notes from the editor's desk

Perhaps you have heard the story about three blind people encountering an elephant for the first time. One touched its trunk and described the elephant as a long hollow tube. The second touched its leg and described it as thick and wide around as an oak tree. The third touched its tail and described it as a thin wispy creature. The moral of the story, of course, is that what we see is determined by what we chance to encounter and by the powers of observation we have at our disposal.

In this issue, my goal is to reveal the "elephant" that is standing in front of us by expanding on previous articles I have published in OMJ (Rogel, 2007, 2010, 2015), bringing the ideas together so that we can see how the "trunk," the "legs," and the "tail" are all connected. With this article, I am introducing the term "Restorative Kinematics." Kinematics refers to "the features or properties of motion in an object." (dictionary.com) My particular focus in this article is the features of the pelvis that enable it to move.

I believe the ligaments hold the key to understanding how the body moves, how joints become injured, how joints heal from those injuries, and how we as practitioners can facilitate that healing. In "Rethinking Orthopedics" (2010) I present this notion in detail and endeavor to argue that it is the ligaments rather than the muscles that control alignment and motion. Of course, movement is not possible without muscles; but my argument is that muscles respond to bony alignment and can function through a wide range of alignment possibilities. I believe they react to rather than control alignment and that muscles cannot be exercised to restore alignment.

In "Seeking Equilibrium" (2015) I trace nine "key" areas around the body that I believe must be addressed when treating injury and especially when attempting to restore joint alignment. In that article I explain what is unique about each of these nine areas, and I show how the parts are interconnected and why the body must be treated as a whole rather than as isolated parts.

In the third article, "'Gold Needle' Acupuncture (2007)," I describe acupuncture points located in the stiff tissues of the axial skeleton and a method for needling them. I use this method for needling stiff tissue at each of the nine "keys," and particularly the pelvis, which is the subject of the current article.

This article on the pelvis focuses mainly on the bony and ligamentous structure of the pelvis, how it is constructed, what this structure tells us about movement and injury, what happens with injury and wear-and-tear, and how to reverse these effects. In addition to discussing anatomy, including some little known facts about pelvic construction, I also suggest needling locations that I have found to be highly effective; and I offer some exercises designed specifically to address the unique features of the pelvis and how it is connected with the rest of the body through the ligaments. I hope you will find the information useful to your practice, regardless what type of acupuncture you practice.

Seeking equilibrium,

Mary J. Rogel, PhD, LAc

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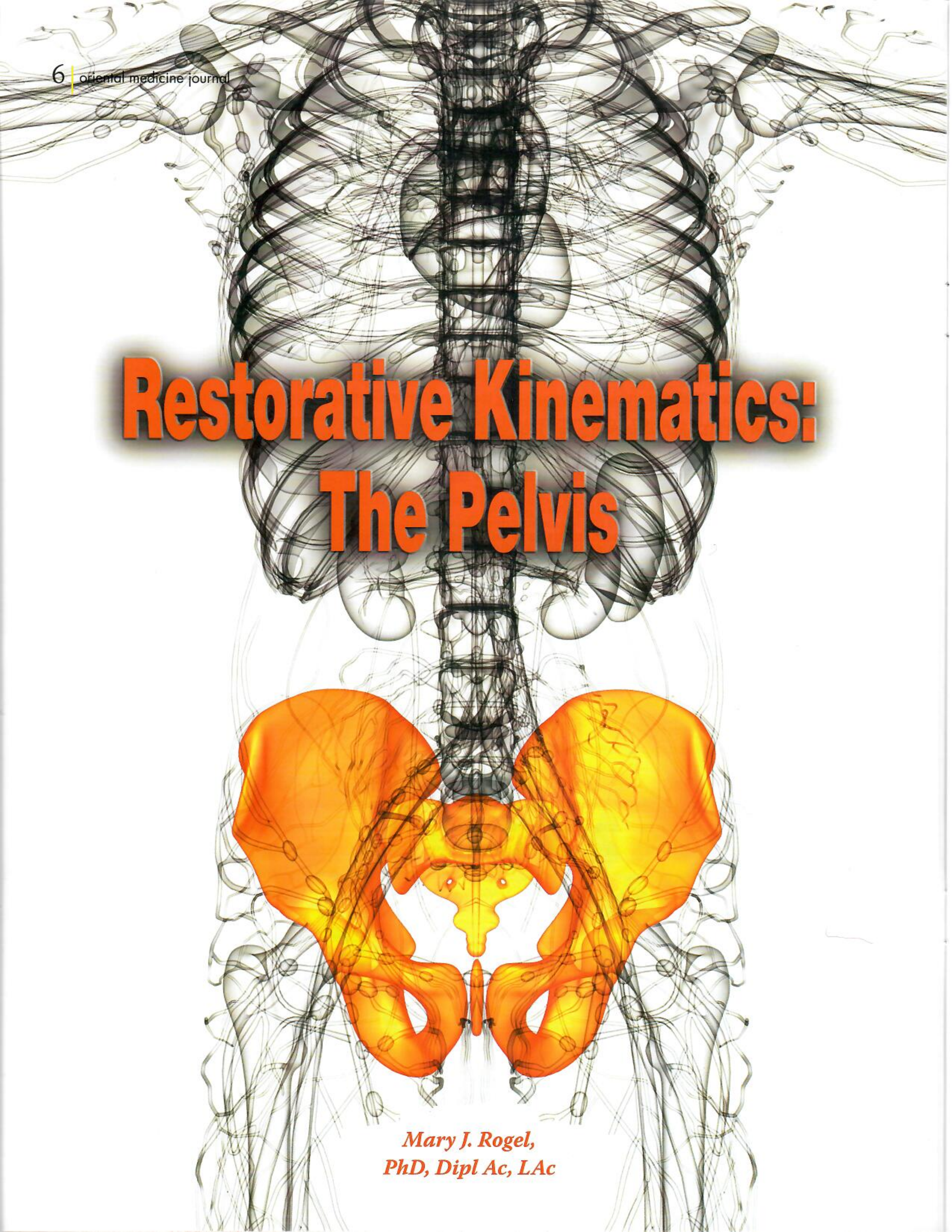


Restorative Kinematics: The Pelvis

Mary J. Rogel,
PhD, Dipl Ac, LAc

Introduction

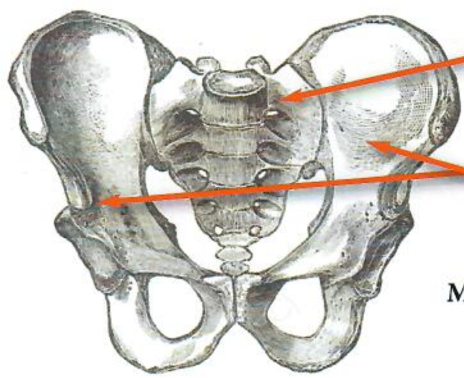
In many ways, our bodies are like tall buildings. The pelvis is the foundation upon which the upper body is built. The lower extremities are like pylons on which the foundation rests. What makes it all so interesting is that the foundation is articulated, and it participates in moving us through space. It also makes a nice container for holding some of our softer parts.

In this article we will examine the structure and function of the pelvis. We will talk about the pelvic bones and ligaments, how they move, male-female differences, how the pelvis participates in walking, how the pelvis is related to the hips, and why the pelvis is so involved in back pain, sciatica, almost every orthopedic problem, and many internal medicine problems. We end with treatment suggestions that flow from an understanding of how ligaments control joint alignment and movement, an approach that I am calling "restorative kinematics."

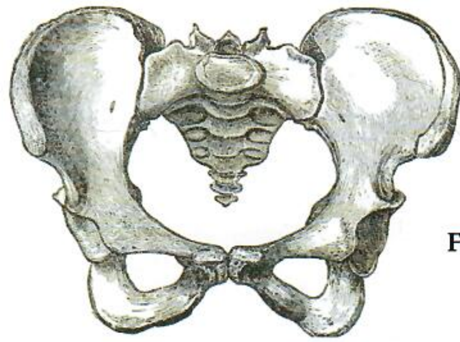
Bones of the Pelvis

The language used to describe pelvic structure can be confusing, so we begin with terminology. "Pelvic bone," "innominate bone," "coxal bone," "os coxa," and "hip bone" all refer to the same two large flattened bones that house the hip sockets, one on each side of the body. The two pelvic bones taken together are known as the "pelvic girdle" and are part of the "appendicular skeleton," referring to their function of supporting the lower appendages. The "bony pelvis," or "pelvis," comprises four bones: the two bones of the pelvic girdle plus the sacrum and coccyx, which are part of the "axial skeleton."

Pelvic Girdle



Male Pelvis



Female Pelvis

Pelvic Bones

Each pelvic bone consists of three bones – the ilium, the ischium, and the pubic bone – which begin to fuse during puberty. Prior to puberty, the three bones are separated by cartilage. Different sources specify different ages at which the bones fuse to form the acetabulum, which is the socket into which the head of the femur fits. Generally they begin to fuse by age 15-17, and the process is completed by age 20-25. (Wikipedia, Hip bone; Knipe, et al.; Singh, A.P.) The concavity of the acetabulum develops in response to the presence of the head of the femur (Ponseti, I.V., 1978), which means that the acetabulum fits around the head of the femur like a glove fits the hand. In the absence of abnormalities, the head of the femur glides smoothly in the socket.

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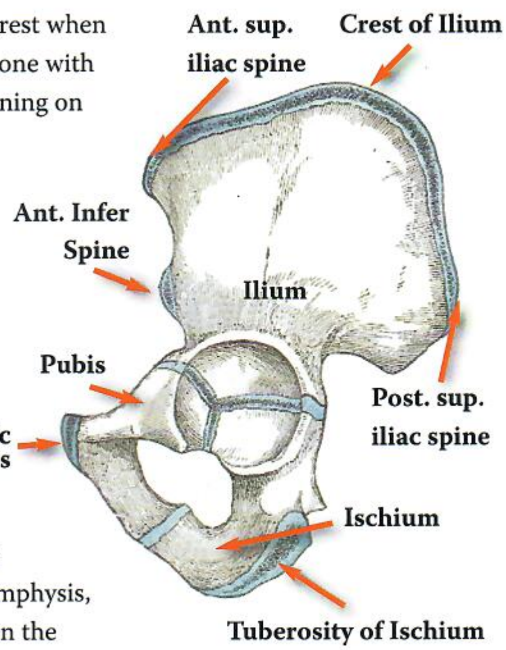
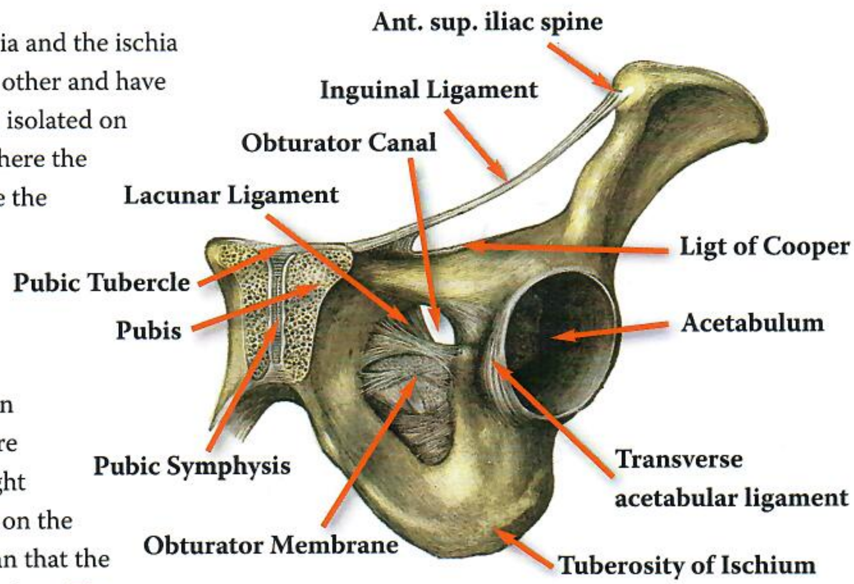
The **ilium (plural "ilia")** is the large rounded bone on which our hands rest when we stand with our hands on our hips. Practitioners generally evaluate this bone with the patient standing or prone, which allows them to compare what is happening on the two sides of the body.



The **ischium (plural "ischia")** is the bone on which we sit, which is why people sometimes call it the "sit" bone. An easy way to locate the ischia is to sit on a hard chair. If you feel like you are sitting on two bumps, those are the ischia. Practitioners generally locate this bone with the patient prone. It is the bone onto which the hamstrings attach.

The **pubic bone** is located in the front of the body, at the bottom of the abdomen. The easiest way to feel the pubic bones is to lie supine so that the abdominal muscles are relaxed. Then "walk" your fingers down the abdomen until you come to a solid structure that stretches from hip to hip. This is the pubic bone. There are two, one on each side of the body, joined in the middle by a joint known as the pubic symphysis, orpubic joint, which has a fibrocartilaginous disc oriented vertically between the articular surfaces of the two bones.



