CHAPTER V

SACROILIAC JOINT & PELVIS

Chapter V: Sacroiliac Joint & Pelvis

Note To Reader

This chapter is meant to expand the massage therapist's understanding of the function of the sacroiliac (S.I.) joints and how to assess them. Therefore, much more information on anatomy and physiology (biomechanics) is given here than might otherwise seem reasonable in a textbook on assessment.

See the Introduction to the Examination of the Spine for an outline of the comprehensive structural examination of the pelvis and spine. The comprehensive structural examination as presented later in this chapter, highlights in **bold** those tests which, when positive, require more detailed testing of the innominates, the S.I. joints, or both. This chapter presents the detailed information and description of such specific testing. This provides an overview or summary of how testing should proceed in an organized and efficient manner.

Choosing the type and amount of information to be given in this chapter (and also, to a lesser degree, in all the chapters on the spine) has taken the author many years to decide on. The basis for the choices taken has come from many years of self-study, instruction from others who are much more knowledgeable than me, and especially from my experiences of teaching on this topic to both students of massage therapy and practicing massage therapists.

As soft-tissue therapists whose clients overwhelmingly come to us with back and neck pain and impairments to movement, I believe that we need to learn to appropriately and efficiently assess the synovial joints of the spine. How can we claim to be therapists if we cannot assess and treat the most common problems associated with back and neck pain?

As the base for the entire spine, the sacrum demands a firm understanding of its structure and function. Whatever is impaired or misaligned here will create impairments and dysfunctions throughout the upper body. Further, the motions, stresses and strains coming from the lower body that try to pass through an impaired pelvis will be turned back onto the lower body, resulting in inevitable breakdown.

Though there are some orthopaedic tests for innominate and sacroiliac impairments, they are not really of much use, except to provoke symptoms at the site of the impairment. They do not tell us about the nature of the impairment and, so, do not help us to develop a treatment plan. Further, if used prior to motion testing, which most of the chapter is devoted to, the provocation of pain or re-creation of the injury may well make motion testing impossible that day.

The orthopaedic tests are presented primarily because of their traditional use, and because many other health care practitioners rely solely upon them. Therefore, understanding these tests assists us in communicating with other health care practitioners, and in helping us understand the type of testing our clients may already have received prior to seeking our help.

CHAPTER V SACROILIAC JOINT & PELVIS

Chapter Organization

The chapter is organized into six parts:

Part I will be an expanded Clinical Considerations of Anatomy & Physiology containing definitions and brief biomechanical explanations of motions of the S.I. joint and the innominates. Enough information has been given so that hands-on testing can be explained. More detail on gait and the movement of the sacrum and innominates is in an Appendix at the end of the chapter. This material is extensive and may be difficult for some. Those who have a fair grasp of the material, may wish to ready only Parts III, V and VI, which are specific to testing innominate motion and the S.I. joints.

Part II will deal with describing the types of innominate impairments. Once again, this provide mostly theory and information.

Part III will then focus on testing for impairments to innominate motions, or iliosacral dysfunctions. However, to test for innominate impairments we do need to understand S.I. joint motions, hence, the importance of the information in Part I. Therefore, included in this section are some palpatory exercises that double as basic sacral testing. Please note that though some of the information on the innominates and testing is similar to the chapter on the hip, it varies slightly (especially in depth) because we are viewing it specifically in terms of its relationship to the sacrum.

Part IV will focus on describing more fully the types of S.I. joint impairments.

Part V will then focus on specific testing of the S.I. joint impairments.

Part VI will describe the traditional orthopaedic tests.

Appendix: This contains the details of gait and sacral motion, which provides many clues as to how the sacrum functions, how motion testing is meant to work, and the type of information that is gained. A good section for those therapists who need to understand how things work in order to be able to understand and learn the testing protocol.

Part I: Clinical Implications Of Anatomy & Physiology

• The following is a list of key anatomical structures and tissues that should be reviewed.

Sacroiliac Joint (S.I. Joint)
Synovial-hyaline cartilaginous joint.

Symphysis Pubis
Cartilaginous joint.

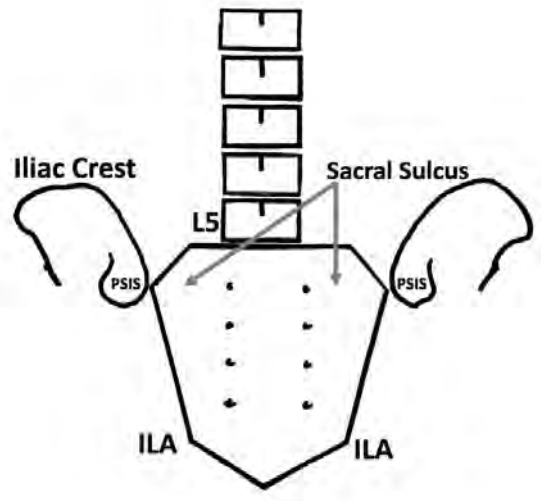
Sacrococcygeal Joint
Usually fused in adults, uniting with the sacrum with a fibrocartilaginous disc.

Ligaments
• Interosseus sacroiliac ligament (deepest, with transverse orientation)
• Short and long sacroiliac ligaments (oblique fibres between the sacrum and innominates)
• Long posterior sacroiliac ligament (fibres run almost vertically); part of the long dorsal ligament that has fibres running down from the lumbar aponeurosis, crossing the sacrotuberous ligament into the tendon of the hamstrings
• Anterior sacroiliac ligaments
• Sacrospinous
• Sacrotuberous

To do many of the testing procedures in this chapter you will need to be able to palpate or landmark the following:

Posterior
• Iliolumbar Ligaments
• Posterior Superior Iliac Spine (PSIS)
• Sacral Base: superior portion of the sacrum on which L5 sits
• Sacral Sulcus: Landmark the PSISs, which are at the level of S2, and palpate with the thumb just medial and slightly superior to the PSISs, (approximately the S1 area). Needed to test for motion impairment to the S.I. joint.
• S.I. Joint Line
• Sacral Crest: Palpable crest down the centre of the Sacrum, to the sacral hiatus
• Sacral Hiatus
• Inferior Lateral Angles (ILA): Landmarking needed for testing of impaired motion to the S.I. joints.
• Sacrospinous Ligaments
• Sacrotuberous Ligaments
• Ischial Tuberosity

Anterior
• Iliac Crest Height
• Anterior Superior Iliac Spine (ASIS)
• Anterior Inferior Iliac Spine (AIIS)
• Inguinal Ligament
• Symphysis Pubis
• Greater Trochanter



CHAPTER V SACROILIAC JOINT & PELVIS

S.I. Joints & Impairments
The S.I. joints are involved in almost all low back (lumbar) pain scenarios, either as a contributing factor or as a consequence of impaired lumbar motion. The S.I. joints are stressed by any imbalance of forces or impairments above in the trunk or head. Also, the S.I. joints are put under stress by any impairment to the hip, or forces conducted through the hip by impairments to the lower limbs. Therefore, we must be able to assess the S.I. joints sufficiently to be able to identify if these joints are impaired, and (if possible) how. Otherwise, we will not be able to fully address most low back or hip pain.

