneeling also provides a stable and symmetrical base from which your center of gravity can be raised so the spine can fully extend, beautifully expressed in poses such as ustrasana (page 220) and eka pada rajakapotasana (page 223).

VAJRASANA

Thunderbolt Posture

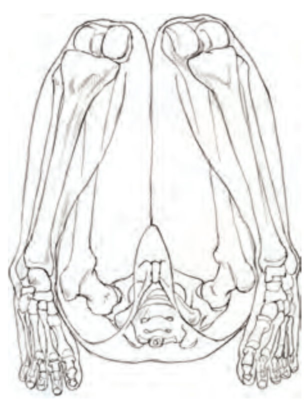
vahj-RAHS-anna
vajra = thunderbolt, diamond



VIRASANA

Hero's Posture

veer-AHS-anna
vira = man, hero, chief



COMMON SKELETAL JOINT ACTIONS (FOR TWO PREVIOUS POSES)

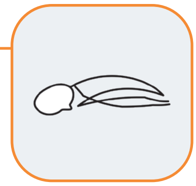
Spine	Lower limbs
Neutral or axial extension	Hip flexion, internal rotation, and adduction; knee flexion; ankle plantar flexion

Notes

As in sitting poses such as sukhasana (page 176), siddhasana (page 176), and padmasana (page 177), the goal is steadiness and ease, or sthira and sukha, the fundamental qualities of all asana as described by Patañjali in the *Yoga Sutras*. The symmetry of kneeling poses, in which neither leg is crossed in front of the other, offers fewer distractions than when your legs are crossed, which creates an asymmetrical action in your pelvis and hips that can also be felt in your spine. Virasana and vajrasana are also excellent poses for supporting your spine and skull in a way that allows the senses to turn inward for pranayama and meditation (like the sitting poses beginning on page 175).

For some people, these kneeling positions are easier on their hips and knees than sitting cross-legged because their hip joints do not need to externally rotate or abduct as they do in siddhasana or sukhasana. For others, the pressure on their knees, shins, and feet makes kneeling poses much more challenging than sitting cross-legged.

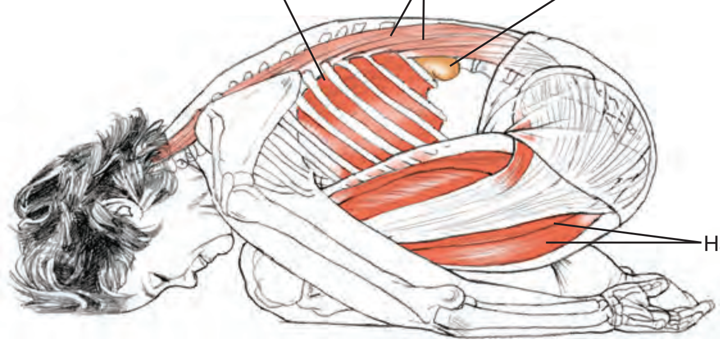
BALASANA



Child’s Pose

bah-LAHS-anna

bala = young, childish, not fully grown or developed



SKELETAL JOINT ACTIONS

Spine	Lower limbs
Flexion	Sacroiliac (SI) joint nutation, hip flexion and adduction, knee flexion, ankle plantar flexion

Notes

Gravity can draw your body deeper into this position and reveal places of habitual holding.

One possible goal of this pose is to bring your sit bones to your heels and your forehead to the floor. To do so, many muscles have to lengthen: the back of your torso and buttocks, the front of your thighs and shins, and the tops of your feet.

Variations include widening your knees (which can create more neutral extension in your spine and make room for your belly and chest), extending your arms overhead, clasping your heels with the hands, crossing your arms under your forehead, and turning your head to one side.

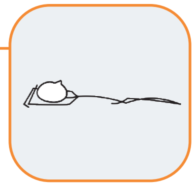
Sometimes there is a sensation of congestion in the fronts of the hip joints. This sensation can be caused by a habit of using your anterior hip muscles to pull your body down toward your thighs rather than allowing gravity to create that action. (The feeling of congestion can also come from a lack of myofascial differentiation in your hip flexors.)

If the extensors of your toes are habitually held (so that your toes are always lifted) or if there is a lack of mobility in the bones of your feet, restriction can also be felt in the tops of the feet. In addition, underuse in the intrinsic muscles of the feet might underlie the cramping that happens in this and similar positions such as virasana and vajrasana (page 214).

Breathing Inquiry

Although this asana is often used as a resting or release pose, its effects are not universally calming. With your hips fully flexed and adducted and the front of your torso resting on the anterior surfaces of your thighs, can you tune in to the quality of your breath in your abdomen? Is breath movement available in the back of your waist and rib cage? Do you gain a sense of security from your ability to remain vigilant about your surroundings? Notice whether this pose provokes a sense of anxiety because it limits your range of vision. Does repositioning your arms increase or decrease your ability to breathe in this position?

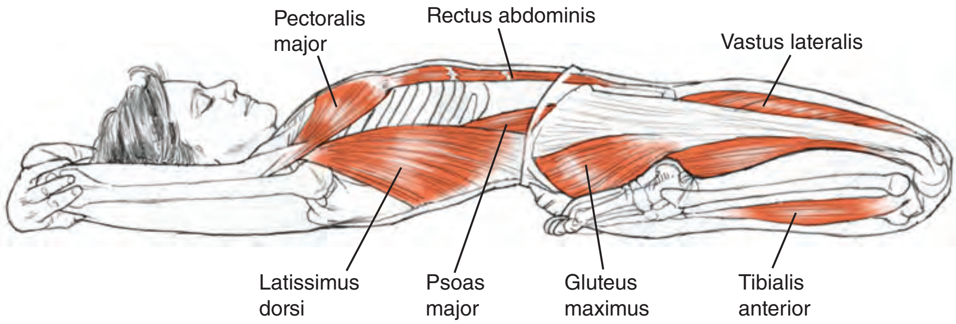
SUPTA VIRASANA

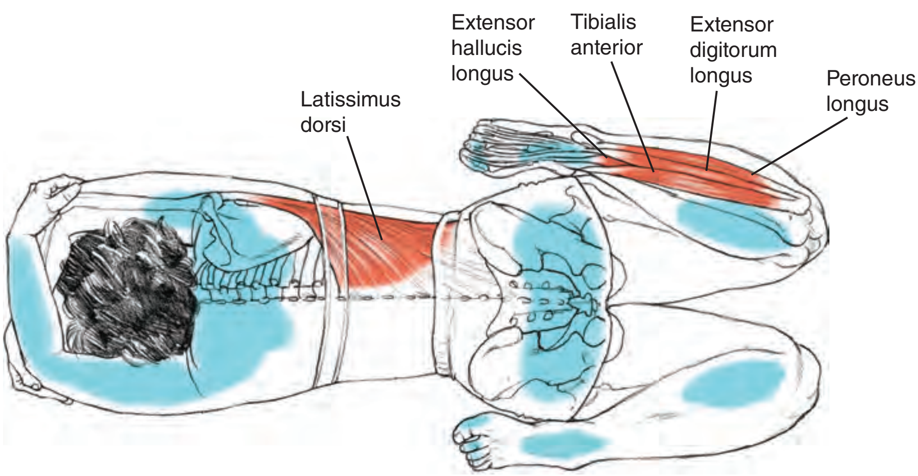


Reclining Hero Pose

soup-tah veer-AHS-anna

supta = reclining, lain down to sleep; *vira* = a brave or eminent man, hero, chief





SKELETAL JOINT ACTIONS

Spine	Lower limbs
Axial extension	SI joint counternutation; hip extension, internal rotation, and adduction; knee flexion and medial rotation; ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**LENGTHENING**
To prevent overmobilization of lumbar spine: Psoas minor, abdominal muscles	Psoas major
Lower limbs	
CONCENTRIC CONTRACTION	**LENGTHENING**
To keep knees together: Gracilis, adductor magnus	Psoas major, rectus femoris, vastii, sartorius, tibialis anterior, extensor digitorum longus, extensor hallucis longus

Notes

Many variations exist for the arm position in this pose—at your sides, reaching overhead, or propped up on your elbows. (If your superficial back muscles are not able to lengthen, reaching your arms overhead can cause hyperextension of your spine because of the muscles between your scapula and your spine.)

Those of us who regularly sit in chairs often have a habit of holding in our hips, which then limits hip extension. Hip extension with your legs internally rotated is generally more challenging than hip extension with your legs externally rotated. In supta virasana, the internal rotation of your hips is bound into place by the weight of your body, so the backward movement that is meant to happen in your hips might show up as spinal extension (a back bend) rather than hip extension.

If this pose is somehow forced to the floor and your hip flexors aren't able to lengthen, force can be transmitted into your lower back or into your knees. Instead of focusing on getting to the floor, what happens if you focus on supporting the pose in a way that allows for maximum hip extension in order to more evenly distribute the forces in your body? Keeping the feet active to avoid supination is also helpful for supporting the integrity of your knee joints.

This pose helps some people alleviate sciatic and low back pain if done gradually and with attention to the internal rotation and extension in their hips. However, the pose can exacerbate low back pain in some people.

Breathing Inquiry

In this position, notice whether the potential for tautness in your psoas major and abdominal wall creates posterior or anterior pressure in your abdominal cavity. Notice whether this effect can be magnified or lessened depending on how you use your abdominal muscles to manage your lumbar curve. Can your breath adapt to this pose by releasing into the back of your rib cage or the base of your pelvis? Does focusing on breath movement in your pelvis assist in releasing tension in your hips and gluteal region?

USTRASANA

Camel Pose

oosh-TRAHS-anna
ustra = camel

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular adduction and downward rotation, shoulder joint extension and adduction, elbow extension	SI joint counternutation, hip extension and adduction, knee flexion, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION	ALSO LENGTHENING
To extend spine (although most action of extension is caused by gravity): Spinal extensors	**To prevent overmobilization of lumbar spine:** Psoas minor, abdominal muscles **To resist hyperextension in cervical spine as head extends:** Anterior neck muscles	Psoas major

Upper limbs

CONCENTRIC CONTRACTION		LENGTHENING
To adduct, elevate, and downwardly rotate scapula: Rhomboids, levator scapulae **To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff	**To extend and adduct shoulder joint:** Triceps brachii (long head), teres major, posterior deltoid **To extend elbow:** Triceps brachii	Pectoralis major and minor, biceps brachii, coracobrachialis

Lower limbs

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To extend, adduct, and internally rotate hip: Hamstrings, adductor magnus, gluteus maximus	**To resist hip extension and knee flexion:** Rectus femoris **To resist knee flexion:** Articularis genu, vastii

Notes

In theory, gravity pulls your torso into this back bend, while what stops the backward movement is your arms and the eccentric action of the spinal flexors on the front of your body. One of the potential challenges of this asana is distributing the movement of extension throughout your spine: The cervical and lumbar portions of your spine generally extend more easily than the thoracic portion of your spine. Learning where in your own spine to seek less extension and where to seek more extension is part of the process.

It can be challenging to find a supportive extension of your spine at the base of your neck or the top of your thoracic spine, especially negotiating the weight of your head moving backward, which for many of us is disorienting, if not frightening. In your cervical spine, the anterior neck muscles support your head with eccentric activity, and in your lumbar spine the muscles of the front of your abdomen are also eccentrically active. Gradually learning how to find a sense of both activity and lengthening in the front of your neck, chest, and abdomen might help this asana be more accessible.

If your legs externally rotate (as in knees apart and feet together), your SI joints might be more free to move. For some people, this will increase the depth of their back bend, and for some people it will bring too much movement to their SI joint. (Maintaining internal rotation of your legs will help stabilize your SI joint by encouraging the front of your SI joint to be more congruent, and it will emphasize hip extension rather than movement at your sacrum.)

Ustrasana, like other deep back bends, can be an intense movement for your digestive system, especially the esophagus, so a practitioner with a hiatal hernia should approach with caution.

Cueing Callout: Are Back Bends "Heart Openers"?

Ustrasana and other back bends are often characterized as "heart-opening poses." Because our heart (like all our organs) is a three-dimensional structure, any spinal movement might open one side of our heart and close the other side. For example, while spinal extension might expand the front of our heart, it would condense the back; spinal flexion, on the other hand, would condense the front and expand the back of our heart. (And lateral flexion would expand one side of our heart or the other.)

The fact that the major blood vessels that flow to and from our heart are on its posterior surface might raise questions about the value of back bends as *heart opening*, and might also lead us to question whether physically expanding the heart is of value at all (whatever we might intend metaphorically).

Breathing Inquiry

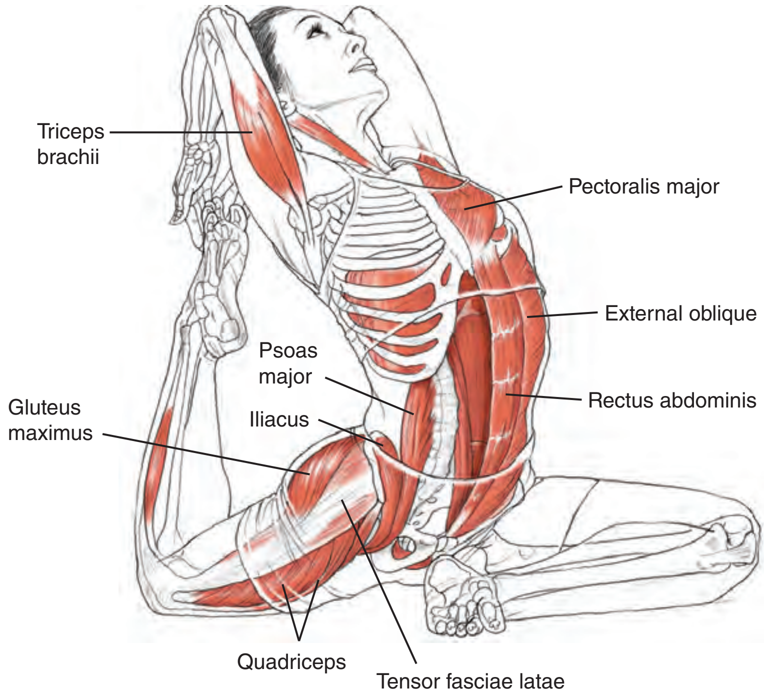
In ustrasana, can you tune in to what you're sensing in your abdominal wall, which is lengthened in this position? Because the front of your thoracic structures are maintained in an inhaled position, see whether you find it challenging to breathe even more deeply into those areas while in ustrasana. Where else can your breath move? Perhaps quiet, efficient breathing rather than full breathing is a possibility. It is interesting to notice the relationship between the deepest layer of anterior neck muscles and the smaller, yet significant, breath movement in the apex of your lungs, which are in relationship with your two upper ribs and your inner scalene muscles. Remember, there is also lung in your armpits.

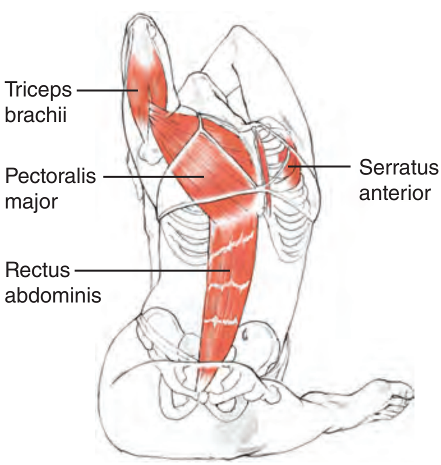
EKA PADA RAJAKAPOTASANA

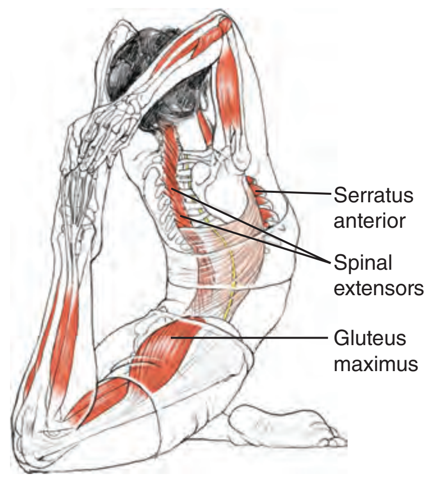
One-Legged Royal Pigeon Pose

eh-KAH pah-DAH rah-JAH-cop-poh-TAHS-anna

eka = one; *pada* = foot, leg; *raja* = king, royal; *kapota* = dove, pigeon







SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs: Front leg	Lower limbs: Back leg
Extension	Scapular upward rotation, abduction, and elevation; shoulder joint flexion, adduction, and external rotation; forearm supination; hand and finger flexion	SI joint nutation, hip flexion and external rotation, knee flexion, ankle plantar flexion, foot supination	SI joint counternutation; hip extension, internal rotation, and adduction; knee flexion; ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION		ECCENTRIC CONTRACTION
To extend spine: Spinal extensors	**To neutralize twist from position of back leg:** Internal oblique (front-leg side); external oblique (back-leg side)	**To prevent hyperextension at lumbar spine:** Psoas minor, abdominal muscles

Upper limbs

CONCENTRIC CONTRACTION	
To abduct, upwardly rotate, and elevate scapula: Serratus anterior, upper trapezius **To stabilize, flex, and adduct shoulder joint:** Rotator cuff, pectoralis major (upper fibers), anterior deltoid, biceps brachii (short head)	**To rotate forearm and grasp foot:** Supinator and flexors of hand and fingers

Lower limbs

Front leg: ECCENTRIC CONTRACTION	Back leg: CONCENTRIC CONTRACTION	Back leg: LENGTHENING
To resist hip flexion: Hamstrings, piriformis, obturator internus, superior and inferior gemellus	**To create hip extension and knee flexion:** Hamstrings **To create hip extension, internal rotation, and adduction:** Adductor magnus	Iliacus, psoas major, rectus femoris

Notes

As with all poses, a variety of experiences are available in this asana, depending on each person's interests, strength, balance, and range of motion. This pose is categorized as a kneeling pose because that is one potential starting position, but the base of support is not actually kneeling when in the pose. Similar to hanumanasana (page 207), this asana has as a base of support the back surface of your front leg and the front surface of your back leg.

In this asana the weight of your body can put additional pressure on your front knee, the hamstring attachment of your front leg, or the inner hip and thigh of your back leg. Using your pelvic floor and the backs of your legs and pelvis eccentrically can help distribute the weight created by the force of gravity through the whole base of the pose.

Even though your front leg is externally rotated, this pose still requires a great deal of length in the muscles of external rotation on the outside of your hip. This is because these muscles are also hip extensors and abductors, and the actions in your front leg are hip flexion and adduction—the more adducted your front leg is, the more emphasis will be given to those muscles.

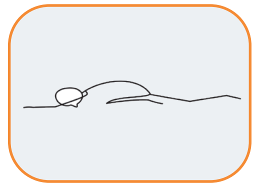
When your front knee is more extended (toward 90 degrees of flexion), the rotation at your hip is greatly intensified. This action can put more pressure on your knee, especially if there is restriction in your hip joint, and your knee is much more susceptible to twisting forces when at 90 degrees. The action in your feet and ankles can help to stabilize and protect your knee.

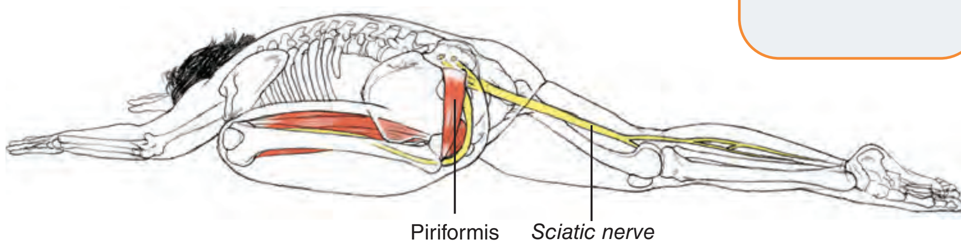
Breathing Inquiry

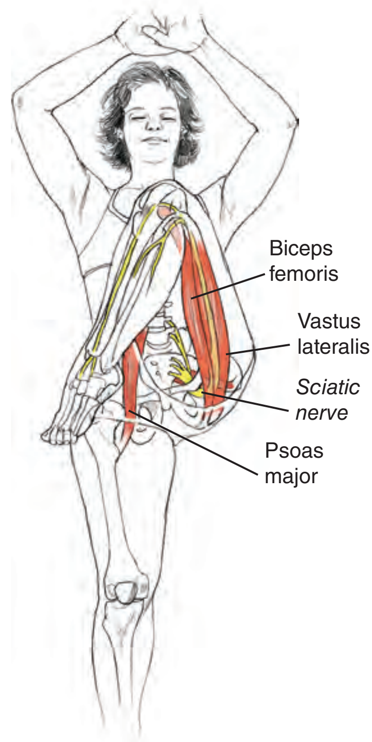
Many of the same inquiries for ustrasana (or any deep back bend) are also relevant to pigeon pose, with an additional focus on how the overhead arm position affects your breath in the upper lobes of your lungs. This is in contrast to the backward reach of your arms in camel pose.

EKA PADA RAJAKAPOTASANA VARIATION

Folded Forward







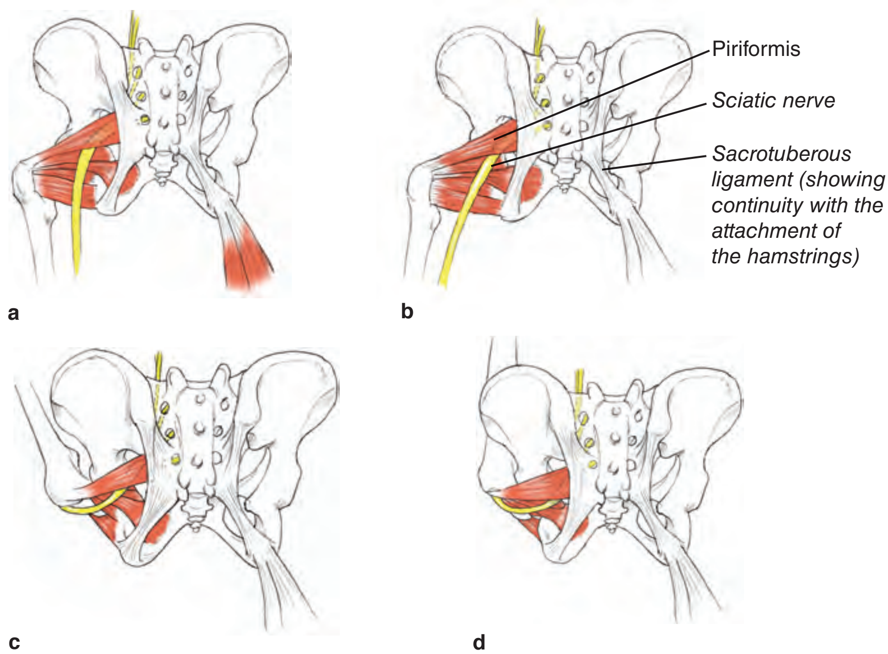
Notes

This variation intensifies the actions in the back of your thigh and other hip extensors of your front leg because of deeper hip flexion and more body weight over your front leg. At the same time, it diminishes the actions in your back hip and in your spine.

This position is frequently used to "stretch" your sciatic nerve. When sciatic pain exists, however, it is not necessarily useful to lengthen your sciatic nerve. It may indeed be true that doing this asana often helps relieve this pain, but it's more likely that the mobilization of your hips and pelvis and the effects on all the muscles of your lower body are responsible.

The following illustrations show the relationship of your sciatic nerve to your piriformis muscle in various positions:

1. Neutral hip position (figure *a*)
2. External rotation and abduction, which shorten your piriformis (figure *b*)
3. Hip flexion, which begins the lengthening of your piriformis and other external rotators (figure *c*)
4. Hip flexion combined with adduction, which maximally lengthens your piriformis, along with your sciatic nerve (figure *d*)

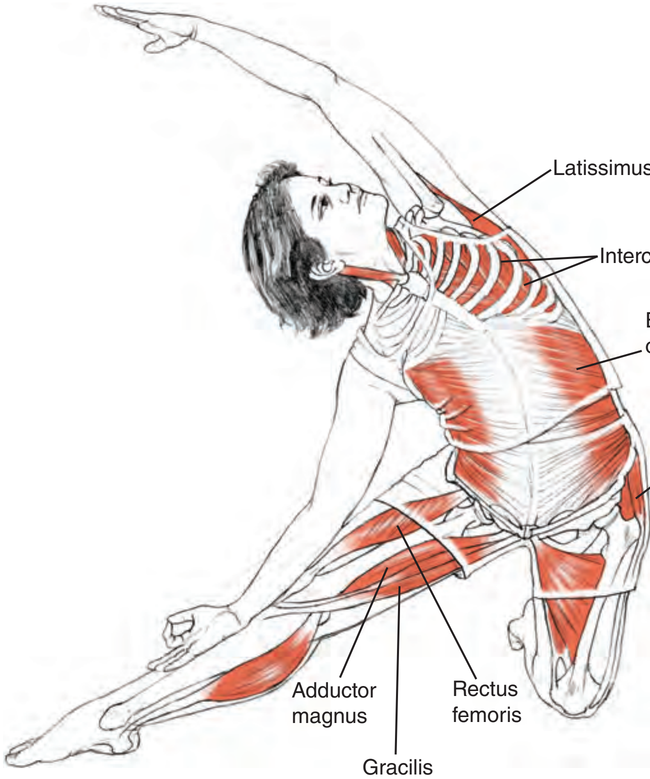


A hip joint, sciatic nerve, and piriformis muscle in four positions as they go into the folded-forward pigeon variation: (*a*) neutral; (*b*) externally rotated and abducted; (*c*) externally rotated, abducted, and flexed; and (*d*) externally rotated, flexed, and adducted.