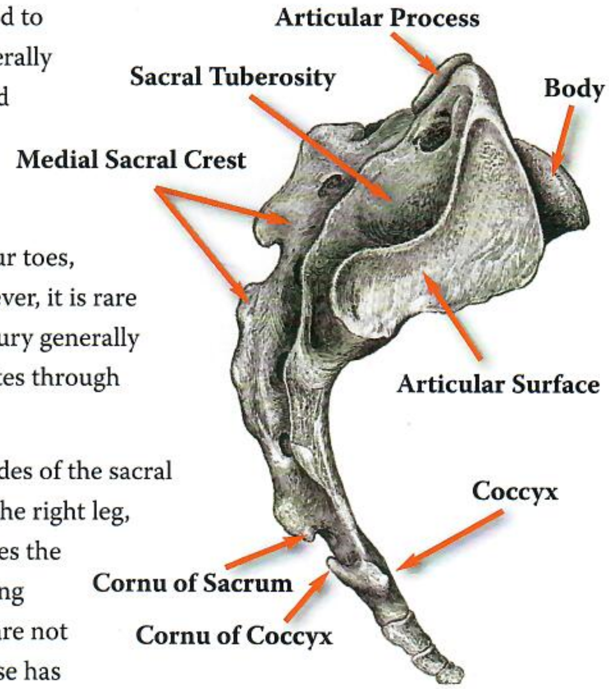
The pubic bones are different from the ilia and the ischia because the pubic bones actually meet each other and have a joint between them. The ilia and ischia are isolated on each side of the body. Therefore, the joint where the two pubic bones meet is also the joint where the two pelvic bones meet. The two large fused bones of the pelvic girdle articulate at the pubic symphysis, the small, slightly flexible connector between the pubic bones.

The two pelvic bones do not have to be in the same plane, and most of the time they are not. If you look at the way you are sitting right now, chances are you are not sitting equally on the two ischial tuberosities; and that would mean that the two halves of the pelvis are not in the same plane. The two halves of the pelvis communicate directly with each other through the pubic symphysis, and they are almost never symmetrically aligned, whether in movement or at rest.

The positions of the two pelvic bones are constantly changing in relation to each other. In order for that to happen, they have to be connected not only in the front but also in the back, at the axial skeleton, where we find the other two bones of the pelvis, the sacrum and coccyx, closing the circle in the back of the body. The two pelvic bones meet the sacrum at the sacroiliac joints, which are much larger connectors than the pubic symphysis.

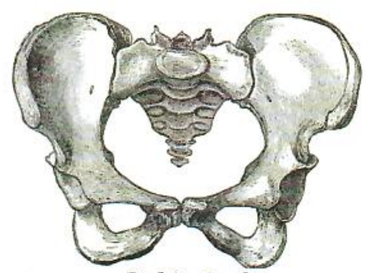
Sacrum

The sacrum is a curved bone that is wider at the top, narrower at the bottom; is wider on the anterior surface, narrower on the posterior surface; and has sides that are twisted like a propeller wing. The sacrum is composed of five vertebrae that fuse between the ages of 18 and 30 to form one bone. (Wikipedia, Sacrum)



In order to understand how the sacrum moves, we need to imagine it in three dimensions. Its basic movement is generally described as nutation and counternutation. When we bend backward at the waist to look upward, for example, the base of the sacrum (its upper surface) moves forward in a motion that is called nutation; think of the sacrum as "nodding." When we bend forward at the waist to touch our toes, the sacral base moves backward in counternutation. However, it is rare that we move in perfect nutation and counternutation. Injury generally means that one side of the sacrum nutates or counternutates through a slightly greater range than the other side.

Indeed, the very act of walking requires that the two sides of the sacral base move in different directions simultaneously. Raising the right leg, for example, in preparation for taking a step forward, moves the right ilium in a posterior direction as though we are bending forward. Yet we are standing on the left leg and therefore are not bent forward. Consequently, the right side of the sacral base has moved into nutation, while, of necessity, the left side of the sacral base is in counternutation. As we walk or run, each side of the sacrum alternately moves into and out of nutation and counternutation. We will return to the question of how the sacrum moves when we talk about pelvic ligaments.

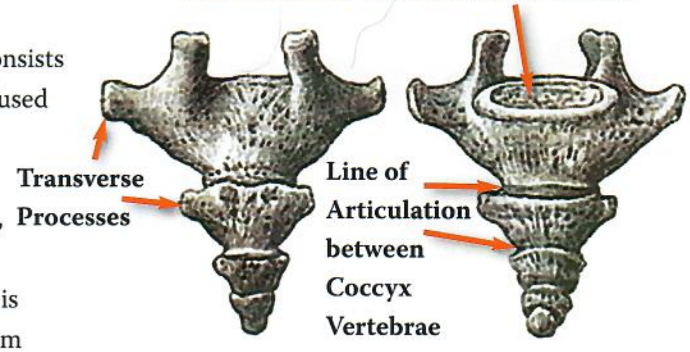

Pubic Arch

The sacrum is commonly described as the keystone of an arch. It has the shape of a keystone, but there is disagreement as to whether it is actually a keystone. Serola argues that it does not function as a keystone because it does not transfer weight by bone to bone contact as would happen in an arch with a keystone. Rather the sacrum is suspended by the ligaments that support it. (Serola, Keystone)

I agree with Serola that the sacrum does not function as the keystone of an arch. Nevertheless, it is the place where the pressures from the upper body and the pressures from the lower body meet. The weight of the upper body is conveyed to the sacrum by virtue of its being at the bottom of the spine, and the pressures that come up from the legs, in effect, push the pelvic bones upward. Imagined this way, it is easy to see how the sacrum would be suspended within the pelvis by the ligaments that connect it to the pelvic bones.

Coccyx

Underneath the sacrum is the tailbone, or coccyx, which consists of three to five rudimentary vertebrae that are separate or fused to form up to five segments, though most commonly there are two or three. Hence, it is incorrect to say that the coccyx is fused. (Wikipedia, Coccyx; orthopaedicsone.com, Coccyx) The sacrum and coccyx are separated by a slightly moveable joint called the sacrococcygeal symphysis, which is located within the oval space between the apex of the sacrum andthe base of the coccyx. The coccyx generally is less than an inch in length and tends to become less mobile later in life.



Posterior View   Anterior View

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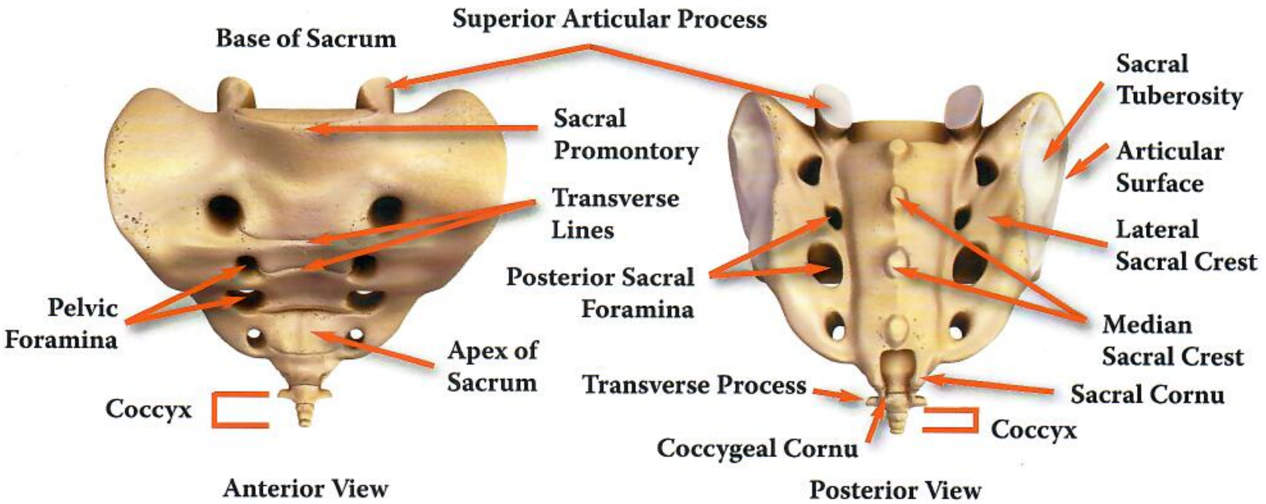
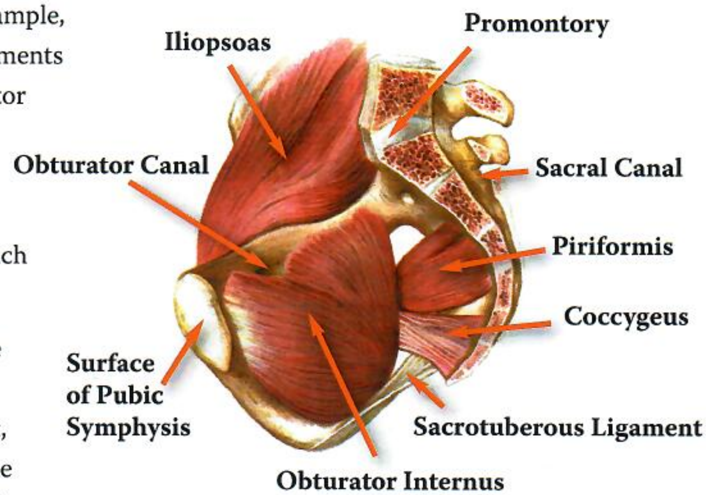
Sacrum and Coccyx





Its movement, flexion and extension, is passive, for example, during labor. The coccyx is an attachment site for five ligaments and various muscles, including the gluteus maximus, levator ani, and fibers of the sacrotuberous and sacrospinous ligaments. It contributes to the functions of the pelvic floor, such as defecation and continence; and it functions with the ischial tuberosities as part of the tripod upon which we sit, especially when we lean backward.

To summarize, the pelvic bones are formed from three bones, the ilium, ischium, and pubic bone, which begin to fuse during puberty to form the acetabulum, or hip socket, in each innominate. The pelvic bones, which are part of the appendicular skeleton, meet and articulate slightly in the front at the pubic symphysis, and they meet the sacrum in the back at the sacroiliac joints. The weight of the body pushes down on the sacrum; the forces from the legs push up on the pelvic bones; and the pressures meet at the sacroiliac joints. The sacrum, which is part of the axial skeleton, has a slightly movable joint with the coccyx, which is located directly beneath it; and it is suspended within the pelvis by ligaments.

Pelvic Ligaments

Movement is possible because the bones are connected to each other with ligaments that are strong enough to hold the ends of the bones close to each other yet are flexible enough to allow movement in virtually all directions without tearing apart. In my view, the ligaments hold the key to understanding the tremendous and dynamic ability of the body to accommodate to injury and to wear and tear. Ligaments connect bone to bone and are named for the bones they connect, while tendons connect muscle to bone

Tendons often assist the ligaments in their work, as the fibers of tendons and ligaments may intermingle. However, because the tendons connect to muscle rather than to another bone, they cannot be responsible for the integrity of joints. Muscles are elastic, in comparison to the stiffness of ligament or tendon, so muscles will "give" under stress more than the stiff tissues will. Bones have an astonishing range of possible alignments within a joint. Just think of all the positions the head of the femur can comfortably assume within the hip capsule. The muscles stretch or contract as needed to make those positions possible. When a muscle is under constant strain from bone alignment that cannot return to its most efficient neutral position, it adapts to the new neutral position by adding or removing tissue as needed to reduce the strain. The best example of this adaptive muscle shortening, or lengthening, is in women who always wear high-heeled shoes. Eventually their calves shorten in length, and they cannot walk in flats without pain unless they "regrow" the muscles by gradually lowering the height of the heels they wear.

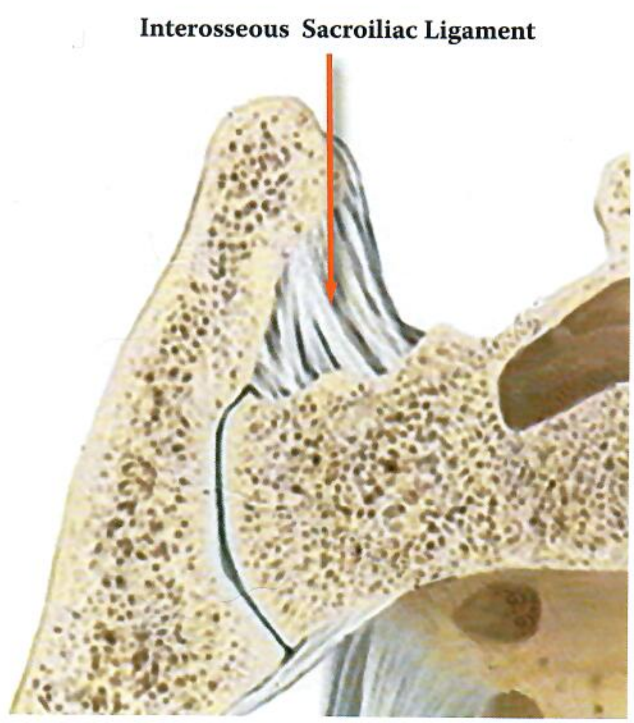
In this section, we will examine the sacroiliac joint and the major pelvic ligaments associated with the sacrum, specifically the sacroiliac, iliolumbar, sacrotuberous, sacrospinous, and sacrococcygeal ligaments.