If the sacral base is unlevel (sidebent), then to compensate, the lumbar spine must sidebend to the opposite side, which means a scoliosis is created. If the sacral base is tipped too far forward, then the lordosis of the lumbar spine is exaggerated, and if not tipped forward enough, then the lumbar lordosis is flattened. The consequences of this could be in the low back and/or anywhere else up the chain (i.e., up the spine): the thoracic spine and rib cage, cervical spine and/or the occiput-C1 (occipital-atlanto joint). Of course, such changes to the S.I. joints will also affect innominate function, and the function of the lower extremities.

Within the curve of a scoliosis, the muscles on the concave side of the curve are usually short and tight which can make them go into spasm, while the muscles on the convex side are lengthened and weakened and easily strained.

Of course, the S.I. joints can themselves be the cause of pain, whether sharp and intense or dull and achy, on-site or referred some distance. We will discuss how each type of impairment of the S.I. joint creates its specific pain once we have discussed the nature of the impairments that can occur and the findings of our testing.

Further, I would just briefly like to mention that clinical experience has shown me that an S.I. joint impairment can often cause a reduced Achilles tendon (S2) deep tendon reflex (DTR) on the same side as the lesion. And, when the lesion is corrected, the DTR will return to normal. Of course, if it doesn't return to normal, then a full neurological testing protocol should be done, with the appropriate referral out.

Note: What follows is a detailed summary of terminology, anatomy and physiology (bio-mechanics) of the sacroiliac joints. If you are familiar with this material, then you may wish to go directly to the testing protocols. See Parts II, III and IV. If you are not familiar with this information then please study it carefully and give yourself time to digest the material fully so as to better understand what the testing seeks to find and how these tests accomplish this.

Terminology & Mechanics Of Sacral Motion

• Physiological motion: These are motions that occur in a joint that constitute its normal functional movements. However, the joint can become fixed or "stuck" at the end-range of such a motion. These are referred to as physiological impairments.

• Non-physiological motion: These are motions that occur in a joint that are not normal for that joint or not in accordance with its anatomy and function/physiology. These usually result in impaired (dysfunctional) movements, also referred to as non-physiological impairments.

Movements Of Sacroiliac Joints & Their Axes

• The S.I. joint is crescent-shaped. It has also been called auricular in shape which means that it is shaped somewhat like a human ear.

• No two S.I. joints are the same: No two people have the same shape or configuration of S.I. joints. In fact, no individual has two S.I. joints (left and right) which are the same shape or configuration. Some joints could be shallower than most, or have an unusual auricular shape, for example. This variety in joint structure or configuration can help explain why some people seem prone to S.I. joint impairments while others are not, or why in some individuals they have a consistent recurring problem with one of their S.I. joints.

• The iliac portion of the S.I. joint surface is cartilaginous with a central crest running from the top to the bottom of the joint surface making this surface convex. This central crest stays roughly in the centre of the joint surface and follows the crescent orientation of the articular surface. The apex of this convexity (its most prominent portion or bulge) is approximately at the level of S2 and is less prominent above and below that level. This is matched by a concavity in the sacral joint surfaces. Hence, we should not be surprised that the transverse axis on which the sacrum flexes and extends, is at this S2 level, where the ileum bulges the most into the sacrum.

• The sacral portion of the joint also has an irregularly shaped (wrinkled or corrugated) surface but it has a central canal, or groove, into which the ileum's joint surface fits. As mentioned above, the deepest portion of that concavity is at the S2 level of the sacrum.

• The joint surfaces are irregular with a wrinkled appearance, running roughly horizontally over the crest and canal, with the wrinkles matching on each side of the joint in such a manner that allows the two joint surfaces to mesh like a pair of gears.

• The sacral articular surface is made of hyaline cartilage. The iliac's articular surface is also hyaline in nature (histologically) but it is re-inforced by dense bundles of collagen fibres that make it appear as if it is fibrocartilage.

The crescent-shaped surfaces of the S.I. joint permits some limited movement in a semicircular path. The appearance or placement of an axis during various movements of the sacrum may vary with each type of movement, due to the type and direction of forces exerted on the sacrum. Therefore, in general, flexion and extension move around a transverse axis at S2, however, the axis may actually slide about, shifting as the degree of sagittal movement increases from neutral. An alternating (moving from one side to the other) oblique axis is formed when we are walking. For more on this, see the information on gait, later in this chapter.

CHAPTER V SACROILIAC JOINT & PELVIS

Some Points To Consider

The amount of movement within the S.I. joints has been a contentious issue for over a century. That there is any functional movement at all in these joints has only been recently accepted (in the 1990s) by the orthopaedic professions, such as physiotherapy and orthopaedic physicians. The movements that have been traditionally spoken of (by osteopaths, etc.) are very small, and are considered to be less than a fraction of an inch. During gait, for example, torsional forces go through these joints, where movement may be minimal but extremely important none the less. Therefore, restriction on one side demands compensatory increase of motion in surrounding joints. Also, it may well be that often we are dealing with the result of tensile (tension) or compressive forces that are being exerted through the joint and its supportive structures, and the loss of potential movement for that joint translates into a rigidity that restricts certain pelvic or lumbar motions.

If there was no movement at all through the S.I. joints, and the pelvis was truly a fused-bone bowl, then the motions of gait would place such stress through this bowl that it would begin to fracture, and do so where the S.I. joints are located. (Bogduk) Therefore, movement must happen through the pelvis, so torsional and compressive forces can be accommodated. However, if the S.I. joints were held together by ligaments alone, "creep" (physiological changes in connective tissues due to sustained stress that cause them to lengthen) would cause the ligaments to quickly "fail" as support. Therefore, the study of movement in the S.I. joints needs to take the unique shape of the bones and joint surface anatomy into consideration to understand the ability of this joint to remain functional. For a discussion of this see below: "What stabilizes the S.I. joint?"

