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As with other anatomy texts, David references body parts with anatomical words and descriptions; however, he goes further. Using his own experience with yoga *asana*, putting his own body into the many gravity-defying structures, he creates an understanding for you, the reader, in everyday language. This book is a bridge across the gap between the professional academic and the self-exploring yoga student. You, too, will gain a personal understanding and insight by taking David's gems of wisdom to your yoga mat, and through your own personal practical exploration, will connect all separated parts into one whole functioning and breathing body, alive steady in *asana – sthira/sukha*.

It is an honor and a pleasure to write a foreword to this exploratory journey into the functioning of the physical body. When I read through David's draft, I could hear his voice, the complexity yet simplicity of the presentation. It felt as though I was present in one of his workshops, eager to be lead by David through the practical anatomical exercise on the yoga mat. This book is a journey of deep exploration that will enhance each individual's understanding of what it really means to inhabit a body that not only stands in anatomical neutral, *samasthitih*, but also moves with the breath to create *asana*. A body that "shape shifts" towards the postural understanding of our bodies, tension free, relaxed, still, and steady—gracefully moving in space, mastering the relationship of posture, breath, and gravity.

—Enjoy

John Scott

## Introduction

My idea for this book grew as I traveled around the world teaching anatomy to prospective yoga teachers. Usually I serve as an adjunct faculty in a teacher training program, offering the minimum amount of anatomy training required to certify new teachers. Twelve hours is barely an introduction to this wonderfully complicated body of ours. My hope is that this book offers a more complete exploration of the human body in a context that is both accessible and exciting.

As I teach, I sometimes question whether those on the sincere path of a yogi really need to know anatomy. By this I mean, if you're practicing yoga for the ultimate intention of self-knowledge and not just jumping around on a mat, how much anatomy do you really need to know? The truth is if we adhere to the definition of yoga offered in Patanjali's sutras, yoga is the cessation of the fluctuations of the mind. It is detaching from all of the voices (and their stories) in our head long enough to realize our true self.

So what does this have to do with anatomy? Well, honestly, not much. Most of us do not have the wherewithal to simply sit down, quiet our mind, and enter into a state of yoga. So what are we to do? What is our vehicle for accessing this state? How do we find our way there? The answer is simple: through our very own research laboratory—the body.

Hatha Yoga was born to accommodate those of us who can't just sit down and quiet our mind. *Asana* (a.k.a., jumping around on our mat) is the vehicle with which we begin to purify the body (*annamayakosha*). The *asanas* touch us on all levels. At the most basic level, they increase our flexibility and strength. More subtly, they purify our tissues, and even more subtly, they affect the energetic system that supports and sustains our tissues. Finally, when all the moving and jumping is done, the *asanas* bring us to a state where we might sit comfortably and quietly without our mind being distracted by our body. This "jumping around" on the mat is also our vehicle for studying the body in a deep and kinesthetic way. This is where anatomy intersects *asana*.

If you have practiced *asana* consistently for 10 years or more for at least one hour each day, it is certain that you know the workings of your body quite well. You may not have the technical anatomical names or understandings, but your kinesthetic knowledge is a very real and powerful way to know the body. This is knowledge that cannot be learned from a book.

Unfortunately, many people today are teaching yoga before they have practiced for even one year. In general, if you haven't done the exploration in your own body, it will be harder to lead someone through an exploration of theirs. But every teacher and student must start somewhere. For those of you who have not dedicated the time to

exploring your body deeply on a daily basis, it is crucial for you to understand anatomy and the wide variety of differences in individual anatomy. Keep in mind, however, that at some point you must do the self-inquiry.

If you are reading this book to learn what your students should or shouldn't do with this or that condition or pain, the answer is, "There is no answer." Oh yes, I am serious. If you think these conditions can be boiled down, categorized, systematized, and then spat back, you will never be a great teacher. I assume that each teacher wants to be the best they can be, and for that, you need to practice and study for years. You need to think, inquire, and be open to possibilities!

You might have gathered that the information in this book is not the final answer to any particular situation or problem. You're right: it isn't. But you *will* find explanations that may fit what you observe in class. I try to provide these in a way that helps you understand the bigger picture that always goes along with the little picture expressing itself in your class. I provide broad anatomical explanations that might be applied to any individual in your class.

After reading this book, you will be filled with information that inspires you to think critically. You will have the tools to hypothesize what's going on in a student's (or in your own) body and what to do about it. I want you to be a thinker. Question everything you read and hear (including what I say), not for the sake of questioning, but for a deeper comprehension. And finally, I want you to understand what you will learn by practicing.

In teaching anatomy, I seek to strike a balance between simplicity and honoring the complexity of the human body. Most of the questions I receive from students are the "why and what" questions: "Why can't I do this *asana*?" "What is restricting me in this pose?" "What do you do if you have knee pain?" "What poses should I avoid with this condition?" These are practical questions.

The aim of this book is to be as practical as possible. At the same time, I offer many possibilities and perspectives. I don't do this to confuse you, but to keep you aware of the myriad possibilities; filtering through many possibilities is the reality of a yoga teacher. When I make suggestions to my students about their problems, conditions, and restrictions, I offer a working hypothesis. In other words, I make an educated guess at what may be causing the concern and what might help to alleviate or improve the situation. I have to be willing to change my hypothesis based on the student's feedback or what I observe the student doing as we move forward.

If there is an inherent problem with studying anatomy, it is that we divide the body into pieces and parts in order to talk about it. There is no other way I can think of to approach the information. The downside of this is that we then think of the body as being distinct parts that are somehow assembled together.

We need to remember that our body started its formation with yoga. The literal translation of the word is "yoking" or "joining." It is when the sperm meets the egg that the first physical yoking begins in our own body. From this point, a single cell is formed. From that single cell, every bone, muscle, organ, piece, and part has formed out of cell division. The body did not name its own parts. That's something we humans have done. So, as the body functions as a whole (rather than as an assembly of individual parts), we need to approach it as a whole.

There is a similar issue in approaching yoga from an anatomical perspective. While it is hoped that any serious student will study all of yoga's eight limbs, because this is an anatomy book, we deal exclusively with only one limb—*asana*. Most yoga students today enter the path of yoga via *asana*. This is neither good nor bad. *Asana* is a great way to engage with the whole of yoga. Yoga does not care how we interact with it. That we are interacting with it on any level suggests it will lead us through the whole of the practice over time.

As practitioners, it is important that we do not get stuck in *asana*. It's definitely possible. There is a lifetime of work to do in fully understanding and experiencing these postures, and studying anatomy can add to this natural emphasis on the physical. It is not my intention to get you stuck in your thinking mind or your body. As you read, I hope you will take this information and experience it for yourself, thereby merging your intellect with your physicality.

As you read, allow your understanding of what anatomy means to expand. Begin to explore your body as an integrated whole. As you practice, experience *asanas* not as individual postures but as elements that are related to one another in the context of a greater whole.

In summary, this book will encourage you to explore your understanding of anatomy via the personal laboratory that is your own body. As a result, you will become a more mindful practitioner and a better teacher. If I do my job well, you will be inspired to continue your study of anatomy, your practice, and yourself well beyond the pages of this book.

Namasté, David Keil

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## CONVERGING HISTORIES

From the moment of our birth, our bodies are affected by the lives we live. There is a convergence of information and energy that comes together inside of us. Circumstances, decisions, accidents, and intentions all influence who we are. They form us as certainly as we were physically formed in our mother's womb. It is impossible to separate a person from their life experiences.

I call these life experiences or influences "Converging Histories." These histories comprise a wide array of informational energies that are absorbed by our system. Every event in our life, from watching a movie to riding a bicycle or practicing yoga, has an influence on our being. All of these events have a certain energetic, physical, and emotional quality that impact and become part of our physical body.

Our converging histories make us exactly who we are in this moment. Some of these histories happened to us; we had no conscious control over them. Some of them we chose; we consciously added them to our life experiences. Every moment that we live, we choose experiences, activities, and relationships that become part of our own sea of converging histories. They become part of us.