Sacroiliac Joints

Serola (Sacroiliac Ligaments) describes the sacroiliac joints as being smooth and flat, permitting them to glide in all directions, until the late teen years. By the early twenties, the iliac surface develops a ridge that corresponds with a groove on the sacral surface. Soon after, the axial sacroiliac joint develops on the ilium, along with a corresponding depression on the sacrum, just posterior to the articular portion of the sacroiliac joint. The axial sacroiliac joints appear to be non-weight-bearing centers of motion upon which the sacrum pivots simultaneously in a rocking motion. This is easy to imagine when we think of the sacrum as being suspended on its ligaments.

Sacroiliac Ligaments

The sacroiliac joints lie at the level of S1-S3 on the lateral edges of the sacrum, which is sometimes described as an L-shaped surface that has a twist similar to that of an airplane propeller. Each sacroiliac joint is formed by three sacroiliac ligaments – the posterior, anterior, and interosseus ligaments. Serola (Keystone) argues convincingly that the sacrum is actually suspended from the ilia by the sacroiliac ligaments rather than allowing force transfer directly by the compression of bone against bone while weight bearing. My clinical experience of adjusting the position of the ilia in relation to the sacrum corroborates Serola's argument.



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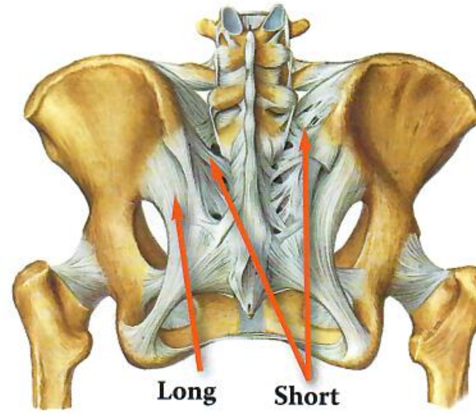
Posterior Sacroiliac Ligaments

The long and short posterior sacroiliac ligaments are the most superficial of the sacroiliac ligaments; hence we can palpate and needle them directly. They lie on the posterior surface of the sacrum on either side of the median sacral crest. Each is composed of strands of ligamentous fibers that go in varying directions, connecting the sacrum and the ilium. The short ligaments lie primarily in a horizontal orientation at the level of the S1 and S2 sacral segments. The long ligaments, sometimes called the dorsal sacroiliac ligaments, lie primarily in an oblique orientation from the lower sacral segments to the posterior superior iliac spine.

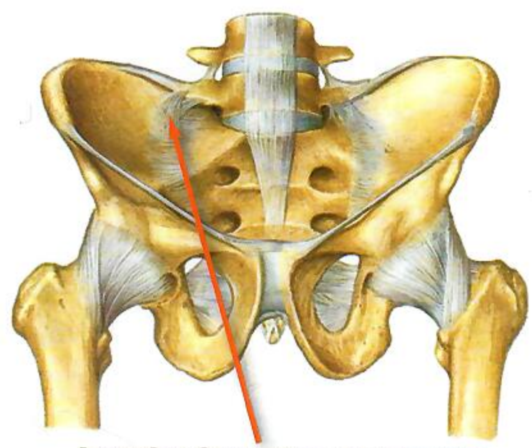


Posterior Sacroiliac Ligaments

Counternutation of the sacrum, as occurs while sitting, creates tension in the portion of the long posterior sacroiliac ligament that attaches to the posterior superior iliac spine, while nutation creates tension in the sacrotuberous ligament. It is interesting to note that in some people fibers of the posterior sacroiliac ligament extend into the sacrotuberous ligament and attach to the ischial tuberosity. Tension in the long posterior sacroiliac ligament during counternutation means that it can be a source of pain when counternutation is sustained (Vleeming, et al., 1996), as we will see later is often the case when pelvic movement through the gait cycle becomes restricted, usually in response to injury in the sacroiliac joints.

Anterior Sacroiliac Ligaments

The anterior sacroiliac ligaments span the anterior surfaces of the sacrum and ilia at the level of S1-S3. This is a part of the sacrum and pelvis that we never can touch, and relatively little information seems to be available about them other than that they are generally considered to be a thickening of the anterior sacroiliac joint capsule, which tends to be thin and prone to tearing, and that they may be a significant source of pain. (Serola, Sacroiliac Ligaments)


Anterior Sacroiliac Ligaments

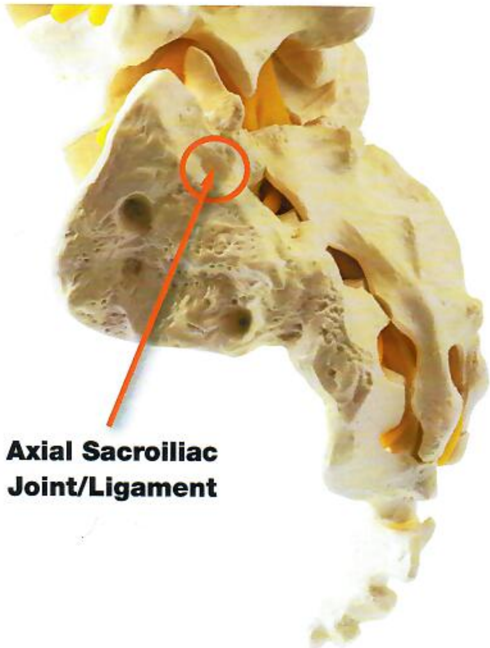
Interosseus Sacroiliac Ligaments

The third sacroiliac ligament is the interosseus ligament, the ligament "between the bones." This ligament consists of many short, strong fibers that pass between the two bones in various directions. (Rosatelli, et al., 2006) It was described to me as being twisted, something like a rope. (Marcus, 1994) When the ligament contracts, the strands of this ligament twist around each other, and it shortens. If you take an actual rope and twist it, you can see the rope contract and shorten; and when you untwist it, the rope relaxes and lengthens. This is how the interosseus sacroiliac ligament behaves. When it relaxes, it is longer; and the connection between the sacrum and the ilium is loose, enabling the leg to swing. When it contracts, it pulls the sacrum and ilium closer together, though they never actually touch, and it allows them to function as a unit. The action is something like that of the clutch in a car with manual transmission. Pushing in the clutch separates the two pieces of metal that had been in contact and rotating as one, allowing them to move at different speeds. That is similar to what happens in the body. When the interosseus ligament relaxes, the sacrum and ilium move apart and the two bones can move more independently; and when it contracts, the clutch is engaged, so to speak, and they move at the same speed – they move together. When we stand on one leg, the interosseus ligament contracts, pulling the sacrum and ilium closer together, enabling them to function as one and creating a strong column on which to balance weight. When we lift one leg, the ligament relaxes, the ilium can move more independently of the sacrum, and we can swing the leg to take a step forward or backward.

The sacroiliac ligaments are extremely strong, and the interosseus sacroiliac ligament is the strongest of all the ligaments in the body. These ligaments have to be strong, because a strong structure is needed to stand on one leg with all of our weight. Likewise, they must withstand the momentum of swinging the leg, especially when running, while at the same time they must be strong enough so that the joints do not fly apart.

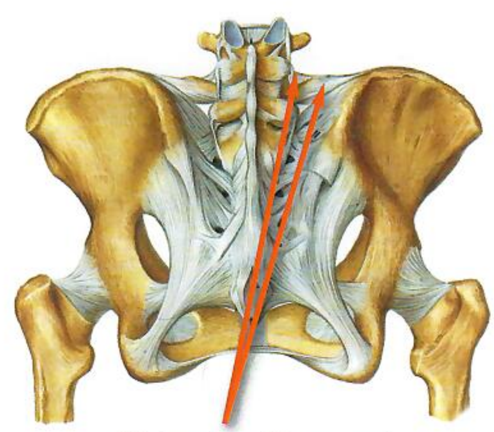
Axial Sacroiliac Ligaments

The axial sacroiliac ligament is unique among the sacroiliac ligaments. It lies within the axial sacroiliac joint, which is situated posterior to the most concave part of the articular portion of the sacrum and anterior to the interosseus sacroiliac ligament. These two ligaments have an interesting relationship. The axial sacroiliac ligament is one of the weakest ligaments in the body, compared with the interosseus sacroiliac ligament, which is one of the strongest. Further, the axial sacroiliac ligament has no structural strength in the sacroiliac joint. In contrast, the sacroiliac joints collapse when the interosseus sacroiliac ligaments are removed; the sacrum drops into bony contact with the ilia, stopping all movement in the sacroiliac joints. (Serola, Sacroiliac Ligaments) Serola presents research to demonstrate that the axial sacroiliac joints are the pivot points of sacroiliac joint motion. The fact that the axial sacroiliac ligaments have no structural strength within the joints strengthens the argument that they are pivot points.



Iliolumbar Ligaments

While the sacroiliac ligaments connect the ilia with the sacrum, the iliolumbar ligaments connect the ilia with the lumbar spine, specifically with L4 and L5, the lowest two vertebrae in the lumbar spine. These two sets of ligaments (sacroiliac and iliolumbar) work together to provide stability and to limit the movement of the lower lumbar vertebrae and sacrum as the ilia move.



Sacrotuberous and Sacrospinous Ligaments

The sacrospinous and sacrotuberous ligaments connect the lower portion of the sacrum with the innominates. The sacrospinous ligament arises from the lateral edges of the sacrum and coccyx and attaches to the spine of the ischium. Its fibers intermingle with those of the sacrotuberous ligament. (Wikipedia, Sacrospinous Ligament)

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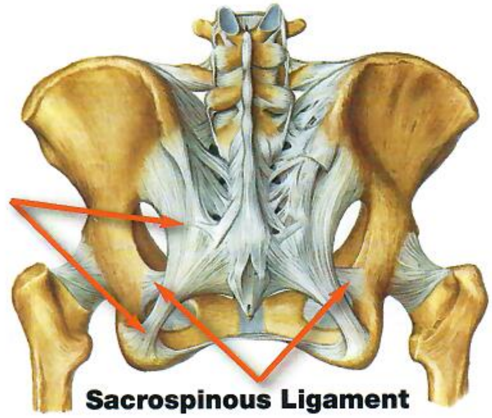
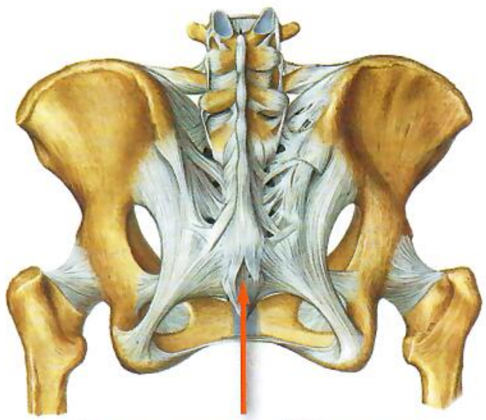
The sacrotuberous ligament has fibers that arise from the lower portion of the sacrum and the upper portion of the coccyx and join with fibers arising from the posterior superior iliac spine and the posterior sacroiliac ligament to attach on the medial margin of the ischial tuberosity. Superficial fibers from the lower part of the ligament blend with the tendon of the biceps femoris (one of the hamstring muscles). (Wikipedia, Sacrotuberous Ligament)



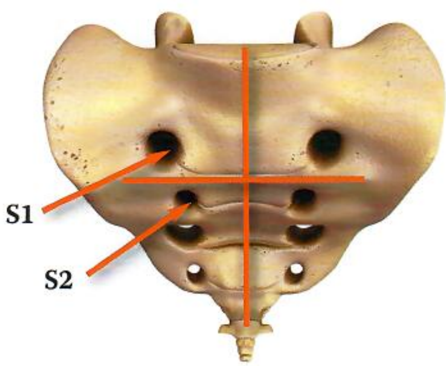
Sacrococcygeal Ligaments

The sacrococcygeal symphysis, the joint between the sacrum and the coccyx, is contained within the four sacrococcygeal ligaments – posterior, anterior, and two lateral.