PARIGHASANA

Gate-Latch Pose

par-ee-GOSS-anna
parigha = an iron bar used for locking a gate



SKELETAL JOINT ACTIONS

	Upper limbs		Lower limbs	
Spine	**Top arm**	**Lower arm**	**Kneeling leg**	**Extended leg**
Lateral flexion, cervical rotation and extension	Scapular upward rotation and elevation, shoulder joint abduction, elbow extension	Shoulder joint abduction, forearm supination	Hip extension and adduction, knee flexion, ankle dorsiflexion	Hip flexion, external rotation, and abduction; knee extension; ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To orient torso to front: Internal oblique (flexed-leg side); external oblique (extended-leg side)	**To resist falling into gravity:** External oblique, quadratus lumborum (flexed-leg side)

Upper limbs

Upper arm

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To upwardly rotate, abduct, and elevate scapula: Serratus anterior **To stabilize shoulder joint:** Rotator cuff **To extend elbow:** Triceps brachii, anconeus	**To extend arm overhead without falling into gravity:** Teres major, latissimus dorsi

Lower limbs

Extended leg		Kneeling leg		
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION	CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION	ALSO LENGTHENING
To rotate and abduct leg: Sartorius, piriformis, superior and inferior gemellus, obturator internus	**To keep from collapsing into hip:** Hamstrings	**To extend, adduct, and internally rotate hip:** Hamstrings, adductor magnus, gluteus maximus	**To resist hip extension and knee flexion:** Rectus femoris **To resist knee flexion:** Articularis genu, vastii	Gluteus medius and minimus, tensor fasciae latae

Notes

When you laterally flex your spine, rotation also happens in your intervertebral joints. Combined with the pull of gravity and the spiraling pathway of the muscles in your torso, this can create a tendency to rotate your torso (usually toward your underneath leg) when doing this side-bending asana (see also parivrtta janu sirsasana, page 188). One way to minimize the rotation and find the fullest amount of lateral flexion is to move gradually into the pose, finding the lateral flexion available in each part of your spine (cervical, thoracic, and lumbar) and noticing where rotation, flexion, and extension also tend to happen.

If you have a habitual holding pattern in the muscles of the outside of your hip joint in your standing leg, then that hip might try to flex rather than maintain neutral extension and adduction. When there is habitual holding in the muscles of your back, lifting your arm overhead can push your rib cage forward (limiting movement in the floating ribs and inhibiting your breath in general), or it can pull your scapula downward even as your arm is lifting, potentially creating impingement of the muscles that cross your shoulder joint.

Cueing Callout: Is It Possible to Do a Pure Side Bend?

When we ask students to do a simple side bend (or any flat or two-dimensional movement) as if between two panes of glass, the movement is not nearly as simple as the shape. It is important to realize that all movement is three dimensional, and that simple shapes and movements might involve complex adjustments and negotiations in the joints, ligaments, and muscles of our spine and limbs.

Whenever you laterally flex your spine (side bend), rotation also happens in your intervertebral joints. Because of the angles of the articular facets, lateral flexion will always have an element of flexion or extension in that single joint, and axial rotation always also arises because of asymmetrical compression of your discs and contralateral tension from your spinal ligaments.

Pure lateral flexion is impossible to execute in a single spinal intervertebral joint (between two vertebrae). When you do a simple side bend, one that doesn't also have flexion or extension, you actually perform a complex set of actions in the many intervertebral joints to balance out the flexion and extension that is happening throughout your spine.

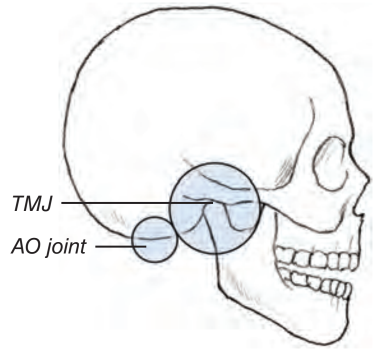
Breathing Inquiry

Breathing in this (or any) highly asymmetrical pose can be revealing because your diaphragm and its organic relations are themselves highly asymmetrical. Which side of your diaphragm seems to move more in this pose—the upper, lengthened side or the lower, compressed side? Does your breath feel evenly distributed from the front to the back of your body in this unusual shape? Are the answers to these questions the same for both sides of your body?

SIMHASANA

Lion Pose

sim-HAHS-anna
simha = lion



The temporomandibular joint (TMJ) represents the center of gravity of the skull, while the atlanto-occipital (AO) joint is its base of support.

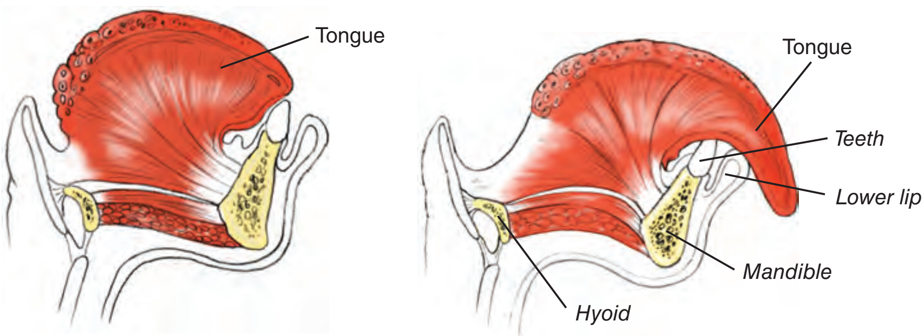
SKELETAL JOINT ACTIONS

Spine
Atlanto-occipital joint flexion, neutral spine, adduction and elevation of eyeballs

Notes

The lengthening activation of your tongue lifts your hyoid bone; this can affect your hyoid muscles, sternum, rectus abdominis, pubic bone, pelvic floor, and digestive system.

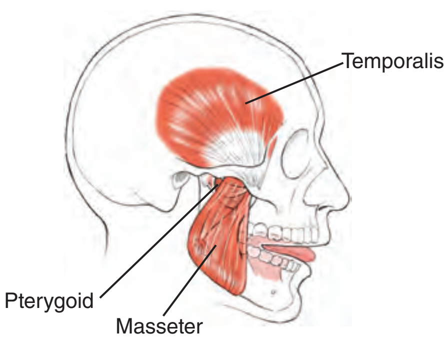
(*continued*)



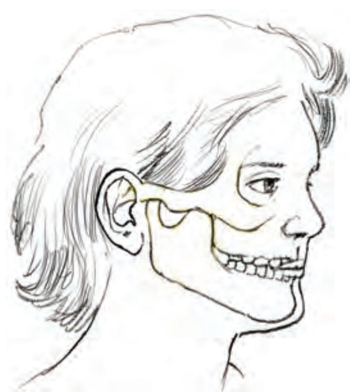
(*a*) The tongue at rest, and (*b*) tongue extension.

A strong exhalation (lion's roar) employs the three diaphragms: thoracic, pelvic, and vocal. The platysma muscle can also be recruited in simhasana. To direct your gaze inward and upward, the superior and medial rectus muscles of your eyes both contract.

Simhasana can stimulate and release a host of often overlooked muscles. Your tongue and jaw can be thought of as the front of your neck, and cervical tension can frequently be related to habitual holding in these structures. Conscious actions to engage these muscles increase the ability to relax them during inspiratory efforts.



Jaw muscles.



Location of the TMJ.

Breathing Inquiry

This pose is usually performed with a strong exhalation though your mouth, and then the pose is released on the following inhalation. What happens if you hold the pose for several breaths so you are also inhaling though your mouth with your jaw wide open and your tongue extended? Can you curl your tongue upward toward your soft palate with the jaw held wide open? Does that affect your ability to keep your airways open for breathing?

11

SUPINE POSES

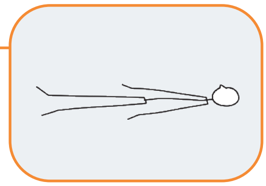
Supine means lying in a faceup position. It is the opposite of prone, which is lying facedown. Similarly, supination means to turn a hand, foot, or limb upward; whereas pronation refers to turning them downward.

Both words originate from Latin: *Supinus* means "leaning backward," and *pronus* means "leaning forward." Interestingly, this is the reverse of the usual movement from each position. From a supine position, engaging the front of your body to create flexion in your spine and limbs is generally what moves your body into space; from a prone position, it is extension in your spine or limbs.

Just as tadasana (page 122) is a foundational standing position, savasana (page 234) is a fundamental supine position. In savasana, the back surface of your body is almost completely in contact with the support of the floor. There is nowhere to fall, so your postural muscles can relax from their constant dance with gravity, and other patterns might be revealed.

Savasana has the lowest center of gravity possible and is a starting point for all the supine poses. It is also the position in which those asanas usually end. Because little effort is required to stabilize your body while it is supine, poses that evolve from here are usually categorized as langhana and become more brhmana (see page 103) as your center of gravity is raised higher, but as has been previously noted, your individual responses may vary.

SAVASANA

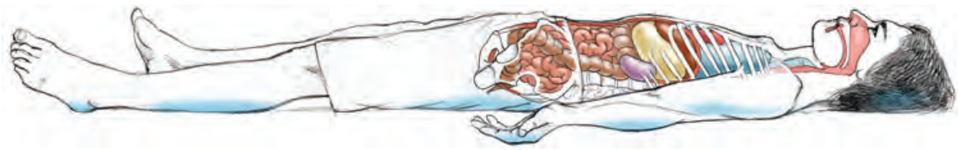


Corpse Pose

shah-VAHS-anna

sava = corpse

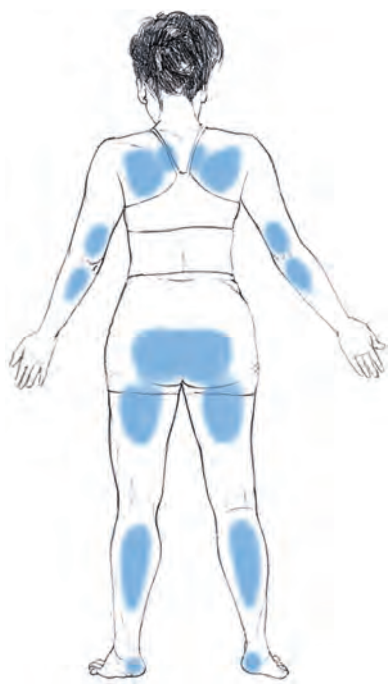
This pose is also referred to as the death pose, or mrtasana (mrit-TAHS-anna). *Mrta* means death.



Notes

Savasana is said to be the easiest asana to perform but the hardest to master. Whatever demands other asanas may make on your balance, strength, or flexibility, the challenge of maintaining awareness without effort or exertion reveals habitual patterns of movement and thought in another way.

In savasana, the structures that are in full, weight-bearing contact with the floor exhibit the primary curves of your body (see figure 5.30, page 67). These include the posterior surfaces of your heels, calves, thighs, buttocks, rib cage, thoracic spine, scapulae, and skull. The structures that are off the floor mirror the secondary curves of your body, specifically the hollows of the back of your ankles, knee joints, lumbar region, and cervical spine. The points of contact for your arms vary widely from person to person, and your arms can be arranged in a variety of positions.



Shaded areas show the major weight-bearing structures, including most primary curves.

Symmetry

Often in savasana your limbs are carefully placed to be symmetrical when viewed from the outside. This can conflict with your body's kinesthetic (proprioceptive) feedback because what *looks* symmetrical is not what always *feels* symmetrical. We can negotiate this contrast in inner and outer experience in a variety of ways.

It might be useful to place your limbs as symmetrically as possible, and then see if you can receive the kinesthetic feedback of the sensations of asymmetry without needing to respond. Perhaps your proprioceptors can even adapt to this new information and redefine your perception of neutral.

Alternatively, it can also be valuable to organize more from the inside and seek inner comfort and quiet, regardless of how asymmetrically your limbs are arranged. We can find balance without being symmetrical, which is a valuable distinction for everyone to recognize. None of our internal structures are symmetrical. Nevertheless, they all are able to find balance and harmony. Because all human bodies are inherently asymmetrical, a certain amount of surrender to this fact might help us find a state of emotional and physical integration.

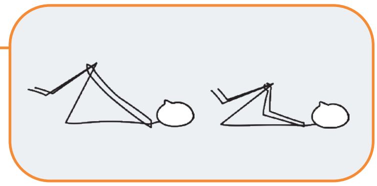
Breathing Inquiry

The physical stillness of savasana can allow your body to be completely at rest so your metabolism is freed of the demands of contending with gravity. This reduced demand for oxygen can allow your breath to be very quiet, but is it? Does your body actually feel quiet in this pose, or do you notice all the subtle movements within the pose? Does your mind experience stillness or activity? Can you be aware of your breath, but not be controlling your breath?

Cueing Callout: Is Savasana Relaxing?

As much as teachers might wish for their students to experience complete relaxation in this pose, students may frequently feel the opposite. Many students become agitated not only by the intentional stilling of their body, but also by the teacher's suggestion that they should be feeling calmness, relaxation, or ease. It is best to frame the practice of savasana (and all asana, for that matter) as an inquiry into what is actually being noticed, rather than telling students what they should be feeling.

APANASANA

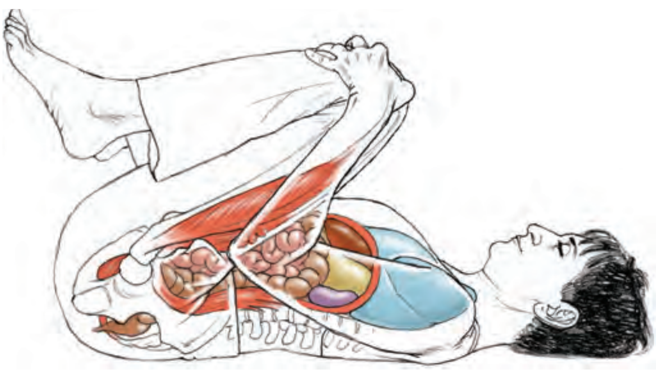


Apana Pose, Wind Release Pose

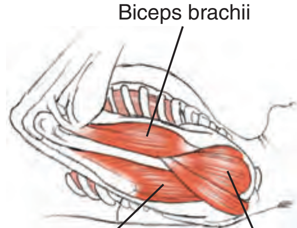
ap-an-AHS-anna

apana = the vital air that eliminates waste from the system

Inhalation.



Exhalation.



Notes

Apanasana is considered a key tool in therapeutic yoga because it is a simple and accessible practice that directly links your breath and body movement. In this simple vinyasa (or sequence of movements), your hands are placed on your knees. With your inhalation, your legs move away from your body, and with your exhalation, your legs move toward your body. This movement can be created in a variety of ways: through the gentle movement of your breath, a simple movement of the limbs, or a more vigorous movement of your spine. Each variation offers a different experience of the relationship between your breath and your movement.

Breathing Inquiry

In apanasana, your knees can be drawn into your body either by actively using your abdominal and hip flexor muscles without the help of your arms, or by using your arms to "pump" your thighs against your abdomen while leaving your abdominals and hip flexors passive. Try alternating between the two and see which method works best for you to stimulate the upward release of your diaphragm on your exhalation.

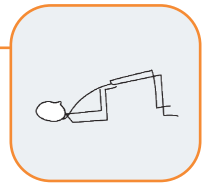
Low back discomfort can sometimes be the result of holding patterns in your diaphragm. Apanasana can be a simple and effective way to help your lower back by mobilizing the contents of your abdomen and creating more diaphragmatic space for your abdominal muscles to create postural support.

Taken together, dwi pada pitham (page 240) and apanasana constitute a pair of counterposing movements that can facilitate profound changes and healing.

Cueing Callout: Apana Happens

Another name for apanasana is "wind relieving pose," especially when it is performed as one-leg variations. It may be useful to mention this during group instruction in case someone actually relieves their wind; it will help them feel like they've successfully achieved the goal of the practice rather than feel embarrassed for farting.

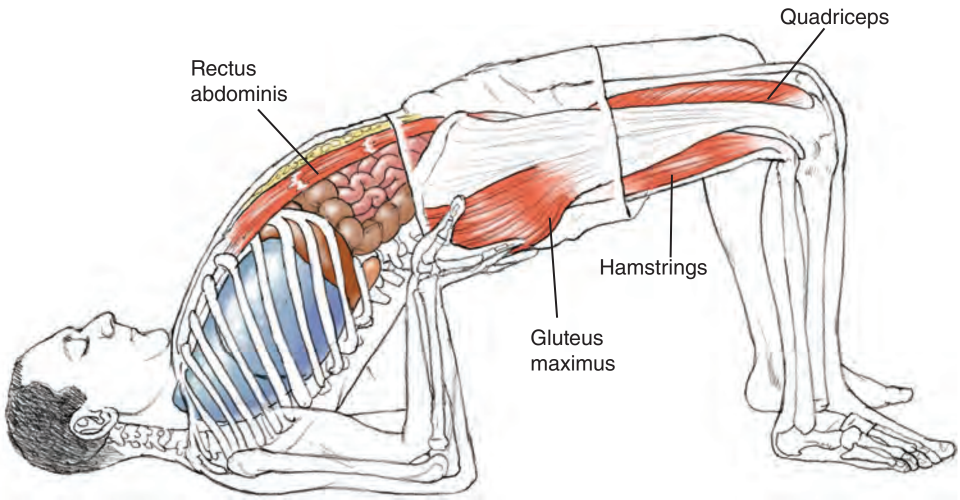
SETU BANDHASANA



Bridge Pose

SET-too bahn-DAHS-anna

setu = dam, dike, bridge; *bandha* = lock; *setubandha* = the forming of a causeway or bridge



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical and upper thoracic flexion, lower thoracic and lumbar extension	Scapular adduction, downward rotation, and elevation; shoulder joint extension and adduction; elbow flexion; forearm supination; wrist dorsiflexion	Sacroiliac (SI) joint counternutation, hip extension, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend lower thoracic and lumbar spine: Spinal extensors	**To resist lumbar hyperextension:** Psoas minor, abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To adduct, elevate, and downwardly rotate scapula: Rhomboids, levator scapulae **To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff **To extend and adduct shoulder joint:** Triceps brachii (long head), teres major, posterior deltoid **To flex elbow and supinate forearm:** Biceps brachii, brachialis	**To receive and support weight of pelvis:** Flexors of wrist and hand

Lower limbs	
CONCENTRIC CONTRACTION	**LENGTHENING**
To extend hip: Hamstrings, gluteus maximus **To extend, adduct, and internally rotate hip:** Adductor magnus, gracilis **To extend knee:** Articularis genu, vastii	Psoas major, iliacus

Notes

This pose calls for extension in both your hip joints and your lower spine. It can be a challenge to find full hip extension in this pose without also abducting or externally rotating, which pulls your knees away from each other. If you find that the muscles that combine extension, abduction, and external rotation at your hip joints are more active than the muscles that extend, adduct, and internally rotate, you might keep your pelvis lower and practice finding a different muscle pattern in your legs (instead of pulling your knees together after lifting as high as you can). While the final position of your knees is a flexed shape, the action of coming into the pose is one of extension because it is moving from more flexion to less flexion.

The elevation and adduction of your scapulae moves your shoulder blades into the floor, which then lifts your rib cage away from the floor. At the same time, your scapulae downwardly rotate, so that your humerus bones can move toward each other under you. This combination of downward rotation, elevation, and adduction might seem contradictory but is possible and is important in creating the foundation of this pose. As part of that foundation, it is key that your scapulae are not depressed or pulled down your back, because that action moves your scapulae away from your cervical spine, leaving your flexed neck instead of your shoulder girdle to bear the weight of your upper body.

The action in your shoulder girdle and arms is also the foundation for salamba sarvangasana (page 241) and viparita karani (page 246); the action in your hips and legs is the same as for lifting into urdhva dhanurasana (page 298).

Breathing Inquiry

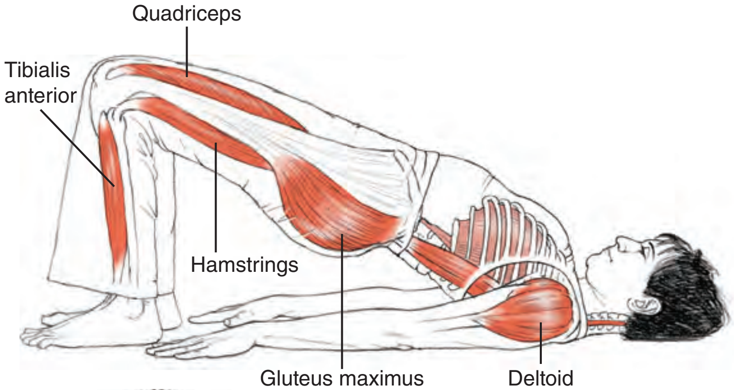
The position of your spine in bridge pose combines elements of a back bend with forward flexion of your neck. Do elements or regions of your breath feel constricted or facilitated in this pose? Does a fuller or a quieter breath help sustain you in bridge pose? Wherever your hands are placed, can you sense breath movement beneath them?

SETU BANDHASANA VARIATION

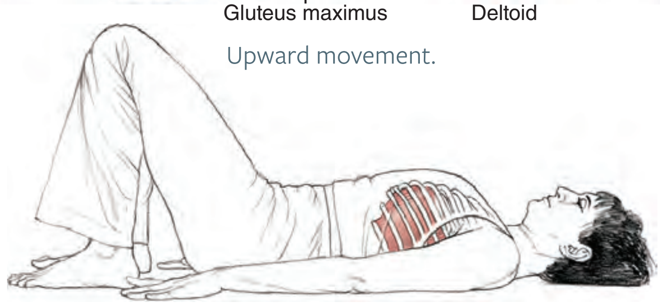
DWI PADA PITHAM

Two-Legged Table

dvee PA-da PEET-ham
dwi = two; *pada* = feet; *pitham* = stool, seat, chair, bench



Upward movement.



Downward movement.

Notes

Except for the arm position, the actions of the muscles, spine, and joints of this pose are nearly identical to those of setu bandhasana. The main difference between setu bandhasana and dwi pada pitham is that dwi pada pitham is a vinyasa, a dynamic movement that is coordinated with your inhalation and exhalation.

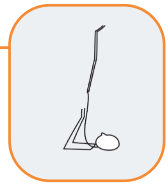
This simple yet versatile practice can be used in a variety of ways to release tension from your spine and breathing structures. It can also help balance your leg and hip actions that support similar poses, such as setu bandhasana and urdhva dhanurasana (page 298).

Breathing Inquiry

Many breath patterns can be employed while lifting and lowering your spine in this practice. Lift on an inhalation, and lower on an exhalation, or vice versa. Move only on exhalation or only on an inhalation. If your main objective is to experience the most articulation in your spine as you lift and lower, what breathing pattern facilitates that? Keep in mind that your answer may change from day to day.

Another goal could be to feel the activation of the three bandhas as you lower your spine toward the floor. Try lowering while suspending your breath at the end of an exhalation (bahya kumbhaka). This can help to create a lift in your pelvic floor as your abdominal contents rise toward the zone of lowered pressure in your thoracic cavity. On the subsequent inhalation, can you sense a downward release of the pelvic floor and a noticeable sense of relaxation in this sometimes tense region?