In light of this, therefore, let us propose that much in the same way as we can assess the mobility of synovial joints in the extremities according to the amount of potential joint space available to them (for accessory motions), we might be better off thinking of assessment of the S.I. joints as assessing the "strain patterns" being placed through their structures, and not become fixated on gross movements. With any region of the body we are not only concerned with a specific joint and its internal structures. We are also concerned with the affect that any restrictions or laxity in that joint may have on all the tissues and structures nearby, and even for those at some distance from that specific joint. Usually what we feel when testing a joint is what ranges of motion have a sense of "ease" and which have a feeling of "bind," in which direction would the joint be willing to move and in which direction would it be unwilling to move. This is precisely the purpose of most S.I. joint palpation and testing.

Make no mistake, there is joint play available in the S.I. joints for the purposes of assessment and treatment. Motions can occur at these joints, and they can be moved both through trauma and through manipulation. All that is being proposed here is to also think of some of these dysfunctions described below as similar to losses of accessory motions in other synovial joints (see Joint Mobilizations in introductory chapter), and not always as dysfunctions involving gross movement. Though small, the motions within the S.I. joints are essential for full function of the hips (especially during gait) and for the motions of the lumbar spine.

The model of S.I. joint motion outlined on the next page is just that: a model. It is a model that helps explain what is palpated in the clinical setting. Yes, more could be happening than what can be explained by this model, or the model may have difficulty explaining some clinical findings. But until we reach a point where we understand exactly all that is happening in the body, (something that is not going to happen anytime soon, if ever), we have to work with models that help us to treat the impairments that clients present. Certainly, these models can be questioned, scrutinized and improved upon, for sure. But they should not be dismissed simply because they do not answer all questions or do not yet have 'proof' of all their claims. As long as a model provides clinically observable beneficial results, and as long as no other explanation (model or metaphor) can do the job better, we are obligated to work with it. That is the meaning of the phrase "a working hypothesis" – the cornerstone of science.

Definitions Of Sacroiliac Movements

Nutation (Nodding)
Movement or positioning of the sacral base anteriorly and inferiorly with respect to the innominate. Sometimes called anterior nutation, or anterior rotation (flexion) of the sacral base. Nutation of the sacrum occurs when we are exhaling and our spine's lordosis and kyphosis exaggerate, when we stand up, and when we extend our lumbar spine. The term has also been used to describe movement or positioning of the innominate posteriorly with respect to the sacral base. To avoid confusion we will use nutation for describing the position of the sacrum, and refer to the movement or positioning of the innominate as posterior rotation.

• During extension of the lumbar spine, the nucleus pulposus of the L5-S1 disc shifts forward, and pushing down on the anterior portion of the sacral base. The auricular (ear-shaped) surface of joint directs the sacrum anteriorly and inferiorly. The sacrum flexes (nutates) when the lumbar spine extends. Therefore, to avoid confusion between the motions of the spine and the sacrum we will stay with the term nutation.

Counter-Nutation
Movement or positioning of the sacral base posteriorly and superiorly with respect to the innominate. Sometimes called posterior nutation, or posterior rotation (extension) of the sacral base. Counter-nutation occurs when we inhale and the spine lengthens, when we are sitting, or when we forward flex the lumbar spine. The term also describes movement or positioning of the innominate anteriorly with respect to the sacrum. Again, we will use counter-nutation for describing the position of the sacrum, and refer to the movement or positioning of the innominate as anterior rotation.

• During flexion of the lumbar spine the nucleus pulposus of the L5-S1 disc shifts backward, tipping the sacral base posteriorly while the flexing lumbar spine pulls the sacrum superiorly. The auricular surface of joint directs the sacrum superiorly and posteriorly. The sacrum thus extends (counter-nutates) when the lumbar spine flexes. Therefore, to avoid confusion between the motions of the spine and the sacrum we will stay with the term counter-nutation.

Sacroiliac Movement
Describes movement of the sacrum on a fixed innominate. The sacrum is moving in concert with the lumbar spine (and movements of the trunk). For example when the spine rotates, while the legs/innominates are not moving, there are consequential movements in the sacrum.

Iliosacral Movement
Describes movement of the innominate on the fixed sacrum. For example, when a lower limb is in motion causing movement of an innominate, the sacrum can be held fixed by the weight-bearing limb (by force closure of the S.I. joint, see following pages). To avoid confusion, we will usually speak of innominate motion/movements rather than iliosacral movement.

These last two definitions talk of a fixed sacrum or a fixed innominate, but this is to make the point clear about the meaning of the terms sacroiliac and iliosacral. Often neither is fixed and both are moving in concert, the sacrum mediating between the lumbar spine and the innominates. The terms are meant as referential, to help orient us when we are looking at the influences on the pelvic girdle and in the naming of impairment or dysfunctions.

INSIGHTS

The Motion Of Walking Comes To Rest In The Sacrum

Both iliosacral and sacroiliac motions are happening during walking:

• On heel-strike of the right foot, the right innominate rotates posteriorly (and with slight external rotation) and on toe-off, the left foot produces anterior rotation (with a slight internal rotation) of the left innominate. Thus, there is anterior and posterior rotation happening in the sagittal plane through a transverse axis, with the pelvis as a whole rotating slightly left on a vertical axis (in a transverse plane).

• Meanwhile, the trunk is rotating right with the left arm swinging forward and the right arm swinging back. Thus, the lumbar spine is rotating right (on a vertical axis through horizontal plane) and sidebending slightly left (on an anterior-posterior axis through the coronal plane).

• Therefore, there is motion from above with trunk rotation and from below with innominate motion (via the legs). And, these motions are occurring all at once in several planes – and sometimes even in opposite directions – with all of these torsional forces meeting at the S.I. joints.

• In detail, the sacrum tries to accommodate all of this by moving in opposite directions:

- The right sacral base (the right upper corner of the sacrum) moves forward/anteriorly and down (nutates) on the right innominate as it is posteriorly rotating.
- The left sacral base tries to move ever so slightly posteriorly and superiorly (counter-nutates) on the left innominate that is rotating anteriorly. It is held almost still by the gluteus maximus, erector spinae and quadratus lumborum (on the left). (See force closure.)
- Since the sacrum has moved slightly inferiorly on the right, the sacral base as a whole is tilted to the right. Therefore, the lumbar spine compensates by sidebending to the left. (Otherwise our trunk and especially the shoulders would sway wildly to the right and then have to sway to the left as the legs change position.)
- Because the right corner of the sacral base is anterior and inferior while the left is held in neutral (or very slightly posterior and superior) the anterior surface of the sacrum is turned to the left. Yet, the lumbar spine (sidebent left) is rotated right. (Note: It has to turn this way because the right posteriorly rotated innominate's iliolumbar ligaments attached to L4's and L5's TVPs pull/turn the lumbar spine to the right).