The first and most basic of these histories is common to us all. It is the history of human evolution. What has human evolution done to our bodies? Imagine for a moment that it is billions of years ago and we are quadrupeds. Our center of gravity as four-legged creatures is in a different place. Our feet and hands are also different. Thus when we evolve to bipedalism, our bodies have to change. As two-legged creatures, the relationship of muscle to bone must shift.

As two-legged creatures, walking is our main mode of transportation. Therefore, we have developed strong lower bodies designed to propel us forward. Along with this development, our upper half has evolved as well. We are quite good at interacting with things in front of us. We grab, pull, and manipulate the tangible world as perceived by our eyes, nose, and mouth. Due to the incredible mobility of our hands, we're better able to protect our front and our more vulnerable underside.

Our fantastic "new" appendages have made using tools and playing the piano possible. And our hands have helped further the development of our brain. Yes, our ability to pick things up, manipulate objects, and create new things with our hands has fed our brain massive amounts of information, which has in turn led to the human consciousness and intelligence we now know. Our upper limbs are also useful in their coordination with the lower half. We use our arms to help move the body while running and to maintain balance in difficult situations. (Can anyone say *Utthita Hasta Padangusthasana*?)

Our genetic history is another piece of our converging histories. From the vast pool of possibilities, we have been born to two parents, each with their own genetic make-up. Out of this genetic mixing pot come our eye color, foot size, and shape of the arches in the feet (or lack thereof). Our height and weight predispositions, the length of our torso relative to our arms, and so on, also come out of the mix. On a physiological level, our parental genetic history predisposes us to certain diseases or illnesses. The implications of genetic history are far-reaching.

Somewhat related to genetics is the history I refer to as “Learned Parental Behavior.” This is a scary one for some of us. It can be distressing to wake up one morning and realize that we are turning into our parents, which we swore we would never do. It’s hard to escape the powerful imprints left by our parents during the formative years.

On a physical level, we learn how to walk by watching and mirroring the way our parents walk. We talk, make expressions, and have similar body language as our parents. This is only natural. Our parents are the first place we saw any of these things happening.

In addition, we adopt ways of thinking, ways of being, and patterns of thought from the input and influence of our parents. Even our mental attitudes derive in part from our learned parental history. The implications are deep. Perhaps this is one way to explain why millions of people are in therapy trying to eradicate the “negative” influence of their parents. In no way should we pass judgment on Mom and Dad. They did the best they could. It is our work to recognize the traits and behaviors that stem from our learned parental history and then determine which to maintain and which to discard.

The fourth and fifth converging histories I’ve identified are physical ones. Our “Activities History” comprises all the physical activities we have learned over the years. Perhaps we played sports such as baseball, football, or soccer. Or maybe we spent time dancing, horseback riding, or practicing martial arts. All of these activities create patterns of movement in our bodies and help forge relationships between the brain, the senses, and our motor skills. The degree of refinement we develop in our activities and how long we participate in them helps to determine the strength of the patterns developed.

I was exposed to yoga very early in life by my pre-school teacher, Mrs. Elphenbein. We did yoga a few times a week on our little rugs. I don’t fully know the degree to which this impacted my body or mind. But I have to believe these formative experiences played a role in my later desire to study Tai Chi Chuan and yoga.

I also did judo for a short time and played baseball for a number of years. I played catcher, which definitely left a physical imprint on me. I had to squat for long periods of time, which lengthened or built certain muscles in my lower body and likely impacted

my posture. Some, like me, have done many activities in their lives while others have participated in just a few. Either way, they all have an influence on how our body develops and the patterns that we acquire.

We also need to consider our “Injury History.” Sometimes our injuries are the result of our activities and sports. Sometimes they are the result of accidents, such as falling out of a tree and breaking an arm, stepping off a curb and twisting an ankle, or even getting hit by a car. No matter the cause, all injuries have an influence on our patterns, and we might not be aware of what these are. Perhaps the position of our sacrum or pelvis is changed in a fall. Or maybe the healing of a broken bone causes one leg to become slightly longer. We must become aware of the far-reaching effects of our injury history as we come to know and understand our body.

When I was nine years old I broke my femur (thigh bone). I was playing soccer at the time. I kicked a soccer ball at the exact same moment that my neighbor (a boy at least twice my size) kicked the ball in the opposite direction. The impact of our simultaneous kicks completely broke my femur. Is it any wonder that this leg is a bit twisted, a bit longer, and definitely harder to get behind my head? Even the food we ate as children or the amount of beer we drank in college can influence our bodies and what they are capable of. Thus we also have a “Nutritional History” that influences who we are right now.

Finally we have what is perhaps a larger and more profound history that can impact who we are, what injuries we have had, and how our body moves. It influences the very essence of our being. I call this our “Spiritual History.” Within this history are some very large questions about who we are, what we believe, and how we live. Our spiritual beliefs not only inform our inner well-being, but can impact our physical body as well.

Since we are talking about yoga, we should also consider whether there is an influence from past lives. What about personal karma or *samskaras* and their effect on our physical body? Is it possible we did yoga in a past life? If so, how is it influencing our practice of *asana* today?

There is just one more history worth mentioning: our “Mental/Emotional History.” Our emotional history plays a part in shaping how we view the world and ourselves. These influences can come from our parents, embarrassing or proud moments, and even our injuries. As a teacher, I see this in students all the time. By watching the way they approach their practice or deal with their aches and pains, I can tell a lot about their history. An injury that happened years ago can keep a student from even trying a given posture.

For example, I met a student who had an injury to his hip joint about 15 years before I met him. Pins were placed inside temporarily to keep the cartilage against the end of the bone so that it could heal. From that point on, he had assumed there was some boney deformation that prevented him from adducting his hip joint or bringing his femur to his chest.

His approach to practice was one of caution (a good thing). By the time I met him he had basically given up on a regular practice because it was causing more trouble than good, and most teachers were baffled by the condition of his hip. I could see how strong the beliefs were, the connection to the old injury, and the assumptions that were turned into fact. A number of postures were just not going to happen with all of these beliefs and stories in place.

To be honest, I didn't know what the truth was, but neither did the student. With three days of practice and a lot of trust, we got his femur to his chest and his hip joint did adduct. Slowly but surely, the beliefs and emotions stored within the body were being released—often showing up in the form of hopeful and joyful tears; disbelief and recognition of stories that were wrong and as stuck as the hip itself were dissolving.

It doesn't matter how you divide or categorize the "histories"; I could have done it differently. What is important is that you see how each one of them ultimately ties together to create our state of being in any given moment.

When we look at a student, we are seeing the product of these converging histories. Beginning to observe what shows up (inside and out) in the moment is the best way to see someone. Learning to see beyond the body is part of learning to teach yoga. As we become able to see beyond the body, we become better able to see our students as they are in the moment. But we need to keep in mind that sometimes (perhaps in a large class situation) individuality is lost and everyone is given the same instruction for the same pose, despite their individual differences.

So, how do we treat each student as an individual? Each pose has its basic principles and guidelines. For instance, everyone should rotate their thigh outward or inward and engage this or that in a given pose, right? How do we layer these fundamentals with our consideration of who a particular student is right now, in this moment? And how can we move our students from where they are now to where we think they should be in a way that suits them? How many of these histories are you able to see when you watch your students practice? Should students do (or not do) certain postures on the basis of their personal histories? How do these histories fit into a student's development in the practice of *asana* as well as the larger picture of yoga? These are just a few things to consider. Let's leave it at this: It is enough that you begin to look for these pieces of the puzzle in your students. It is enough that you try to see beyond the body.