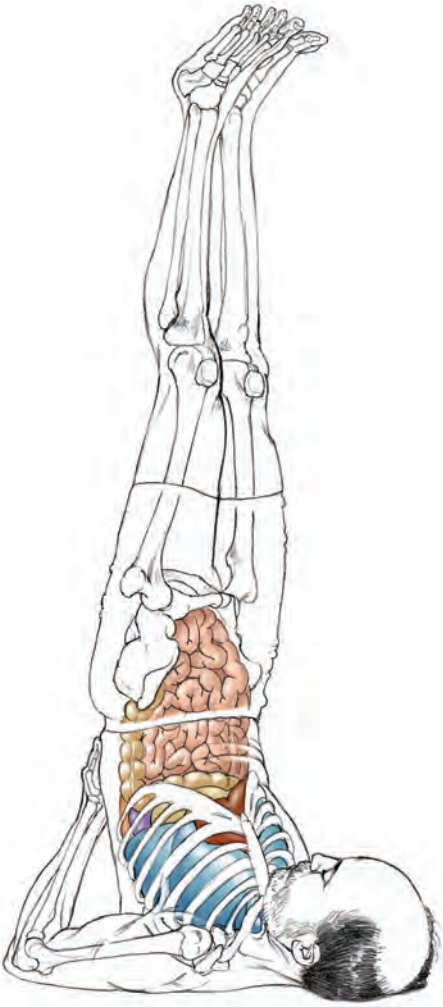
SALAMBA SARVANGASANA

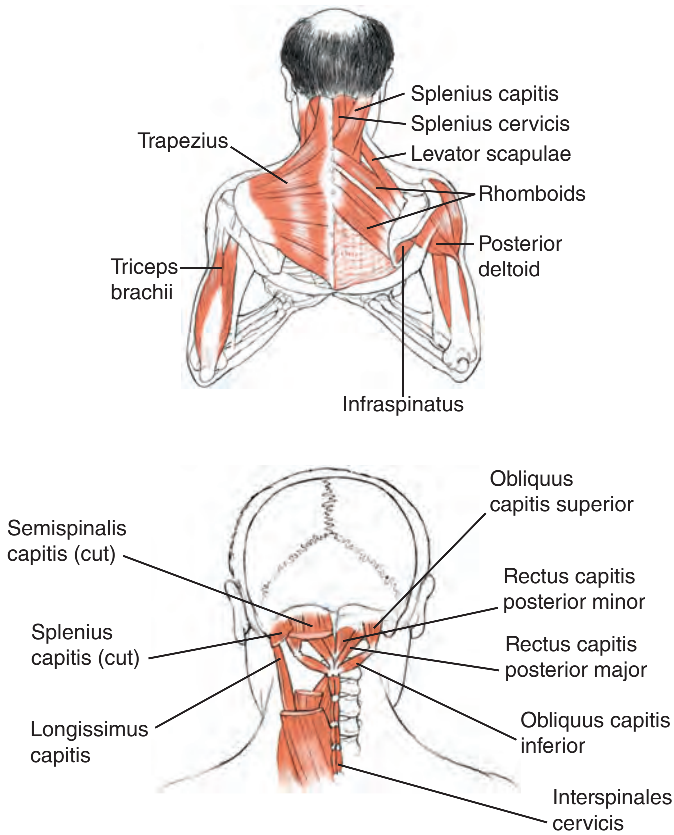


Supported Shoulder Stand

sah-LOM-bah sar-van-GAHS-anna
salamba = with support (*sa* = with, *alamba* = support); *sarva* = all; *anga* = limb

The term *salamba* distinguishes this variation of the shoulder stand from the unsupported (niralamba) version.





Some of the deeper musculature attaching to the base of your skull that can be eccentrically active in salamba sarvangasana, halasana (page 248), and variations.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical and upper thoracic flexion, lower thoracic and lumbar extension	Scapular adduction, downward rotation, and elevation; shoulder joint extension and adduction; elbow flexion; forearm supination; wrist dorsiflexion	Hip extension and adduction, knee extension, ankle dorsiflexion

(continued)

Salamba Sarvangasana *(continued)*

SELECTED MUSCULAR ACTIONS

Spine	
	ECCENTRIC CONTRACTION
To calibrate concentric and eccentric contractions to support spine: Spinal extensors and flexors	**To resist flexion from weight of body:** Cervical spinal extensors
Upper limbs	
CONCENTRIC CONTRACTION	
To adduct, elevate, and downwardly rotate scapula: Rhomboids, levator scapulae **To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff	**To extend and adduct shoulder joint:** Triceps brachii (long head), teres major, posterior deltoid **To flex elbow and supinate forearm:** Biceps brachii, brachialis **To support rib cage:** Flexors of wrist and hand
Lower limbs	
CONCENTRIC CONTRACTION	
To resist leg falling toward face: Hamstrings, gluteus maximus **To extend, adduct, and internally rotate hip:** Adductor magnus, gracilis	**To extend knee:** Vastii

Notes

The foundation of this pose, as in setu bandhasana (page 238), is your shoulder girdle (not your neck). To truly be a shoulder stand, the muscles that elevate, adduct, and downwardly rotate your scapulae must be strong enough to keep your scapulae in that position despite the weight of your entire body resting on them. When preparing for this pose, it is essential that your scapulae find elevation along with the other actions; if your scapulae are depressed, your cervical spine receives the weight of your whole body while in a flexed position, which makes it more vulnerable to injury from overarticulating.

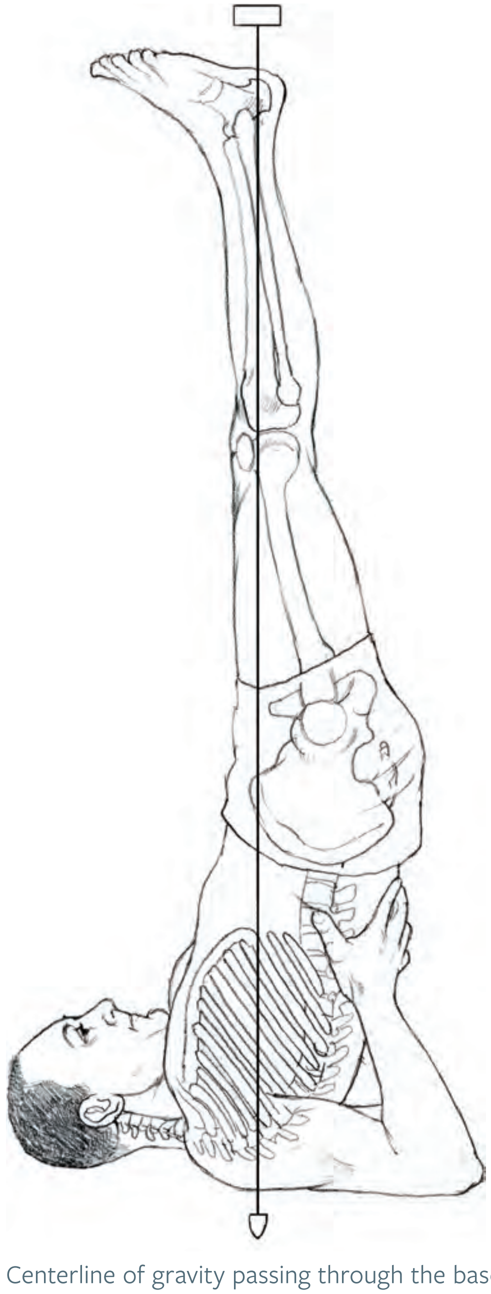
Entering the pose from halasana (page 248) is more demanding on the extensors of your spine, especially your thoracic spine, because they are in an elongated position before contracting. Entering from setu bandhasana is more demanding on the extensors of your shoulder joints and the flexors of your spine.

From the perspective of the muscles of your spine and abdomen, being in this pose is less challenging than getting into it. However, remaining in the pose is more challenging for the muscles of your scapulae because they are bearing the static load of your body.

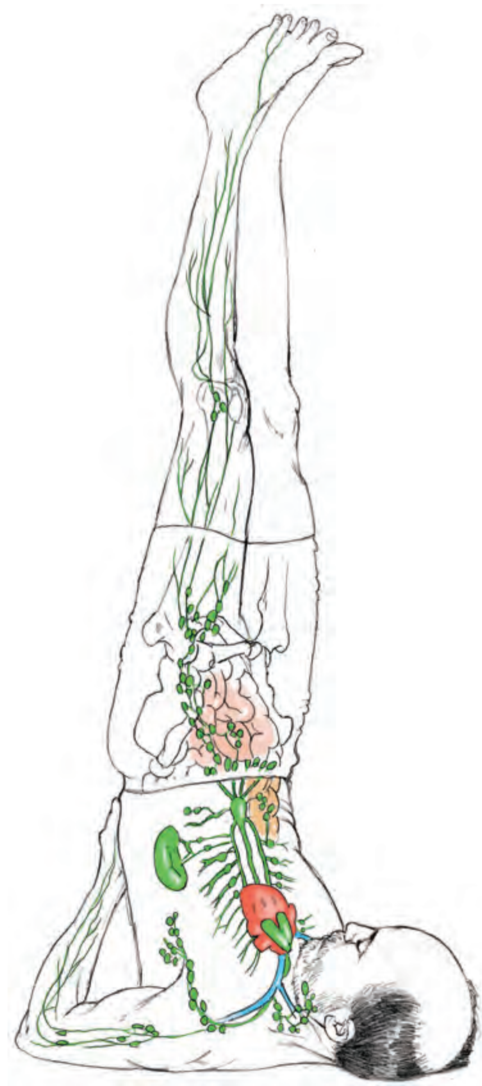
Breathing Inquiry

Can you sense the relationship between the mobility and stability of your shoulder girdle and the relative freedom of your breath in this position? This pose takes a considerable amount of both flexibility and strength in your entire shoulder region. Do you notice the relationship between the integrity of your shoulder girdle and the tendency of your weight to shift down into your thorax and add resistance to the movements of your diaphragm? Wherever your hands are placed, can you sense breath movement beneath them?

As with any inversion, a possible point of focus is keeping the base of your rib cage open, allowing your diaphragm and abdominal viscera to shift effectively cranially. What effect does that headward shift have on your breath?

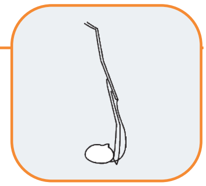


Centerline of gravity passing through the base of support.



Lymph drainage in shoulder stand.

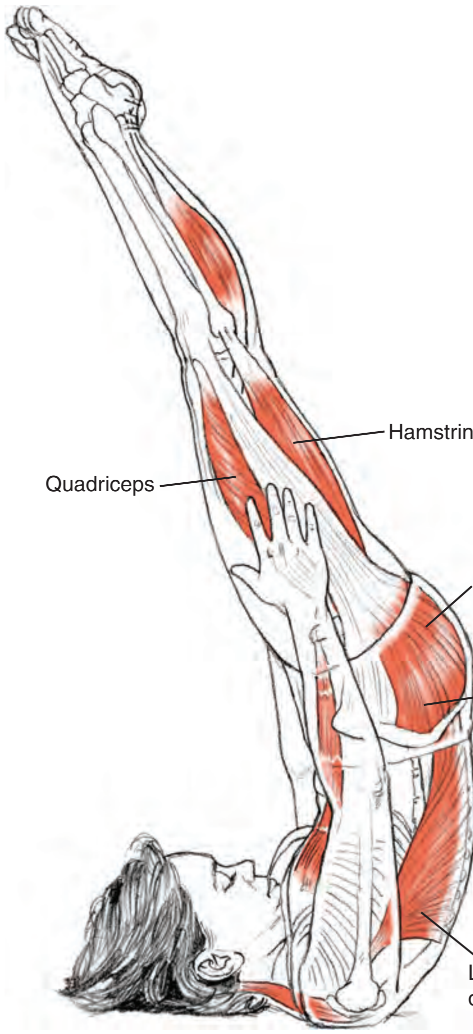
NIRALAMBA SARVANGASANA



Unsupported (No-Arm) Shoulder Stand

neera-LOM-bah sar-van-GAHS-anna

niralamba = no support, independent, self-supported; *sarva* = all; *anga* = limb



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical and upper thoracic flexion, lower thoracic and lumbar extension	Scapular adduction, upward rotation, and elevation; shoulder joint adduction; elbow extension; forearm pronation	Hip extension and adduction, knee extension, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
To calibrate concentric and eccentric contractions to support spine: Spinal extensors and flexors	**ECCENTRIC CONTRACTION** **To resist flexion from weight of body:** Cervical spinal extensors

Upper limbs	
CONCENTRIC CONTRACTION	
To adduct, elevate, and upwardly rotate scapula: Trapezius, levator scapulae **To upwardly rotate scapula:** Serratus anterior **To flex and adduct shoulder joint against pull of gravity:** Teres minor, coracobrachialis	**To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff **To adduct shoulder joint and extend elbow:** Triceps brachii

Lower limbs	
CONCENTRIC CONTRACTION	
To resist leg falling toward face: Hamstrings, gluteus maximus	**To extend, adduct, and internally rotate hip:** Adductor magnus, gracilis **To extend knee:** Vastii

Notes

In this pose, your scapulae are elevated, adducted, and slightly upwardly rotated; without the levering action of your arms, this calls on the muscles that move your scapulae on your rib cage to work strongly. It might seem contradictory to perform adduction, elevation, and upward rotation simultaneously. But it is indeed possible and in fact necessary in this pose to protect your neck. If your scapulae are not maintained in adduction, the weight of your body falls into your spine; if your scapulae do not upwardly rotate, it is challenging to position your arms alongside your body. (Your scapulae are positioned in neutral rotation as they extend to the knees, but the action that gets them there is upward rotation as they come from the downward rotation of niralamba sarvangasana.)

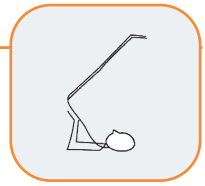
The muscles that flex your thoracic and upper lumbar spine are strongly engaged here to maintain the spinal flexion in your thoracic spine. Without the support of the arms, lumbar flexion occurs to bring your legs farther overhead and counterbalance the pull of gravity. Resisting this tendency toward lumbar flexion makes your spinal extensors work much harder eccentrically against your body weight's tendency to roll down to the floor.

In this balancing act between spinal flexors and extensors, imbalances that are usually imperceptible might show up because your arms aren't acting to leverage symmetry. When these imbalances appear, they make this pose that much more challenging to balance.

Breathing Inquiry

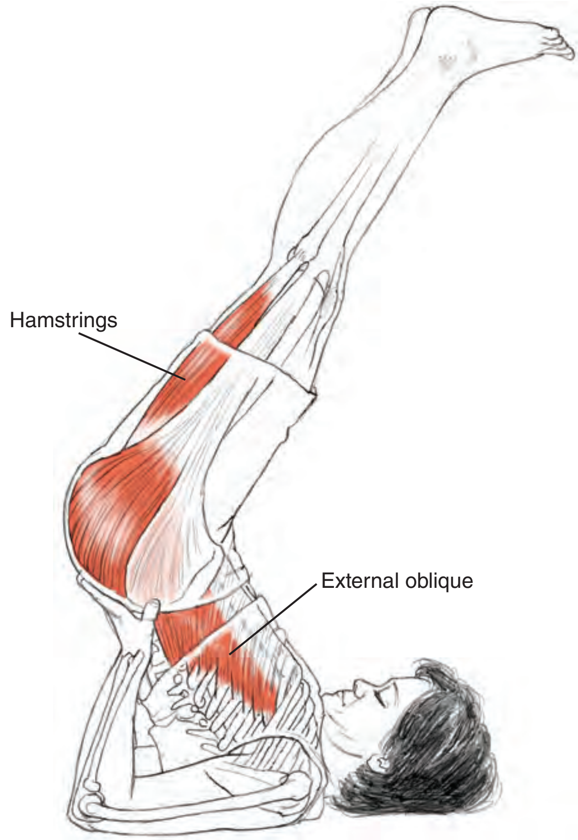
In niralamba sarvangasana, the intense action in your torso's flexor and extensor groups can create considerable resistance to the shape change of breathing. What happens to your stability if you attempt to breathe too deeply in this challenging balance pose? What do you notice if you strive for efficiency of breath action—finding the minimum amount of effort necessary to maintain the position—while allowing your limited breath movements to supply just enough energy to sustain the pose?

VIPARITA KARANI



Inverted Pose

vip-par-ee-tah car-AHN-ee
viparita = turned around, reversed, inverted; *karani* = doing, making, action



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical and upper thoracic flexion, lower thoracic and lumbar extension	Scapular adduction, downward rotation, and elevation; shoulder joint extension and adduction; elbow flexion; forearm supination; wrist dorsiflexion	Hip flexion and adduction, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend lower thoracic spine: Spinal extensors	**To resist lumbar hyperextension and counterweight of leg:** Psoas major and minor, abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To adduct, elevate, and downwardly rotate scapula: Rhomboids, levator scapulae **To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff **To extend and adduct shoulder joint:** Triceps brachii (long head), teres major, posterior deltoid **To flex elbow and supinate forearm:** Biceps brachii, brachialis	**To receive and support weight of pelvis:** Flexors of wrist and hand

Lower limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend knee: Vastii	**To resist leg falling toward face:** Hamstrings, gluteus maximus **To extend, adduct, and internally rotate hip:** Adductor magnus, gracilis

Notes

In viparita karani, your abdominal muscles are active in an eccentric contraction. If they do not have the ability to modulate their lengthening, the weight of your pelvis might drop onto your hands or wrists. Practicing entering and leaving this pose can help with other actions that require abdominal eccentric control, such as dropping your legs over into urdhva dhanurasana (page 298) from a headstand or handstand, controlling vrksasana (page 137), dropping back into urdhva dhanurasana from tadasana (page 122), and others.

Body proportions and individual differences in weight distribution between your upper and lower body greatly affect the experience of this pose. People who have more weight in their lower body might find controlling the movement more difficult than those who have more weight in their upper body.

Breathing Inquiry

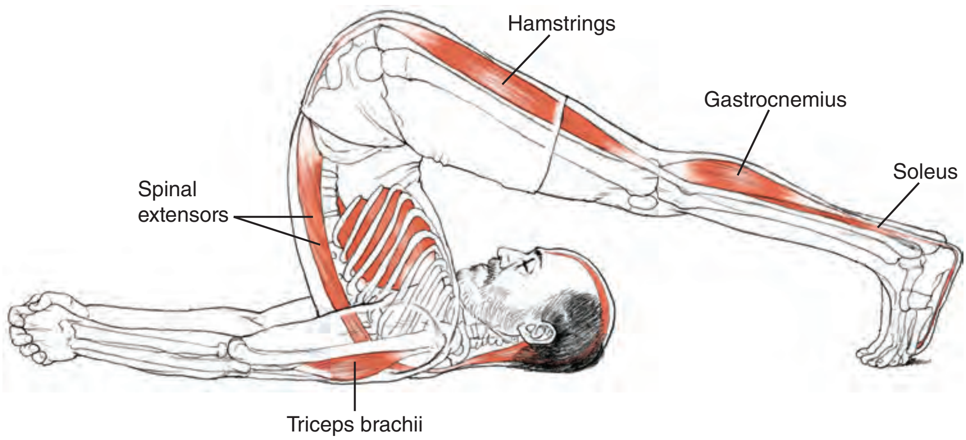
Inquiries for the other inverted asanas apply here as well. Try experimenting with supported versions of this pose using a bolster, folded blanket, or the wall. All of these can be valuable staples of restorative yoga practice.

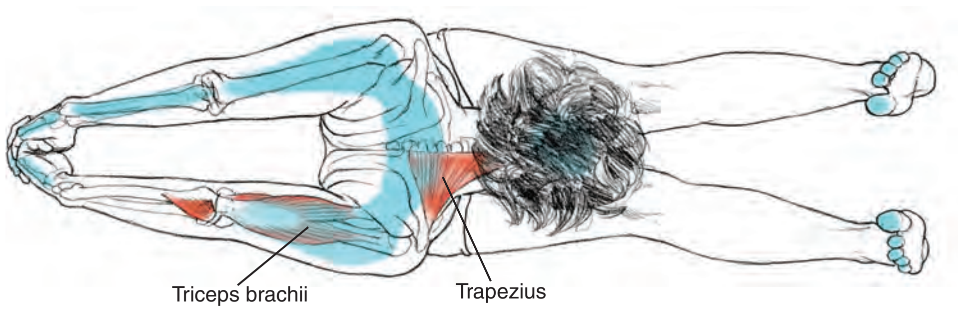
Dropped version of viparita karani.

HALASANA

Plow Pose

hah-LAHS-anna
hala = plow





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Flexion	Scapular adduction, downward rotation, and elevation; shoulder joint extension and adduction; elbow extension; forearm pronation; wrist extension; hand and finger flexion	SI joint nutation, hip flexion and adduction, knee extension, ankle dorsiflexion, toe extension

SELECTED MUSCULAR ACTIONS

Spine		
ECCENTRIC CONTRACTION		
To resist flexion from weight of body: Spinal extensors		

Upper limbs	
CONCENTRIC CONTRACTION	
To adduct, elevate, and downwardly rotate scapula: Rhomboids, levator scapulae **To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff	**To extend and adduct shoulder joint:** Triceps brachii (long head), teres major, posterior deltoid **To extend elbow:** Triceps brachii **To clasp hands:** Flexors of hand and fingers

Lower limbs		
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**ALSO LENGTHENING**
To extend knee: Vastii **To dorsiflex ankle and tuck toes under:** Tibialis anterior, toe extensors	**To maintain alignment of legs:** Hamstrings, adductor magnus, gracilis	Gastrocnemius, soleus

Notes

This pose has many variations: spine more or less extended, arms overhead, or hands on your back as in salamba sarvangasana (page 241). Some of these variations direct more pressure into your spine than others. For example, when your arms reach overhead and clasp your toes, your scapulae upwardly rotate and move away from your spine, and weight falls into your upper spine. This variation requires a lot of movement in your thoracic and cervical spine; there is potentially intense pressure from the weight of your legs and pushing action of your feet and, if the backs of your legs and pelvis are not free to move, from the greater spinal flexion required by limitations in hip flexion.

Because this pose can produce intense flexion for your spine, especially the cervical region, it's more important to maintain the integrity of your scapulae and cervical and thoracic spine than to get your legs to the floor. Support your legs if necessary to maintain the foundation of the pose.

Breathing Inquiry

Halasana can present an interesting challenge to your breathing. It's one thing to have the range of motion and flexibility to get into the pose but quite another for your diaphragm and organs to be free enough that you can remain in the pose and breathe comfortably.

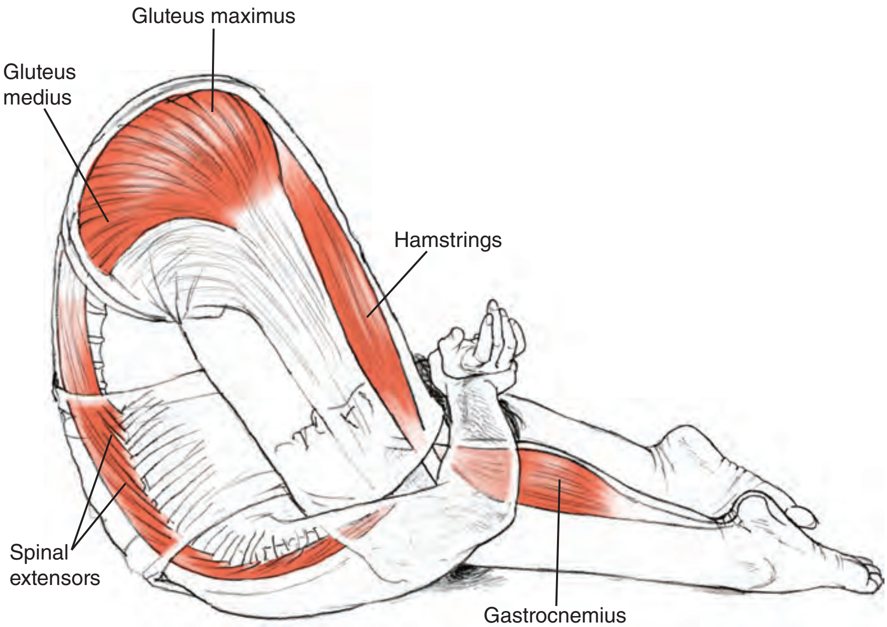
Do you notice similarities and differences in your breathing between salamba sarvangasana and halasana? In halasana, does the addition of hip flexion to the inversion create more (or less) of a feeling of intra-abdominal pressure? Does this affect the freedom of your breath movement? Can you sense breath movement in your upper lungs, your back, and even your armpits?

KARNAPIDASANA

Ear-to-Knee Pose

KAR-na-peed-AHS-anna

karna = ear; *pidana* = squeeze, pressure



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Flexion	Scapular abduction and upward rotation, shoulder joint flexion, elbow flexion, hand and finger flexion	SI joint nutation, hip flexion, knee flexion, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
LENGTHENING	
Spinal extensors	
Upper limbs	
CONCENTRIC CONTRACTION	LENGTHENING
To flex elbow: Biceps brachii **To clasp hands:** Flexors of hand and fingers	Rhomboids, trapezius
Lower limbs	
LENGTHENING	
Gluteus maximus	

Notes

When moving into this pose, your arms move overhead and your scapulae spread away from your spine. Weight bearing shifts from your scapulae to the spinous processes of your thoracic spine.

If the extensors of your spine can all participate in lengthening, this deep flexion can be distributed along the whole spine rather than overarticulating your thoracic and cervical spine. (The weight of your legs and pelvis can direct pressure into the potentially vulnerable muscles of your neck and upper back.)

This asana can counterpose the shoulder action of sarvangasana (pages 241 and 244) because the spinal extension and scapular adduction of the shoulder stand is reversed. This means the muscles that were active are now lengthening.