Therefore, as the sacrum is generally moving in the opposite direction to the motions of both the lumbar spine and the innominates it acts somewhat like a gyroscope, co-ordinating all of the forces that pass through it, keeping us upright as we move. By moving opposite to the structures around it, the sacrum becomes the centre of motion during walking. And, like the hub of motion, the sacrum itself moves hardly at all.

Sacroiliac impairments imply that the sacrum is the source of the dysfunction in the pelvis; that the sacrum has become fixed or hypomobile and will not move within the S.I. joint. If not for this, the innominates would be functioning normally.

Iliosacral impairment, or innominate impairment as it will be subsequently called, implies that the movement of the innominate is impaired. And, while the sacrum may have some mild restriction of motion due to dysfunctional innominate motion, it is still capable of motion. If the innominate impairment is corrected, then the sacrum will function normally.

Pelvic Tilt (Innominate Rotation)
See the Hip & Innominate chapter for more on this.
• The innominates can bilaterally rotate anteriorly or posteriorly. These are pelvic tilts.
• They can also rotate unilaterally, anteriorly or posteriorly. These are innominate rotations.
• Innominates move in accordance with the lower extremities, while the spine usually drives the sacrum – hence, the trunk and lower body meet at the S.I. joint.
• The pubic symphysis rotates during gait, with one pubic ramus rotating anteriorly as the other rotates posteriorly. These motions correlate to and match the innominates rotating anteriorly and posteriorly. Also, one ramus can translate (shear) superiorly or inferiorly when under strain, as in jumping from a height and landing on one leg. Problems with shears (up/down-slip) lead to problems with rotation, which will affect motion in the pelvis as a whole.

What Stabilizes The S.I. Joint?

Stability By Joint Shape/Structure
1. The upper portion of the S.I. joint (just above S2, at S1) is wider, posteriorly than anteriorly. Thus, the joint surfaces are bevelled. This restricts the superior portion from tipping too far forward (from nutating more) between the innominates. The innominate has a matching bevel. The lower portion (below S2) is wider anteriorly than posteriorly. This, in turn, prevents the lower portion of the sacrum from moving too far backward, again preventing excessive movement of the sacral base forward into nutation.

The bevelling especially provides stability to the spine when we are standing; specifically preventing the sacrum from sliding forward out from between the innominates and causing excessive extension (hyperlordosis) of the lumbar spine. Thus, the sacrum can only move within the confines of the shape of the joint surfaces. This bevelling works best to prevent the motion of nutation when standing still. However, during gait, with the gapping of the joints, some motion into nutation is possible.

2. The sacral joint surface is somewhat concave, while the surface of the innominate is somewhat convex. Also, each surface is uneven – hills and valleys fitting into near matching hills and valleys, or fitting together like a set of gears. This helps, along with number 1, to restrict excessive motion.

Ligaments
The posterior sacroiliac ligaments are thicker and stronger than the anterior. The deep ligaments run short and oblique, and as they become more superficial they move laterally and they become longer and more vertical. The lateral portion of the posterior ligaments, at this point referred to as the long dorsal ligament, blends with the sacrotuberous and sacrospinalis ligaments.

The anterior sacroiliac ligaments are much thinner and weaker than the posterior ligaments. The sacrum, therefore, is principally suspended between the innominates by the posterior ligaments.

However, no matter how tight these ligaments are, they cannot prevent all movement at the S.I. joints. The only way to absolutely prevent any movement is to fuse all of these joints together with bone, and this would have to be considered pathological in nature.

Muscles, Ligaments & The S.I. Joint: Movement & Stability
Fibres from the erector spinae and multifidus meld with the posterior ligaments and into the long dorsal ligament. The superior fibres from the tendon of the biceps femoris hamstring are (usually) continuous with the sacrotuberous and, in turn, the long dorsal ligament.

Vleeming writes: "The long dorsal sacroiliac ligament has close anatomical relations with the erector spinae muscle, the posterior layer of the thoracolumbar fascia, and a specific part of the sacrotuberous ligament (tuberoiliac ligament). Functionally, it is an important link between legs, spine, and arms. The ligament is tensed when the sacroiliac joints are counter-nutated and slackened when nutated. The reverse holds for the sacrotuberous ligament. Slackening of the long dorsal sacroiliac ligament can be counterbalanced by both the sacrotuberous ligament and the erector muscle. Pain localized within the boundaries of the long ligament could indicate among other things a spinal condition with sustained counter-nutation of the sacroiliac joints. In diagnosing clients with a specific low back pain or peripartum pelvic pain, the long dorsal sacroiliac ligament should not be neglected. Even in cases of arthrodesis of the sacroiliac joints, tension in the long ligament can still be altered by different structures." (Vleeming, et al)

The gluteus maximus also uses these ligaments for part of its attachment. Further, the piriformis has some fibres that originate on the sacrotuberous ligament. The coccygeus and levator ani (which are part of the pelvic diaphragm) attach to the sacrospinalis ligament. These muscular attachments can increase the tension on these ligaments when they contract, or lessen the tension if they relax. In turn, misalignment of the sacrum, and the concomitant tension (or lack of) on these ligaments can affect the tone and function of any and all of these muscles, which could lead to what has been called pelvic pain syndrome.

We should mention that the iliacus has fibres onto the anterior ligaments of the sacrum as well as the lower portion of the anterior body of the sacrum.

There are no prime movers of the S.I. joint. The sacrum moves and responds to the motion in the innominates and the lumbar spine, along with mass action of muscles that attach to the hip and pelvis. Or to put it another way: the movement of the spine from above (motion through L5) and movement from the hips through the innominates puts torsional (twisting) forces through the S.I. joints, causing the sacrum to oscillate (squirm or twist) between the innominates. Therefore, muscles are considered to only indirectly move the S.I. joint. However, they may have a more direct effect on fixing or holding still some parts of the sacrum – such muscles as the piriformis, gluteus maximus, multifidus, hamstrings, etc.

All of the muscles that move the hip joint pass their forces into the innominate bones and, by the deformation of the innominates (inflares, outflares, etc., and by their anterior and posterior rotations), these muscles pass their forces into the S.I. joints.

Such deformations of the living (i.e., soft and pliable) bone of the innominate can occur from the rectus femoris, sartorius, tensor fascia lata, iliotibial band; from the quadratus lumborum, iliacus and the obliques and transverse abdominal muscles.