## IT IS ALL ONE

Now that you have a taste for how hard it really is to see the whole person, perhaps you can sense the difficulty in teaching anatomy in a way that emphasizes how well-integrated the body actually is. As it is easy to lapse into our old mindset of seeing the body without taking into account the person alongside their life experiences, it is quite natural to disregard the interconnection of all of our parts. We tend to think of our sore shoulder, tight hip, or flexible spine as separate issues with little to no correlation. And when taking a subject as broad and complex as anatomy, it is helpful (and perhaps necessary) to divide it into pieces for easier comprehension. This certainly has value. The problem arises if we forget to put these pieces back together or don't make an effort to understand how they interrelate to create the whole.

It is common for us to think of a muscle as one piece, a bone as another piece, and connective tissue as yet another piece of the body. And it doesn't help our cause that we can actually replace a knee, hip, or shoulder. The miracle of modern medicine reinforces this idea of our being distinct pieces—and replaceable pieces at that! Although it is true that we can replace certain broken parts, this is not the way we were created, manufactured in a plant using nuts and bolts. Far from it.

Our beginnings and, therefore, the beginning of all of our "parts" is much more magical and integrated than that. If we start from the very beginning, there were two parts: one sperm and one egg. That miraculous act of fertilization initiated the amazing process of formation. We developed from that point on. One cell split into two cells, which split into four cells, which split into eight, and so on. This is our true beginning, one cell dividing into many until those cells began to specialize and eventually comprise all of our parts. Although the crux of my message is the integration of the body, that information has to be given in pieces. However, we must always step back and look at the individual part in relationship to everything that surrounds it.

## THE ILIOTIBIAL BAND

The IT band or tract (ITB or ITT) is a piece of fascia on the outer part of the thigh. Its name describes its attachments. At the top it attaches to the ilium (bone of the pelvis) and below to the tibia in the foreleg. It attaches to the ilium via a muscle called the tensor fascia latae (TFL). If we look at the name of the muscle closely, it is the tensor of the lateral fascia which is exactly what the ITB is, the lateral fascia.

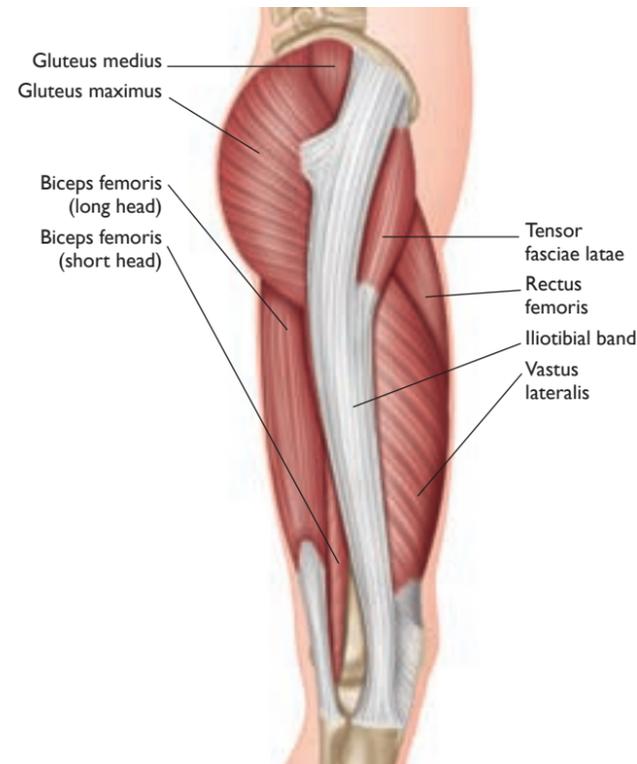


Figure 3.22: The iliotibial band.

In addition to attaching at the ilium via the TFL, the ITB also attaches to the gluteus maximus and gluteus medius. The connective tissue runs down the outer part of the leg, over the lateral quadriceps (vastus lateralis), and attaches to the lateral part of the tibia as it crosses the knee joint.

The ITB is normally considered to be a stabilizer of the knee, especially during walking and running. With overuse, such as sometimes seen in runners, cyclists, and other sports enthusiasts, the ITB can adhere fascially to the lateral quadriceps beneath it. This can lead to a number of tensional issues that can affect hip and knee function. Avid runners and cyclists actually need an ITB that is taut to support the knee during those activities. If we recognize that someone has an ITB that is too tight, simply stretching it out with yoga postures may lead to trouble in other activities. This doesn't mean that we want a super tight ITB either. It's about balance and what activities you want to do. A loose ITB

can cause instability while running. A tight ITB can cause pain at the knee in postures like Lotus. Hips that are tight from either running or cycling are often the exact opposite of what we want them to be like in order to do Lotus Pose.

## INTEGRATING ANATOMY INTO YOUR PRACTICE

We're all familiar with the advice to bend our knees when stooping down to pick up a heavy box. We do this to help distribute the weight from the lower back into the legs. This same concept can be used in our transition in and out of standing postures. Straight-legged standing postures themselves do not call for bending the knees, but in a standing forward bend, Triangle Pose, or any other straight-legged standing pose for that matter, bending the knees distributes the weight in the legs.

Play with entering and exiting a number of standing poses with the legs straight and then with the knees bent. Compare the difference. Bending the knees to transition between postures can be extremely helpful to students with SI, lower back, or knee problems. Once in the final pose, however, you should at the very least be trying to straighten the knees.

Your knees may be indicative of what is happening at the joints and structures that surround them. Take a look at your knees in a simple Downward Facing Dog and see where they point. Bend them slightly, and see if they point straight forward, inwards, or outwards. Better yet, lift your toes and see if this has any effect on your knees. Is there a connection between the feet and the knees?

Try this one. Step into a simple Triangle Pose, and before you reach out to move into the posture, notice where your knee tends to point. Chances are it points inwards. If you bend the knee slightly, you'll notice that it unlocks the hip and brings the knee to point straight forward over the foot.

### Pain in Your Knee During Lotus?

At a workshop, when I ask who has knee pain, approximately 80 percent of those who complain about knee pain in a Lotus type of posture (where the leg is flexed and rotated) say they experience pain on the inside (medial) of the knee. Approximately 10 to 15 percent complain about pain on the outside (lateral) of the knee. The rest usually complain about pain through the centerline of their knee or around the kneecap. All three areas express stress in the knee in different ways.

Pain on the inside of the knee is the most common knee pain associated with the leg being in Half- or Full-Lotus Pose. Using statistics from my own personal observations, I've come up with a working hypothesis: the most common cause of pain on the medial knee is compression of the medial meniscus. Please note that I am not suggesting that all pain on the inside of the knee is coming from the medial meniscus. Nor am I saying that pain on the inside of your knee during Half- or Full Lotus means you have already torn your meniscus. You may simply be irritating it. There are other structures in this area that can get inflamed or irritated and cause pain on the inside of the knee. For instance, the MCL and various muscles crossing the inside of the knee, and even the joint capsule itself, can get compressed and irritated.

One reason I first suspect medial meniscus compression is that I've heard stories of many people who complain about pain on the inside of their knees who eventually experience a "pop" in Lotus position. Swelling in the back of the knee and sometimes a regular clicking sound often follows the pop. It is also possible that the knee will lock intermittently after the original pop occurs. All of these are classic signs and symptoms of a meniscus tear. The best way to confirm if the meniscus has torn is to go to the doctor and have an MRI scan taken.

The other reason I tend to (at least initially) suspect medial meniscus compression, is that Lotus requires the two movements which, when combined, put the most amount of pressure on the medial meniscus: flexion of the knee and internal (medial) rotation of the tibia. Both the femur and tibia have to rotate externally. If the tibia doesn't have enough outward rotation, there could still be enough in the hip to make up for it, or vice versa. If, however, both the tibia and the femur lack the ability to rotate externally, you end up with more internal rotation, which can put pressure onto the medial meniscus. When you combine this with a flexed knee, as in Lotus, you end up with even more pressure on the medial meniscus. If the hips are tight, it is common to feel pressure in the knees.