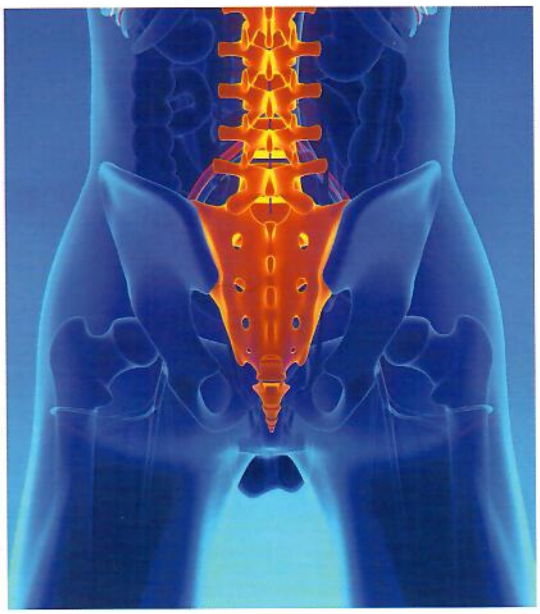


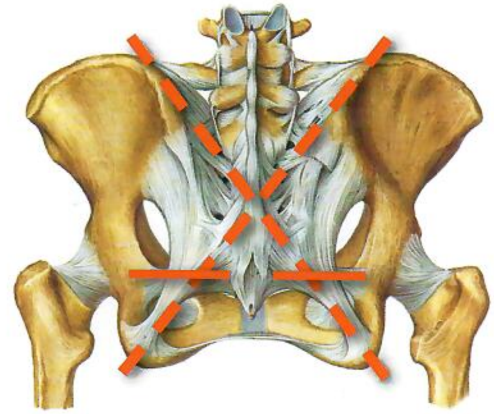
A Kinematic View

Starting from Serola's (Sacroiliac Ligaments) description of the axial sacroiliac joints as the pivots on which the sacrum moves, we can see some interesting patterns unfold. The axial sacroiliac joint and ligament effectively lie within the sacroiliac joint, which is defined by the posterior, anterior, and interosseus sacroiliac ligaments, which suspend the sacrum within the pelvis. Sacral motion is essentially a twist produced by the movement of the innominates. To understand this movement, I imagine a vertical axis down the midline of the sacrum and a horizontal axis between the axial sacroiliac joints. Where these axes cross is the place where the least amount of motion occurs; and the axes themselves can be seen as defining the motion of the sacrum when it is perfectly aligned. The vertical axis is the area of least motion when the sacrum rotates right and left, and the horizontal axis is the area of least motion when the lower back extends and flexes (sacrum nutates and counternutates) in the absence of injury or defect.



Gait introduces the notion of opposing innominate motions. When the right innominate rotates posteriorly, it turns the sacrum in a posterior direction on its imaginary vertical axis and simultaneously pulls the right sacral base into nutation on its imaginary horizontal axis, while the left sacral base counternutates and rotates in a slightly anterior direction. This means that the axes are pulled out of the vertical and horizontal planes, but where they cross is still the neutral place where least motion occurs.





At the same time, I imagine two more sets of axes along which motion occurs. The shorter set of axes is defined by the sacrotuberous and sacrospinous ligaments, of which there is one set on each side of the pelvis. If we imagine the pelvis as three-dimensional and extend the sacrotuberous axes, we can see that they pass through the axial sacroiliac joints to the iliac crests where the iliolumbar ligaments attach.

These axes actually can be considered part of a continuous pathway of ligament, tendon, and muscle that stretches from the sacrum downward all the way to the knee and upward on a diagonal across the body to the opposite elbow along a pathway that includes the hamstrings, thoracolumbar aponeurosis, latissimus dorsi, and long and short heads of the triceps muscle. These form the long axes along which the entire body twists.

The pair of smaller axes formed by the sacrotuberous and sacrospinous ligaments define variable axes of pelvic movement that may be seen as driving the variable axis of total body movement seen in the long axes. Even though it lies in an oblique orientation, the sacrotuberous ligament functions as a vertical axis, particularly when we stand on one leg. We can rotate from right to left very easily around that vertical axis when we are standing on that leg. The horizontal axis is formed by the sacrospinous ligament, which enables us to swing the leg that is suspended in the air easily, assuming no other injury or dysfunction. We move between these two sets of short axes constantly as we walk, and the long axes accommodate to the limits defined by the short axes.

The beauty of these axes is that they can function at many different degrees of angle. In other words, the axes do not have to be symmetrical in order for the axes to function. This makes the pelvis highly adaptable and allows it to function even when the pelvic ligaments are not moving the way they should. The pelvis simply rearranges itself around a different "neutral" and continues to move, and the upper body responds to counterbalance whatever is happening below.

The clinical significance of this is seen when injury causes various pelvic ligaments to contract and remain contracted. For example, falling on the left sacroiliac joint typically causes the left sacroiliac ligaments to contract, drawing the ilium toward the sacrum as happens when standing on the left leg. Because the left side of the sacral base counternutates when standing on the left leg, the right side of the sacral base nutates, assuming no other injury, relaxing and stretching the right interosseus sacroiliac ligaments as the iliac crest moves posterior and pulling the transverse processes of L4 and L5 with it because of the connection created by the iliolumbar ligament. If effect, the pelvic ligaments become "stuck" in a walking position. This becomes the new neutral, and it remains even while the person is sitting or lying down. The "walking" pelvis is visible on X-ray or MRI, and I find that it can explain a great deal of the pain and restricted motion I see in my clinic. Restoring all of the axes noted above to their symmetrical neutral positions effectively treats the pain and restriction. How successful one can be at restoring the body's kinematics depends on a variety of factors, including severity of injury, length of time it has been present, extent of other injuries, age, diet, exercise, and various other considerations.

The Hips

Bony Structures

To understand the hips, we return to the three bones that form each half of the pelvis, the ilium, the ischium, and the pubic bone. During adolescence these three bones begin to fuse to become one bone. The place where they fuse is the

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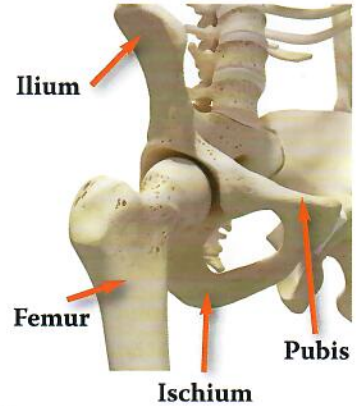
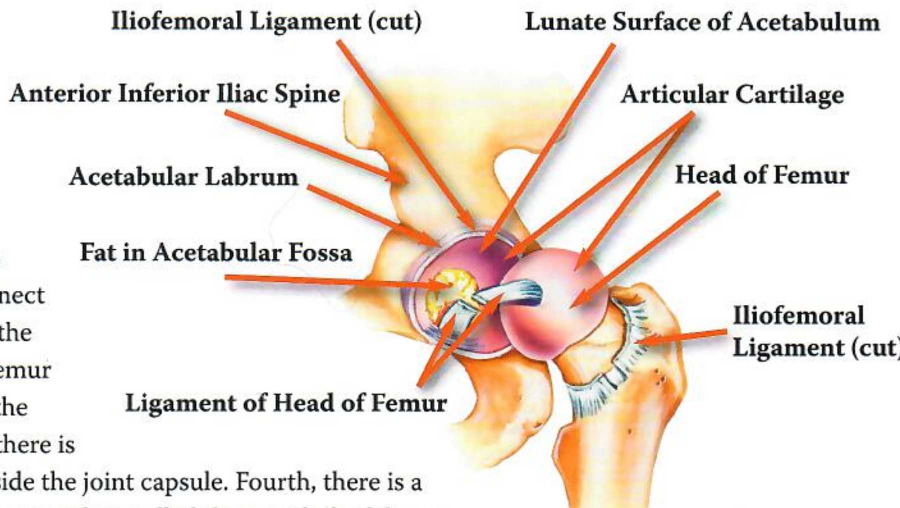
middle of the hip socket, the acetabulum, which is located anterolaterally in the pelvis, just superior to the crease where the leg joins the body.



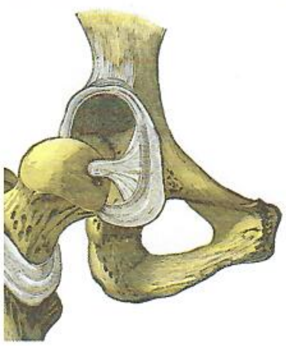
The ball that fits into the acetabulum is part of the femur, the long bone in the upper leg. As the femur reaches the top of the thigh, it changes direction at the greater trochanter so that the femur actually is an angled bone. The short section proximal to the greater trochanter is called the "neck," and at the end of the neck is a ball, known as the head, which fits into the acetabulum, attaching the leg to the pelvis.

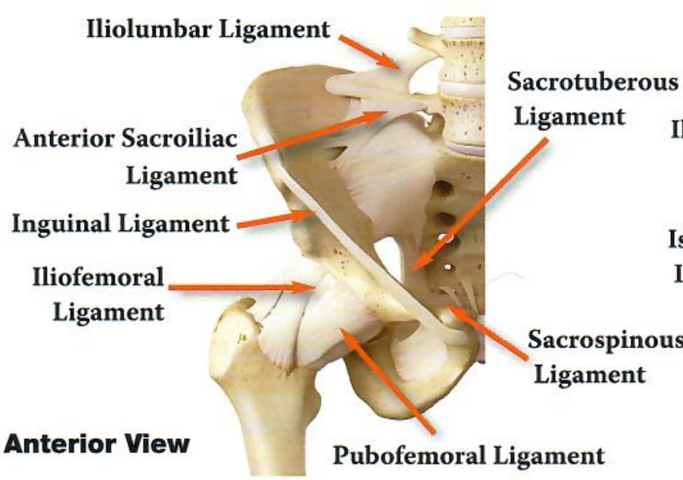
The way the hip fits into the pelvis is really quite ingenious. Because the hip sockets do not face exactly forward but rather face out slightly to the sides, the amount of space that is available for the hips to rotate is increased. A round ball in a round socket that is set out at a bit of an angle gives us maximum rotation for the hip as we move through space.

Ligaments

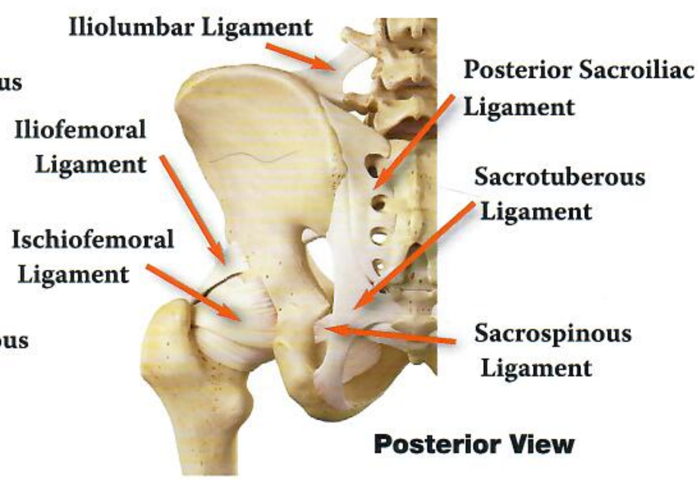


Several mechanisms keep the ball from falling out of the socket. First, there is a short ligament arising in the middle of the acetabulum that connects the head of the femur directly to the socket. Second, there are several large ligaments on the outside of the hip socket that connect the pelvis to the neck of the femur and enclose the joint. Third, there is a vacuum inside the joint capsule. Fourth, there is a ridge of fibrous cartilage called the acetabular labrum, as well as the transverse acetabular ligament, that outline the edge of the hip socket and help to hold the femoral head within the acetabulum. All of these mechanisms enable the hip to move maximally while maintaining a stable connection.





Anterior View



Posterior View

Muscles

Iliopsoas Muscle

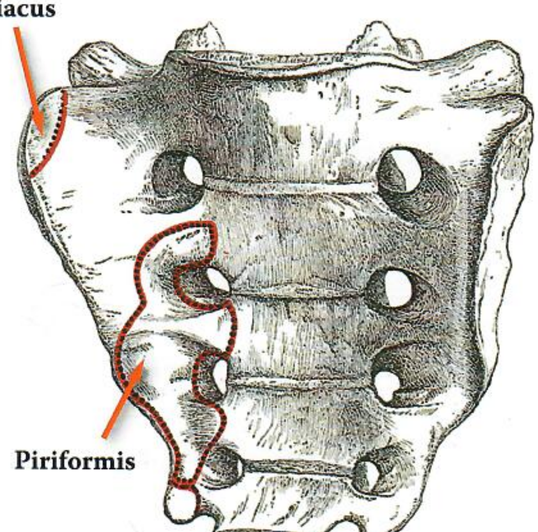
Several muscles also help to hold the hip in place and facilitate its movement. The entire inner surface of the ilium is the attachment site for a muscle called the iliacus, which joins with a second muscle called the psoas major, which originates from the lumbar spine. They form the iliopsoas muscle, which inserts on the lesser trochanter of the femur. These two muscles have a very interesting relationship, since they originate on different bones but insert at the same location. This means that moving the femur has an effect on both the ilium and on the lumbar spine. However, because the ilium and the lumbar spine are separate structures, they move independently when the femur moves, enabling the body to accommodate more easily to various injuries and to varying positions of the axes noted above.

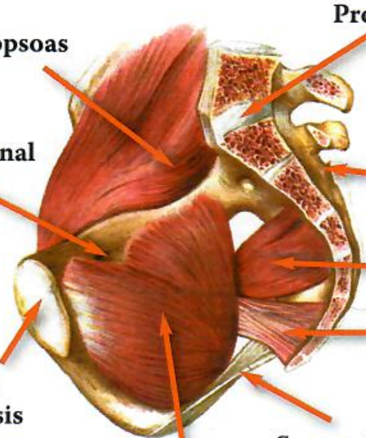
Because the iliopsoas group of muscles effectively jumps over the hip, the femoral head is free to rotate in the hip socket to accommodate hip flexion with the femur in any number of different positions. This is true even when there has been an injury or deformity that produces asymmetry in the pelvis, as long as the asymmetry does not require that the hip move outside its normal range of motion and as long as the hip itself is not injured.