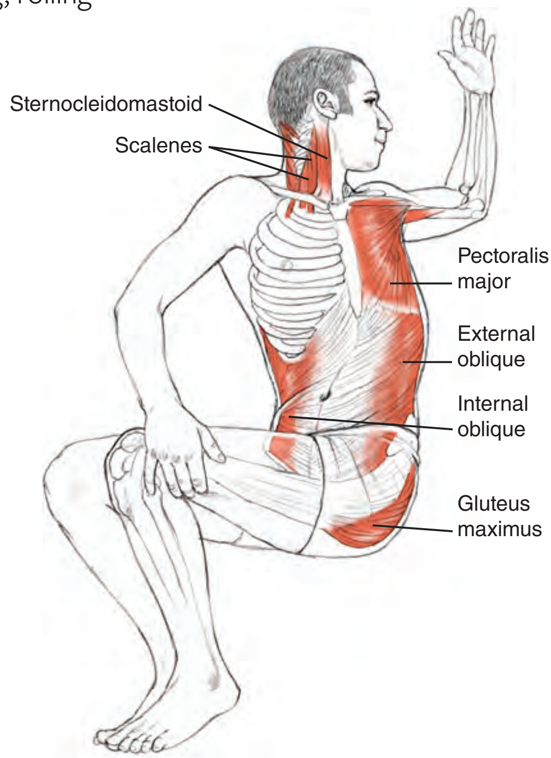
Breathing Inquiry

As with the comparison between sarvangasana and halasana, can you now compare the challenge to free breathing between halasana and karnapidasana? Where might your breath feel restricted, and where can it move in this inverted, tucked position? Is shape change available in your back body? Is your pelvic diaphragm able to move with your breath?

JATHARA PARIVRTTI

Belly Twist

JAT-hara par-ee-VRIT-ti
jathara = stomach, belly, abdomen, bowels, the interior of anything;
parivrtti = turning, rolling



SKELETAL JOINT ACTIONS

	Upper limbs		
Spine	**Arm opposite leg**	**Arm holding leg**	**Lower limbs**
Rotation	Scapular adduction, shoulder joint abduction and external rotation, elbow flexion	Scapular abduction, shoulder joint abduction and internal rotation, elbow flexion	Hip flexion, knee flexion

SELECTED MUSCULAR ACTIONS

Spine
LENGTHENING
External oblique, intercostals, transversospinalis (top-leg side); internal oblique, intercostals, oblique muscles of erector spinae (bottom-leg side)

Upper limbs
LENGTHENING
Pectoralis major and minor, coracobrachialis, latissimus dorsi (arm opposite leg)

Lower limbs
LENGTHENING
Gluteus maximus, medius, and minimus; piriformis; superior and inferior gemellus; obturator internus (top leg)

Notes

Maintaining a neutral spine will help to distribute this twist evenly throughout your spine. Keeping your lumbar curve is often a challenge in this pose because your hip flexion often also becomes lumbar flexion. While flexion in your lumbar spine might allow for more rotation, it also potentially allows too much force to be directed into your lumbar vertebrae and discs, rather than distributed up into your thoracic vertebrae.

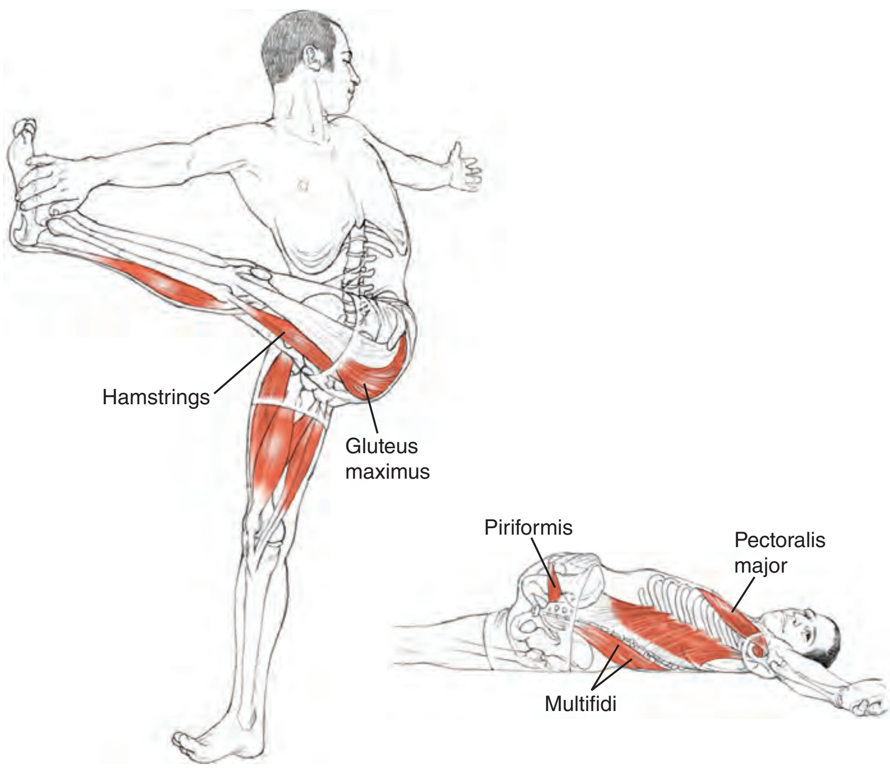
Gravity also pulls the weight of your legs farther into the twist. This helps to deepen the twist, but it also might generate too much force.

Breathing Inquiry

Can you allow your body to release into gravity so it can be fully supported by the floor? Can your breathing and postural muscles move freely in jathara parivrtti? Can you direct your breath in various ways to achieve specific effects? For example, does bringing breath movement into your abdomen release the tone in your abdominal wall and pelvic floor? What do you notice if you try the opposite pattern of restraining your abdominal wall during the inhalation? Can you send the action of your diaphragm into your thoracic structures, mobilizing your costovertebral joints? A similar effect was suggested in the seated twists (see the discussion of ardha matsyendrasana on page 203).

JATHARA PARIVRTTI VARIATION

With Legs Extended



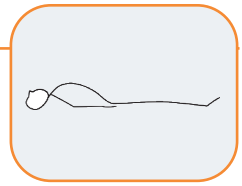
Notes

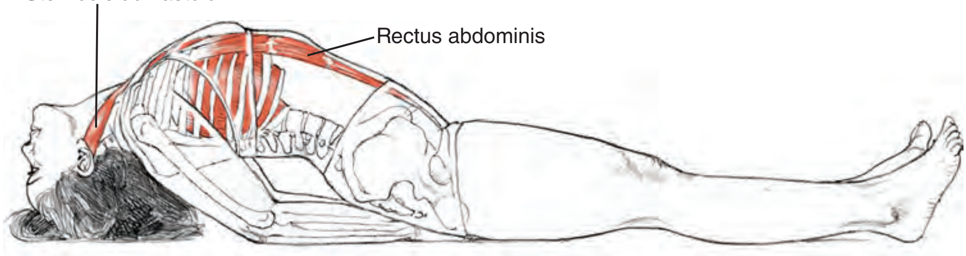
When your legs are extended, more force is directed into your spine. If the backs of your legs don't extend easily, this movement can also pull your lumbar spine into flexion.

MATSYASANA

Fish Pose

mots-YAHS-anna
matsya = fish





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular downward rotation and adduction, shoulder joint extension and adduction, elbow flexion, forearm pronation	Hip flexion and adduction, knee extension

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To lift spine from floor in extension: Spinal extensors **To extend spine (and flex hip):** Psoas major	**To resist hyperextension in cervical and lumbar spine:** Anterior neck muscles, psoas minor, abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	LENGTHENING
To stabilize shoulder joint: Rotator cuff **To internally rotate, extend, and adduct arm at shoulder joint:** Latissimus dorsi **To extend shoulder joint and press hand into floor:** Triceps brachii **To adduct scapula:** Trapezius, rhomboids **To turn hand toward floor:** Pronator quadratus and teres	Coracobrachialis, pectoralis major and minor

Lower limbs	
CONCENTRIC CONTRACTION	
To flex hip (and extend spine): Psoas major, iliacus **To ground leg:** Hamstrings	**To flex hip and extend knee:** Quadriceps

Notes

This pose can be done while focusing on using spinal extensors or resting into the support of your elbows. If the support of your elbows is used, there is less work in the muscles of your torso and perhaps more ease in breathing and more expansion.

If the pose is done while focusing on the muscles that extend your spine, your neck might be better protected when lifting your arms off the floor. Variations can also be done with blocks under your spine and with your feet in baddha konasana (page 194) or padmasana (page 177).

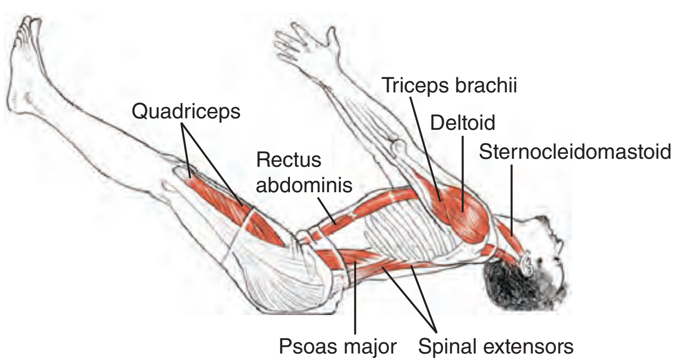
This pose is frequently used as an immediate counterpose to salamba sarvangasana (page 241) because it reverses the position of your cervical spine from extreme flexion to extreme extension. A dynamic approach to balancing the action of salamba sarvangasana would be to gradually reverse the movement of your neck with simple vinyasas leading up to bhujangasana (page 260).

Breathing Inquiry

Matsyasana is a reclined back bend, so both calming and energizing breathing are possibilities to explore. In fish pose, the front of your chest is expanded, but not as maximally as in the arm-supported urdhva dhanurasana (page 298). As a result, there may still be mobility for your breath action to mobilize your ribs, allowing room for thoracic shape change. What do you notice if you send your breath to your chest in this pose? What do you notice if you send your breath movement to your abdominal region? To your back body? Do any of these breathing patterns create a more calming or energizing effect for you?

MATSYASANA VARIATION

With Arms and Legs Lifted

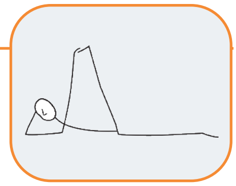


Notes

The action in your legs is greatly increased when they are lifted off the floor, especially for your hip flexors.

ANANTASANA

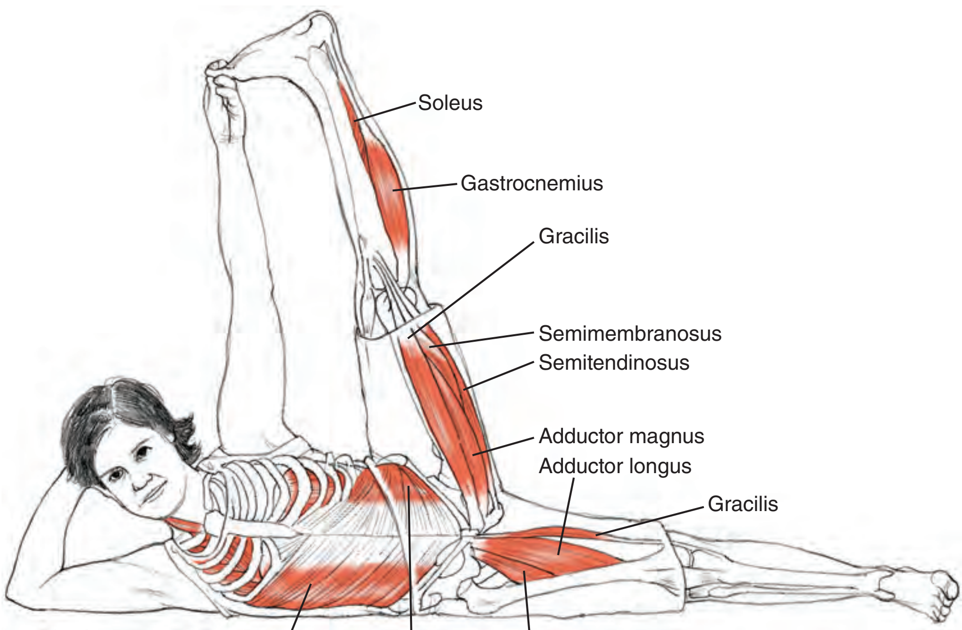
Reclining Vishnu Couch Pose



anan-TAHS-anna

ananta = endless, eternal (*anta* = end, *an* = without)

Ananta is also the name given to the mythical serpent that the god Vishnu reclines on like a couch.



SKELETAL JOINT ACTIONS

Spine	Upper limbs: Top arm	Upper limbs: Bottom arm	Lower limbs: Top leg	Lower limbs: Bottom leg
Lateral flexion	Shoulder joint abduction, elbow extension	Scapular upward rotation and elevation, shoulder joint flexion, elbow flexion	Hip flexion, abduction, and external rotation; knee extension	Neutral hip extension, knee extension

SELECTED MUSCULAR ACTIONS

Spine		
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**	**LENGTHENING**
To create side bend: Spinal extensors, internal and external obliques, quadratus lumborum (top side)	**To stabilize curves of spine:** Spinal extensors, internal and external obliques (bottom side)	Quadratus lumborum (bottom side)
Lower limbs		
Top leg		**Bottom leg**
CONCENTRIC CONTRACTION	**LENGTHENING**	**CONCENTRIC CONTRACTION**
To externally rotate and abduct: Gluteus medius and minimus (posterior fibers), piriformis, obturator internus, superior and inferior gemellus **To flex hip:** Psoas major, iliacus **To flex hip and extend knee:** Quadriceps	Hamstrings, adductor magnus, gastrocnemius, soleus	**To resist hip flexion:** Hamstrings **To press lower leg into floor for stability:** Gluteus medius and minimus

Notes

In the variation in which your leg is lifted, your pelvis and lower body might roll backward. One challenge is to find the balancing movement through the abductors and external rotators of your hip joint rather than through rotating your spine.

Breathing Inquiry

Anantasana is one of the few true side-lying poses. In the side-lying position, gravity can move the dome of your diaphragm closest to the floor cranially (toward your head) and the other dome caudally (toward your tail). This is due mainly to the effect of gravity on your abdominal organs, which are pulled toward the floor, taking your diaphragm with them. In addition, your lung closest to the floor (the dependent lung) becomes more supported and its tissue can become more compliant, meaning that it's under less mechanical tension and can respond more easily to the action of your diaphragm. Can you tune in to your breath movements in this pose to notice these effects?

Consciously tuning in to this asymmetry in your respiratory mechanism may be useful in breaking up deeply ingrained breathing habits. For example, this pose might be beneficial if you are trying to change the habit of sleeping on only one side of your body.

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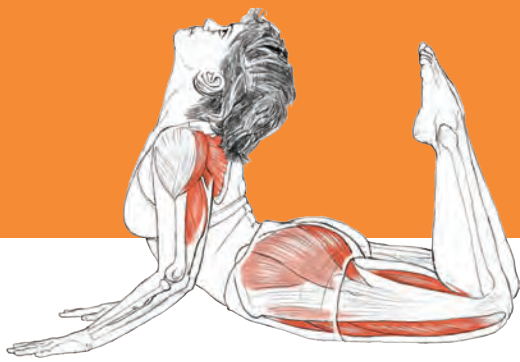


12

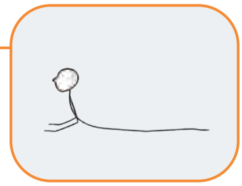
PRONE POSES

Prone means lying in a facedown position. This is a position that (in theory) babies do easily from birth, but many adults find uncomfortable. The discomfort is sometimes a result of restricted movement in your neck and upper back that makes it hard to turn your head to the side. This position can also feel uncomfortable because the movement of your abdomen is inhibited by the weight of your body, and the back of your body has to be more mobile for you to breathe comfortably.

To some people, this position has a stronger connotation of surrender than kneeling does and makes them feel quite vulnerable. (In many religious traditions, placing the entire front surface of your body on the floor is known as full prostration.) For others, this position feels safer than being supine because the vulnerable front body and organs are more protected.

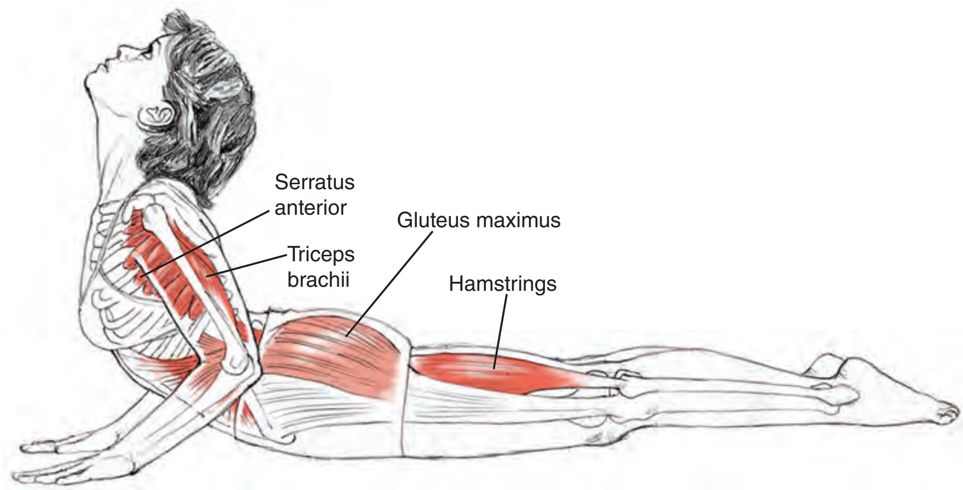
From a prone position, the most available movements are extension in your spine and limbs, which uses the posterior musculature of your body. For this reason many back-strengthening exercises begin in this position. Although your center of gravity in this position is close to the floor, poses that evolve from here can be quite effortful because of the energy needed to lift your body away from the floor.

BHUJANGASANA



Cobra Pose

boo-jang-GAHS-anna
bhujanga = serpent (*bhuja* = arm, shoulder;
anga = limb)



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Elbow extension, forearm pronation	Sacroiliac (SI) joint counternutation, hip extension and adduction, knee extension, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend spine: Spinal extensors **To extend thoracic spine and to coordinate with some of the spinal extensors, which it overlays:** Serratus posterior superior	**To prevent overmobilization of lumbar spine:** Psoas minor, abdominal muscles
Upper limbs	
CONCENTRIC CONTRACTION	
To stabilize scapula on rib cage and translate push of arm into clavicle: Serratus anterior **To stabilize shoulder joint:** Rotator cuff	**To extend elbow:** Triceps brachii **To pronate forearm:** Pronator quadratus and teres
Lower limbs	
CONCENTRIC CONTRACTION	
To extend, adduct, and internally rotate hip: Hamstrings, adductor magnus **To extend knee:** Vastii	**To plantar flex ankle:** Soleus

Notes

Finding the deeper intrinsic muscles of your back to execute the action of spinal extension in this pose, instead of the more superficial back muscles that also connect to your scapulae and ribs, might allow your ribs to move more freely with your breath.

In this pose the push of your arms can help lift your spine, especially if the muscles that connect your scapulae to your ribs are engaged to keep your shoulder blades from sliding upward. Mobility in the bones in your forearms can help balance the forces traveling from your hands through your wrists, elbows, and shoulders. While your legs are not necessarily bearing weight in cobra, they are still active in supporting the extension in your spine.

(*continued*)

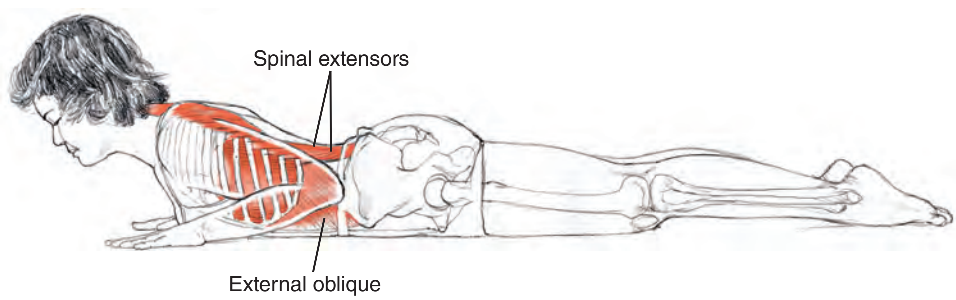
Cueing Callout:
A Neutral Head Position Doesn't Protect Your Neck

In prone back bending poses (and others) you might hear the instruction to keep your head in a neutral position to protect your neck from injury. If you have an injury in your neck (or any joint), it is generally a good idea to avoid the movement that provokes the pain (although there are some cases when this is not true).

If, however, you do not have a neck injury, then avoiding a particular movement won't help your neck be safer. Your cervical vertebrae can flex and extend, rotate, and laterally flex to both sides. You can safely combine movements like flexion and lateral flexion or extension and rotation if you stay in a range of motion that is manageable for you. Having more positions in which the joint space can be balanced will protect a joint (or group of joints such as the neck) from injury more than picking one position to call safe will.

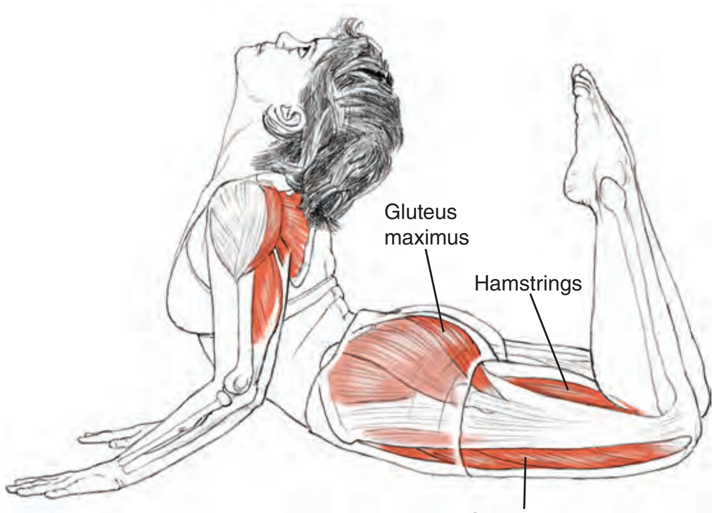
Breathing Inquiry

Although the standard instruction is to inhale while entering into a back bend, it can be liberating to try entering into this basic back bend on an exhalation. Although the front of your rib cage may feel like it is expanding on an inhalation, your spine and the backs of your lungs may feel more at home with the release of an exhalation while you move into this pose. Try it both ways and see what you notice. Which breath you choose to use to enter a pose can have a profound effect on you experience as you remain in the shape and continue breathing.



BHUJANGASANA VARIATION

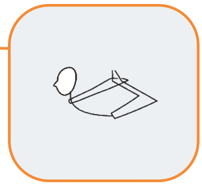
With Knees Flexed



Notes

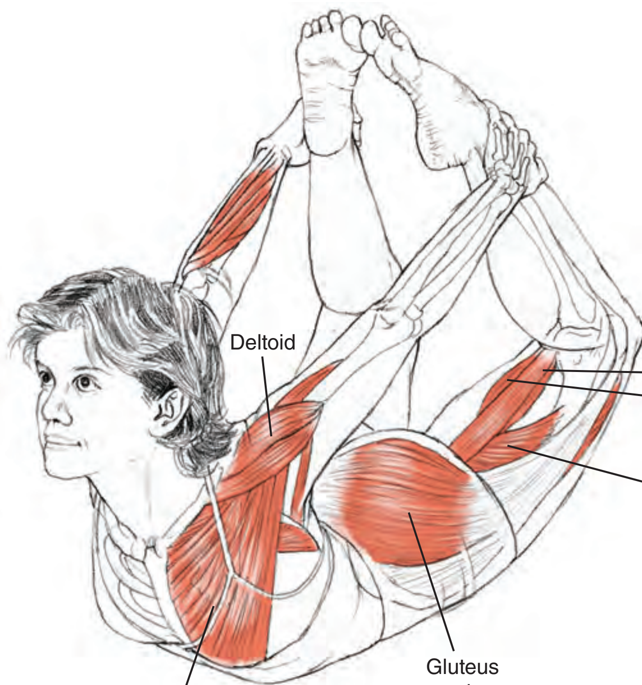
Keeping your legs adducted and parallel might be easier with your knees extended than with your knees bent. When your knees are flexed and your hips extended in this position, the backs of your entire legs are at a very short length, while the fronts of your legs lengthen over both your hip joints and your knee joints.

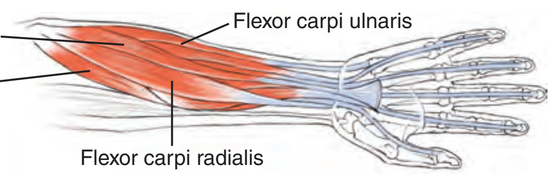
DHANURASANA



Bow Pose

don-your-AHS-anna
dhanu = bow





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular adduction; shoulder joint internal rotation, extension, and adduction; elbow extension; forearm pronation; finger and hand flexion	SI joint counternutation, hip extension and adduction, knee flexion, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine		
CONCENTRIC CONTRACTION		**ECCENTRIC CONTRACTION**
To extend spine: Spinal extensors		**To prevent overmobilization of lumbar spine:** Psoas minor, abdominal muscles
Upper limbs		
CONCENTRIC CONTRACTION		**ECCENTRIC CONTRACTION**
To adduct scapula: Rhomboids **To stabilize shoulder joint:** Rotator cuff	**To extend shoulder joint:** Posterior deltoid, teres major, triceps brachii **To pronate forearm:** Pronator quadratus and teres	**To resist pull of arm on scapula:** Pectoralis major and minor, coracobrachialis, anterior deltoid
Lower limbs		
CONCENTRIC CONTRACTION		
To extend, adduct, and internally rotate hip and flex knee: Hamstrings, adductor magnus, gluteus maximus		**To plantar flex ankle:** Soleus

Notes

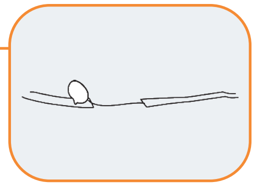
This pose can be explored in a variety of ways by emphasizing different actions: deepening the action in your spine, increasing hip extension, or using knee extension to deepen spinal and hip extension, for example. The balance of movement in your hips and knees will be affected depending on whether you engage the backs of your legs (to extend your hips) or the fronts of your legs (to extend your knees).