There are two ways of dealing with this. The first is an immediate response: the moment you feel the sensation of pain, place one hand on your thigh near your knee and the other on your calf muscle.



Figure 3.23: Externally rotating the upper and lower leg usually alleviates pressure on the inside of the knee.

Try externally rotating both of them, as if you are creating space between the ends of the two bones rotationally. You could also prop the knee higher with a block or a bolster to see if that alleviates the pressure or pain.



Figure 3.24: Elevating the knee often works regardless of where the pressure is.

The long-term solution is to lengthen the tissues in the hip that are restricting external rotation of that joint. [See Chapter 4, pages 133–134 for specific stretches to lengthen the muscles around the hips].

What if you have pain on the outside or in the centerline of your knee around the patella? If you have pain on the outside of the knee, you're in a club of your own! When I meet people who have pain here, I often find (although there are exceptions) that rotation internally of both the tibia and the femur actually decreases their pain. (Note: this is the opposite of what to do if pain is on the inside.)

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# 7 Comparing the Upper and Lower Extremities

I've decided there is a need for another way of looking at what constitutes anatomical position. (That is, standing with feet hip-width apart and palms facing forward). This is the basis for anatomical terminology and for the named movements that we do, but it feels limited, particularly in reference to a body in motion. It assumes that we are standing and beginning our movements from anatomical position. I'd like to add a new perspective, derived from my observations of the functional similarities between the upper and lower body. To show how similar these are, I lie on my back, knees and elbows bent, almost as if preparing for a backbend except that my hands are turned such that the fingers point away from my head. It is easier in this position to see how the upper limb and lower limbs actually mirror one another.



*Figure 7.1: This is a functional anatomical position for being supine on the floor.*

If I straighten my left arm and left leg, the movement is the same in both. If I move my elbow and knee towards each other simultaneously, then again, there is a mirroring effect. Let's look at how this mirroring begins in the structures of the skeletal system first.



*Figure 7.2: Movements of the upper and lower limbs then mirror one another.*

I am still amazed by the similarities between the arm and the leg. Upon casual observation, they seem totally different. After all, they have completely different purposes, so their functions must be different, right? But if you look at the structures themselves, you will see they are strikingly similar in a number of ways.

We'll start at the bottom of each limb. As we've said, the foot is made up of 26 bones: 14 phalanges (toes), 5 metatarsals, and 7 tarsals. The hand is made up of 27 bones: 14 phalanges (fingers), 5 metacarpals, and 8 carpals. The ankle joint flexes, extends, abducts, and adducts. These movements are called dorsiflexion, plantarflexion, eversion, and inversion, respectively. The wrist moves in these same directions: flexion, extension, abduction, and adduction.

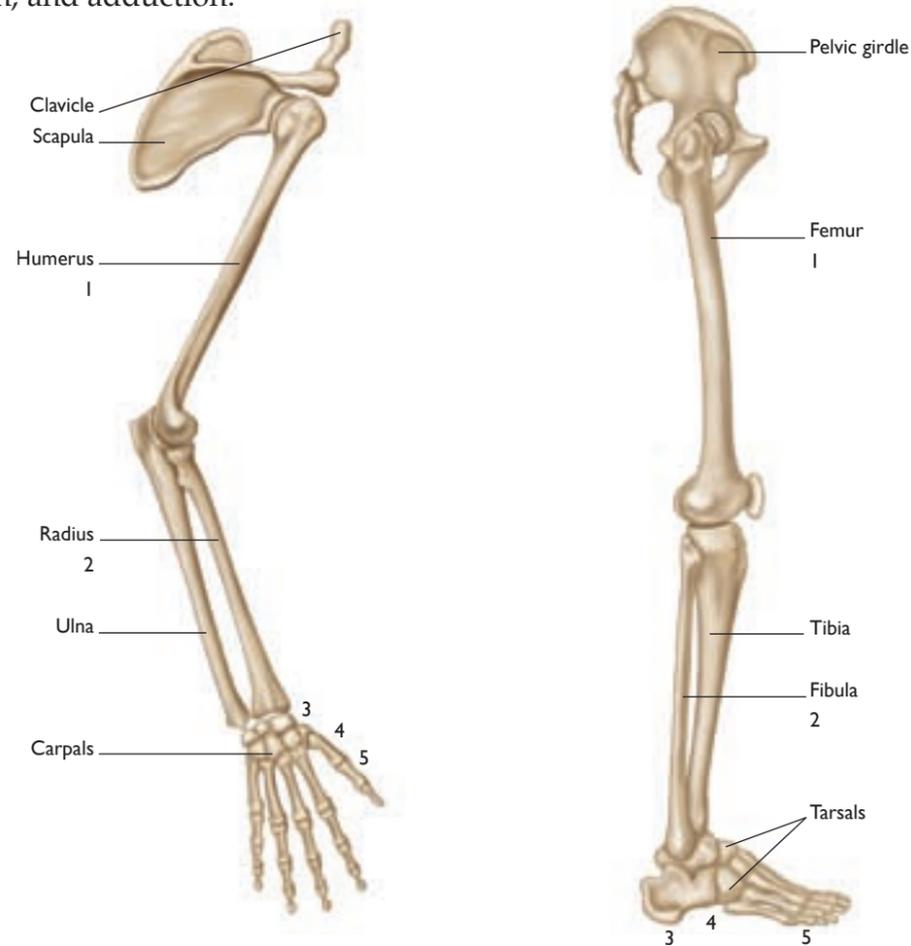


Figure 7.3: Notice the similarities between the extremities.

Moving upwards, there are two bones in the foreleg and two bones in the forearm. The knee and elbow are both hinge joints. Even the pointy part of the elbow (the olecranon) correlates to the kneecap. The knee has the ability to rotate in either direction once it bends ten degrees or more. The radius and ulna also rotate relative to one another. Technically this rotation does not happen at one joint; instead our forearm rotates and moves our hand. We call these movements supination and pronation of the forearm.

As we move up to the femur and humerus, we find that both are long bones that end at the top with a ball and socket joint built for mobility. Of course the socket for the femur is much deeper than the one for the humerus. The femur is built to handle weight and movement while the shoulder is built for mobility.

The similarities don't end there. If you look at one side of the pelvis compared to one scapula, you will find they are both flat, irregular-shaped bones. Take it one step further and compare the clavicle to the pubic bone. Their shapes and functions are quite similar as well. They each connect the pelvis and shoulder girdle together in the front. The two pubic bones meet each other at the pubic symphysis and the two clavicles attach to the sternum.

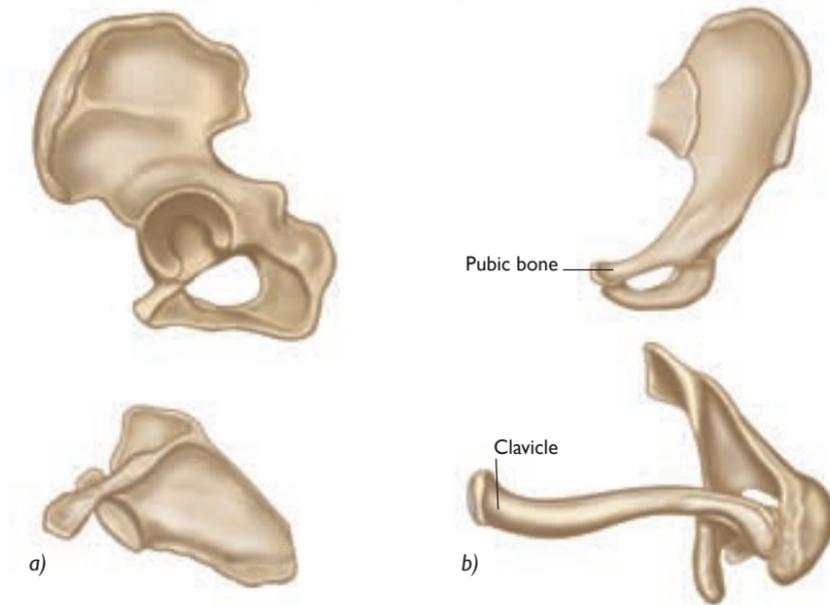


Figure 7.4: More similarities; a) comparing pelvis to scapula, b) clavicle to pubis.