Iliacus and Psoas Major Muscles

Piriformis Muscle

The piriformis muscle arises from the anterior surface of the sacrum with fibers also arising from nearby structures, including the sacroiliac joint and the sacrotuberous ligament, before inserting on the greater trochanter of the femur. In effect, the piriformis moves from the inside of the pelvis to the outside of the pelvis. When sacroiliac joint movements or the nutation and counternutation of the sacrum are restricted, the piriformis muscle is directly affected.





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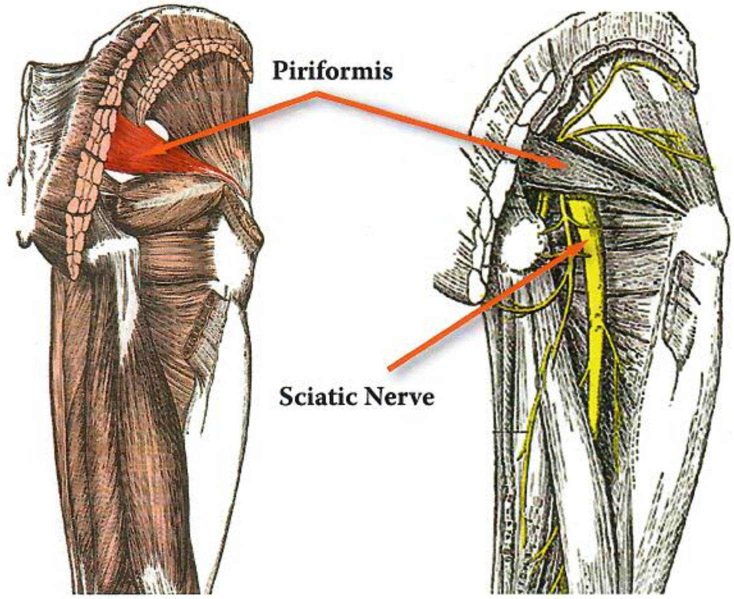
Clinically we may see what is diagnosed as "piriformis syndrome" or sciatica, since the sciatic nerve travels through the piriformis in 17% of people. (Wikipedia, Piriformis muscle) Whether the sciatic nerve travels above, below, or through the piriformis, it will be affected by pelvic and sacral rotations, particularly as those rotations move pelvic and sacral axes farther away from a symmetrical neutral.



Hip Replacement

Even though the hip joint is a highly efficient construction, its socket is part of the pelvis. Therefore, the function of the hip is dependent on the position of the pelvis. Under ideal conditions, the pelvis functions around a symmetrical neutral, and both sides can move through the entire range of possible motion when we walk. But ideal rarely occurs. Most of us get injured at some time in our lives. Injuries that occur in the pelvis and injuries that occur in the lower extremities always have an effect on the sacroiliac joints. Either we injure the joints directly, or we injure them through wear and tear because of an injury in the leg or pelvis. As an example, a broken leg that heals shorter than it was before the injury puts strain in the pelvis which is going to be felt in the ligaments. The foundation cannot be straight if the pylons underneath it are uneven. When one leg is shorter than the other, the pelvis cannot have a symmetrical neutral, creating uneven wear in both the sacroiliac joints and in the hips.

At some point it becomes difficult for the hip to continue moving through its entire range. The ball of the hip is not perfectly round, and the shape of the acetabulum developed in puberty and young adulthood to correspond to the shape of the femoral head. When it is not in its most efficient place, the femoral head eventually starts rubbing on the cartilage that lines the socket, creating a number of conditions including inflammation and spurs from constant tension on the ligaments. Over time the cartilage wears away faster in some places than in others, and eventually it rubs a hole through the lining. This is the process that produces what is called "bone on bone" arthritis. As it rubs, the femoral head tends to fall in the direction of wear along what I like to call "the pathway of least resistance." It is much easier for the femoral head to keep falling into the hole that it has been wearing than it is to try to use muscles to hold the head out of the hole. Muscles and tendons are flexible or semi-flexible and tend to stretch to accommodate the requirements of the bony alignment. This is the process that makes hips wear out and need to be replaced.

A Kinematic View

Theoretically we should be able to restore the pelvis to its ideal condition of symmetrical motion. If we catch the problem early enough in the process, it is possible that we may be able to prevent a hip from needing to be replaced and to prevent problems such as low back pain and sciatica. However, nothing is that simple. In the absence of direct injury to or congenital issues in the hips, problems in the hips are, minimally, the consequence of conditions in the pelvic bones, sacrum, sacroiliac joints, lower lumbar spine, lower extremities, and all the associated ligaments, tendons, and muscles.

So we cannot fix just the pelvis or just the hips. We have to fix the back and all the joints in the legs, as well. In a perfect world, we would hope that full function could be restored in the entire lower half of the body; but, since we live in an imperfect world, sometimes we have to settle for partial restoration, which often can be good enough to see us through in relative comfort to the ends of our lives. I believe that it is not enough to consider the function of each joint individually. Rather the body needs to be considered as a coordinated unit. What happens in the pelvis affects the lower extremities and entire upper body. What happens in the lower extremities affects the pelvis and entire upper body. When all the joints in the chain are taken into consideration, remarkable changes can occur.

Female/Male Pelvic Differences

Several differences between women's and men's pelves (singular "pelvis") have important implications for differences in injury and pain experienced by women and men.

Structural Differences

A woman's pelvis has a larger circumference than a man's, and it has a wider and rounder opening through the center. We all know that the reason for this is so that a baby's head can pass through more easily. There are other differences as well.

While the sacrum generally is wider at the top and narrower at the bottom, a woman's sacrum is wider than a man's; and it curves less as it passes down toward the lower part of the body, allowing the opening through the center of the pelvis to be wider. A woman's sacroiliac joints are also narrower from front to back, enabling them to "give" more easily under the demands of delivery.

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A 2008 article in The New York Times described a problem some people were having with prosthetic ceramic hips – they squeaked. Ecker, et al., (2008) conducted a study to determine the cause of the noise. They determined that the squeaking occurred in hips of a particular design with particular materials used in their construction. The squeaking typically occurred at the midrange of motion after the joint had been contaminated with metal particles that had worn from the prosthesis by rubbing at the extreme ranges of motion. Left unexplored is the reason for rubbing at the extreme ranges of motion. Photographs of wear patterns in the joint showed the wear occurring in one spot on the replacement socket and in one area of the replaced neck of the femur. Consider that a person who has had enough injury in the hip to warrant its replacement is still going to have, after the surgery, the same condition that created the problem in the first place. This means that the prosthetic hip is subject to the same pressures and asymmetries as the original hip. I believe this is the reason for the wear patterns on the replacement hips, with the resulting metallosis that causes them to squeak.

References:

Ecker, T. M., et al. Squeaking in total hip replacement: No cause for concern. In *Orthopedics*. September 2008, 31, 9, 875-876, 884.

http://www.stephenmurphy.org/cv/Murphy%20Squeaking%20Orthopedics%202008.pdf, downloaded July 1, 2018.

https://www.nytimes.com/2008/05/11/business/11hip.html, downloaded July 1, 2018.

During puberty, the female pelvis widens. Children's legs come down rather straight from the pelvis. As boys grow into men, their legs remain fairly straight up and down. As girls become women, the pelvis widens; and, in the process, the hips start to migrate farther apart from each other, so that the femurs are no longer straight up and down the way they were in girlhood but rather become angled. This process changes the angle at which the femur comes down from the hip to the knee. The wider the angle, the more likely a person is to have problems with the knees. On average, this angle, known as the Q or quadriceps angle, is 14 degrees in men and 17 degrees in women

Interestingly, a woman's pelvis becomes smaller again as she approaches and passes through menopause, though her pelvis still remains larger than a man's. The speculation is that downsizing the pelvis, as it were, at menopause provides a bonier, and therefore more stable, floor to support the internal organs after childbearing is no longer a possibility. (Benson, 2016)

Ligamentous Differences

The literature on ligament and tendon differences between women and men is quite sparse. (Leblanc, et al., 2017) Much of the research on the effect of estrogen and estrogen-like compounds on tendons and ligaments focuses on only three anatomical structures, the anterior cruciate ligament (ACL) of the knee, the Achilles tendon, and to a lesser extent the patellar ligament. Much of the little research that exists is driven by the greater incidence of ACL tears in women. While Leblanc, et al., (2017) found most of the research on sex differences to be inconclusive, they did report that women's ACL tendons are considerably less stiff than men's, and they attributed women's greater incidence of ACL injury to this characteristic. Apparently the available research has not attempted to discern whether women's greater incidence of ACL injury is due to the influence of estrogen on the ACL, to the wider Q angle in women, or to the interaction between these factors. The implication is that all tendons in women are less stiff than men's and therefore more prone to injury. (Austin, 2017)

In various places, I have seen women's ligaments described as "soft," "less stiff," "lax," and "weak." These characterizations are not consistent with my clinical experience. Women's ligaments have a different quality to them than men's. In general, my experience is that, after puberty, women's ligaments "give" more. They stretch more, whether women are pregnant or not, whether they ever have been pregnant or not, and whether they are in their childbearing years or in menopause. I find that, in general, because of this it is easier to work with women's ligaments than with men's, and it is easier to realign women's joints. My sample is small, but I would say that young girls' ligaments are more like men's. I have found it more difficult to work on young girls than on adolescent and adult women, perhaps because their tissues have not yet been exposed to high circulating levels of estrogen.

A Kinematic View

When I am asked to describe the differences between women's and men's ligaments, I like to do that by comparing pelvic structure to automobile engines. The way I see it, men's joints are something like our modern automobile engines. They are made with precision tooling; they fit together with close tolerances; things do not go wrong very often with them; but when they do, they are more difficult and more expensive to fix. I find that it is much more difficult to work with men's sacroiliac ligaments than with women's. The sacroiliac joints in men are larger; they fit together with closer tolerances; and the ligaments holding them together are stiffer.

In comparison, a woman's joints are more like the engines of cars from the 1970s. Those engines had wide tolerances. Things went wrong frequently, and yet those engines would continue functioning even with a lot wrong. Women's bodies are something like that. Women's bodies need to keep functioning throughout pregnancy. The weight and shape of the load that is being carried, the center of gravity, the condition of the ligaments, everything is changing constantly during pregnancy. Women's bodies are built to be able to adapt to those changes. That is why I believe women are more likely to have pain, and more likely to want and need body work to keep their adaptable bodies more comfortable. It also slows down the wear and tear if we can keep them better balanced.

Given the greater structural adaptability of their bodies, it makes sense that women could have more problems with their pelvic organs. All the structures within the pelvis are likely to be affected when the pelvis has an asymmetrical neutral, such as the bladder, the uterus, and the ovaries. I think it is worth considering pelvic alignment as a potential explanation for some of the problems that women have, including bladder spasms, incontinence that does not respond to medication, fibroids in the uterus, endometriosis, infertility and miscarriages that do not have any apparent cause, and painful or irregular menstruation. These conditions are likely to have something to do with poor blood circulation. In Oriental Medicine, we do treat many of these as problems of qi and blood stagnation; and I would like to propose that we consider poor pelvic alignment as a possible cause for the blood and qi stagnation.

Treating the Pelvis

Structure predicts function and informs diagnosis and treatment. The body is an incredibly dynamic, adaptable, and integrated construction designed to function within a large range of possible joint alignments. I consider the pelvis and lower lumbar spine to be the Foundation of our bodies. Many of our problems originate in the Foundation or in the lower extremities, which affect the balance and function of the Foundation along with everything in the upper body. I can trace almost every problem I see in my clinic back to the Foundation, either as a direct injury to the pelvis or as an indirect injury to the pelvis that has originated in the lower extremities. I have yet to encounter an upper extremity problem that has created a problem in the Foundation. Consequently, I begin all my treatments with a quick assessment of what is happening overall, keeping in mind that I am assessing a three-dimensional structure in which everything is connected.

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Getting A Sense Of The Big Picture

Most of my assessment is palpation, often with my eyes closed to better sense what is going on and not be distracted by visual cues. I begin with the patient standing and look at the head position in relation to the shoulders, then feel the shoulder positions relative to each other, the position of the rib cage, and the general position of the pelvis and extremities.

Following that, I conduct a simple version of the Stork Test in order to give me a general sense of how the sacroiliac joints are functioning and how the pelvis is moving. I do this by placing the right thumb on the right posterior superior iliac spine (PSIS) and the left thumb on the midline of the sacrum at the same level and asking the patient to raise the right knee to 90 degrees. Then I repeat on the other side. The original Stork Test includes a step I do not use, which is asking the patient to raise the left leg while the thumbs are still in position on the right side, and then repeated with the other side. My reason for abbreviating the test is that I am trying to get a general sense of how the sacroiliac joints are functioning. If the right innominate does not rotate posterior when the right leg is raised, then I know that the sacrum and pelvis are not aligned around a symmetrical neutral, and there is restriction in the right and left sacroiliac ligaments, as it is not possible for one side of the pelvis to be restricted without involving the other. Indeed, I can usually see the dysfunction in the pelvis without doing the Stork Test, but it is a helpful measure for tracking the progress of treatment. It gives both the patient and me a marker for how well we are proceeding through treatment, and it gives me a somewhat objective measure in case I need to communicate with the patient's physician or insurance company.