For example:
• The rectus abdominus directly affects the movements and stabilization of the symphysis pubis (rotation and translation/shearing) in concert with the adductor muscles attached to the pubic ramus.
• The principal hip flexors (the iliopsoas and the rectus femoris) are the principal culprits in bilateral, or unilateral, anterior rotation of the innominate.
• The further contribution of the iliacus and sartorius to anterior rotation also causes the innominate to flare inward as it anteriorly rotates.
• The tensor fascial lata, along with the iliotibial band and gluteus minimus and medius, promotes outflares of the innominate.

Static Closure & Force Closure
All of this brings us to what has been called static closure and force closure of the S.I. joints.

Static closure refers to how the shape of the bones, joints, and ligaments hold the S.I. joint closed, i.e., stable. This was described at the beginning of this section in "What Stabilizes The S.I. Joint."

Force closure refers to the tightening of the ligaments and, hence, the S.I. joint by the contraction of the gluteus maximus (especially), the piriformis, the biceps femoris, and from above the multifidus and erector spinae (directly), and the muscles that exert forces through the thoracolumbar aponeurosis (such as the latissimus dorsi).

Force closure can be used by the body to fix one of the S.I. joints while leaving the other more free to move, as happens during walking. Thus, one S.I. joint can become an axis of movement for the sacrum. Or, force closure can be engaged to bilaterally fix the S.I joints during times of exertion (which leads to locking of the S.I. joints) such as when lifting heavy loads; or it can be used to stabilize a hypermobile joint as protective spasming (often referred to as holding and guarding).

CHAPTER V SACROILIAC JOINT & PELVIS

Testing Within The Examination Of The Spine

See the comprehensive examination of the spine chapter for details.

The observations, below **in bold,** require further testing if found to be positive. Generally, a positive observation shows asymmetry with respect to landmarks. A motion test is positive if restriction or asymmetry in the motion of a joint is found. Even if the therapist is sure that the S.I. joints or the innominates are impaired, they should perform the following comprehensive structural examination prior to specific testing. Doing so may reveal how innominate or S.I. joint impairments are affecting the rest of the body. You will then have done a truly comprehensive examination.

1. Standing Postural Views – Front, Side, Back
Looking for relationships with gravity line: Static plumb line vertical and horizontal landmarks.
Note asymmetries and deviations:

2. Sitting behind client:

a. Landmark levels of arches of the feet, ischial tuberosities, trochanters, PSISs, iliac crest heights, (creases of) waist, inferior and superior angles of scapula, mastoid processes.

b. **Return to PSISs. While landmarking PSISs have client bring chin to chest, then roll down to lumbar flexion, noting movement of PSISs (Standing Flexion Test).** Then, check spine for flat spots, excessive curve, bulking of erector spinae, then have client returns to standing straight. Have client extend back while observing changes to curves of the spine (lordosis-kyphosis).

c. Have client bring ear to shoulder; then have them slide hand down side of leg to knee, observing how the spine curves during sidebending (from above). Check both sides.

d. Have the client flex one knee while the other remains 'locked' – note lumbar sidebending (from below). Check both sides.

e. Hold the client's hip stable. Have the client bring their chin over a shoulder and note head and cervical rotation; then have them bring that shoulder back toward you – observing thoracic rotation. Note also the difference in the amount of resistance required at hips to resist lower trunk rotation (ease versus effort).

f. Challenge sagittal plane (anterior-posterior) stability (via manubrium and T2).

g. Challenge coronal plane (sidebending) motion, either by pressure on acromions or inferiorly directed tug on wrists.

3. Have client sit:

a. **Re-check iliac crest heights, PSISs,** shoulder/scapula landmarks, **tissue bulk, etc.** Observe all changes of orientation to landmarks, tissue changes, etc., during the following motion.

b. **Seated flexion test: While landmarking PSISs, have the client flex forward. Check for asymmetry of tissue bulk on either side of spine.**

c. Sidebending: With elbow at 90°, client brings ear to shoulder, then lowers it toward the table.

d. Challenge to sidebending: Push down alternately on each shoulder cap.

e. Rotation: Turn chin toward shoulder and, at end-range, push shoulder back.

4. Client supine: (after traction of legs or other corrections to client's orientation)

a. **Note medial malleoli levels**

b. **Check ASISs**
- Level (innominate rotation)
- Heights from table (pelvic rotation)
- Distance from mid-line (in/out flare)

c. Check rotations (fascial exam) – Compare heights from table of hips (ASISs, as above), lower rib cage, upper ribs, anterior shoulders, L and R occiput, i.e., from table compared to norm and compared bilaterally; and then compare directions of rotation from one set of landmarks to the next.

d. Tests sidebending comparing ease/bind: at waist (lumbar), mid-ribs (thoracic) and neck (cervical).

5. When, or if, specific testing has the client prone, check the following:
Levels of plantar surface of heels, ischial tuberosities, PSISs (and height from table), and the lateral curves in spine, tissue bulk of erector spinae, and scapula orientation.

If the tests in bold on the previous page were positive, then a more thorough examination of either the innominates or the S.I. joints is needed. The tests mentioned specifically in the bold type, and all of the further specific testing for the region, are explained and shown in this chapter.

Ideal Testing Order
Ideally, the iliosacral and sacroiliac joints would be tested at the same time, but to simplify instruction, they will be presented in this chapter separately. Once the student is comfortable with both sets of tests, they can be combined in the ideal fashion as follows:

1. Testing for postural asymmetries: Do a standing postural examination.
2. Test for motion impairment of the innominates (iliosacral) using the stork test or its alternative, the standing flexion test.
3. Seated flexion test: Do this to check for sacroiliac motion impairment.

If we have a positive stork test but a negative seated flexion test, we need to do the following specific innominate testing:
• Identify the orientation of the innominate that the stork test revealed as lesioned;
• Note the effect on leg length, if any;
• Pelvic challenge for pubic symphysis impairments;
• Passive palpation of sacral motion (4-Point palpation of respiratory motion and/or sacral springing and/or gapping of the S.I. joint).

If we have a positive seated flexion test, we would still do the innominate testing as above and add to that S.I. joint testing as follows:
• Palpation of 6-Point landmarking;
• Prone extension test (Sphinx test) to identify the nature of the lesion.

Testing Order For Instruction Purposes
We will now proceed to Part II in order to discuss innominate motions and their impairments. Following that we discuss the testing for those impairments to innominate motion in Part III. We will then go through the causes and types of sacroiliac impairments in Part IV, and then the testing protocol for S.I. joint impairments to motion in Part V.