In addition to these obvious structural similarities, there are several muscular similarities as well. Think of the flexors of the forearms, which are much larger than the extensors. They are similar to the large calf muscles, which move the ankles and are significantly larger than their opposing muscles.

In the upper leg we have the quadriceps, which is a muscle divided into four sections. On the upper arm we have the triceps brachii, which is a muscle divided into three sections.

## Simple Twist—*Marichyasana C*

We will look at three anatomical aspects to this twist. They are the pelvis, the binding, and the twist. All three must come together for the posture to happen. The same elements that we discussed in the Revolved Side Angle apply to the Seated Twist.

In this particular seated posture, while both legs are flexed at the hip joint, one is flexed at both the hip and the knee (the leg we are going to bind). This tends to pull the pelvis under in a posterior tilt on the side of the bent knee. This is usually obvious in people with tight hamstrings. With this added tension, the pelvis might also tilt slightly, so that the sit bone on the side of the bent leg lifts off the floor. There's another reason why this can happen. Sometimes the sit bone lifts off the floor because of the relative proportions of the upper and lower leg. If your foreleg is shorter than the femur, your sit bone will either be on the floor or closer to it. If your foreleg is longer than the femur, the opposite will occur. Your sit bone will lift higher off the floor.

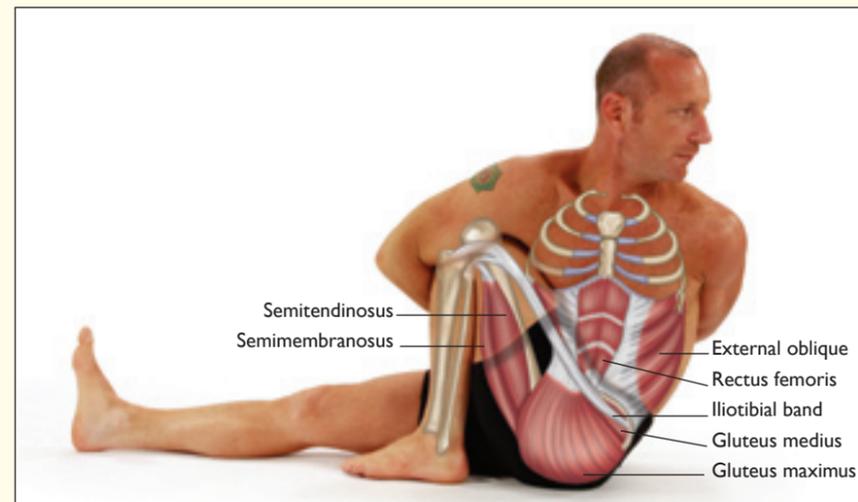


Figure 11.11: We often find that the pelvis drops into this posterior tilt when the hamstring and hip joint muscles are tight. This forces the abdominals to hold us up.

Oftentimes tight hamstrings will prevent beginners from just being able to sit upright. The hamstrings pull the sitting bone under, which causes a posterior tilt, and the spine flexes. As a result, their weight moves behind the center of gravity and they start to fall back. Because gravity draws them back, their foundation is unstable. If they can't sit up, how can they possibly bind?

The importance of taking the pelvis into an anterior tilt for seated postures should not be overlooked. The solution to this pattern is pretty simple: place the hand on the floor behind you. Initially, a beginner does this to keep from falling back, as well as to help sit up straight. But we should know what we're trying to achieve and what the hand on the floor tells us about the anatomy.

First we need to look at the hips and the role they play in this aspect of the pose. There are two choices: either the knee moves across the midline, or the individual moves around the knee. The second is often done quite dramatically with a big lean back (gravity will take us back that way anyhow). This takes the twist as low as possible in the spine, which can be aggravating for students with lower back issues and SI joint problems.

In order to move the knee across the midline, we need length in the outer line of the hip and thigh, namely the glutes. If we are flexible enough, this allows the knee to adduct across the midline from the hip joint. Once this happens, further flexion at the hip and spine are needed to take the chest towards the thigh where the arm will reach forward to begin its required rotation.

The rotation of the arm into the bind requires certain actions at the shoulder complex. First, as it reaches forward, the torso flexes. The scapula moves around the front of the torso in protraction, the humerus internally rotates in the shoulder joint itself, and the scapula rotates downward and elevates at the same time. When the scapula moves, so does the clavicle. In this case, the clavicle does its little known rotation along its axis. Finally, the elbow bends or flexes to finish the movement. Keep in mind that all of these actions together have naturally created a twist in the spine simply by moving the leg across the midline and flexing the torso. These actions pull the pelvis in such a way that the spine ends up twisted relative to it.

For these movements to occur as easily as possible, all elements of the twist should be seen as a chain from the bottom up. This includes the hip joint, pelvis, and lumbar and thoracic vertebrae. The hamstrings must have enough length to allow us to sit up and move forward at both the hip and the spine. This vertical posture allows the armpit to get as close to the knee as possible, which in turn puts the rest of the arm in a position to rotate and bind around the knee.

If any muscles that are involved in the twist are tight enough to restrict the internal rotation required, then something else will compensate. Often it will be the scapula, which lifts up in elevation. You see this often when a student is trying to bind and their shoulder ends up scrunched up by his or her ear. This might suggest restriction in the arm or shoulder, but it could just as easily be any of the elements down below. This is what happens when all of the components of an *asana* do not add up.

Finally we come to the twist. To be honest, if you have gotten to this point in the pose, you're already in a twist! What lies ahead is just deepening the rotation through the spine. There are a couple of anatomical pieces to add here.

The spine is designed to twist in the thoracic section. That said, a twist happens relative to the position of the pelvis. In other words, from anatomical position with the pelvis in neutral, the spine rotates in either direction relative to its base, the pelvis. If the pelvis moves with the spine, it is not a spinal twist. It is movement at the hip joints. Normally, in any twisting *asana* we see a combination of movement in the hips and spine.

Let's go back to *Marichyasana C*. With the pelvis in neutral, moving the leg across the midline tends to pull that side of the pelvis forward. If the left leg is bent and the knee moves towards the right, the left side of the pelvis will be pulled forward during a twist to the left. You could say that the pelvis (or lower part of the spine) moves in the opposite direction of the upper torso, which automatically creates or increases the depth of the twist.

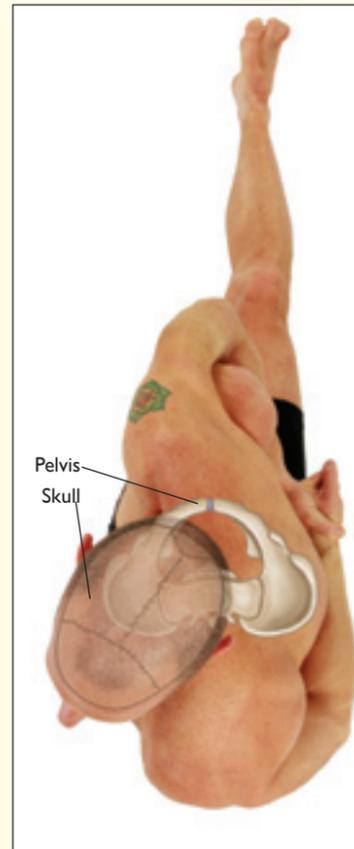


Figure 11.12: When the pelvis is square to the front, the twist is more purely in the spine.

If, however, the pelvis moves in the same direction as the twist, it does exactly the opposite. It reduces the twist in the spine, right? If you look at someone who is already in a twist and you see that their pelvis is at an angle (that is, not parallel to the front of the mat), it will almost definitely be turned in the direction of the twist. This pelvic movement is not necessarily wrong, but it does reduce the overall twist in the spine. This

may be necessary for some individuals, depending on the condition of their sacroiliac joint or even their spine.