Because this is a bound pose, with your hands grasping your ankles, it is possible to direct a lot of force into your joints. Your knees and the fronts of your shoulder joints might be especially vulnerable. The organization of your legs at your hips and the activation of your feet can help to maintain the integrity of your knees, and the mobilization of your scapulae can help balance the joint space in your shoulders.

Breathing Inquiry

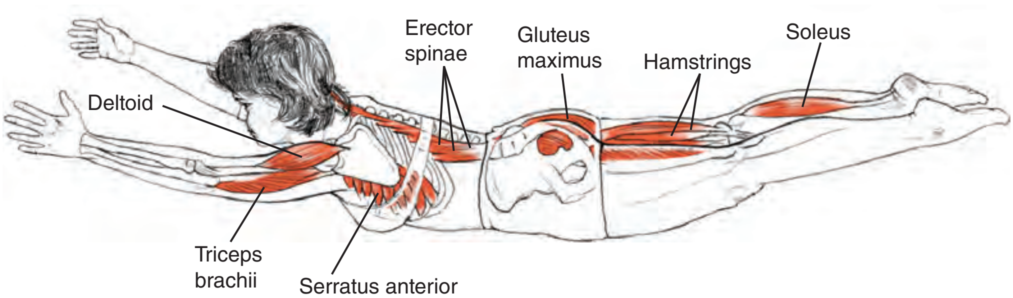
One exploration is to rock back and forth in this pose by pushing your belly into the floor with each inhalation. It is also interesting to try to minimize rocking by directing your inhalation away from the abdominal region. There are benefits to be explored in both movement and stillness. What is your experience?

SALABHASANA



Locust Pose

sha-la-BAHS-anna
salabha = grasshopper, locust



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular upward rotation, elevation, and abduction; shoulder joint flexion; elbow extension	SI joint counternutation, hip extension and adduction, knee extension, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION

To extend spine:
Spinal extensors

Upper limbs

CONCENTRIC CONTRACTION

To upwardly rotate and elevate scapula:
Serratus anterior

To stabilize shoulder joint:
Rotator cuff

To flex shoulder joint:
Anterior deltoid, biceps brachii (long head)

To extend elbow:
Triceps brachii

To pronate forearm:
Pronator quadratus and teres

Lower limbs

CONCENTRIC CONTRACTION

To extend, adduct, and internally rotate hip:
Hamstrings, adductor magnus, gluteus maximus

To extend knee:
Vastii

To plantar flex ankle:
Soleus

Notes

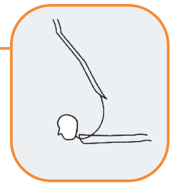
It can be a challenge to lift your arms from prone while your spine is in extension. If the muscles around your scapulae and arms are also recruited to extend your spine, they can inadvertently get in the way of lifting your arms.

This position of your legs uses a complex interaction among adductors, medial rotators, and hip extensors. Many of the muscle actions that lift and support your body in this position create other actions that must be neutralized by opposing or synergistic muscles. Different priorities or points of focus will generate different experiences (as in all asana), which also depend on where you start and your preexisting patterns and habits.

Breathing Inquiry

To rock, or not to rock? Does it feel like all the weight of your body is brought to bear on your abdomen in this variation? If you hold this pose for several breaths, does your body rock back and forth with the action of your diaphragm? As in bow pose, an interesting challenge is to keep from rocking, allowing the floor to push into a yielding abdomen, rather than your abdomen pushing against the resistance of the floor.

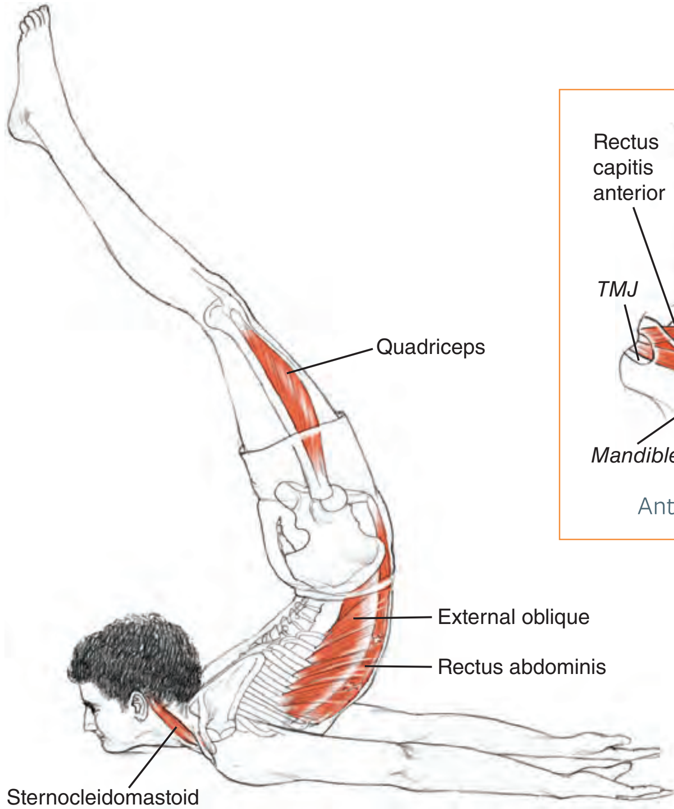
VIPARITA SALABHASANA

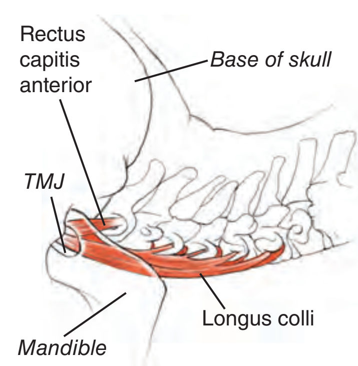


Full Locust Pose

vip-par-ee-tah sha-la-BAHS-anna

viparita = reversed, inverted; *salabha* = grasshopper, locust





Anterior neck muscles.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular downward rotation, elevation, and abduction; shoulder joint internal rotation, flexion, and adduction; elbow extension	SI joint counternutation, hip extension and adduction, knee extension, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
ECCENTRIC CONTRACTION	
To keep pelvis and leg from dropping into floor: Abdominal muscles, psoas minor	**To prevent hypermobilizing of cervical spine:** Anterior neck muscles
Upper limbs	
CONCENTRIC CONTRACTION	
To stabilize shoulder joint: Rotator cuff **To abduct scapula:** Serratus anterior	**To flex shoulder joint and lift body weight:** Pectoralis major, anterior deltoid, biceps brachii, coracobrachialis
Lower limbs	
ECCENTRIC CONTRACTION	
To keep leg from dropping behind head: Psoas major, vastii	

Notes

What it takes to move into this pose is nearly the opposite of what it takes to remain in it. Lifting the weight of your body into spinal extension requires a significant action of your arms and spinal extensors. Then once past vertical, gravity pulls the weight of your body into extension, so the trunk flexors must engage to prevent hyperextension. Based on the balance of strength and flexibility in your extensor and flexor muscle groups, you might have the ability to get into full locust but not to sustain it, or you might find you can't get there by yourself but can stay there if assisted into the pose.

Breathing Inquiry

As with many back bends, it is useful to try exhaling while lifting your body into locust pose. This may work better for you because releasing your diaphragm's contraction can create more space between the base of your rib cage and the front of your spine, which move away from each other in this pose.

If you can remain in this pose for several breaths, can you notice how it affects your breath to have your abdominal wall both lengthened and engaged? How does the action of pushing your arms into the floor affect your breathing? Does having your neck in weight-bearing extension add resistance to your airway? Does your breath in full locust pose feel similar to other inverted positions? Can you use your breath to exit from this pose in a controlled, smooth manner, rather than simply falling out of it?

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13

ARM SUPPORT POSES

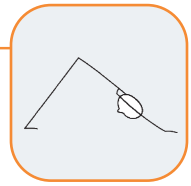
Despite their obvious similarities, your upper and lower extremities have evolved to perform different functions. The structures of your foot, knee, hip, and pelvis point to their functions of support and locomotion, while the highly mobile structures of your hand, elbow, and shoulder girdle have evolved to reach and grasp.

Within the proportional structures of your hand and foot, there is an inverse relationship between the weight-bearing and the articular structures. In your foot, the heavy, dense tarsal bones comprise half the length of its structure. Adding to the weight-bearing function of the metatarsals, it can be said that four fifths of your foot's structure is dedicated to bearing weight. Your foot's phalangeal structures (your toes) contribute one fifth of its total length.

These proportions are reversed in your hand, in which half the length is composed of the highly mobile phalangeal (finger) bones. Your hand's metacarpals are also very mobile (compared to your metatarsals), whereas the less mobile carpals (wrist bones) comprise one fifth of the total length of your hand.

When you use your upper limbs in weight-bearing poses, it usually takes extra attention to create clear pathways of weight so that too much force isn't directed into joints that might easily overmobilize. While weight-bearing might not be as easily organized in your hands as in your feet, taking the time to learn how to organize support through your hands and upper limbs can be a terrific recuperation for the ways people habitually use their hands, arms, shoulders, and upper backs while sitting at desks and using computers.

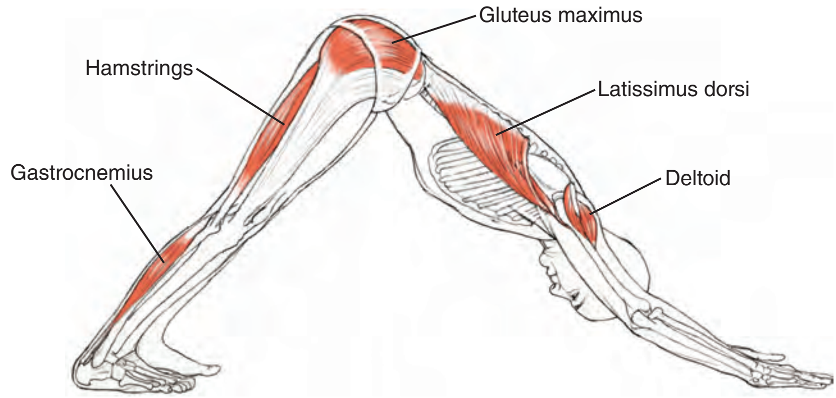
ADHO MUKHA SVANASANA

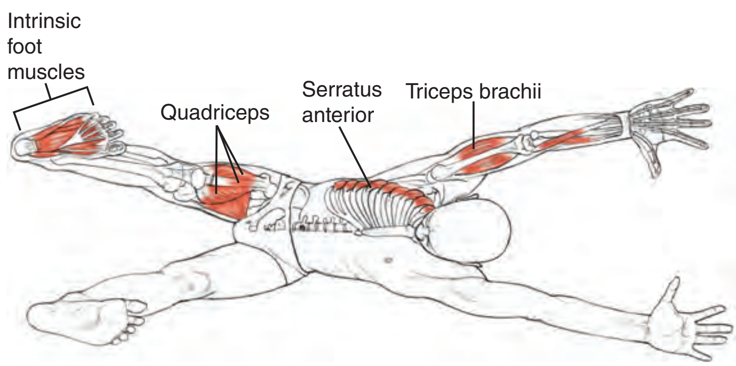


Downward-Facing Dog Pose

AH-doh MOO-kah shvah-NAHS-anna

adho = downward; *mukha* = face; *shvana* = dog





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Neutral spine	Scapular upward rotation and elevation, shoulder joint flexion, elbow extension, forearm pronation, wrist dorsiflexion	Sacroiliac (SI) joint nutation, hip flexion, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine

To calibrate concentric and eccentric contractions to maintain neutral alignment of spine:
Spinal extensors and flexors

Upper limbs

CONCENTRIC CONTRACTION

To upwardly rotate and abduct scapula on rib cage:
Serratus anterior

To stabilize shoulder joint:
Rotator cuff

To flex shoulder joint:
Deltoid, biceps brachii (long head)

To extend elbow:
Triceps brachii

To pronate forearm:
Pronator quadratus and teres

To maintain integrity of hand:
Intrinsic muscles of wrist and hand

Lower limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To internally rotate, adduct, and move femur back in hip socket: Adductor magnus **To extend knee:** Articularis genu, vastii **To maintain arches of foot without inhibiting dorsiflexion of ankle:** Intrinsic muscles of foot	**To prevent overarticulating in hip joint:** Hamstrings

Notes

There are many approaches to working with adho mukha svanasana, many ideas about how to do it correctly, and many statements about its benefits. As with any asana (see chapter 7), it is impossible to say what benefit this asana will have for someone. We can certainly describe potential effects of the pose, but whether those changes are beneficial or not depends on the individual.

Adho mukha svanasana, for example, qualifies as an inversion because your head is lower than your heart, and thus has an effect on your heart rate and blood pressure. What exactly that effect is depends on the resilience of your cardiovascular system; after an initial increase, your heart rate and blood pressure might remain elevated or return to a lower level. That response depends on a variety of circumstances in your life: age, fitness, medications you take, and so on. And whether the experience is restful or stimulating or calming or agitating depends on your own past experiences and associations.

This asana engages both your arms and legs in supporting your spine. The clarity of the pathway of weight through your shoulder girdle is especially important because your arms are both overhead and weight-bearing, which might be an unfamiliar combination of activities. (See Cueing Callout on next page.)

The latissimus dorsi are often recruited to help “pull the shoulders down” and to assist in the action of your arms, but these muscles actually internally rotate and extend your arms (pulling them down from overhead) and depress your scapulae (pulling them away from your arms), which can create an impingement at your acromion process in your shoulder.

The intrinsic action in your hands to find and keep their spiraling pathways of weight (like the pathways in your feet) is important for the integration of your whole arm and for joining your feet in bearing the weight of your body. If rotation between your radius and ulna is limited in your forearms, you might end up overmobilizing your elbows or wrists.

Your upper and lower limbs’ pathways into your spine are at an angle to the pull of gravity (rather than perpendicular to the floor). This might call on different muscle patterns than being perpendicular to the floor and might help you notice your usual patterns and habits.

Breathing Inquiry

From the perspective of your breath, can you experience this pose as an inversion? How does your breath naturally move in this position? Because in inversions gravity tends to move your diaphragm cranially (toward your head), try deepening the exhaling action of your abdominal muscles. Is it possible for you to maintain your lower abdominal engagement when initiating your inhalation (maintain mula bandha)? This can encourage your thoracic structures to mobilize, which can be challenging in an arm-supported pose.

(continued)

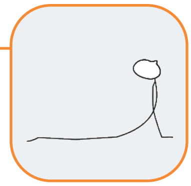
Cueing Callout: Don't Pull Down Your Shoulder Blades

In poses in which your upper limbs are bearing weight, a common concern is how to stabilize your shoulder joints so they are not injured. For this reason, students are frequently told to "pull your shoulder blades down your back" to protect their shoulders. The position of your scapula on your rib cage does not necessarily determine the integrity of your shoulder joint, however, and keeping the position of your scapulae fixed doesn't mean your shoulder joints are safe. Because of how your shoulder joints and shoulder girdle work, this "pulling down" can instead lead to overmobilization of your shoulder joints.

Here is why. There are four joints in your shoulder girdle: glenohumeral joint (humerus and scapula), acromioclavicular joint (scapula and clavicle), sternoclavicular joint (clavicle and sternum, and scapulothoracic joint (scapula and ribs). Your shoulder joint is technically your glenohumeral joint. The range of motion in just this joint is about 90 degrees to the front and side, less to the back. If you want to lift your arms higher than 90 degrees to the front or to the side (above shoulder height), then your scapulae also need to move on your rib cage, which is movement at your scapulothoracic joint. This movement of your scapulae on your rib cage allows your shoulder joints (glenohumeral joints) to move through space and greatly increases the range of motion of your arms.

When you lift your arms overhead but pull your shoulders down your back, you are pulling the bones that compose your glenohumeral joint in opposite directions, by taking your humerus bones away from your scapulae. This pulling apart movement doesn't help the joint space in your glenohumeral joint be balanced, and doesn't facilitate a clear pathway of weight through the bones (see page 13).

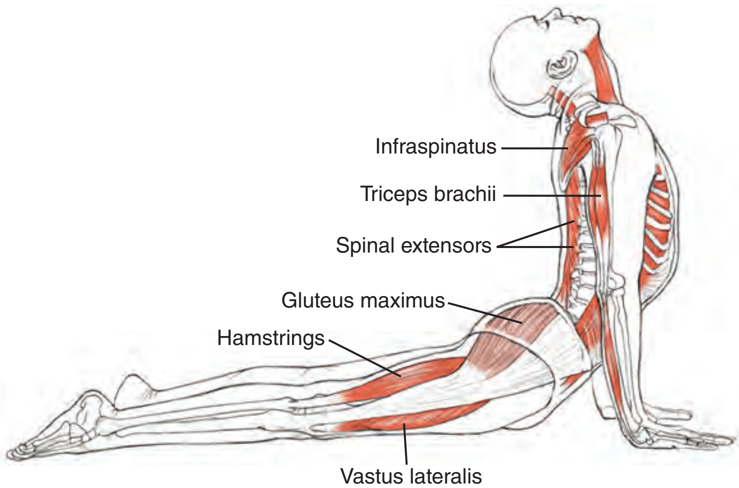
URDHVA MUKHA SVANASANA

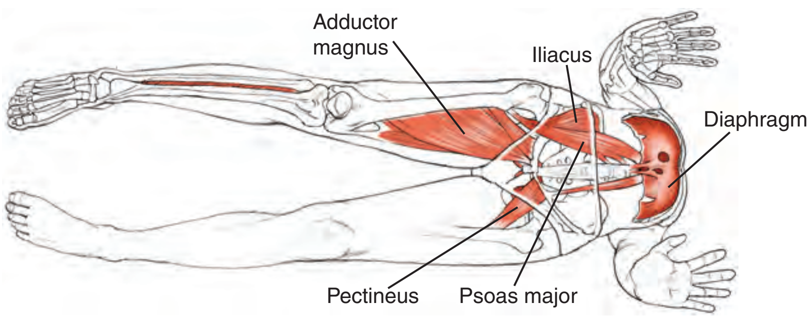


Upward-Facing Dog Pose

OORD-vah MOO-kah shvah-NAHS-anna

urdhva = rising or tending upward, raised, elevated; *mukha* = face; *shvana* = dog





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Shoulder joint extension and adduction, elbow extension, forearm pronation	SI joint counternutation, hip extension and adduction, knee extension, ankle plantar flexion

(continued)

Urdhva Mukha Svanasana *(continued)*

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend spine, especially thoracic curve: Spinal extensors	**To prevent overmobilization of lumbar spine:** Psoas minor, abdominal muscles **To resist hyperextension in cervical spine as head extends:** Anterior neck muscles

Upper limbs	
CONCENTRIC CONTRACTION	
To stabilize scapula on rib cage and translate push of arm into clavicle: Serratus anterior **To stabilize shoulder joint:** Rotator cuff	**To extend shoulder joint:** Posterior deltoid **To extend shoulder joint and elbow:** Triceps brachii **To pronate forearm:** Pronator quadratus and teres

Lower limbs	
CONCENTRIC CONTRACTION	
To extend, adduct, and internally rotate hip: Hamstrings, adductor magnus **To extend knee:** Articularis genu, vastii	**To plantarflex ankle:** Soleus

Notes

One way to approach this pose is to try to distribute the spinal extension through your whole spine. For most people, this means trying to minimize the extension in your lumbar and cervical spine, while emphasizing the extension in your thoracic spine. For the muscles of your torso, this translates into concentric work for the extensors in your thoracic spine and eccentric work for the flexors in your cervical and lumbar spines.

The muscles that pull your scapulae down the back are not helpful in this pose because they can fix your scapulae on your rib cage and inhibit extension in your thoracic spine. They also produce internal rotation of your humerus and depression and downward rotation of your scapulae, which is the opposite of what needs to happen for full extension of your thoracic spine.

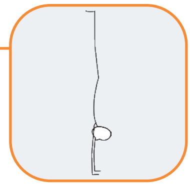
Either internal or external rotation of your upper arm bones might be useful, depending on how your scapulae are moving and how you are coming into the pose. The intrinsic muscles of each hand help distribute pressure through your whole hand to protect the heels of your hands and to decrease pressure in your wrists.

The sequence of chaturanga, upward dog, downward dog—in that order—has become ubiquitous in vinyasa class sequencing. Interestingly, the reverse of this movement (downward dog to upward dog to chaturanga) is seldom practiced in class sequences.

Breathing Inquiry

As the counterpose to adho mukha svanasana (page 272), which is often entered into on an exhalation, this pose is often cued to the action of inhaling. What happens if you reverse that order? If you hold this pose for several breaths, what do you notice in the front and back of your body when you inhale and when you exhale?

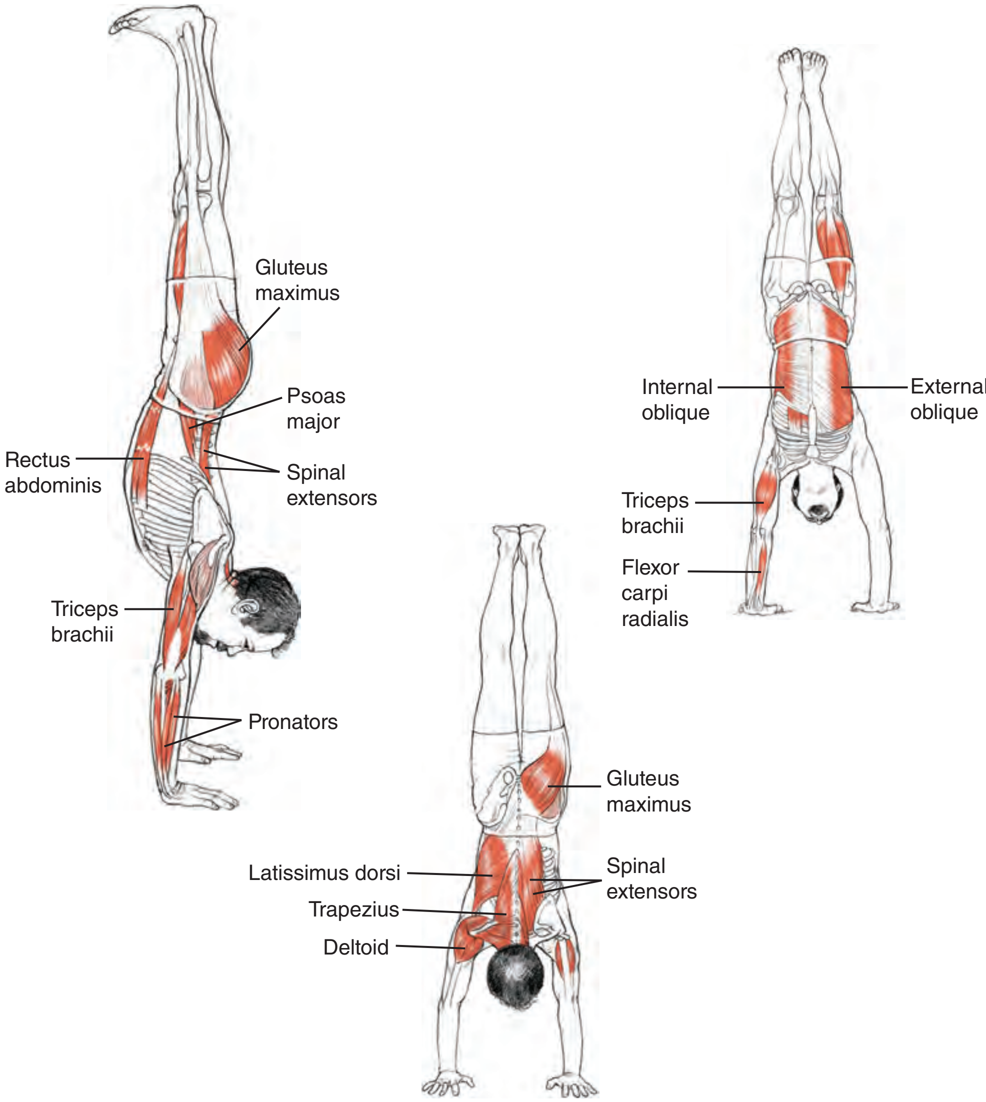
ADHO MUKHA VRKSASANA



Downward-Facing Tree Pose

AH-doh MOO-kah vrik-SHAHS-anna

adho = downward; *mukha* = face; *vrksa* = tree



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical extension, slight thoracic and lumbar extension	Scapular upward rotation and abduction, shoulder joint flexion, elbow extension, forearm pronation, wrist dorsiflexion	Hip neutral extension and adduction, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
To calibrate concentric and eccentric contractions to maintain neutral alignment of spine: Spinal extensors and flexors	

Upper limbs	
CONCENTRIC CONTRACTION	
To upwardly rotate and abduct scapula on rib cage: Serratus anterior **To stabilize shoulder joint:** Rotator cuff **To flex shoulder joint:** Deltoid, biceps brachii (long head)	**To extend elbow:** Triceps brachii **To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand

Lower limbs	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To extend, adduct, and internally rotate leg to neutral: Hamstrings, adductor magnus, gluteus maximus	**To resist leg falling back:** Psoas major, iliacus

Notes

This pose asks your hands and your upper limbs to support all your body weight while you balance upside down. As in adho mukha svanasana, the movement of your shoulder girdle (upward rotation and abduction) to stay in relationship to your upper arm bones supports having your arms both overhead and bearing weight.