Almost everyone I see has the same pattern of dysfunction, which is one or the other, usually the right, sacroiliac joint not releasing when the clutch is let out, as I described earlier. The interosseus ligament should relax when the leg is raised and allow the innominate to move freely in relation to the sacrum. If the Stork Test is positive on the right, it will often appear to be negative on the left. However, the sacroiliac joint cannot be functioning on one side and not functioning on the other. The dysfunctional joint causes the innominate and sacrum to function as a unit on the dysfunctional side, turning the entire pelvis in the process and making the opposite side appear to be functioning well. Remember that we can "see" only the posterior sacroiliac ligaments.

Although Rosatelli, et al., (2006) argue that the Stork Test is not useful because of ossification within the interosseus sacroiliac ligament, I find the Stork Test to be quite useful, even in the simplified form that I employ. After decades of performing this test, I can feel and see nuances in sacroiliac joint function while doing this test that allow me to distinguish which sacroiliac joint most needs treatment and whether the loss of a symmetrical neutral is more likely to be due to restrictions in the sacroiliac joints or in the pelvic ligaments. This is particularly helpful as we proceed through treatment, as I am able to discern when I have restored motion to the sacroiliac joints and can therefore spend more time on the pelvic ligaments or other factors that are contributing to the asymmetry.

When the patient lies prone, the dysfunction in the pelvis becomes more apparent because now the patient is lying on the anterior superior iliac spines (ASIS) and the body is no longer free to turn as it is when we are standing. The twisting of the body while we are standing hides the dysfunction somewhat, but lying prone or supine makes it more apparent. For almost everyone, the right innominate is restricted in posterior rotation, pulling the right sacral base, iliolumbar ligament, L4, and L5 in the direction of the posteriorly rotated ilium. The right innominate appears to be rounded, and the left innominate appears to fall away to the left side and sometimes appears flattened. It is actually medially rotated at the left hip, which is what the lower extremity does when we stand on one leg. Everything winds medially, creating a strong column on which to stand. In the process the left sacroiliac joint tends to be pulled "open," which makes the Stork Test on that side appear to be negative.

Palpating the sacrotuberous and sacrospinous ligaments and the hip flexors and extensors rounds out the picture. When the right innominate is rotated posteriorly, generally one or both sacrotuberous ligaments are prominent on palpation and the tissues that attach to the right greater trochanter are contracted. At the same time, the left iliopsoas is generally contracted. There often appears to be a line of contraction starting at the right iliac crest, or even the lower right rib cage or right shoulder, and leading across the right PSIS to the left sacroiliac joint and down to the left lesser tubercle where the iliopsoas attaches. The prominence of the right iliac crest is often accompanied by prominence of the right ribs and right shoulder, such that the bones on the right side of the body appear to form the letter "C" when looking at the patient who is lying prone.

While this is the most typical pattern that I see, it is not the only pattern; but it illustrates what I see and how I interpret it. I generally describe this pattern as the position the body assumes during gait. These are the things that happen in the body when a person raises the right foot to take a step forward. Theoretically it should not be happening in the body at rest. However, when the sacroiliac joints become restricted and cannot return to their neutral resting positions, the rest of the joints cannot return to their neutral resting positions either, and the body creates a new asymmetrical neutral.

Therefore, the focus of my treatment is to restore motion to both sacroiliac joints so that they can return to their symmetrical neutral resting positions, and then I can restore motion and symmetry to the rest of the body. I do this using a combination of acupuncture, manual therapy, and home exercises. In this article we will focus only on the treatments for the pelvis, and we will use the Keys to the Kingdom as our guide. For a detailed explanation of the Keys, see my article in the 2015 Earth issue of OMJ. Here we will discuss only Key #1 (Foundation) and Key #4 (Hips).

Treating Key #1-Foundation

Rather than discuss treatment by modality, it is more useful to discuss the outcome we wish to achieve so that each practitioner can modify current treatment modalities and strategies to accomplish this goal. The Foundation is composed of the innominate bones, the sacrum and coccyx, the lower two lumbar vertebrae (L4 and L5), and the ligaments and joints that connect them. If we can loosen the ligaments and the axes that describe movement and qi flows through the structure of the body, we create space that enables us to mobilize the sacroiliac joints, move the sacrum into its proper position relative to the innominates, and restore pelvic motion. When the ilia and sacrum are aligned, we can reset the pubic joint and release the coccyx, restoring the pelvis and therefore the rest of the body to a more symmetrical neutral.

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Key #4-Hips can and should be treated at the same time as Key #1-Foundation because they work together. However I have chosen to separate the discussion of Key #1 and Key #4 so that their different functions will be better understood.

Clinically I have found that needling points over the laminae of the vertebrae is just as effective as, and possibly more effective than, needling the Shu points on the Bladder channel. In fact, I long ago stopped needling Shu points and needle the lamina points instead. (Rogel, 2007) The lamina points are located on the dorsal surface of the sacrum in the continuation of the lamina groove from the spine. They are extremely effective clinically. For example, in recent years I have treated three clients with bladder spasms diagnosed as arising from three different causes, one from bladder cancer, one from unknown etiology, and one as post-surgical trauma from a transurethral resection of the prostate (TURP). Normally we would treat bladder spasms using BL 27 (*Xiao chang shu*) and BL 28 (*Pang guang shu*). All three individuals had spasms not only in their bladders but also in their posterior sacroiliac ligaments. I treated the spasms in the ligaments rather than needling the acupuncture points. In all three cases the bladder spasms resolved almost instantaneously as the spasms in the posterior sacroiliac ligaments were released with acupuncture and with manual therapy to mobilize and align the sacroiliac joints and pelvic bones. The better the alignment, the more completely the spasms reduced and the less likely they were to return.

The easiest way to release the posterior sacroiliac ligaments is to needle the lamina points of the sacrum, using the technique I described in "'Gold' Needle Acupuncture" (2007). This technique is best described as a type of pecking that is done in the ligament using a Seirin #8 (gold) needle. Seirin is the best needle for this technique because the handle does not bend and the needle is comfortable for the patient. The #8 (0.30 mm diameter) needle is best for this technique because it is strong enough to withstand the bending force that a contracting ligament places on a needle. The #10 or #12 needles would be the best of all, but they are not available in the United States. Thinner needles will relax the tissue, but they do not allow the practitioner to manipulate the tissue with the needle. I use the needle as a tool, a handle, that allows me to stretch the stiff periosteal and ligamentous tissue that is lying near the bone. Overstretching the tissue is necessary if one is to reset the golgi tendon organ from its injured "short" position to its relaxed "long" position so that the tissue will stay relaxed and not tighten again because the golgi tendon organ is still set to "short."

The posterior sacroiliac ligaments may also be released manually. The main technique is still overstretching the tissue to reset the golgi tendon organs from short to long. Liniments and salves may help the process whether working manually or with needles. However, be careful using heat or moxa. A small amount of heat is helpful, but overheating the tissues takes away their ability to overstretch, and the golgi tendon organs will not reset from short to long.

It is not sufficient to loosen only the posterior sacroiliac ligaments. All three sacroiliac ligaments (posterior, anterior, and interosseus) must be released. However, since the posterior ligament is the only one we can palpate directly, we must use other methods to release the deeper ligaments. The most effective approach is to loosen the other main pelvic ligaments and then use the innominates themselves to release the deeper ligaments and realign the sacroiliac joints.

Sacrococcygeal Symphysis

The sacrococcygeal symphysis and the ligaments that attach the sacrum and coccyx are also easily palpated and treated with the "gold needle" technique and can be treated at the same time as other pelvic structures are being needled. Because of their position within the various axes that cross in the pelvis, the sacrococcygeal symphysis and ligaments play a role in pelvic and leg pain and should be assessed and treated along with the sacrum and its various ligaments. DU 2 (*Yao shu*) and BL 35 (*Hui yang*) are useful points. Patients sometimes experience profound benefits in parts of the body far distant from the coccyx. The coccyx also responds to manual therapy.

Iliolumbar Ligaments

The iliolumbar ligaments can be loosened by needling the lamina points of L4 and L5 and by needling the other end of the ligament where it attaches to the iliac crest. This can be done at the same time as the lamina points of the sacrum are needled. Often at the end of a treatment session on the pelvis, patients still feel some tension at the iliolumbar ligament attachment at the iliac crest. I simply have them sit on the table, and I needle this point again using the "gold needle" technique. Inevitably it releases the remaining tension or pain that they feel and restores motion to the ligament.

Sacrotuberous and Sacrospinous Ligaments

The sacrotuberous and sacrospinous ligaments will be discussed under Key #4-Hips, but I needle them at the same time as I needle the lamina points of the spine and the other pelvic ligaments. The most effective place for needling them is where they cross, inferior and lateral to the inferior lateral angle (ILA) of the sacrum. If necessary, I may also needle the sacrotuberous ligament at the ischial tubercle.

Realigning the Sacroiliac Joints

Once the spinal and pelvic ligaments have been loosened on both sides, the practitioner who wishes to realign the joints now has the opportunity to do so. Remembering how the sacroiliac joint is constructed, with its propeller-twisted internal surfaces, its three layers of ligament, the middle one of which is like a twisted rope, and its axial pivot, the practitioner who wants to move the joint will need to develop a feel for it. The trick to realigning it is not to force it. By feeling where it wants to go and allowing it to go there, the joint has a propensity to align itself. That is not to say that the practitioner is not working hard. It is to say that the practitioner is not deciding where the joint should be and forcing it to go there.

To understand this joint better, we have to remember two things – how the sacrum moves in relation to the innominate and how the innominates move during gait or when the sacroiliac ligaments have been injured. First of all, we are talking about a three-dimensional structure. Nothing is up and down or forward and backward. Everything twists and rotates. When the right sacroiliac joint is injured, for example, the ligaments draw the innominate toward the sacrum and keep it there; this is the "short" position of the golgi tendon organ. When the right innominate and sacrum function as a unit, the left sacroiliac ligaments generally release to the "long" position. Because the pelvis assumes an asymmetrical neutral, the ligaments that must function in the "long" position become overworked and tired, as they are doing more of the "work" since the other side is contracted and cannot "give" as much. Some view this as "laxity" or "weakness" in the ligament. However, I believe that this is not the case. In my experience, when the shortened right ligaments reset to "long," the stretched left ligaments contract and shorten; and the pelvis returns to a symmetrical neutral.

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In normal gait, when the right innominate rotates posteriorly, the right side of the sacrum is supposed to nutate. Under conditions of injury, this does not always happen. This is why we loosen the lamina points on the sacrum; needling them loosens the posterior sacroiliac ligament and enables us to coax the sacrum and the innominate to move independently and the axial sacroiliac joint to align on its pivot.

After the more superficial ligaments have been loosened, the practitioner can loosen the deeper ligaments by toggling or "shearing" the sacrum and innominate along the planes where movement is occurring. By working with it and not forcing it, the joint will typically slide into a better position, often with a click.

Each practitioner will find the treatment method that works best, given relative size and strength of practitioner and patient and given the condition of the joints. I find it easiest to align the right sacroiliac joint while the patient is prone and the left while the patient is supine; however, I work on both joints from both the prone and supine positions. The main technique is to place one hand on the innominate and one on the sacrum and, in effect, rock them in posterior and anterior opposition. With the patient prone and working from the right side of the patient, I stand on a stool with my center of gravity over the patient's Foundation and place my right hand under the ASIS. Then I place my left hand on the right sacral base and lift the innominate in the plane where it moves most easily and toggle the innominate and sacral base posteriorly and anteriorly, alternating my hand pressure. This requires "listening" to what the joint is communicating and adjusting pressure vectors and hand positions, sometimes into the lumbar spine, according to the joint's response. I make a similar movement on the left side with my left hand close to the left hip socket and my right hand on the left sacral base. On the left side, the motion is more of a rotation of the femur than a shearing of the sacroiliac joint.

With the patient supine and again from the patient's right side, I adjust the sacroiliac joints by first placing my left hand under the patient's left sacroiliac joint and lifting my left arm so that the patient's weight is resting on my arm and I can roll the patient to a point of balance where the body feels at ease. With the fingers of my left hand at the left sacroiliac joint and my right hand on the ASIS, I toggle or roll the left innominate until the left sacroiliac joint releases and moves when I press on the ASIS. Then I shift my left hand to the right sacroiliac joint and do the same thing. Both patient and practitioner can feel when the joints begin to move.

If the practitioner cannot or prefers not to use manual adjustments, there is an exercise that the patient can do, either on the treatment table or at home, to try to make the adjustment. This exercise will be presented under Key #4-Hips, but it is as much for the sacroiliac joints as it is for the diagonal structures in the pelvis.