If the pelvis is square, it is in a neutral position and all the restriction comes from the elements more directly related to the spine itself. Potential restrictors of a spinal twist are the abdominal muscles (the obliques, specifically) and the small muscles surrounding the facet joints in the spine. But perhaps the most significant and most obvious restrictors of twists are the ribs and intercostal muscles. Unfortunately, they are frequently overlooked.

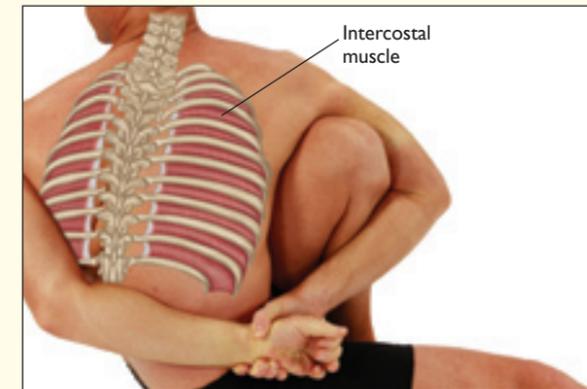


Figure 11.13: We forget how significant the tension from the ribs and intercostals can be in a twist.

The intercostals are three layers of muscles between the ribs. When we twist, we put pressure on the ribs as well as the tissues between them. This is one of the most obvious inhibitors of twists. We can observe the impact of tension in these tissues by observing the breath. It is harder to breathe in twists because the ribs have a hard time moving relative to one another, making space for the incoming air. What prevents them from moving? The change in the position of the ribs relative to the vertebrae they attach onto and articulate with. The twisting loads the tissues and ribs with tension, making it both harder to twist further and harder to breathe. The flip side is that twisting also stretches the tissues, which increases our ability to deepen the twist and breathe more easily in the pose.

Each of these elements—the pelvis, the arm and shoulder, and the ribs and spine, can limit your ability to bind in a twist. The body is good about working around one restriction, but working around two or three restrictions becomes more difficult. I am hopeful that by deconstructing a posture this way you will more clearly see which parts you can emphasize in your practice. The long-term result will be a more integrated posture, a deeper twist, and perhaps even a binding!

psoas of the upper body for more detail.) However, before we dive further into specific muscles and actions used in arm balancing, let's establish our foundation—the hands.

## THE FOUNDATION

At the base of any arm balancing postures are the hands (sometimes the forearms). When we're upside down, the hands play the role of the feet as they support all of our body weight. If you thought the surface area of the feet was a ridiculous size relative to the rest of the body, what about the hands? The bony orientations of the hands are different, as well. In the foot, the bones themselves line up in such a way that the weight coming down from the body through the tibia gets dispersed evenly across the feet. About 50 percent of your body weight goes into the heel of the foot and the other fifty percent is distributed forward of the line of the tibia.

This isn't the case in the bony structure of the hand. First, there is no heel sticking back from the line of the bones in the forearm. This means that almost all of our body weight lands under the forearm bones (in the heel of the hand); just a tiny bit is carried by the fingers up front. This also means that most of our weight will be taken by the heel of the hands, secondarily by the palm. Thus the fingertips can help control our balance rather than being consumed by weight-bearing. Because of how weight passes through the arms in inversions, the wrist takes the brunt of the pressure in the hands.

Some postures allow the elbows to bend and move backwards, reducing the angle at the wrist. This minimizes potential compression at the top of the wrist. Other postures ask us to straighten the elbows, which tends to put more stress on the top of the wrist. Without establishing a balance of strength and flexibility, this can be a source of pain and discomfort.

You may recall that the flexors of the hand and wrist are four times stronger when the wrist is in hyperextension than when it's in an arm balancing position. In an arm balance, these flexors resist hyperextension, at the same time helping us to balance in the pose. The fingers, which are controlled by these very muscles, are quite active both when moving into and holding a balanced position on the hands.

In this sense, the fingers act like toes, gripping as weight moves into them or lifting as weight is pulled away from them. Our fingers don't just *feel* the floor. They increase our awareness of how to press into the floor, as well as how to root down through the palm of the hand. This awareness allows us to better build the pose above. (Note the images of B.K.S. Iyengar in *Light on Yoga* that show him using his fingers in arm balancing postures.)

## WORKING THE ARMPIT

When the hands press into the floor in an arm balancing pose, they have to be pressing from somewhere. It's an important concept to remember! This shifts our focus of strength and stability from the hands upwards to the shoulder girdle.

It is the combined movements and actions of the scapula, clavicle, and humerus at the shoulder joint that really create the strength and stability needed to work with a variety of arm balances. The "psoas of the upper body," as I've already described, is at the heart of this. Let's review: two muscles comprise the psoas of the upper body—the serratus anterior and the latissimus dorsi. The serratus protracts and upwardly rotates the scapula, helping to bring the scapula and humerus forward and overhead beyond what the muscles of the shoulder joint can do. Once the arm is in this position, the strongest shoulder extender, the latissimus, can then help stabilize the shoulder joint.

When your hands are on the floor in a pose like High Plank, the serratus anterior stabilizes the scapula (separate from the literal shoulder joint). It helps to keep the shoulder blade pinned down to the rib cage by lifting the rib cage between the two scapulae. The serratus anterior is key to establishing the pattern that is needed both to get into (movement) and to stay in (stability) arm balancing postures. These movements often require protracted scapulae.

In addition, in arm balances we need to consider both the stabilization and movement of the shoulder joint itself. The deltoids, pectoralis major, and rotator cuff muscles do this two-pronged work. Finding our way into arm balances and then staying there requires finesse and coordination of several muscles of the upper body.

## CREATING THE PATTERN

In addition to considering the muscles that need to contract or release in an arm balance, we should also consider neuromuscular patterns. We can focus on these patterns as we practice to strengthen the muscles we will eventually use in Full Handstand. Where does this work start? Ask yourself what other postures require you to protract and upwardly rotate the shoulder blades. You might have to go back further in your sequencing than you think! Which postures take the arm into this position? Go ahead: put your arms up as though you were doing a Handstand, even if you're sitting down. Now think. What yoga postures put your upper arms and scapulae in this position? How about Down Dog? Backbending? Bend your elbows and you will see a forearm balance and even a Headstand. All of these postures rely on the serratus to protract, upwardly rotate, and help stabilize the scapula. Ah ha!

## The Very First Piece

Let's go way back in our sequencing for a moment. There is a moment in each Sun Salutation that provides an opportunity to train these very muscles. It is directly after the hands go to the floor in the first forward bend. There is a divergence of opinion as to how one should look up from this position. It is common to keep the back as straight as possible and lift up onto the fingertips. This does create a certain type of pattern that can be positive, but it's not the pattern we want to strengthen the upper body for arm balances and Handstands.

On the positive side, lifting up with a straight spine creates a long, flat back. This reduces the flexion in the lumbar spine, which can be important for students with disc problems. So the question is, what would help a particular individual create a particular pattern at a particular time in their development of a pose? What is this student trying to learn from this movement?

This extended way of looking up requires the back muscles to tighten to partially lift and straighten the spine.



Figure 12.4: In order to lift up in this way, your lower back muscles and hamstrings must contract.

It also requires that the hamstrings contract to rotate the pelvis around the heads of the femurs. Therefore, this pattern may be appropriate for students with disc issues, students who are trying to figure out how to move their pelvis, and students who are learning the nuances of working with their hamstrings. It might also be appropriate for practitioners who have already established the relationship between their hands, the floor, and the work involved that leads to doing Handstand. But for those working towards arm balancing, there is an alternative. Unfortunately, this is more difficult and requires more effort, in a different way.