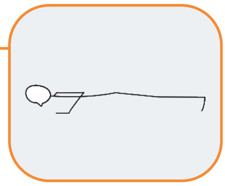
Also like adho mukha svanasana, your spine in this pose might be in extension, axial extension, or neutral. Different ways of doing the asana might be challenging or easy for you, depending on your previous experiences and movement habits.

While it can be challenging to maintain the integrity of your hands with all the weight of your body balancing on them, the intrinsic activity in your hands is an important support for your wrists and for the nerves passing through your carpal tunnels. Finding support from your deep, intrinsic muscles can help the pose be both stable and fluid, which might help your ability to breathe.

Breathing Inquiry

This can be one of the most difficult poses in which to breathe effectively because of the challenges of balancing, inverting, and performing strong upper body actions. Do you tend to instinctively hold your breath? If so, is it partly out of fear or is it because you need to stabilize the many movements of your spine to create a single center of gravity? If you can maintain this balance for more than a few seconds, how do you integrate your breath into the pose in a way that doesn't disrupt your balancing or stabilizing actions?

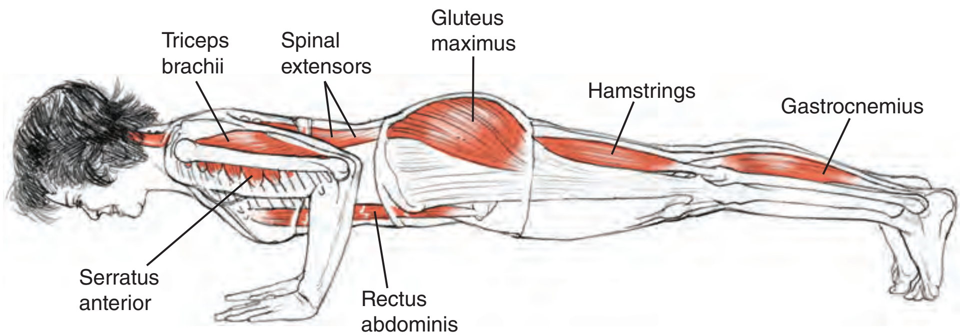
CHATURANGA DANDASANA

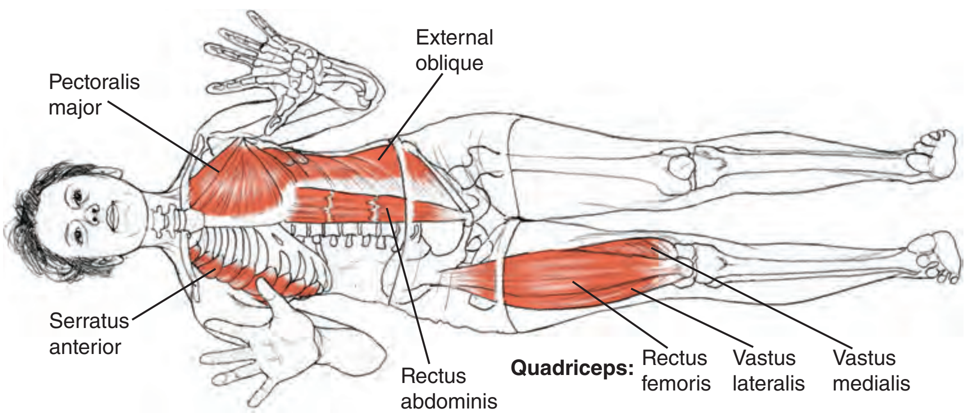


Four-Limbed Stick Pose

chaht-tour-ANG-ah dan-DAHS-anna

chatur = four; *anga* = limb; *danda* = staff, stick





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Neutral spine	Scapular abduction, elbow flexion, forearm pronation, wrist dorsiflexion	Hip neutral extension and adduction, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
To calibrate concentric and eccentric contractions to maintain neutral alignment of spine: Spinal extensors and flexors	
Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To prevent scapular winging: Serratus anterior **To stabilize and protect shoulder joint:** Rotator cuff, deltoid **To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand	**To resist extension of shoulder joint created by pull of gravity:** Pectoralis major and minor, coracobrachialis **To extend elbow:** Triceps brachii
Lower limbs	
CONCENTRIC CONTRACTION	
To maintain neutral hip extension and adduction: Hamstrings, adductor magnus, gluteus maximus **To adduct hip:** Gracilis	**To extend knee:** Articularis genu, vastii **To create dorsiflexion:** Tibialis anterior **To support weight of leg on toes:** Intrinsic and extrinsic foot muscles

Notes

One of the challenges of this pose is keeping your spine in its neutral curves while parallel to the floor. As gravity tries to pull your hips and lumbar spine into extension, it's easy to overcompensate and flex your spine, flex your hips, or round your shoulders forward.

Depending on your existing habits and patterns, you might need to focus on keeping your hips in neutral extension (without flexing or dropping toward the floor), keeping your scapulae connected to your collarbones and rib cage (without overly protracting, retracting, or winging), or moving only as far into the elbow flexion as you feel allows you to keep the integrity of the connection between your limbs and spine.

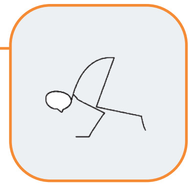
Breathing Inquiry

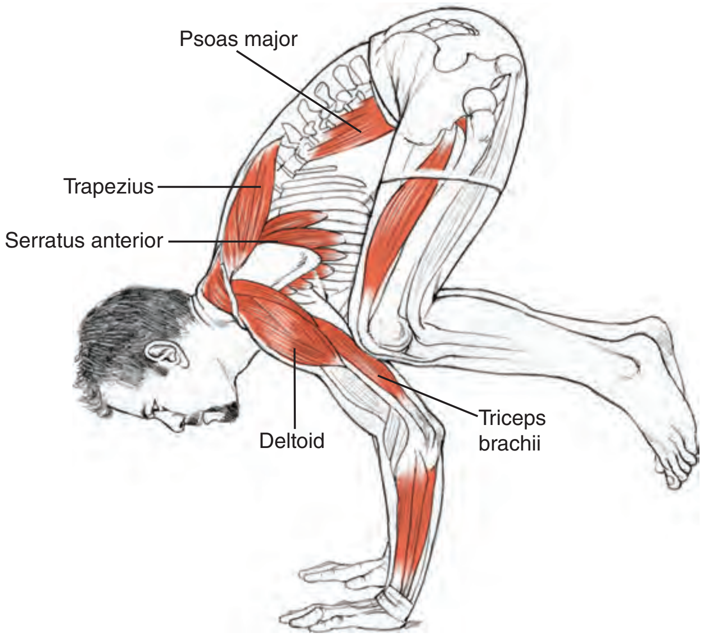
Maintaining this position relative to gravity calls into play all your respiratory muscles along with your arms and shoulder girdle. Can you sense this degree of muscular effort producing a strong stabilizing effect on the movements of your diaphragm? How can your muscular effort be as efficient as possible? Is it possible to maintain both the alignment and smooth breathing for increasingly longer periods of time? Vocalizing in this asana is an interesting way to challenge and explore your breath and postural integrity.

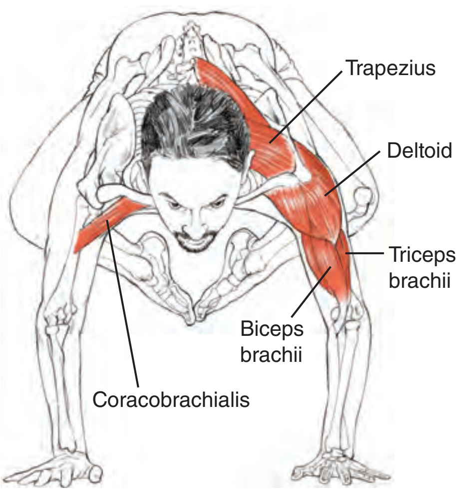
BAKASANA

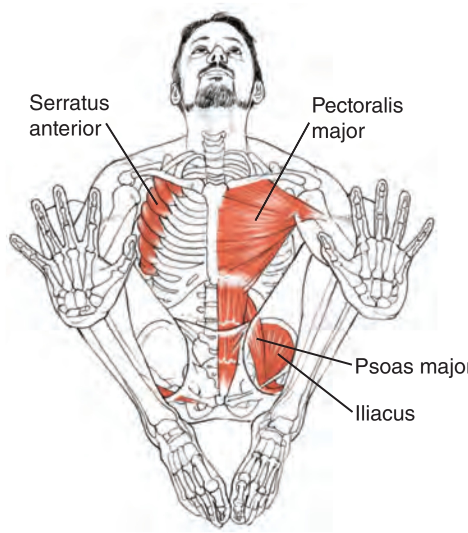
Crow Pose, Crane Pose

bak-AHS-anna
baka = crow, crane, heron









SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical extension, thoracic and lumbar flexion	Scapular abduction, shoulder joint flexion and adduction, elbow flexion moving toward extension, forearm pronation, wrist dorsiflexion	SI joint nutation, hip flexion and adduction, knee flexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	
To extend cervical spine: Rectus capitis posterior, obliquus capitis superior	**To create deep flexion in lumbar spine:** Psoas major (upper fibers), psoas minor, abdominal muscles, pelvic floor
Upper limbs	
CONCENTRIC CONTRACTION	
To abduct scapula: Serratus anterior, pectoralis major and minor, coracobrachialis **To stabilize and protect shoulder joint:** Rotator cuff, deltoid **To extend elbow:** Triceps brachii	**To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand
Lower limbs	
CONCENTRIC CONTRACTION	
To flex hip: Psoas major, iliacus **To adduct and flex hip:** Pectineus, adductor longus and brevis	**To flex knee:** Lower hamstrings

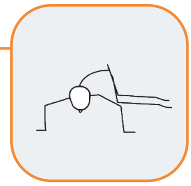
Notes

The bird poses (crow, eagle, rooster, peacock) have these joint actions in common: flexion of your thoracic spine, abduction of your scapulae, and extension of your cervical spine. Doing these movements requires precision, strength, and articulation to extend your cervical spine without recruiting the muscles that would interfere with the action of your scapulae and arms. Although initially you widen your knees to get into this position, the final action of your legs is adduction, hugging your knees to the sides of your upper arms or outer shoulders.

Breathing Inquiry

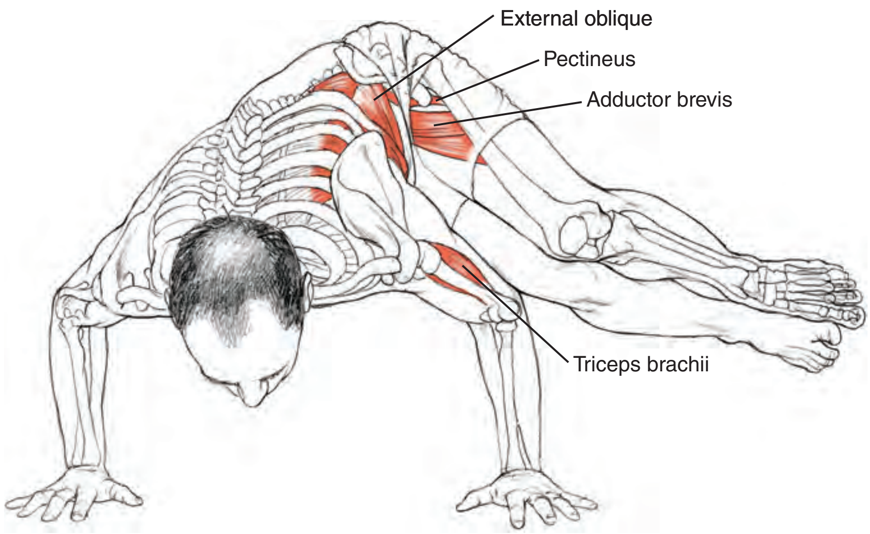
Because your thoracic region is maintained in flexion, can you feel your breath movements in the front of your rib cage being minimized in this pose? Is the movement in your lower abdomen also stabilized somewhat by the deep abdominal and hip flexor action? Where is your breath relatively free to move?

PARSVA BAKASANA



Side Crow Pose, Side Crane Pose

parsh-vah bak-AHS-anna
parsva = side; *baka* = crow, crane, heron



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical extension, rotation	Scapular abduction, shoulder flexion and adduction, elbow flexion moving toward extension, forearm pronation, wrist dorsiflexion	Hip flexion and adduction, knee flexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	
To extend cervical spine: Rectus capitis posterior, obliquus capitis superior	**To rotate spine:** Internal oblique, erector spinae (bottom side); external oblique, multifidi, rotatores (top side)
Upper limbs	
CONCENTRIC CONTRACTION	
To abduct scapula: Serratus anterior, pectoralis major and minor, coracobrachialis **To stabilize and protect shoulder joint:** Rotator cuff, deltoid **To extend elbow:** Triceps brachii	**To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand
Lower limbs	
CONCENTRIC CONTRACTION	
To flex hip: Psoas major, iliacus	**To adduct and flex hip:** Pectineus, adductor longus and brevis

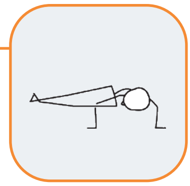
Notes

In this rotated pose, your spine is more extended than in bakasana (page 282). If your knees separate in this pose, the rotation might be happening more in your hip joints than in your spine.

Breathing Inquiry

Is your breathing in this pose similar to that in bakasana? What else do you notice because of the twisting of your spine?

ASTAVAKRASANA

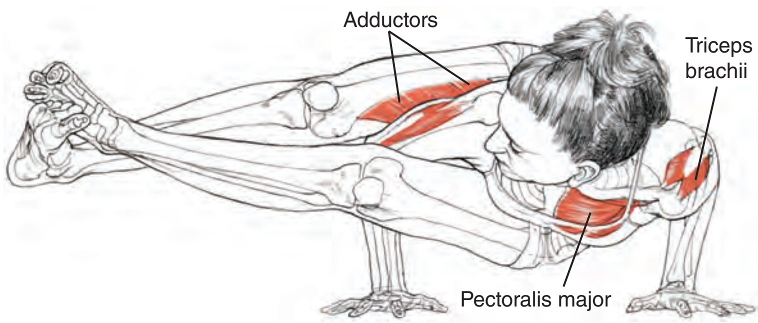


Eight-Angle Pose

AHSH-tak-vah-KRAHS-anna

ashta = eight; *vakra* = crooked, curved, bent

Astavakra was a learned sage whose mother attended Vedic chanting classes while pregnant. While he was in his mother's womb, he winced at eight of his father's mispronunciations of Vedic prayers and was thus born with eight bends in his body.



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical extension, rotation	Scapular abduction, shoulder joint flexion and adduction, elbow flexion moving toward extension, forearm pronation, wrist dorsiflexion	Hip flexion and adduction, knee extension, ankle dorsiflexion, foot eversion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION

To extend cervical spine:
Rectus capitis posterior, obliquus capitis superior

To rotate spine:
Internal oblique, erector spinae (bottom side); external oblique, multifidi, rotatores (top side)

Upper limbs

CONCENTRIC CONTRACTION

To abduct scapula:
Serratus anterior, pectoralis major and minor, coracobrachialis

To stabilize and protect shoulder joint:
Rotator cuff, deltoid

To extend elbow:
Triceps brachii

To pronate forearm:
Pronator quadratus and teres

To maintain integrity of hand:
Intrinsic muscles of wrist and hand

Lower limbs	
CONCENTRIC CONTRACTION	
To flex hip: Psoas major, iliacus **To adduct and flex hip:** Pectineus, adductor longus and brevis **To extend knee:** Articularis genu, vastii	**To dorsiflex ankle:** Tibialis anterior **To evert foot:** Peroneals

Notes

This pose requires almost the same action in your spine as parsva bakasana (page 284); your spine might be slightly more extended (toward neutral) in astavakrasana, which allows for a more even distribution of the rotation throughout your spine.

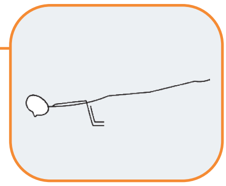
In astavakrasana, the binding of your feet keeps your legs symmetrical. This symmetry in your legs and hip joints means that the rotation has to happen more in your spine and less in your hip joints. With the wrapping of your legs around your arm, less twist is needed than in parsva bakasana because your bottom leg doesn't have to move to the top of your arm, but stays under it.

As in ardha matsyendrasana (page 201), if your spine is not able to rotate to the degree called for in this pose, you might find that the twisting happens more in your scapulae on your rib cage. Also, the wrapping of your legs around your arm creates a fairly stable pivot point, which can make this pose more about balance and flexibility than strength.

Breathing Inquiry

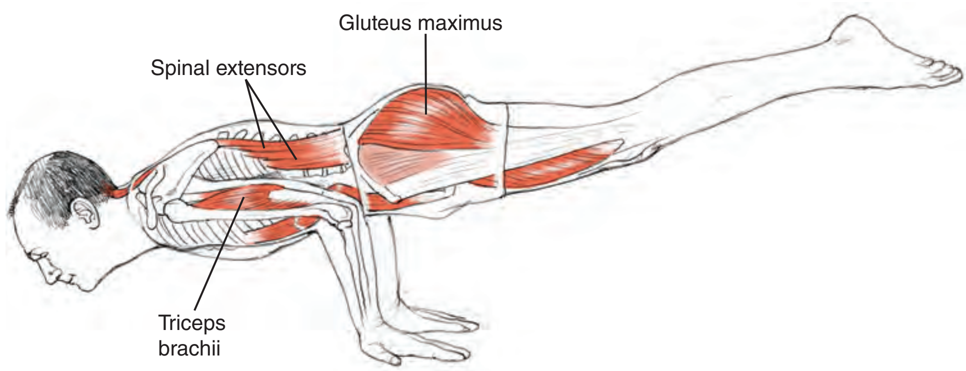
Compare parsva bakasana, in which your body weight is lifted and supported on your upper arms, with astavakrasana, in which you suspend the weight of your lower body from the support of your upper arms. Which pose affords easier breathing? Which pose requires more or less expenditure of energy? Which offers more freedom of movement for your diaphragm? Does your experience change when doing this on one side or the other?

MAYURASANA



Peacock Pose

ma-your-AHS-anna
mayura = peacock



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical extension, thoracic flexion, lumbar extension	Scapular abduction, shoulder joint adduction, elbow flexion, forearm supination, wrist dorsiflexion	Hip extension and adduction, knee extension, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine

CONCENTRIC CONTRACTION

To extend cervical spine:
Rectus capitis posterior, obliquus capitis superior

To flex lower thoracic spine:
Psoas major (upper fibers)

To extend lumbar spine:
Spinal extensors (lower fibers)

Upper limbs

CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To abduct scapula: Serratus anterior, pectoralis major and minor, coracobrachialis **To stabilize and protect shoulder joint:** Rotator cuff, deltoid **To stabilize elbow:** Biceps brachii, brachialis **To supinate forearm:** Supinator **To maintain integrity of hand:** Intrinsic muscles of wrist and hand	**To stabilize elbow:** Triceps brachii

Lower limbs	
CONCENTRIC CONTRACTION	
To extend, adduct, and internally rotate hip: Hamstrings, adductor magnus, gluteus maximus	**To extend knee:** Articularis genu, vastii **To plantarflex ankle:** Soleus

Notes

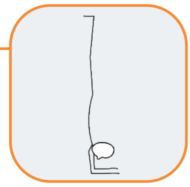
As in other bird poses (eagle, crow, rooster), mayurasana involves flexion of your thoracic spine, abduction of your scapulae, and extension of your cervical spine. In most arm-balancing poses, your forearms are in pronation, but in this pose they are supinated, which changes the action in your elbows and might call different muscles into use.

A variation of mayurasana with your legs in padmasana (lotus) is generally easier to do because the lever of your legs is shortened by folding them in.

Breathing Inquiry

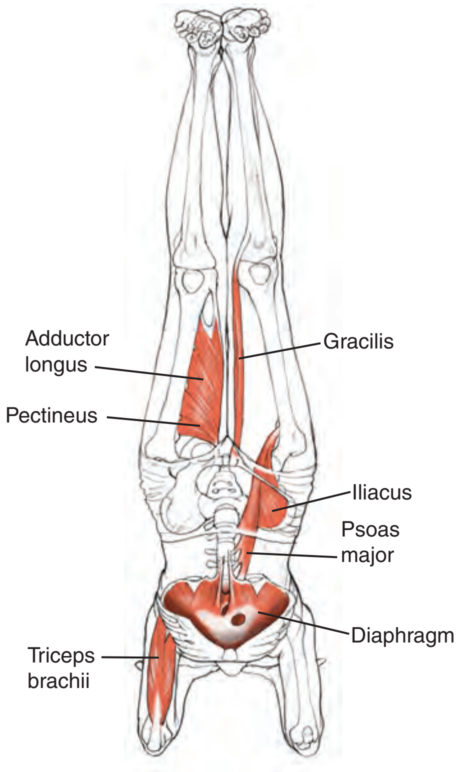
In mayurasana, your abdominal muscles activate to resist the pressure of your elbows into your viscera. Your abdominal organs are being strongly squeezed from front and back, as well as from above and below, by your respiratory and pelvic diaphragms. If you maintain this pose for very long, where is there room for your breathing? Considering how much muscular energy you expend to maintain this pose and the minimal amount of breathing it permits, it's no wonder that it is rarely held for more than a few breaths.

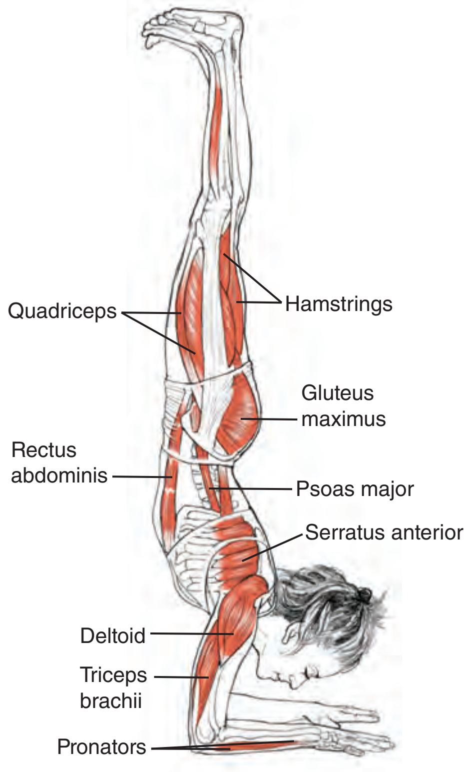
PINCHA MAYURASANA



Feathered Peacock Pose

pin-cha ma-your-AHS-anna
pincha = a feather of a tail; *mayura* = peacock





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular upward rotation, elevation, and abduction; shoulder joint flexion and adduction; elbow flexion; forearm pronation	Hip adduction and neutral extension, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To lift head away from floor: Rectus capitis posterior, obliquus capitis superior **To maintain extension of spine and keep from falling into flexion:** Spinal extensors	**To keep from falling into extension:** Psoas major (upper fibers), psoas minor, abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To upwardly rotate, abduct, and elevate scapula: Serratus anterior **To stabilize and protect shoulder joint:** Rotator cuff, deltoid **To resist shoulder joint extension:** Anterior deltoid **To flex and adduct shoulder joint:** Biceps brachii, anterior deltoid **To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand	**To resist elbow flexion and falling onto face:** Triceps brachii
Lower limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To maintain neutral hip extension and adduction: Hamstrings, adductor magnus, gluteus maximus **To adduct hip:** Gracilis **To extend knee:** Articularis genu, vastii **To create dorsiflexion:** Tibialis anterior	**To prevent leg falling backward:** Psoas major

Notes

In this asana, finding a clear connection in your shoulder joints can free your scapulae to mobilize on your rib cage, which allows more freedom in your thoracic spine for extension and in your rib cage for the movements of breathing. Mobility in your thoracic spine can be helpful; much like in urdhva mukha svanasana (page 275), the more extension available in your thoracic spine, the less your lower back and cervical spine have to do.

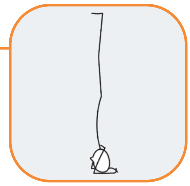
If habitual holding patterns in your forearms (either in your supinators or in your interosseous membranes between your radius and your ulna) restricts full pronation, your elbows might swing open or your hands might move together. This is often interpreted as "tightness" in your shoulders or weakness in your wrists, but instead has to do with mobility in your forearm.