CHAPTER V SACROILIAC JOINT & PELVIS

Part II: Innominate Motions & Impairments

We need a few more definitions of the terms used in characterizing normal physiological motions of the innominate versus impaired motion.

Movements Of The Lumbopelvic Girdle
The innominates go through predictable movements during flexion and extension of the spine and, hence, through nutation or counter-nutation of the sacrum:
• When the spine is extended, the sacrum nutates by sliding inferiorly and anteriorly. This results in a narrowing of the space between the PSISs. This is means that the PSISs have moved slightly toward each other, which is matched by the ASISs moving apart. Further, the ischial tuberosities move slightly apart. (Each ischial tuberosity motion matches or complements the motion of the ipsilateral ASIS.) These innominate movements are known as an outflare, a gapping force through the pubic symphysis.
• As the spine flexes the sacrum counter-nutates, sliding superiorly and posteriorly. This results in a widening of the space between the PSISs. This means that the PSISs have moved slightly apart, while the ASISs move toward each other. Further, the ischial tuberosities move slightly toward each other. These motions are collectively known as an inflare, which places a compressive force through the pubic symphysis.

When testing for inflares and outflares (described below), the principal references are the ASISs. However, when inflares or outflares are suspected, other landmarks, such as the PSIS and the ischial tuberosities, should also be investigated. For brevity, we will often refer only to the position of the ASIS, but the other landmarks are implied.

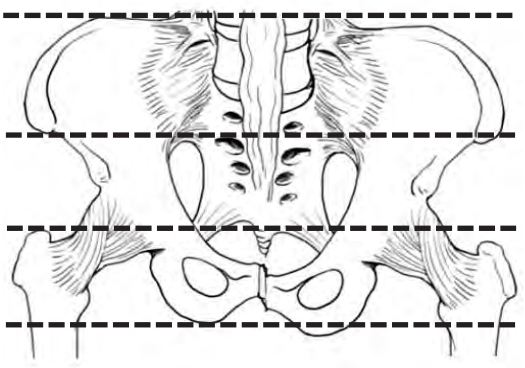
Outflare
When the lumbar spine is extended – and the sacrum nutates – we have a bilateral outflare. Or when a single innominate is posteriorly rotated, the ASIS on that side may move away from the mid-line, (a unilateral outflare). This outflare (or external rotation) of the innominate means that the position of the acetabulum has changed, and the hip joint will be also externally rotated. However, the hip joint may compensate with internal rotation.

It is also possible that the innominate can be pulled to an outflare position by muscular and fascial forces, without necessarily rotating the innominate posteriorly. Remember that living bone is pliable and plastic. Some of the most common culprits here are the tensor fascia lata, the iliotibial band, and gluteus minimus.

Inflare
When the spine is flexed, and the sacrum counter-nutates and the ASISs move toward each other, we have a bilateral inflare. A unilateral inflare can occur when a single innominate is anteriorly rotated (the ASIS on that side moves toward the mid-line). However, the anterior portion of the innominate can be pulled toward the mid-line without the presence of anterior rotation. As with outflares, it is usually muscular and connective tissue force that causes the inflare, via the iliacus, internal obliques, sartorius and a contracturing inguinal ligament.

Upslip (Superior Shear)
If the ASIS, PSIS and the ischial tuberosity on the same innominate are all higher than the contralateral innominate, then we have what is called an "upslip" of the innominate on the sacrum. This is the result of a shearing of S.I. joints and the pubic symphysis. Another palpable observation is that the greater trochanter on the side of the upslip should be higher than its opposite. (If the femur and tibia are truly equal in length, the leg on the side of the upslip will likely look shorter.) There would be a shearing taking place at the pubic symphysis. Therefore, if palpated, the pubic bone would also be found to be higher on the side with the upslip.

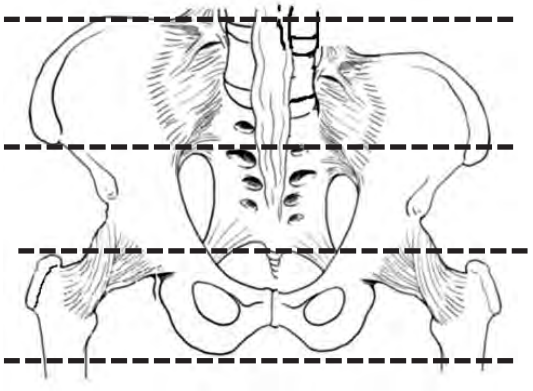
Upslip On Right Side



It follows that there is the possibility of a "downslip," or inferior shear, the opposite of an upslip. A downslip would usually immediately self-correct upon weight-bearing. However, even if corrected by weight-bearing, the sacral joints and the pubic symphysis may not all necessarily correct automatically. One or more joints may be held misaligned due to a persistent muscle imbalance caused by the original shearing. If the downslip does not correct on its own, it may imply a dislocation of the S.I. joints and pubic symphysis, and would present as severely painful. Refer out to primary physician.

Note: If, on palpating and landmarking, you find that the PSIS and ASIS are higher on one side, but the ischial tuberosity is level or even lower than the contralateral ischial tuberosity, then the client may have what is referred to as a "hemi pelvis." This means that one innominate as a whole is actually larger than the other. This can occur in any paired bones of the body. It can even happen to vertebrae, which can be thicker, for example, on the left side and thinner on the other, creating a wedge-shaped vertebra. This is often seen in a structural scoliosis.

Hemi Pelvis



CHAPTER V SACROILIAC JOINT & PELVIS

Physiological Motions Of Innominates During Gait

Unilateral Anterior Rotation Of The Innominate
The ASIS on the innominate that is anteriorly rotated is lower when compared to the contralateral ASIS. Also, the PSIS will be higher on the side that is rotated anteriorly, compared to the other side. This occurs naturally during gait when that foot is toeing-off (and the hip is in extension).

When one innominate rotates anteriorly, the acetabulum and the head of the femur on that side also move anteriorly and inferiorly, compared to the other hip. This then makes that leg "functionally" longer than the unrotated side.

When the innominate is held anteriorly rotated, the palpatory findings would be as follows:
• ASIS lower on one side and its corresponding PSIS is higher on that innominate as well.
• The unilaterally anteriorly rotated innominate, therefore, usually assumes an inflared position, and the ASIS is then closer to the mid-line.
• This innominate's ischial tuberosity may present slightly posterior when palpated, compared with the tuberosity on the other side.