In this pattern, the hands go flat on the floor, just as they would for an arm balance. Placing the hands in line with the toes is ideal, but not necessary for someone just beginning. Some students may need to put their hands flat on the floor in front of the line of their toes. (Everyone should plant their hands shoulder distance apart). You may need to bend the knees to reach the floor.

Next, put the appropriate amount of weight into the hands and lean forward. A series of things occur as you lean forward into the hands. First, your fingertips will start to feel the floor and will strengthen over time. Second, you will begin to push back into the floor as the weight goes into the hands. When we do this, we start to use the shoulder girdle muscles. The other shoulder muscles that stabilize you in an arm balance are trained to contract in a synchronized way with the rest of the tissues.

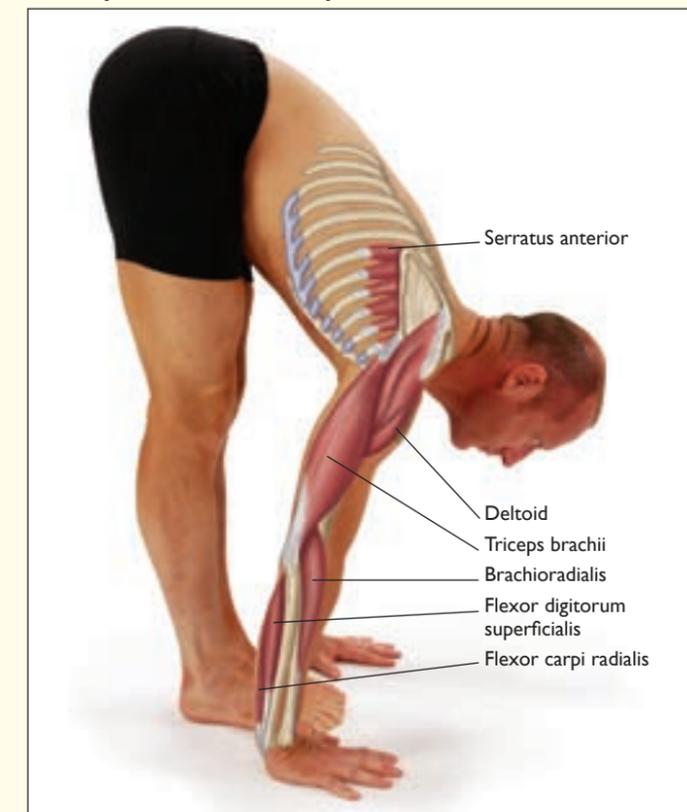


Figure 12.5: By taking weight in the hands the stabilizing muscles needed for a handstand will activate.

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# 3 Anatomical Patterns in Backbends

Backbends have been a long and slow process for me. I wasn't born with a super bendy spine, and I always feel there is more work to do in these postures. The work of *asana* is never done! But my own struggles in this category of poses have provided an opportunity to use my body as a laboratory to figure out the anatomical pieces that interrelate. Once I figure them out, I can work with different elements to impact and change my own body.

This process forced me to look at how my Upward Dog related to my backbends and how tension around various joints was preventing me from being in a comfortable place while backbending. Was that pinching feeling in my lower back really necessary in Full Wheel? As it turns out, it wasn't necessary and I really appreciated the journey that brought me to that realization.

For conversation's sake, let's say that a Full Wheel or *Urdhva Dhanurasana* is the pinnacle of backbending. There are deeper, more dramatic backbends, such as *Kapotasana*, where one is on their knees in a backbend and holding onto their feet or heels. You can even drop back into a backbend as part of this family. That being said, *Urdhva Dhanurasana* is universal enough for our conversation.

It is easy to classify certain postures as backbending poses based simply on the position of the spine. I take it a step further to create two basic groups. In the first we are in a prone or face down position. From here we lift into a backbend. These postures include *Salabhasana*, *Bhujangasana*, *Urdhva Mukha Svanasana*, and *Dhanurasana*. In the second we are face up in a supine position. In these postures the limbs often support the backbend in some way. They include *Ustrasana*, *Kapotasana*, *Setu Bandhasana*, and *Urdhva Dhanurasana*. I make this division because each type requires different muscular actions, and they feel quite different as well. For instance, the prone type does not typically take us beyond our unassisted range of motion. The supine type uses the leverage of the limbs to deepen the backbend. One exception is Upward Facing Dog, which is a prone backbend that is supported by the hands and feet. The more important element to all of the backbending postures, regardless of how we classify them, is that they all rely on the interrelationship between multiple joints. Seeing this bigger picture is pivotal to creating the right patterns of strength and flexibility in the necessary tissues.

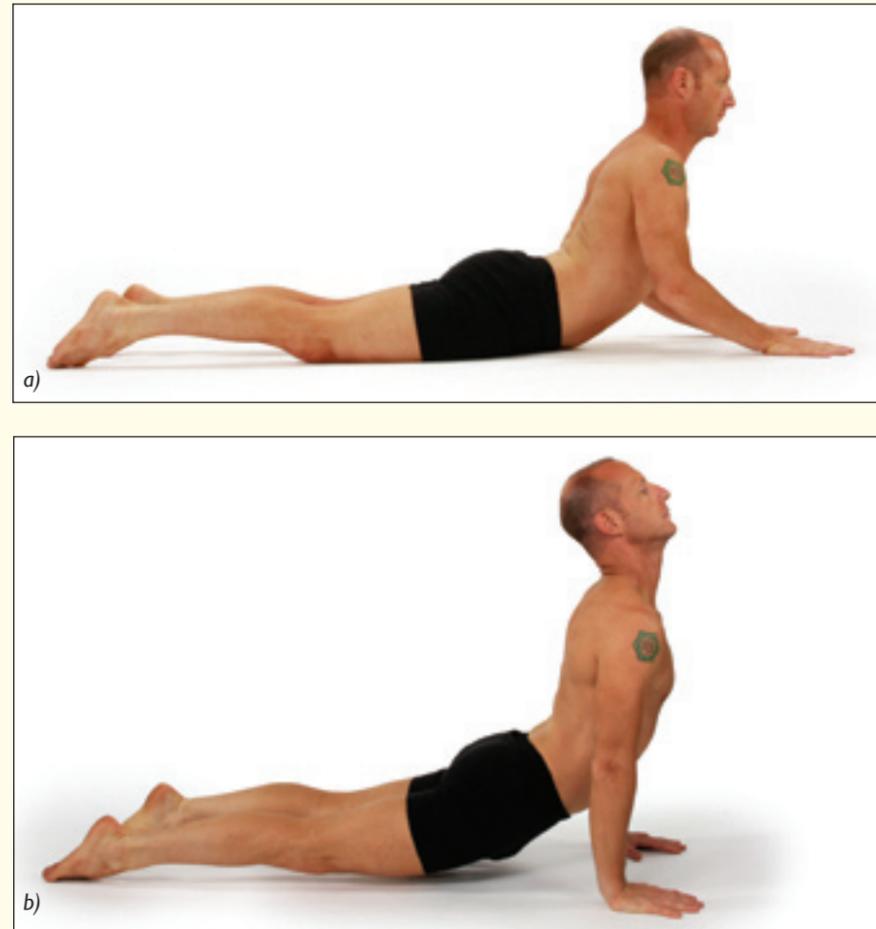


Figure 13.1: a) Bhujangasana, b) Urdhva Mukha Svanasana.

## TAKING IN THE WHOLE

In keeping with this idea of making connections between postures and anatomical function, the backbending family gives us a lot to work with. As always, we need to remember our theme of integration. Backbends not only teach us to integrate movement between all sections of the spine, but also to integrate the surrounding limbs into the movement of the posture as much as possible. Doing so helps us avoid over-using our most flexible parts (if we have them) and take advantage of the backbend as a whole.

Students, and sometimes even teachers, can overlook the fact that backbends involve more than just the spine. People tend to think that we need to increase the bend in the spine for backbending postures. I'd like to talk about the tissues that allow or restrict the totality of a backbend. Therefore, as I make my way through the various postures on the journey to wheel, not all will necessarily be backbending postures. In other words, because we are exploring the role of the arms and the legs in a backbend, some of the postures in this chapter will be focused on that component of our pinnacle posture, *Urdhva Dhanurasana*.