Realigning the Pubic Joint

When the sacroiliac joints are moving and the innominates are more symmetrically aligned, then, and only then, the pubic joint can be realigned. If the sacroiliac joints are not moving, then the pubic joint will not respond to the realignment procedure, which is a muscle energy technique. With the patient lying supine and a pillow under the knees to relax the abdominal muscles, "walk" your thumbs down the lower abdomen to the pubic bone. Doing it this way helps to relax the muscles and allows the patient to know what you are doing. I also tell the patient what I am going to do so that the patient will be comfortable with the procedure. When you get to the pubic bone, palpate the anterior surfaces of the pubic bones to determine whether one is more anterior than the other. Then palpate the superior surface of the pubic bones to determine whether one is superior to the other. More often than not, the right pubic bone is anterior compared to the left pubic bone, and the left is superior to the right, reflecting the positions that the innominates take when the right innominate is posteriorly rotated.

To adjust the joint, begin with the leg on the side where the pubic bone is anterior. Gently rotate the femur medially and laterally to locate the most "unpacked" or neutral position. With the femur at that angle of rotation, bend the patient's knee and lift the patient's leg until you can support it on your own knee with the patient's hip in the most "unpacked" position. Gently place your hand on the medial surface of the knee and ask the patient to lift the entire leg to the ceiling, including the foot. The patient should not struggle to do this, and the practitioner should not hold the patient's leg down so firmly that the leg cannot move. The muscles need to be able to engage, and the patient needs to be able to lift the leg off the table without rotating the pelvis. Hold for a count of about 10 seconds or until the joint "pops," whichever occurs first. Then retest. If necessary, repeat on the same side or on the opposite side.

The second step of the realignment procedure is to pull down the pubic bone that is superior. To do this, the patient remains supine but now bends the knees so that the feet are flat on the table. Ask the patient to move the knees apart so that the practitioner can place the forearm firmly between the patient's knees in a position so that the practitioner's wrist is protected. Firmly notch your elbow on the medial side of the knee closest to you, and place the palm of your hand on the medial side of the other knee. Ask the patient to squeeze; hold for about 10 seconds, or until the joint "pops," whichever occurs first. If at any moment the practitioner experiences pain or feels at risk of injury, immediately drop the elbow down from the patient's knee. This will stop the squeeze and prevent any injury. The patient has to understand that this is not a contest. You are not arm wrestling. What you are doing is creating tension in the tendons and ligaments to pull the bones into alignment. If the maneuver does not reset the joint, repeat with the patient's feet closer together.

Recheck the alignment of the pubic joints. If these maneuvers do not align the joints or if the patient's pressure is very weak, then the sacroiliac joints and the pelvis and sacrum are not aligned. More work will be needed either in the current treatment session or the next time you see the patient. It is acceptable to give the patient the second step of the realignment procedure as homework. Instruct the patient to find a book that is a similar length as the patient's forearm and wrap it in a towel to avoid bruising the legs. Sit in a chair and squeeze the book for about 10 seconds, once. It is not necessary or helpful to repeat this exercise, but the patient may do it several times during the day if desired. One of my patients who felt she needed to run a marathon in spite of her misaligned pelvis decided to use this exercise to get herself through the race. Periodically she stopped, bent over, placed her forearm between her knees and squeezed, and then continued running. This is not something I would generally recommend, but it enabled her to run the race without injuring herself.

Once the pelvis is properly aligned, it is not necessary to repeat this exercise. Its purpose is to reset the "safety valve," the pubic joint. When there is too much tension in the pubic joint because of the rotations and flares of the innominates, the joint eases itself and allows the pubic bones to rotate away from each other. This maneuver restores the integrity of the pelvic circle once the sacroiliac joints have been realigned.

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Treating Key #4-Hips

The alignment of the Foundation, Key #1, directly affects and is directly affected by the lower extremities. However, the Foundation also has an intimate connection with the upper body, which counterbalances everything that happens in the lower body, whether it arises from the Foundation itself or from the lower extremities. In this section we will look at how the Foundation (Key #1) affects the hips (Key #4) and transmits alignment information upward.

While the right innominate is drawn toward the sacrum, the pelvis must assume an asymmetrical neutral, which we can see when the patient is standing or lying down. Typically, the right innominate rotates posterior and the left innominate rotates medially so that the left ASIS tends to compress the left groin. The right groin is also compromised because the right innominate remains rotated posteriorly, which thrusts the right hip forward. Frequently both hips are contracted on palpation, but the reasons for the contraction are different.

The most useful way to think about treating Key #4 is in terms of diagonals. When looking at the body as a whole in terms of the Keys, it becomes apparent that the upper lumbar vertebrae, L1 – L3, function as a crossing point for what might be described as qi flows across the body. These qi flows can be assessed and stimulated while the patient is prone. Standing on the right side of the patient and high enough to be able to bend over the patient comfortably, place your left hand on the sacrum and your right hand on the right scapula. Imagine the qi flowing in a line from beyond the ends of the universe, through the right shoulder and scapula, through the upper lumbar spine, down through the left sacroiliac joint and left sacrotuberous ligament, and out the left leg to beyond the ends of the universe. Feel the qi coming from beyond the ends of the universe into the right arm along the diagonal into the left leg and out beyond the ends of the universe. Then the qi comes back into the leg and moves out the right arm. You can feel whether this rocking motion is occurring and what direction it takes. When the qi movement is unobstructed, the qi will rock back and forth freely along this diagonal as well as along the diagonal formed by the left arm and right leg. Often the qi is not flowing freely, and often the axes are not symmetrical. By rocking the qi back and forth along the diagonals, first one, then the other, it is sometimes possible to move the qi and loosen the stiffness in the back. Whether you are able to loosen the qi movement or not, this activity will show you where the stiff tissue is bound up. This technique will certainly loosen the fascia, but it should not only be used at the level of the fascia. It is important to feel the deeper structures, namely the ligaments, tendons, and bony skeleton.

Focusing more specifically on Key #4, there are essential structures that enable the qi to flow in this way. The first set of structures is the crossing sacrotuberous and sacrospinous ligaments that we encountered in Key #1. These ligaments act as alternating axes of gait. When the sacroiliac joints are restricted, the sacrotuberous and sacrospinous ligaments alter the angle at which they cross so that they are no longer right-side and left-side mirror images. Restricted sacroiliac joints shift the Foundation from a symmetrical neutral to an asymmetrical neutral that is located somewhere in the gait cycle, where depending on the injury. This means that the pelvis no longer rests in a symmetrical position but rather in a position with one innominate rotated somewhat posteriorly and the other in a position that counterbalances it.

Other structures along the diagonal qi flows include the iliopsoas muscle and its component muscles the psoas major and iliacus, the thoracolumbar aponeurosis and the latissimus dorsi whose tendons flow out of its fibers, and various other muscles that are not part of the current discussion, such as the hamstrings, serratus posterior, teres minor, long head of the triceps, and diaphragm tendons.

Because the acetabulae, and therefore the femoral heads, are physically located in the innominates, their position is directly affected by how the innominates move in the gait cycle. When the sacrotuberous and sacrospinous ligaments cross in a symmetrical neutral, the hip joints also move symmetrically. A good image for understanding this is the swinging of a pendulum. A pendulum that experiences no friction moves as far to the left as it does to the right. When there are no restrictions, the hips basically move this way, too. When the gait cycle is restricted, the sacrotuberous and sacrospinous ligaments cross in an asymmetrical neutral, and the hips become asymmetrical as well.

This asymmetry is communicated upward via Key #4. When the innominates are asymmetrical, the acetabulae sit in different planes, and their respective femoral heads move through different ranges of motion. Because the femurs now sit at different angles, the iliopsoas muscles which attach to the lesser tubercles are no longer symmetrical on their pathways from the femur to the lumbar spine, and their "pendulum swing" is also no longer symmetrical, communicating the asymmetry of the Foundation upward.

Needling the upper lumbar lamina points helps to restore movement along the diagonals, as does manual release of the lamina grooves. This is done simultaneously with treating Key #1. If necessary, the ischial tuberosity can be needled to release the sacrotuberous ligament, but I find it most effective to needle the sacrotuberous and sacrospinous ligaments simultaneously at the place where they cross near the inferior lateral angle of the sacrum. Mainly I work these ligaments manually as described in Key #1, usually by stabilizing the sacrum and rotating the femur and/or stretching the iliopsoas while the patient is lying prone and then by gently rotating and tractioning/compressing the hips while supine. The hip typically aligns during the supine maneuvers.

Once the short and long diagonals have been mobilized, the ability of the sacrum to nutate and counternutate has been restored, and the attachments on and beside the sacrum and coccyx have been loosened, work can begin on realigning the sacroiliac joints as described in Key #1.

The most effective treatment sequence in my experience is to begin with the patient prone. Loosen the long, entire body qi flow axes. Then assess the smaller sacrotuberous/sacrospinous ligament axes and the iliolumbar and sacroiliac ligaments, and needle appropriate points, using whatever topical preparations you use and moxa. After the needles are removed, use manual techniques (or "gold needle" acupuncture) to release the ligaments and align the joints. Then, with the patient supine, continue with manual techniques to release any remaining tight ligaments and align any joints that still need it. Finish with "gold needle" acupuncture on any remaining points that need it, and apply a topical analgesic, such as Zheng Gu Shui, to reduce rebound from your treatment. This is particularly important when you are learning these techniques and your ligament releases are not as effective as they will be when you are more familiar with how to do it and your hands have developed sensitivity for the nuances of body alignment.

Restoring Alignment With Exercise

Restoring alignment is a process that requires teamwork between the practitioner and the patient. The body is very efficient in its use of materials. If a person does not use a body part, the brain begins remapping itself almost immediately (Doidge, (2007), and the body begins reshaping itself by shortening tissues you are not using and lengthening tissues that are constantly stretched. The same thing happens when the Foundation develops an asymmetrical neutral. All the tissues of the body gradually reshape themselves in response. In fact, the body is constantly changing in this way, as we get taller and then shorter with age, as we get injured and heal, as we have joint injuries and joint replacements; and it will change in response to joint realignment and restorative kinematics.

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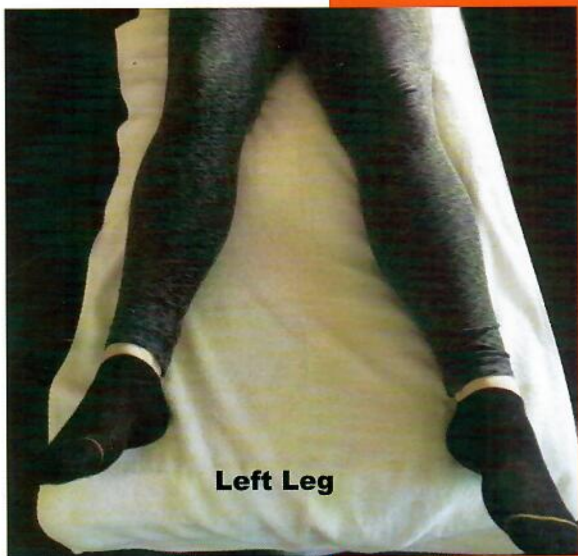
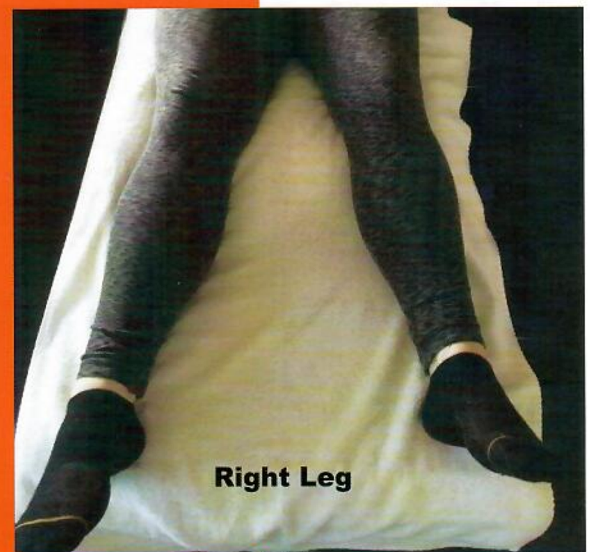
Following is an exercise and a set of variations that can be used in conjunction with realignment therapies such as acupuncture and manual body work. I give these exercises to my patients, and I use them myself to realign my own joints. This exercise is specifically for Keys #1 and #4. It helps to realign the sacroiliac joints and the lower lumbar spine as well as to restore movement along the diagonals of the large and small axes of qi flow and pelvic motion.

Basic Restorative Kinematics (RK)

The basic exercise of Restorative Kinematics is done lying supine, preferably in bed or on a surface that has some give in it. With your body relaxed, use your left hip and lower back to slide your left leg away from your body center. When you are stiff or in pain, this movement may be extremely small. How far you move your leg is not important. The important thing is initiating the movement so that the tissues receive the signal to lengthen. Then relax and repeat on the right side. Be sure that you are lengthening the leg from the hip and not dorsiflexing the foot and leg instead. The movement is similar to what would happen if you could walk while you are lying down, except that you do not lift your knees or bend your hips. Let your pelvis do the walking by itself.