When the client is supine:
• The greater trochanter on the side of the anteriorly rotated innominate should also palpate as slightly lower than on the other side.
• That side's pubic ramus may be rotated inferiorly at the pubic symphysis. (See Pubic Symphysis Impairments later in this section.)
• The leg on the anteriorly rotated innominate can appear longer and palpation at the malleoli will reveal this (if the bones of the leg are relatively equal in length on both sides).
Remember: If a longer leg is observed, and the difference is only functional, the difference between the heights of the malleoli should match the difference in height between the two ASISs.

INSIGHTS

Further Postural Implications
With a functionally longer leg present (on the right, for example), the hips may shift toward the shorter leg, (in this example, the left leg). This, in turn, leads to the upper body sidebending over that shorter leg, which makes the shorter leg the principal weight-bearing leg. When the client begins to favour using this shorter leg to bear the bulk of the weight of the body, it causes this stress load to slowly, but surely, rotate the innominate on that side posteriorly. The mechanism for this is that the 'short leg' compensates by extending the hip to try and lengthen itself. This moves the acetabulum forward, and the forces running down to the hip and up from the ground through the leg push the innominate into posterior rotation. However, the hips may not shift away from the long leg, but rather the upper body may bend over the long leg. Thus, the long leg becomes favoured in weight-bearing. Either of these situations could have consequences for both S.I. joints and the joints of the lumbar spine, and beyond.

When the innominate becomes fixed anteriorly (usually from muscle imbalance, such as tight hip flexors), then other structures of the leg on that side may compensate for the added length (rotation of femur, or tibia, valgus knee, and/or pronation of foot, etc.). A functionally longer leg can, therefore, have the same consequences on posture that a "structurally long leg" would have. Therefore, for example, the client may present with medial knee pain that could be due to an anterior innominate with a valgus compensation at the knee (See the Hip and Innominate chapter for more on this).

Unilateral Posterior Rotation
The ASIS on this side is higher, and the PSIS will be lower. This occurs naturally during gait when that foot is in heel strike position (and the leg is in flexion). The leg on this side will become shorter and, if the innominate becomes fixed posteriorly (usually from muscle imbalance), then the leg on that side will remain functionally shortened. The body may then compensate for that functionally shortened length by externally rotating the femur and internally rotating the tibia (resulting in a varus knee). Further, supination of the foot may occur; all of which help to make that short leg longer.

When the innominate is held posteriorly rotated, the palpatory findings would be as follows:
• ASIS is higher on one side, and its corresponding PSIS is lower on that innominate as well.
• The unilaterally posteriorly rotated innominate, therefore, usually assumes an outflared position, seen by the ASIS farther from the mid-line.
• As well, this innominate's ischial tuberosity may be palpated as slightly anterior compared to the other side.

With the client supine:
• The greater trochanter on the side of the posteriorly rotated innominate should palpate slightly higher than it does on the other side.
• That side's pubic ramus may be rotated superiorly at the pubic symphysis. (See Pubic Symphysis Impairments on the next page.)
• The leg on the rotated innominate can appear shorter, and palpation at the malleoli will reveal this (if the bones of the leg are relatively equal in length on both sides).

Remember: If a shorter leg is observed, and the difference is only functional, the difference between the heights of the malleoli should match the difference in height between the two innominate's ASISs. These functionally longer/shorter legs can, in turn, unlevel the sacral base and lead to compensatory changes in the spine (such as rotoscoliosis) and, hence, predispose the client to impairments of the spinal and/or sacral joints.

Bilateral Anterior Rotation Of Innominates (Anteriorly Tilted Pelvis)
This is when both ASISs are lower than the PSISs (when compared bilaterally) by an angle of more than 15° from level when viewed from the side. Such mal-positioning of the pelvis is usually due to muscle imbalance, especially short hip flexors. This will result in an increased lumbar lordosis (hyperlordosis) which will put increased strain on the intervertebral joints (discs, vertebral bodies, facet joints, ligaments, etc.). The anterior tilt also moves the lumbar spine out of neutral position: the joints of the spine and the S.I. joints will behave as if the person is bent backward into extension at the low back. This predisposes all these joints to more readily become injured and impaired. With respect to the sacrum, this anterior tilt causes it to go into nutation and resist returning to neutral. Therefore, during walking the S.I. joints will lose some of their mobility.

Note that even though both ASIS are lower and the pelvis can be defined as an anteriorly tilted pelvis, one innominate may still be more rotated than the other – and, so, there can be an accompanying unilateral anterior rotation impairment occurring as well.

Bilateral Posterior Rotation of Innominates (Posteriorly Tilted Pelvis)
Both ASISs are level with, or even higher than, the PSISs when observed from a lateral angle. This causes a decrease in the lumbar lordosis or "flat back." The sacrum is pulled into a counter-nutated position. This positioning of the structure of the lumbar spine and sacrum will impact on the function of the associated joints, affecting the health of the intervertebral discs and making the S.I. joints prone to impaired motion. One of the most consequential effects of this is loss of the natural spring that belongs to the regularly curved lumbar spine: movements coming up from the ground are now more jarring through the spine. Again, note that one innominate may be more posteriorly rotated than the other.

Pubic Symphysis Impairments

Any shift in innominate positioning will impact on the pubic symphysis joint. Even if this joint is the axis of movement, there will be rotational stress within the cartilaginous disc (often drawing the pubic rami toward each other, i.e., compressing the joint).

Superior/Inferior Shears
These impairments have one pubic ramus shifted higher or lower than the other. Often, they are accompanied by unilateral rotations of the innominate on that side. Hence, a unilaterally posterior innominate could have its pubic ramus elevated or sheared superiorly, while a unilaterally anterior innominate may have an inferior shear of its ramus. Note that this is not automatically the case.

The pliability of the bones which comprise the pelvic bowl can allow for the possibility of unilateral rotations of an innominate without a shear occurring. The rotation of the innominate (depending on the conditions of the muscles and connective tissues involved) could occur on an axis that is close to, or even, in the symphysis pubis. The cartilaginous disc may then have rotational stress through it but not shear forces specifically, e.g., one ramus may appear sheared when it is, in fact, rotated.

Compressed Pubic Symphysis
The cartilaginous disc can be placed under compressive forces in a number of circumstances, and this could be sustained by muscle imbalance and/or connective tissue shortening. The compression could be seen along with a bilateral inflare of the innominates, with a bilateral counter-nutation impairment of the sacrum, trauma, or even from sustained rotational forces from unilateral innominate anterior rotation impairment.