Holding patterns in the muscles of your back (such as the latissimus dorsi) can also pull your elbows wide by internally rotating your humerus bones. This can feel like "tight shoulders," but might actually be addressed by side bending and other actions that free up your sides and back.

Breathing Inquiry

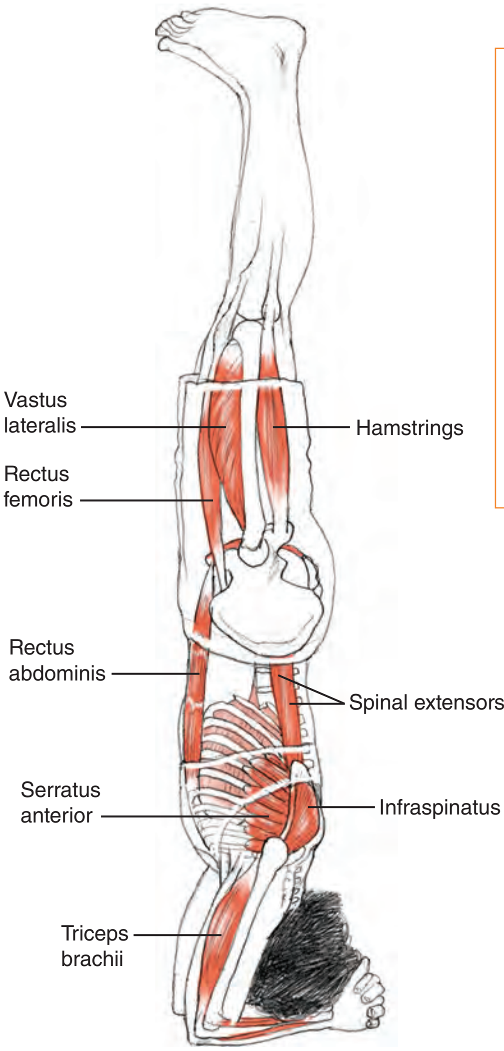
The base of support for this pose is formed by your forearms, rib cage, and thoracic spine, and these structures need to be stable to maintain balance. Does too much chest breathing interfere with your ability to support this forearm stand? On the other hand, because the weight of your legs and pelvis and the curve of your lumbar spine need to be stabilized by your abdominal muscles, is too much abdominal movement counterproductive? What do you notice if you focus on a breathing pattern that moves equally and smoothly throughout your body?

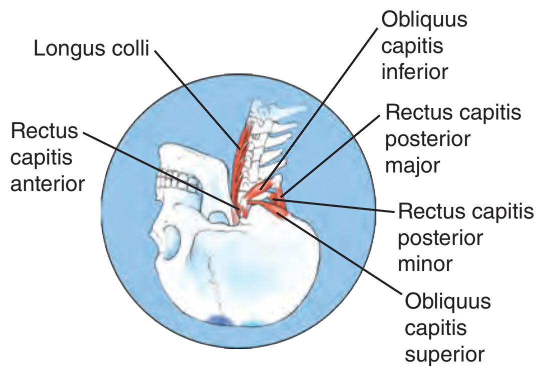
SALAMBA SIRSASANA



Supported Headstand

sah-LOM-bah shear-SHAHS-anna
sa = with; *alamba* = that on which one rests or leans, support; *sirsa* = head





Deep neck muscles.

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Neutral spine	Scapular upward rotation; shoulder joint flexion and adduction; elbow flexion; neutral forearm, hand, and finger flexion	Hip adduction and neutral extension, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
To calibrate concentric and eccentric contractions to maintain neutral alignment of spine: Spinal extensors and flexors	**To balance and stabilize atlantoaxial and atlanto-occipital joint:** Rectus capitis anterior, rectus capitis posterior major and minor, obliquus capitis superior and inferior, longus capitis and colli
Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To upwardly rotate scapula: Serratus anterior **To stabilize and protect shoulder joint:** Rotator cuff, deltoid **To maintain integrity of hand:** Intrinsic muscles of wrist and hand	**To resist elbow flexion:** Triceps brachii
Lower limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To maintain neutral hip extension and adduction: Hamstrings, adductor magnus, gluteus maximus **To adduct hip:** Gracilis **To extend knee:** Articularis genu, vastii **To create dorsiflexion:** Tibialis anterior	**To prevent leg falling backward:** Psoas major

(continued)

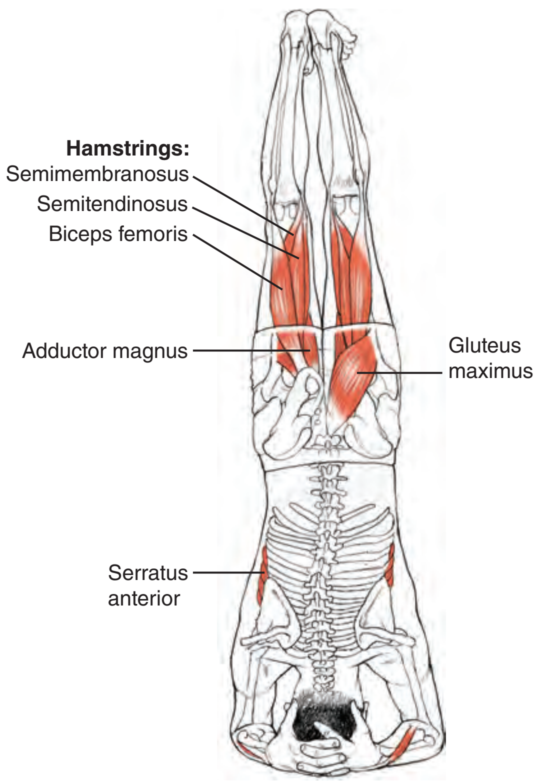
Notes

Many things are said about where to place the weight on your skull for a headstand. For some, the ideal placement of the weight on your skull is on your bregma—the juncture between your coronal and sagittal sutures, where your frontal bone meets your two parietal bones. This leads to a slightly more arched final position, which might engage your back muscles more than the front of your body and make balancing easier. Placing the weight more toward the crown of your head leads to a more neutral spine and more action in both the front and back of your body.

Many people have asymmetries and slight rotations in their spines, which sometimes become more apparent in this pose. Note the rotational shifts and other asymmetries in the illustration of one of the authors in salamba sirsasana.

It can be a challenge for some people to find full hip extension in this pose. If your abdominal muscles are not part of how you find support in this pose, you might flex your hips to keep your balance and keep the work of the pose more focused in your back muscles.

It is commonly said that this pose (and other inversions) increases oxygen supply to your brain because the pull of gravity increases blood flow to your head. This is not accurate; the circulatory system has mechanisms to control the amount of blood moving to any region of your body, no matter what your relationship is to gravity. (Regional changes in blood pressure have been observed based on inversion or compression of major blood vessels by body position, but this is a distinct issue from movement of blood volume and thus oxygen delivery.) That said, inversions do offer an opportunity for increased venous return from the lower body as well as the possibility of improved lymph drainage.



The asymmetries of one of the authors are exaggerated in salamba sirsasana.

Even if you favor the bregma version of this pose and enter into salamba sirsasana with straight legs (and with the intention to end up in a more arched position), practicing the bent-leg entry into this pose can help you develop more strength, coordination, and adaptability while in the pose. One challenge is to see whether you can raise the weight of your legs from your feet without jumping and maintain the pose known as acunchanasana (bent-legged headstand) for several breaths.

Acunchanasana.

Breathing Inquiry

If you can derive the support for salamba sirsasana from the deeper intrinsic muscles of your spine and the coordinated actions of the muscles of your legs, torso, and shoulder girdle, the weight forces of your body are more easily supported in gravity. With the muscular effort to remain in the pose minimized, do you sense that your breath is calm and efficient? Does this inverted pose emphasize certain actions of your diaphragm? Can you sense that your diaphragm acts differently on your internal organs during inversion? How does this affect their movement?

a

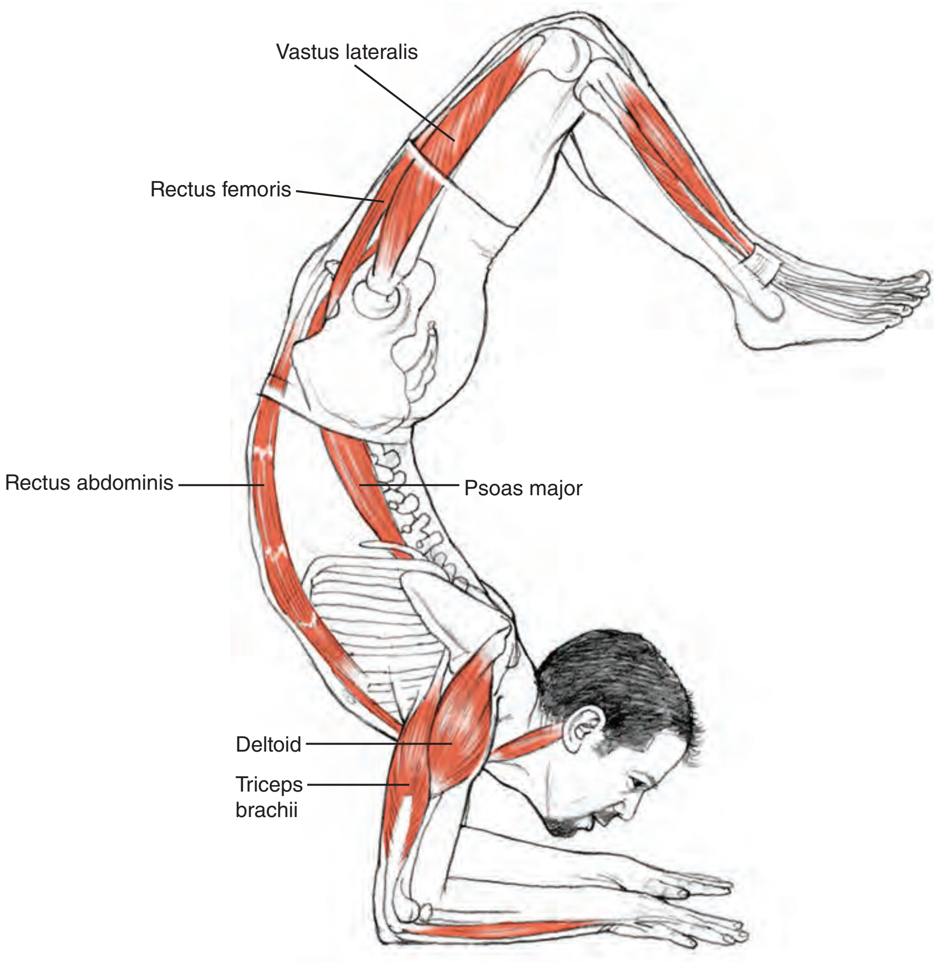
b

Supporting the weight on your bregma—the darker blue spot in figure *a*—results in the slightly more arched position in figure *b*. Supporting weight near your crown—the lighter blue spot in figure *a*—leads to a more neutral spine position.

VRSCHIKASANA

Scorpion Pose

vrs-chee-KAHS-anna
vrschana = scorpion



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular upward rotation, elevation, and adduction; shoulder joint flexion and adduction; elbow flexion; forearm pronation	Hip extension and adduction, knee flexion, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To lift head away from floor: Rectus capitis posterior, obliquus capitis superior **To maximize extension of spine:** Spinal extensors	**To keep from falling into extension:** Psoas major (upper fibers), psoas minor, abdominal muscles
Upper limbs	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To stabilize and protect shoulder joint: Rotator cuff, deltoid **To resist shoulder joint extension and adduct shoulder joint:** Biceps brachii, anterior deltoid **To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand	**To stabilize scapula as it adducts:** Serratus anterior **To resist elbow flexion and falling onto face:** Triceps brachii
Lower limbs	
CONCENTRIC CONTRACTION	
To extend, adduct, and internally rotate hip and flex knee: Hamstrings, adductor magnus, gluteus maximus	**To adduct hip and flex knee:** Gracilis

Notes

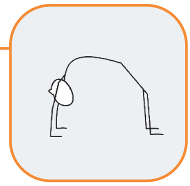
Pincha mayurasana (page 290) is sometimes considered a preparation for vrschikasana. Because of its lower center of gravity, vrschikasana can be an easier pose in which to balance. To move from pincha mayurasana into the deeper back bend of vrschikasana, your scapulae need to slide together on your back, which lowers your rib cage toward the floor and helps to create more mobility in your thoracic spine. Your head can then lift, and your thoracic spine can extend farther. This also changes the pivot point for balancing from between your shoulders to farther down your spine, closer to your sacrum. The lifting of your head is important when shifting the balance point; otherwise, your legs might cause you to fall backward.

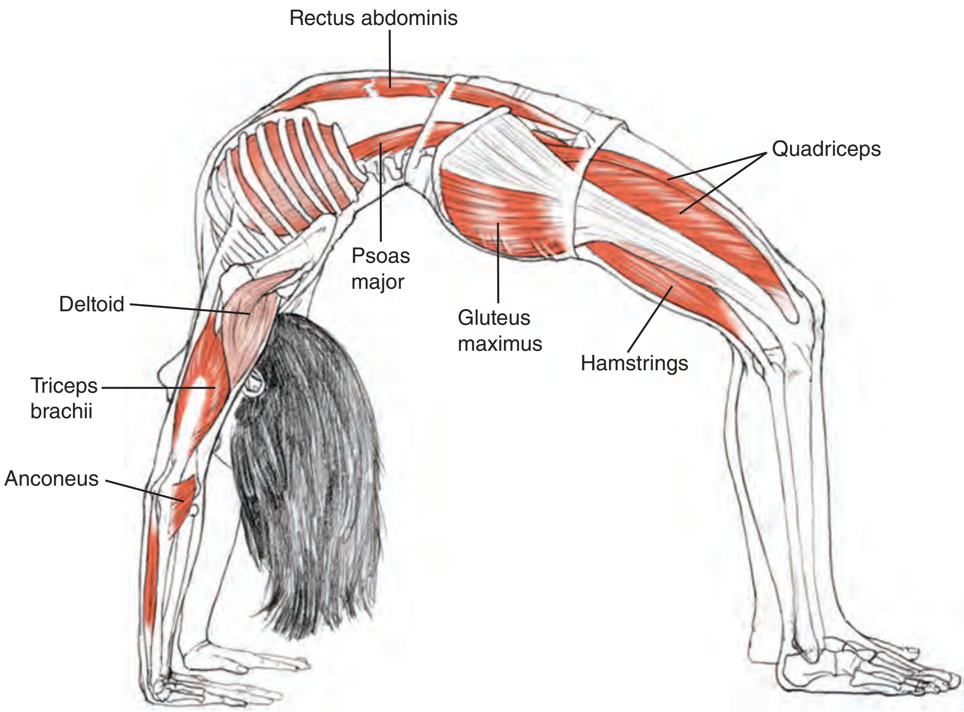
As your knees bend and your feet move toward your head, your hamstrings are at their shortest working length and might cramp while trying to execute the leg action of hip extension combined with knee flexion. If you want to focus on being able to move out of this pose and find the relative neutrality of pincha mayurasana again, practice it in a smaller range, entering and exiting the pose with control.

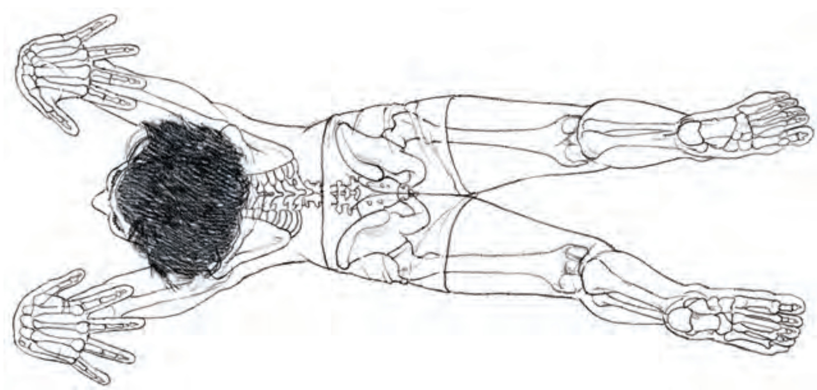
URDHVA DHANURASANA

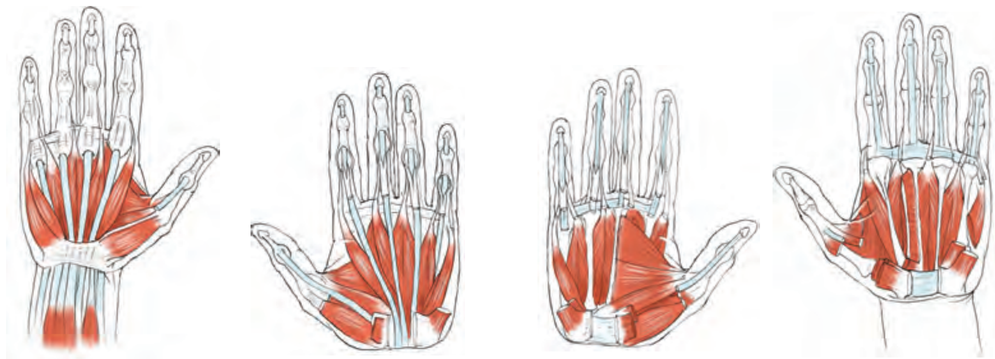
Upward Bow Pose, Wheel Pose

OORD-vah don-your-AHS-anna
urdhva = upward; *dhanu* = bow









a b c d

(a-d) Hand musculature mirroring the layers found in the foot (page 125).

SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular upward rotation and elevation, shoulder joint flexion, elbow extension, forearm pronation, wrist dorsiflexion, hand and finger extension	Hip extension and adduction, knee flexion, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To maximize extension of spine: Spinal extensors	**To keep from hyperextending lumbar spine:** Psoas minor, abdominals
Upper limbs	
CONCENTRIC CONTRACTION	
To upwardly rotate and elevate scapula: Serratus anterior	**To extend elbow:** Triceps brachii
To stabilize and protect shoulder joint: Rotator cuff, deltoid	**To pronate forearm:** Pronator quadratus and teres
To flex shoulder joint: Biceps brachii, anterior deltoid	**To maintain integrity of hand:** Intrinsic muscles of wrist and hand
Lower limbs	
CONCENTRIC CONTRACTION	
To extend hip: Hamstrings, gluteus maximus	**To extend knee:** Articularis genu, vastii
To extend, adduct, and internally rotate hip: Adductor magnus, gracilis	

(continued)

Notes

For some people, coming into this pose is more difficult than staying in it. Using your legs to push your body weight toward your arms when you try to lift can increase the work for your arms and make it harder to get your upper body off the floor. Focusing on lifting your pelvis through hip extension and pulling the weight of your body over your legs might make coming up easier for your upper limbs.

A variety of muscles help extend your hips, and most of them are also either adductors or abductors. Hip extensors that are also adductors and internal rotators (such as the adductor magnus) are more useful than hip extensors that are also abductors and external rotators (such as the gluteus maximus), which pull your knees apart. Keeping your legs from externally rotating and spreading apart can support the pathway of force from your legs into your spine through your sacroiliac joints.

Your arms need to move freely overhead in this pose. This is accomplished by a combination of mobility in your scapulae and a clear pathway of weight in your shoulder joints. Your hips also need to be able to extend. If your shoulder girdle and hips don't have the range you need, you'll require too much movement in your lumbar spine.

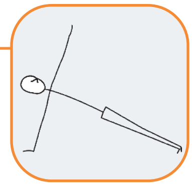
Breathing Inquiry

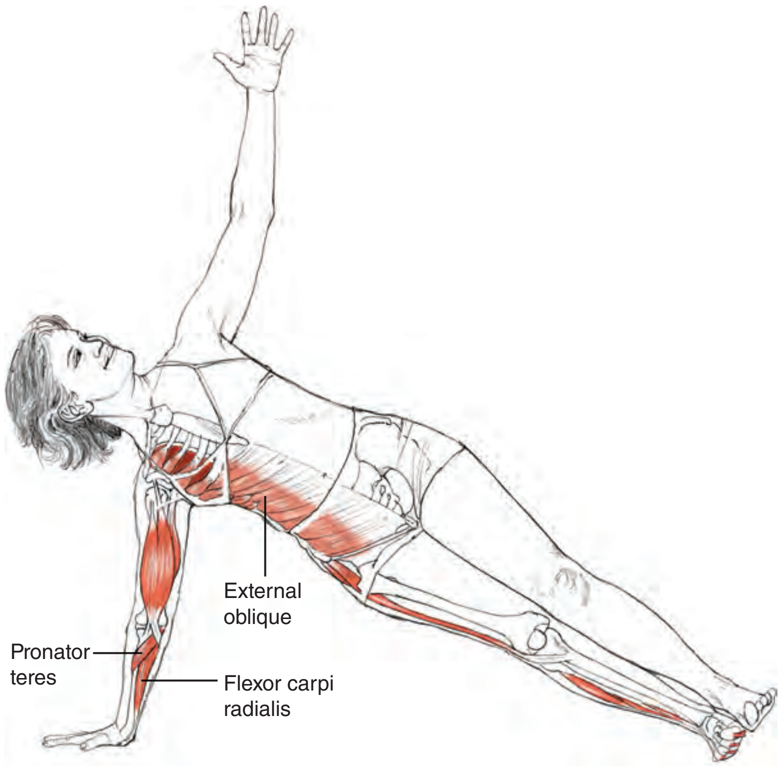
What do you notice if you attempt to take deep, full breaths in urdhva dhanurasana? In this shape, you can do little to further expand the front of your body when attempting to inhale. What do you notice if you focus on your exhalation or if you try quiet, relaxed breathing? Whatever breath pattern you try, the more efficient your muscle action in the pose, the less oxygen you'll need to fuel the effort.

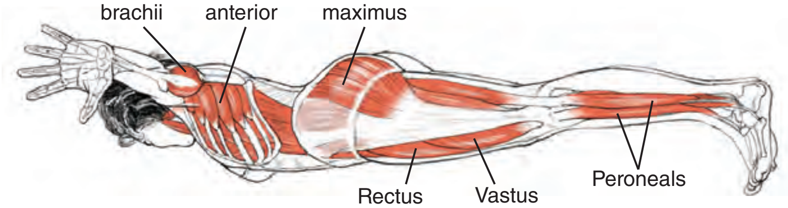
VASISTHASANA

Side Plank Pose, Sage Vasistha's Pose

vah-sish-TAHS-anna
vasistha = a sage; most excellent, best, richest







(*continued*)

SKELETAL JOINT ACTIONS

Spine	Upper limbs			Lower limbs
		Bottom arm	Top arm	
Neutral spine	Neutral scapula, shoulder joint abduction, elbow extension	Forearm pronation, wrist dorsiflexion	Neutral wrist and forearm	Hip neutral extension and adduction, knee extension, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine		
ALTERNATING CONCENTRIC AND ECCENTRIC CONTRACTIONS	CONCENTRIC CONTRACTION	ECCENTRIC CONTRACTION
To maintain neutral alignment of spine: Spinal extensors and flexors	**To resist top hip twisting forward:** External oblique (top side); internal oblique (bottom side) **To rotate head upward:** Splenius capitis (top side); sternocleidomastoid (bottom side) **To resist hip dropping to floor:** Quadratus lumborum (bottom side)	**To resist hip falling back:** Internal oblique (top side); external oblique (bottom side)

Upper limbs	
CONCENTRIC CONTRACTION	
To maintain scapula position on rib cage: Serratus anterior **To stabilize and protect shoulder joint:** Rotator cuff **To abduct shoulder joint:** Deltoid	**To extend elbow:** Triceps brachii **To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand

Lower limbs	
CONCENTRIC CONTRACTION	
To maintain neutral hip extension and adduction: Hamstrings, adductor magnus, gluteus maximus **To extend knee:** Articularis genu, vastii	**To create dorsiflexion:** Tibialis anterior **To evert foot:** Intrinsic and extrinsic foot muscles

Notes

As in chaturanga and handstand, a significant challenge of this pose is not one of flexibility, but instead of maintaining the neutral alignment of your spine and legs and the simple positions of your arms against the force of gravity. The asymmetrical relationship to gravity means that your muscles have to work asymmetrically to create a symmetrical alignment of your body—essentially tadasana (page 122) turned on its side.

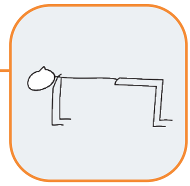
There are many ways that gravity pulls your body out of tadasana in this pose: your spine may twist, your hips may fall forward or your shoulders may fall back (or vice versa), your bottom scapula and bottom leg may both adduct, or your pelvis may move toward the floor. It's easy to overcompensate by lifting your hips too high or to create lateral flexion of your spine in either direction by either giving in to gravity or overresisting it.

Side plank pose is simple, but not easy.