## ON THE WAY TO BACKBEND

Before getting too engrossed in the more traditional supported backbend, let's look at the prone postures for a moment. These postures reveal our unassisted range of motion. When we do postures such as *Salabhasana* and *Bhujangasana* (Cobra Pose), we use muscular effort against muscular tension.

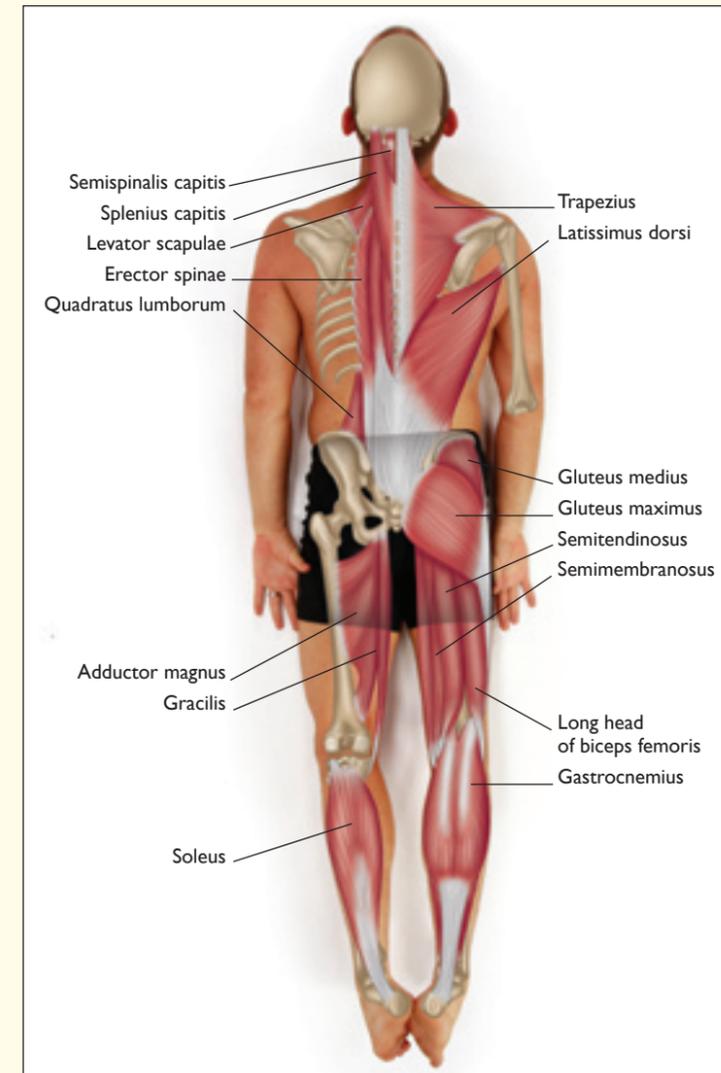


Figure 13.2: The entire back body assists in lifting the body off the floor.

As we begin to lift ourselves up in *Salabhasana*, for instance, all of the muscles on our posterior body contract—the calf muscles, hamstrings, gluteals, and paraspinals, all the way up into the back of the neck. What are they working against? They are working against the resistance of the anterior side of the body and gravity. The shins, quadriceps, hip flexors, and abdominals all provide tension that the posterior part of the body must work through.

Here we see the strength of the posterior tissues working against the resistance of gravity and the anterior tissues. When we add assistance to our posterior tissues we are using an assisted range of motion. *Dhanurasana* and Up Dog offer us this help, taking the unassisted range of motion further while still using the strength of the posterior muscles. The muscles do not shut off when we add assistance.

### Dhanurasana

When we move into *Dhanurasana*, we move beyond our unassisted range of motion. Our hands reach back to grab onto the feet or ankles—and then something interesting happens. We create tension between the hands pulling and the feet pushing that initiates the lifting action in the pose. The relationship between the hands and feet brings the posture to a deeper place. Without this relationship, we would be limited to the same height as our *Salabhasana*. The co-contraction of the buttocks and paraspinal muscles combined with the tension created by holding onto the feet allows us to lift higher and keeps us lifted up!

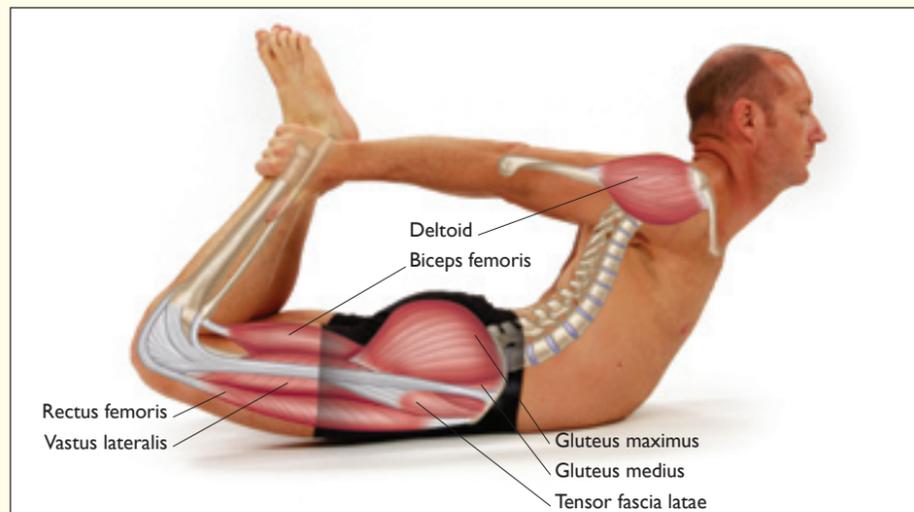


Figure 13.3: The quadriceps engaging against resistance assists us in lifting higher.

Pulling the feet against the hands lifts our chest higher and usually rocks us back towards the pubic bone. The dynamic between the push and pull and how this manifests movement in the body is intriguing. Creating tension in the lower leg, or rather, by straightening the lower legs against the resistance of the hands, allows us to move in the opposite direction at the hip joints. This creates extension at the hips, allowing for a deeper backbend.

### Up Dog

This is often the first backbend we arrive at in our practice. Many classes begin with some variation of Sun Salutations, often including Upward Facing Dog sandwiched between *Chaturanga Dandasana* and *Adho Mukha Svanasana* (Down Dog). In fact, when these two postures are sequenced up against Upward Dog, they also relate to our backbend.

Remember, the path to *Urdhva Dhanurasana* is comprised of other backbending postures. These other postures begin the neuromuscular training in our bodies. Since Up Dog is often done early in one's practice, it is likely where the patterns of backbending take root.

It's not uncommon in the development of our practice to focus exclusively on bending the spine in Upward Dog. While this is the essence of the pose, it is not where the real teaching of it lies. Upward Dog teaches us where the energy of the backbend comes from. It also teaches how to create the dynamic of a full-body backbend. This reveals patterns that lead us to a deeper and more comfortable *Urdhva Dhanurasana*.

Let's take a step back before going any further into Up Dog. We often arrive at this pose via *Chaturanga Dandasana*, thus here we establish the placement of our hands and feet, the points of leverage required to deepen this backbend.

### Chaturanga

The distance between the hands and feet in *Chaturanga* directly impacts our transition into Up Dog. Visualize a line connecting the heel of your hands together across the mat. Then draw a line connecting the big toes in the same way. The distance between these two lines, between the hands and feet, is extremely important in determining what our Up Dog looks (and feels) like. In essence, the backbend of Upward Dog must fit between the foundation that we give it in *Chaturanga*. This is where the compensations in Up Dog can begin.



Figure 13.4: The distance between your toes and hand in Chaturanga is crucial for understanding our Up Dog.