Basic Restorative Kinematics – Starting Position





Basic Restorative Kinematics – Left Leg Lengthened Away From Body Center And Right Leg Lengthened Away From Body Center

If it is easier, you can pull your right leg toward your center as you lengthen your left leg away from your center, and vice versa on the opposite side. Most likely the two sides will not move equally easily or equally far. Note that as information for yourself, and do not force the movement. Move the body in the direction that it wants to go. If it feels good to hold the lengthened or contracted position, then do so. You may also "feather" the joints by making small movements toward and away from the body center while you have your leg lengthened or pulled in.

This movement stretches all the structures in the Foundation, especially the sacroiliac joints, the sacrotuberous and sacrospinous ligaments, and the iliopsoas muscle. Over time, as you do the exercise, you will notice that your body will begin to loosen along the long axes as well as the short axes. Let it move when it is ready to do so. Eventually your head will also begin to rotate from side to side. This is a desired outcome of this exercise, but do not force anything to happen.

You may also experience your joints adjusting themselves. This is normal and should not hurt. ***If at any time you experience pain while doing these exercises, STOP.*** These exercises should not hurt. They should make you feel better.

Basic Variant #1 - Isometric RK

Instead of moving with the lower body completely relaxed, tighten all muscles from the waist to the feet, as you would do in isometric exercises. Then move the pelvis as described above.

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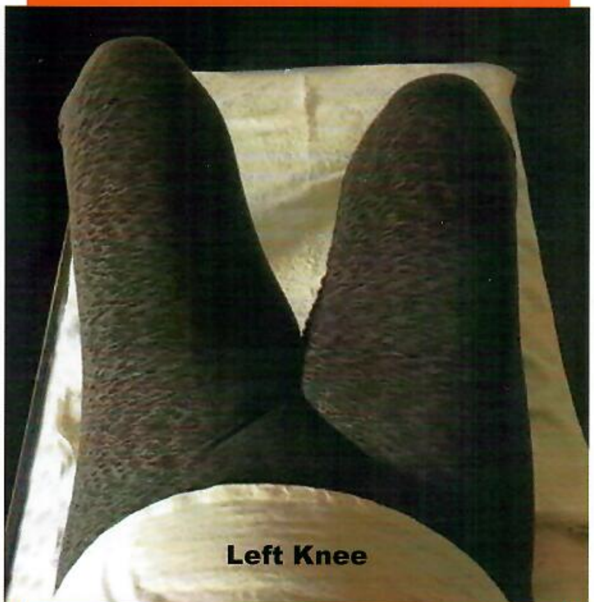
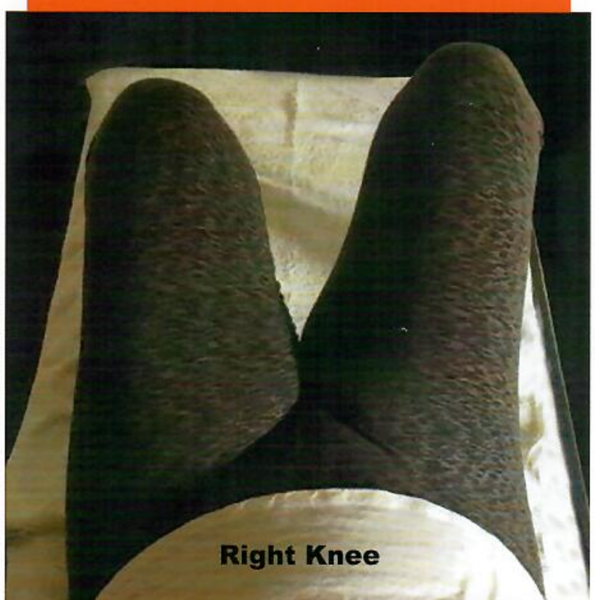
Basic Variant #2 - RK With Knees Bent

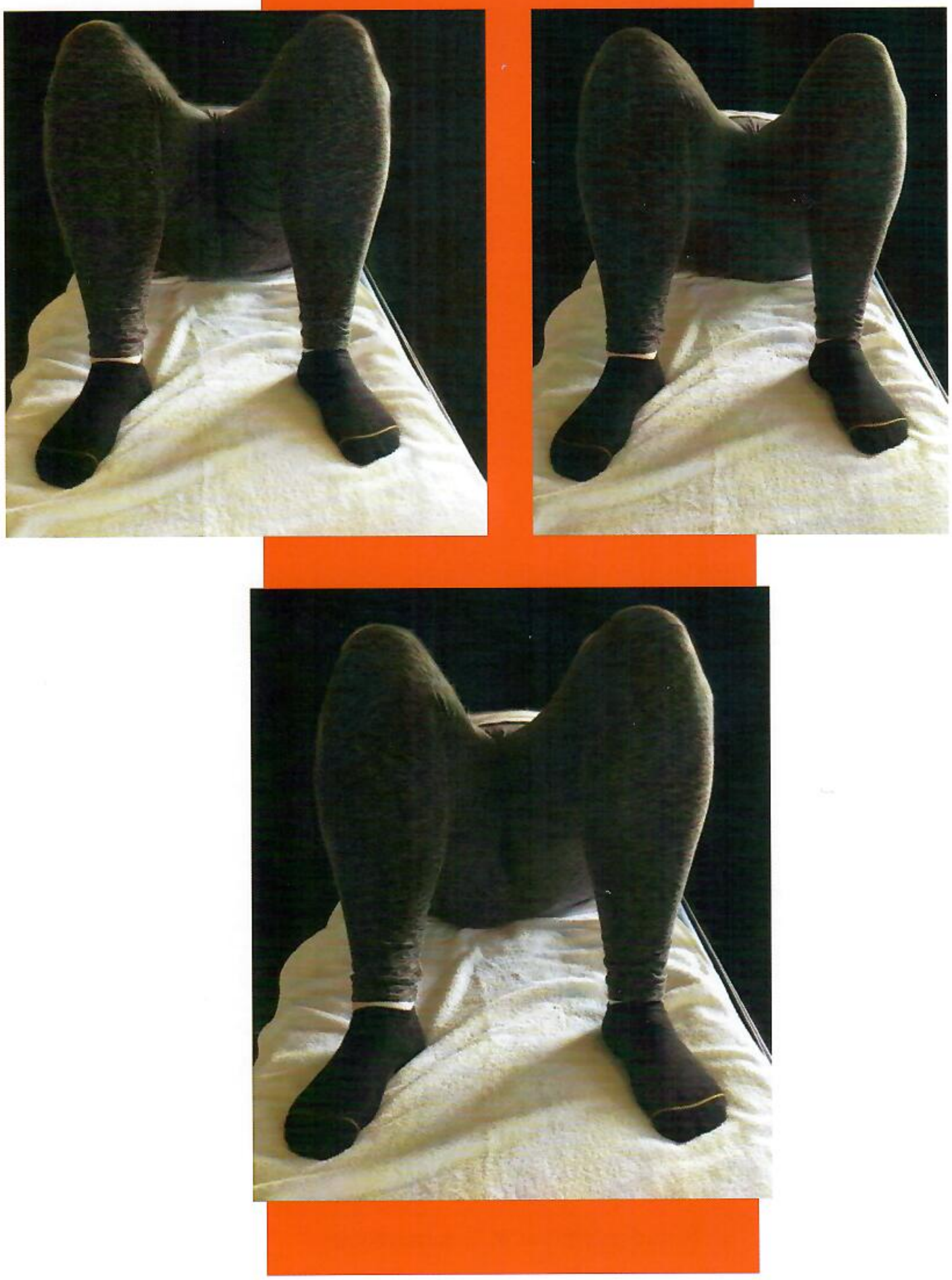
Still lying supine, raise your knees so that your feet are now flat on the bed or floor. As you move your pelvis, your knees will move away from and toward your center. If you have trouble initiating the movement, simply move your knee away from your center; your hip will follow.

Restorative Kinematics With Knees Bent – Starting Position





**Restorative Kinematics
With Knees Bent –
Left Knee Lengthened
Away From Body Center
And Then
Right Knee Lengthened
Away From Body Center**



Basic Variant #3 - RK With Bridge

Remaining supine with knees raised, begin to lift your pelvis off the bed or floor without actually lifting it. Move your hip/knee away from your center, as above. This time when you do the movement, you will notice that your pelvis has a tendency to move from side to side. If it wants to do so, let it. You will see that it produces an effect in the lower lumbar spine as well as in the sacroiliac joints and sacrotuberous and sacrospinous ligaments.

Basic Variant #4 - RK Sitting

Basic RK can also be done sitting in a chair. The movement will not be large, but you may experience more side to side movement than you do while supine. Sitting RK is most effectively done sitting in an automobile, and it is very helpful for easing the stiffness of long car trips. If you decide to do sitting RK while at a stoplight, be safe and put the car's gear into Park.

Advanced Restorative Kinematics

Once you have become familiar with how to do the RK exercises and can do them safely and effectively, you can experiment with advanced postures, such as lying prone or lying on your side. Remember never to force anything. Some days the exercises are easier to do than other days. Be respectful of what your body is telling you, and pay attention to what it is saying.

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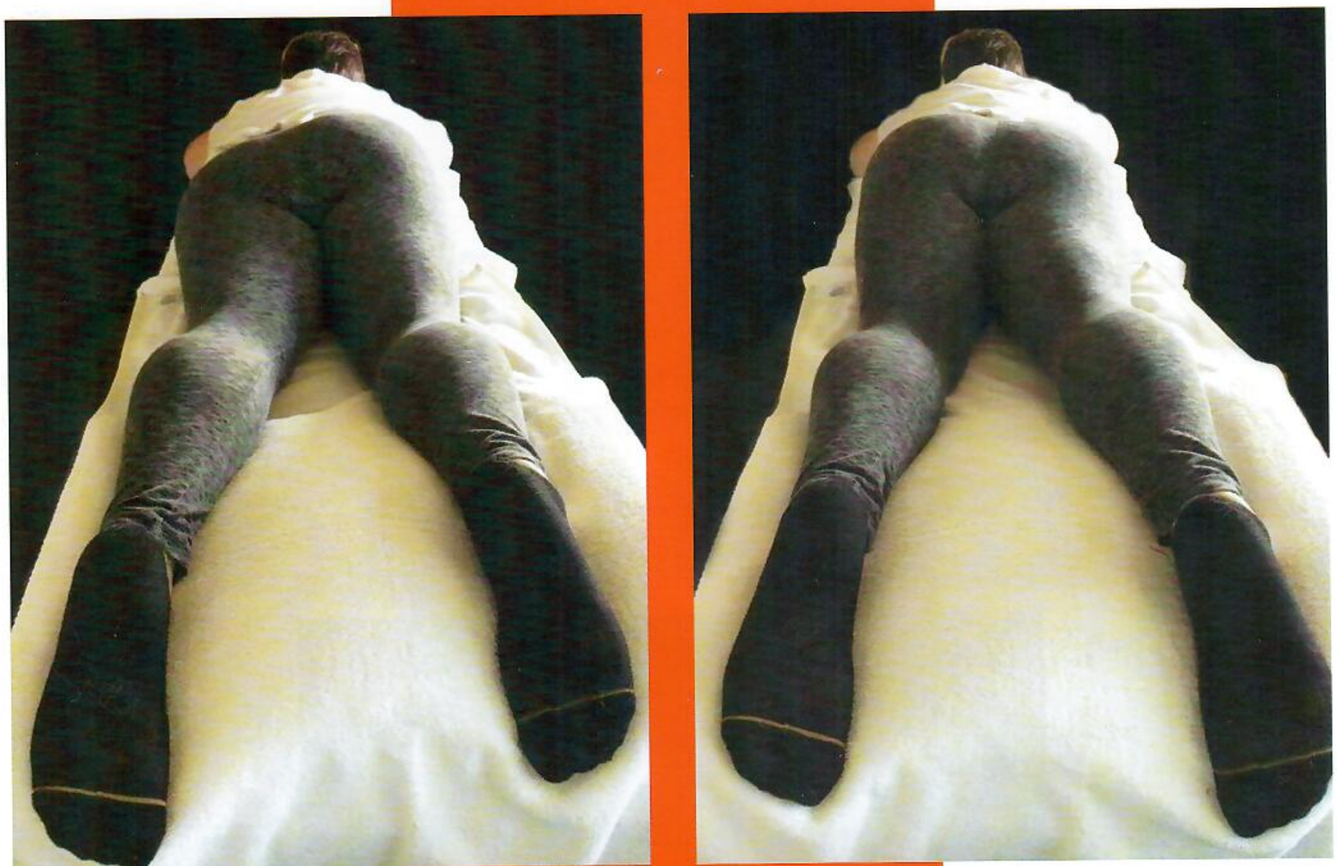

Kinematics:

- The branch of mechanics concerned with the motion of objects without reference to the forces that cause the motion.
- The features or properties of motion in an object.
- Describes the motion of systems composed of joined parts such as the human skeleton

(Kinetics: The Study of How Forces Act on Masses)

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