Breathing Inquiry

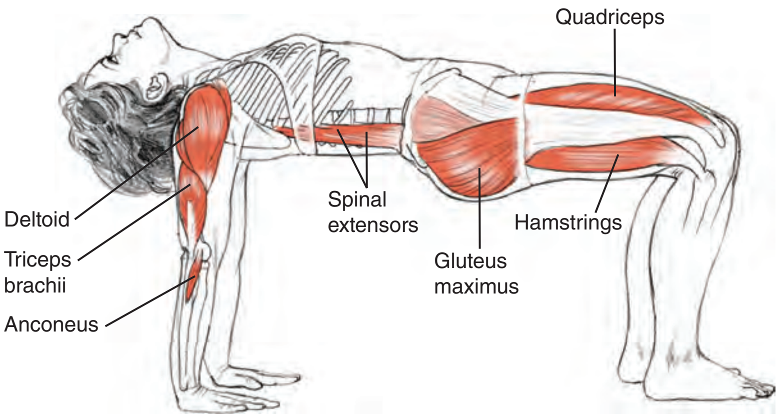
From the standpoint of your breath, can you notice a similarity between this pose and niralamba sarvangasana (page 244)? Both are challenging balancing poses that require much stabilizing action in your abdominal and thoracic musculature. Does side plank seem easier because your arms can be used for support and balance? Does deep breathing have the effect of destabilizing the pose?

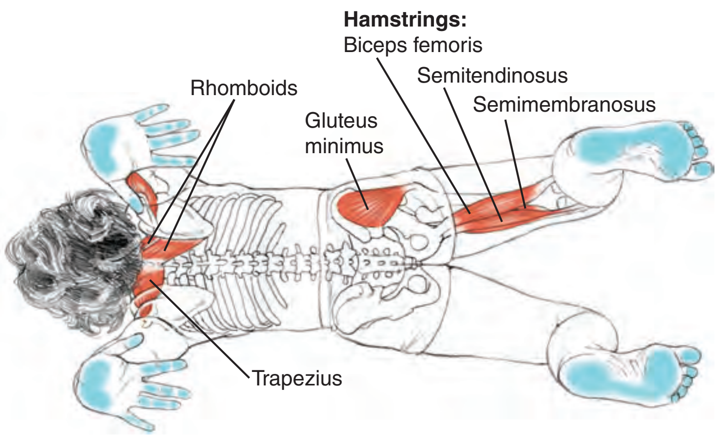
CHATUS PADA PITHAM



Four-Footed Tabletop Pose

CHA-toos PA-da PEE-tham
chatur = four; *pada* = foot; *pitham* = stool, seat, chair, bench





SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Cervical extension, slight thoracic and lumbar extension	Scapular adduction and elevation; shoulder joint extension; elbow extension; wrist dorsiflexion	SI joint counternutation, hip extension and adduction, knee flexion, ankle dorsiflexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend spine, especially thoracic curve: Spinal extensors	**To resist hyperextension in cervical and lumbar spine:** Anterior neck muscles, psoas minor, abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	
To adduct and elevate scapula: Rhomboids, levator scapulae **To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff **To extend and adduct shoulder joint:** Triceps brachii (long head), teres major, posterior deltoid	**To extend elbow:** Triceps brachii **To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand

Lower limbs	
CONCENTRIC CONTRACTION	
To extend hip: Hamstrings, gluteus maximus **To extend, adduct, and internally rotate hip:** Adductor magnus, gracilis	**To extend knee:** Articularis genu, vastii

Notes

In both this pose and purvottanasana (page 307), finding hip extension while moving away from the floor can be demanding for the muscles on the backs of your legs. As in urdhva dhanurasana, combining hip extension, adduction, and internal rotation in your legs can help keep pressure out of your sacrum and lower back.

This pose (and purvottanasana) also requires extension at your shoulder joints and the mobilization of your scapulae to support that extension. Weight-bearing with your arms in extension is generally less familiar for most people and might reveal habitual holding patterns in the fronts of your shoulder joints and upper chest.

Breathing Inquiry

Unlike urdhva dhanurasana (page 298), chatus pada pitham is not an extreme spinal extension that can restrict movement of the back of your thoracic cavity. However, does the extension of your arms at your shoulder joints inhibit the movement of the front of your thoracic cavity, particularly if there is habitual holding across the front of your chest? What do you notice if you encourage your breath to move more into your abdomen? The combination of lifting action in your back body and release in your front body makes for an interesting opportunity to experiment by moving your breath around your abdominal and thoracic regions. Do some breathing patterns have more of an effect on the stability of the pose? Do others assist in opening your upper rib cage?

(continued)

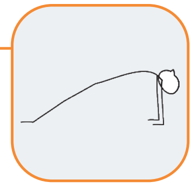
Cueing Callout: You Can't "Use Your Hamstrings" to Lift Your Pelvis

You might hear an instruction in class such as "use your hamstrings to lift your pelvis" or "engage your quads to lift your kneecap." While it is true that those particular muscles participate in generating those particular actions, the instructions are problematic.

From a muscular perspective, there's always more than one muscle engaged in a movement and different people use different muscles and different levels of engagement in the same muscles to create the same movement. From the perspective of our nervous system, we cannot engage our hamstrings by engaging the specific motor nerves to the hamstring muscles. What we can do is plan to create the sensation we have associated with "hamstrings firing" and let our motor nerves and muscles create that sensation for us. This may or may not actually engage the hamstring muscles (or might engage muscles besides the hamstrings) depending on the sensation we're using as a model. These kinds of instructions give a false idea about how much we can directly control in the execution of movement patterns.

We can certainly execute an action in such a way that our hamstrings (or psoas, or quads, or any other popularly named muscle) are engaged, but it happens because of how we organize the whole pattern of movement, not because we can command our nervous system to fire a muscle. As a teaching instruction, it would be more accurate, honest, and inclusive to simply describe or demonstrate the movement and let each person's body find their own way of doing it.

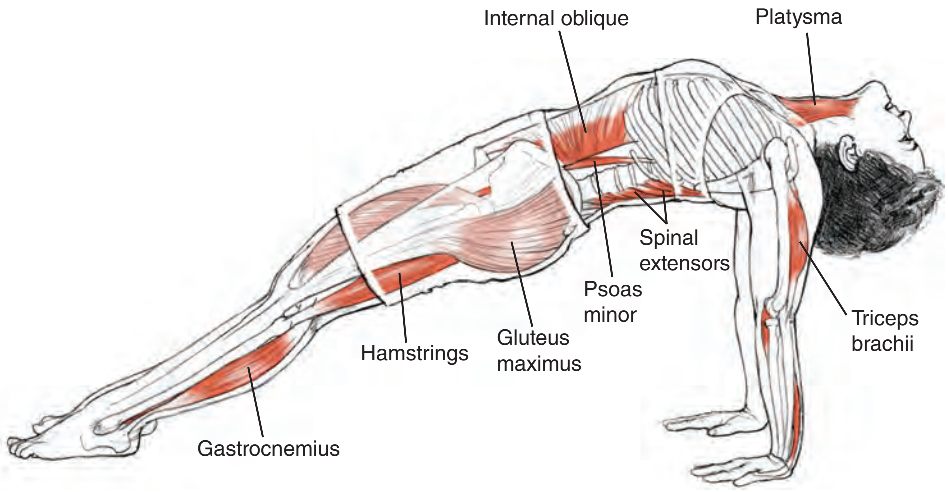
PURVOTTANASANA



Upward Plank Pose

POOR-vo-tan-AHS-anna

purva = front, east; *ut* = intense; *tan* = extend, spread



SKELETAL JOINT ACTIONS

Spine	Upper limbs	Lower limbs
Extension	Scapular downward rotation, elevation, and adduction; shoulder joint extension; elbow extension; wrist dorsiflexion	SI joint counternutation, hip extension and adduction, knee extension, ankle plantar flexion

SELECTED MUSCULAR ACTIONS

Spine	
CONCENTRIC CONTRACTION	**ECCENTRIC CONTRACTION**
To extend spine, especially thoracic curve: Spinal extensors	**To resist hyperextension in cervical and lumbar spine:** Anterior neck muscles, psoas minor, abdominal muscles

Upper limbs	
CONCENTRIC CONTRACTION	
To adduct, elevate, and downwardly rotate scapula: Rhomboids, levator scapulae **To stabilize shoulder joint and prevent protraction of head of humerus:** Rotator cuff **To extend and adduct shoulder joint:** Triceps brachii (long head), teres major, posterior deltoid	**To extend elbow:** Triceps brachii **To pronate forearm:** Pronator quadratus and teres **To maintain integrity of hand:** Intrinsic muscles of wrist and hand

(continued)

Purvottanasana *(continued)*

Lower limbs	
CONCENTRIC CONTRACTION	
To extend, adduct, and internally rotate hip: Hamstrings, adductor magnus, gluteus maximus	**To extend knee:** Articularis genu, vastii **To plantarflex ankle:** Soleus

Notes

One challenge in this pose is finding a balance between extension in your lumbar spine and extension in your hip joints. Doing knee extension and hip extension together in this relationship to gravity is demanding on the muscles of the backs of your legs, and sometimes the hip extension is compromised to achieve knee extension. For this reason, chatus pada pitham (page 304) can serve as a preparation pose for purvottanasana. The actions needed in your scapulae, shoulder joints, and upper back are similar to those in salamba sarvangasana (page 241), although with a different relationship to gravity and without the cervical flexion of your neck that brings your head forward.

Breathing Inquiry

As in chatus pada pitham, notice whether the extension of your arms at your shoulder joints in purvottanasana restricts the breath in the front of your thoracic cavity. If you encourage your breath to move more into your abdomen, does that compromise the action needed to maintain hip and knee extension?

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RESOURCES

Leslie Kaminoff's Yoga Anatomy website—The author's website, containing biographical and contact information, international teaching schedule, booking information, online training information, and his eSutra blog and other writing projects: www.yogaanatomy.org.

Amy Matthews' Movement Practices website—The author's website, containing biographical and contact information, online and in-person teaching schedule, and online training information: www.movementpractices.com.

The Breathing Project, Inc.—Educational nonprofit organization founded by Leslie Kaminoff, providing advanced studies for movement educators and therapeutic classes to the public, New York, NY: www.breathingproject.org.

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ASANA INDEXES

IN SANSKRIT AND ENGLISH

SANSKRIT INDEX

Standing Poses

Tadasana—*Mountain Pose* 122
    Variation: Samasthiti—*Equal Standing, Prayer Pose* 127
Utkatasana—*Chair Pose, Awkward Pose* 129
Uttanasana—*Standing Forward Bend* 131
Utthita Hasta Padangusthasana—*Extended Hand–Toe Pose* 133
    Variation: With Spine Flexed 136
Vrksasana—*Tree Pose* 137
    Variation: With Arms Elevated 139
Garudasana—*Eagle Pose* 140
Natarajasana—*King of the Dancers Pose* 143
Virabhadrasana I—*Warrior I* 146
    Variation: With Longer Stance 149
Virabhadrasana II—*Warrior II* 150
Virabhadrasana III—*Warrior III* 153
Utthita Parsvakonasana—*Extended Side Angle Pose* 155
Parivrtta Baddha Parsvakonasana—*Revolved Side Angle Pose* 157
Utthita Trikonasana—*Extended Triangle Pose* 160
    Variation: With Longer Stance 163
Parivrtta Trikonasana—*Revolved Triangle Pose* 164
Parsvottanasana—*Intense Side Spreading* 167
    Variation: With Arms in Reverse Namaskar 169
    Variation: With Spine Flexed 169
Prasarita Padottanasana—*Wide-Stance Forward Bend* 170
Malasana or Upavesasana—*Squat, Garland Pose, Sitting-Down Pose* 172

Sitting Poses

Sukhasana—*Easy Posture* 176
Siddhasana—*Adept's Posture* 176
Svastikasana—*Auspicious Posture* 176
Padmasana—*Lotus Posture* 177
Mulabandhasana—*Pose of the Root Lock* 177
Dandasana—*Staff Pose* 180
Paschimottanasana—*West (Back) Spreading* 182
Janu Sirsasana—*Head-to-Knee Pose* 185
Parivrtta Janu Sirsasana—*Revolved Head-to-Knee Pose* 188
Mahamudra—*The Great Seal* 190
Upavistha Konasana—*Seated Wide-Angle Pose* 192
Baddha Konasana—*Bound-Angle Pose* 194
    Variation: Supta Baddha Konasana—*Reclining Bound-Angle Pose* 197
Kurmasana—*Turtle Pose* 198
    Variation: Supta Kurmasana—*Reclining Turtle Pose* 200
Ardha Matsyendrasana—*Half Lord of the Fishes Pose* 201
Gomukhasana—*Cow-Faced Pose* 204
Hanumanasana—*Monkey Pose* 207
Navasana—*Boat Pose* 210

Kneeling Poses

Vajrasana—*Thunderbolt Posture* 214
Virasana—*Hero's Posture* 214
Balasana—*Child's Pose* 216
Supta Virasana—*Reclining Hero Pose* 218
Ustrasana—*Camel Pose* 220
Eka Pada Rajakapotasana—*One-Legged Royal Pigeon Pose* 223
    Variation: Folded Forward 226
Parighasana—*Gate-Latch Pose* 228
Simhasana—*Lion Pose* 231

Supine Poses

Savasana—*Corpse Pose* 234
Apanasana—*Apana Pose, Wind Release Pose* 236
Setu Bandhasana—*Bridge Pose* 238
    Variation: Dwi Pada Pitham—*Two-Legged Table* 240
Salamba Sarvangasana—*Supported Shoulder Stand* 241

Niralamba Sarvangasana—*Unsupported (No-Arm) Shoulder Stand* 244
Viparita Karani—*Inverted Pose* 246
Halasana—*Plow Pose* 248
Karnapidasana—*Ear-to-Knee Pose* 250
Jathara Parivrtti—*Belly Twist* 252
    Variation: With Legs Extended 253
Matsyasana—*Fish Pose* 254
    Variation: With Arms and Legs Lifted 255
Anantasana—*Reclining Vishnu Couch Pose* 256

Prone Poses

Bhujangasana—*Cobra Pose* 260
    Variation: With Knees Flexed 263
Dhanurasana—*Bow Pose* 264
Salabhasana—*Locust Pose* 266
Viparita Salabhasana—*Full Locust Pose* 268

Arm Support Poses

Adho Mukha Svanasana—*Downward-Facing Dog Pose* 272
Urdhva Mukha Svanasana—*Upward-Facing Dog Pose* 275
Adho Mukha Vrksasana—*Downward-Facing Tree Pose* 278
Chaturanga Dandasana—*Four-Limbed Stick Pose* 280
Bakasana—*Crow Pose, Crane Pose* 282
Parsva Bakasana—*Side Crow Pose, Side Crane Pose* 284
Astavakrasana—*Eight-Angle Pose* 286
Mayurasana—*Peacock Pose* 288
Pincha Mayurasana—*Feathered Peacock Pose* 290
Salamba Sirsasana—*Supported Headstand* 292
Vrschikasana—*Scorpion Pose* 296
Urdhva Dhanurasana—*Upward Bow Pose, Wheel Pose* 298
Vasisthasana—*Side Plank Pose, Sage Vasistha's Pose* 301
Chatus Pada Pitham—*Four-Footed Tabletop Pose* 304
Purvottanasana—*Upward Plank Pose* 307

ENGLISH INDEX

Standing Poses

Mountain Pose—*Tadasana* 122
Variation: Equal Standing, Prayer Pose—*Samasthiti* 127
Chair Pose, Awkward Pose—*Utkatasana* 129
Standing Forward Bend—*Uttanasana* 131
Extended Hand–Toe Pose—*Utthita Hasta Padangusthasana* 133
Variation: With Spine Flexed 136
Tree Pose—*Vrksasana* 137
Variation: With Arms Elevated 139
Eagle Pose—*Garudasana* 140
King of the Dancers Pose—*Natarajasana* 143
Warrior I—*Virabhadrasana I* 146
Variation: With Longer Stance 149
Warrior II—*Virabhadrasana II* 150
Warrior III—*Virabhadrasana III* 153
Extended Side Angle Pose—*Utthita Parsvakonasana* 155
Revolved Side Angle Pose—*Parivrtta Baddha Parsvakonasana* 157
Extended Triangle Pose—*Utthita Trikonasana* 160
Variation: With Longer Stance 163
Revolved Triangle Pose—*Parivrtta Trikonasana* 164
Intense Side Spreading—*Parsvottanasana* 167
Variation: With Arms in Reverse Namaskar 169
Variation: With Spine Flexed 169
Wide-Stance Forward Bend—*Prasarita Padottanasana* 170
Squat, Sitting-Down Pose—*Malasana or Upavesasana* 172

Sitting Poses

Easy Posture—*Sukhasana* 176
Adept's Posture—*Siddhasana* 176
Auspicious Posture—*Svastikasana* 176
Lotus Posture—*Padmasana* 177
Pose of the Root Lock—*Mulabandhasana 177*
Staff Pose—*Dandasana* 180
West (Back) Spreading—*Paschimottanasana* 182
Head-to-Knee Pose—*Janu Sirsasana* 185
Revolved Head-to-Knee Pose—*Parivrtta Janu Sirsasana* 188
The Great Seal—*Mahamudra* 190
Seated Wide-Angle Pose—*Upavistha Konasana* 192

Bound-Angle Pose—*Baddha Konasana* 194
    Variation: Reclining Bound-Angle Pose—*Supta Baddha Konasana* 197
Turtle Pose—*Kurmasana* 198
    Variation: Reclining Turtle Pose—*Supta Kurmasana* 200
Half Lord of the Fishes Pose—*Ardha Matsyendrasana* 201
Cow-Faced Pose—*Gomukhasana* 204
Monkey Pose—*Hanumanasana* 207
Boat Pose—*Navasana* 210

Kneeling Poses

Thunderbolt Posture—*Vajrasana* 214
Hero's Posture—*Virasana* 214
Child's Pose—*Balasana* 216
Reclining Hero Pose—*Supta Virasana* 218
Camel Pose—*Ustrasana* 220
One-Legged Royal Pigeon Pose—*Eka Pada Rajakapotasana* 223
    Variation: Folded Forward 226
Gate-Latch Pose—*Parighasana* 228
Lion Pose—*Simhasana* 231

Supine Poses

Corpse Pose—*Savasana* 234
Apana Pose, Wind Release Pose—*Apanasana* 236
Bridge Pose—*Setu Bandhasana* 238
    Variation: Two-Legged Table—*Dwi Pada Pitham* 240
Supported Shoulder Stand—*Salamba Sarvangasana* 241
Unsupported (No-Arm) Shoulder Stand—*Niralamba Sarvangasana* 244
Inverted Pose—*Viparita Karani* 246
Plow Pose—*Halasana* 248
Ear-to-Knee Pose—*Karnapidasana* 250
Belly Twist—*Jathara Parivrtti* 252
    Variation: With Legs Extended 253
Fish Pose—*Matsyasana* 254
    Variation: With Arms and Legs Lifted 255
Reclining Vishnu Couch Pose—*Anantasana* 256

Prone Poses

Cobra Pose—*Bhujangasana* 260
    Variation: With Knees Flexed 263
Bow Pose—*Dhanurasana* 264
Locust Pose—*Salabhasana* 266
Full Locust Pose—*Viparita Salabhasana* 268

Arm Support Poses

Downward-Facing Dog Pose—*Adho Mukha Svanasana* 272
Upward-Facing Dog Pose—*Urdhva Mukha Svanasana* 275
Downward-Facing Tree Pose—*Adho Mukha Vrksasana* 278
Four-Limbed Stick Pose—*Chaturanga Dandasana* 280
Crow Pose, Crane Pose—*Bakasana* 282
Side Crow Pose, Side Crane Pose—*Parsva Bakasana* 284
Eight-Angle Pose—*Astavakrasana* 286
Peacock Pose—*Mayurasana* 288
Feathered Peacock Pose—*Pincha Mayurasana* 290
Supported Headstand—*Salamba Sirsasana* 292
Scorpion Pose—*Vrschikasana* 296
Upward Bow Pose, Wheel Pose—*Urdhva Dhanurasana* 298
Side Plank Pose, Sage Vasistha's Pose—*Vasisthasana* 301
Four-Footed Tabletop Pose—*Chatus Pada Pitham* 304
Upward Plank Pose—*Purvottanasana* 307

JOINT INDEX

Note: Asterisk (*) indicates art or textual reference only.

Joint	Page number
Foot and ankle	122-128
	150-151
	170-171
	172-173
	200*
	272-273
Forearm and elbow	140-141
	169*
	200*
	264
	272-274
	290-291
	298-299
	301-302
Hand and wrist	169*
	200*
	275-276
	282-283
	298-299
Hip joint	137-138
	190-191
	200*
	201-202
	218-219
	223-227
	298-300
Knee	129-130
	133-135
	140-142
	170
	200*
	201-202
	218-219

Joint	Page number
Sacroiliac (SI)	185-187
	192-193
	218
	304-305
Scapula (scapulothoracic joint)	143-145
	157-159
	201-203
	241-242
	250-251
	304-306
Shoulder (glenohumeral joint)	150-151
	169
	188-189
	200*
	248-249
	282-283
	291*
	292-293
	307-308

Joint		Page number
Spine	Cervical spine	54*
		150-151
		241-242
		248-249
		268-269
		282-283
		290*
		292-295
	Lumbar spine	54*
		133*
		143-145
		178-179
		201-203
		218-219
		254*
		275-276
		298-300
	Thoracic spine	54*
		198-199
		201-203
		250-251
		275-276
		282-283
		290-291
		296-297

MUSCLE INDEX

Note: Asterisk (*) indicates art or textual reference only.

Muscle	Page number
Adductors (adductor longus, adductor brevis, adductor magnus, gracilis, and pectineus)	137-138
	146-149
	151-152
	170-171
	194-195
	207-209
	228-229
	256-257
Biceps brachii	29*
	236*
	282*
Deltoid	204-205
	236*
	241-242
	264-265
	282-283
	290-291
Diaphragm	79-92
	170-171
	172-173
	198-199
	275*
	290*
External rotators (piriformis, superior gemellus, inferior gemellus, obturator internus, obturator externus, and quadratus femoris)	139*
	172-173
	192-193
	195*
	201-203
	223-224
Gastrocnemius	137*
	167-168
	170*
	182-183
	185-186

Muscle	Page number
Glutes (gluteus maximus, gluteus medius, and gluteus minimus)	129-130
	133-135
	131-132
	140-142
	164-165
	167-168
	207-209
	263*
	304-305
Hamstrings (biceps femoris, semitendinosus, and semimembranosus)	131-132
	134-136
	143-144
	146-149
	170-171
	182-183
	185-186
	207-209
	210*
	224-227
	260-263
	264-265
	292-294
	304-306
Iliopsoas complex (psoas major, psoas minor, and iliacus)	133-135
	137-138
	143-144
	223-226
	275-276
	282-283
	290-291
Latissimus dorsi	149*
	157-158
	164*
	204-205
	218-219
	272-274
	278-279
Levator scapulae	241-242

Muscle	Page number
Obliques (internal and external)	94-98
	155-156
	188-189
	252
	256-257
	301-302
Pecs (pectoralis major and pectoralis minor)	143-144
	146*
	150-152
	220-221
	252-253
	264-265
	280-281
	282-283
Pelvic floor	167*
	172-173
	191*
	283*
Quadriceps (rectus femoris, vastus lateralis, vastus intermedius, and vastus medialis)	154*
	238-240
	280-281
	298-300
	304-306
Rhomboids (major and minor)	157-159
	169*
	201-203
	204-205
	241-242
	304-305
Rotator cuff (subscapularis, supraspinatus, infraspinatus, and teres minor)	140-141
	169
	272*
Serratus anterior	260-261
	280-281
	282-283
	301-302

Muscle	Page number
Soleus	129-130
	132
	137*
	167-168
	248-249
	256-257
	266
Spinal extensors (intertransversarii, interspinalis, rotatores, multifidi, transversospinalis, and erector spinae)	131-132
	143-145
	165-166*
	185-187
	198-200
	250-251
Sternocleidomastoid	150-151
	220-221
	252*
	254-255
	268-269
Tensor fasciae latae	137-138
	140-142
	150*
	160*
	207-208
	228-229
Trapezius	188
	248*
	282-283
	304*
Triceps brachii	204-205
	223*
	236*
	248-249
	260-261
	282-283
	290-291

ABOUT THE AUTHORS

Leslie Kaminoff is a yoga educator inspired by the tradition of T.K.V. Desikachar, one of the world's foremost authorities on the individualized, breath-centered application of yoga for healing. Leslie is the founder of The Breathing Project, a New York City nonprofit organization dedicated to the educational enrichment of the yoga, movement, and embodiment communities. An internationally recognized specialist with over four decades of experience in the fields of yoga and breath anatomy, Kaminoff has led workshops for many of the leading yoga associations, schools, and training programs worldwide. He has also produced and helped to organize international conferences and has actively participated in the ongoing national debate regarding certification standards for yoga teachers and yoga therapists.

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Visual consultant and third edition illustrator **Lydia Mann** is a multi-hyphenate worker: an artist, designer, technologist, event producer, and illustrator with a particular interest in human anatomy and how things fit together. She has studied dissection under Gil Hedley, Lauri Nemetz, and Leslie Kaminoff, as well as designed training materials for Leslie and Amy's online *Fundamentals* course. Having photographed the yoga models for the original edition of *Yoga Anatomy* (see the photo on page 120) and designed the cover, she is thrilled to have had this opportunity to contribute illustrations to the latest edition.

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