Gapped Pubic Symphysis
A decompression, or gapping between the ramus of the pelvis, can occur with nutation impairments of the sacrum, bilateral outflares, or trauma. One of the most common occurrences happens for women during the birthing process with the widening of the birth canal. The pubic symphysis may not automatically return to its normal position post-partum. This can result in a pain in the area, and is also commonly involved in “back-labour” pain, since such gapping is concurrent with sacral misalignment post-partum.
- Any of these impairments could be a hidden or un-investigated source of persistent pelvic pain.
- Always check, by palpation, the obliques and rectus abdominus muscles for balance of tone.

Symptoms Of Innominate Impairments

With respect to pain, the impairments mentioned above fall into two basic categories. Innominate rotations, unilateral or bilateral, along with inflares and outflares, do not usually generate specific pain patterns but are themselves asymptomatic. Pain is the consequence for related structures above and below that will present as painful: sacroiliac, lumbar, symphysis pubic, hip, or farther afield, in pain or impairment to the knee, ankle, thoracic or cervical areas.

This fact speaks to the need for the pelvis to always remain an area of investigation when treating almost any musculoskeletal dysfunction or impairment. The pelvis often displays the effects of impairments in any area of the body and can, in turn, be one of the predisposing factors in mechanical impairments throughout the body. It is suggested that once you have assessed a specific impairment that a client presents with, address the immediate concerns and later perform what we have called the comprehensive structural examination of the pelvis and spine.

Pubic symphysis impairments and innominate shears often present with some local pain: groin pain, iliosacral pain, and the like. Altered gait patterns will accompany innominate impairments. They may be obvious or quite subtle: asymmetry seen in stride, hip motion (side-to-side and/or superior-inferior), heel strike or toe-off, upper body motions, etc.

Part III: Testing For Innominate Impairments

Assessing the nature of the impairment to the innominate requires careful postural landmarking and palpation skills. The motion tests that follow are simply AF-ROM or PR-ROM movements done while palpating specific landmarks and noting motion or lack of motion in specific structures. To confirm an assessment of innominate impairment, we need to gather information from three sources:

1. We need to observe the position of the innominates, relative to one another and to the surrounding structures. This is done by palpating and landmarking while observing the client's posture. We are specifically looking for asymmetries in the landmarks of the pelvis. This gives us the orientation of the various bones that comprise the pelvis.

2. We will challenge the structure to move in a specific way and observe if it does or does not do so. This is sometimes referred to as motion palpation. Motion palpation is simply moving the joint either by the therapist (PR-ROM) or by having the client performing a specific AF ROM while the therapist palpates specific landmarks. We will employ the stork test for this to observe innominate motion.

3. Lastly, we will palpate to see if normal physiological motion is present in the S.I. joint, which tells us if there is sacroiliac involvement. If there is, we will need to pursue specific S.I. joint testing as outlined in Part V of this chapter.

Note: If there is a sacroiliac dysfunction that is causing the innominate impairment found (i.e., if the sacroiliac impairment is primary and the innominate dysfunction secondary), then treatment of that innominate will either not produce a healing response, or the correction will not hold, and the impairment will soon return.

After gathering the three types of information listed above, we will be able to make a judgment about what impairment to innominate function is present. However, we need to do some further testing to clarify the specific muscles and tissues that are involved and how they may contribute to, or be a consequence of, impaired innominate function. Therefore, we add a fourth source of information.

4) We will carry out some differential muscle length and strength testing around the pelvis and lumbar spine. Taken with the postural information noted already and, specific information about what is tight or taut, short or long, hypertonic or hypotonic, it will allow us to understand the specific muscle imbalances and possible connective tissue involvement contributing to the impairment of innominate functions. (In this chapter, we will review tests presented in the Hip and Innominate chapter and the Lumbar Spine chapter.)

Only when the therapist knows the position of the innominates, how they are moving or impaired, how the soft tissues are involved, and the effect this may be having on the S.I. joints, can the therapist consider truly appropriate treatment approaches and have some hope for their effectiveness.

Note: Once we have discussed and explained the testing, we will provide a brief synopsis of the findings specific for the various impairments possible for innominate motion and function.

CHAPTER V SACROILIAC JOINT & PELVIS

1. Observation & Inspection
See postural assessment in the introductory chapter for more detail.

Standing Postural Exam

Important: Have the client stand in a natural pose.
To assist in this, instruct the client to look up slightly (i.e., you do not want them watching their feet) and ask them to take a couple of steps, while staying in place. Do not correct feet positions, head positions, etc. You are trying to have them stand as they naturally do, or to the greatest extent possible in a clinical setting. The views observed are frontal, lateral (both sides) and posterior.

Note: Much of this information is needed to compare with supine and prone examination so we are not misled by what we see when the client is on the table in those positions.
1. Note the upper body's general orientation, especially rotations and sidebending of the shoulders or spine.
2. Note the lower body's general orientation, hips, thighs, knees, tibias, ankles and feet. Note if the hips are shifted right or left over a leg, proportions (tissue bulk), and orientation of the thigh and lower leg (rotations throughout the course of the limbs down to the feet, varus or valgus of knees or ankles, arches of the feet).

Be specific and exact with the following:
• Check iliac crest and greater trochanter heights;
• Record ASIS and PSIS heights from the anterior, posterior and lateral views. Compare heights of the ischial tuberosities;
• Note pelvic obliquity – change in height of one hip compared to the other;
• Note if the pelvis appears rotated around a vertical axis. In other words, does one ASIS (hip pointer) appear more anterior (in the coronal plane), and whether the ASISs are level with each other;
• Observe if the client has shifted their pelvis to one side over a leg (which then usually becomes the principal weight-bearing leg);
• Note whether the client has a hyperlordosis or a hypolordosis of the lumbar spine. Observe whether the lumbar spine seems rotated and/or sidebent;
• Observe whether there is an anterior pelvic tilt (usually with a hyperlordosis) or posterior pelvic tilt (usually with a flat back/hypolordosis). Check line from PSIS to ASIS. Normal tilt is from 5° to 15°. (Women tend to have slightly more of a tilt than men.) Check both sides in order to evaluate if one innominate is more anterior than the other.

Take all of the information you have accumulated to this point and, from that, create a description or mental picture of the relative positions of one innominate to the other, and then to the structures above and below.

Anterior Pelvic Tilt With Hyperlordosis
A bilateral anterior pelvic tilt is a good example of the most common muscle imbalances found in the clinical setting. (See the Lumbar Spine chapter for more examples.)

Tight & Facilitated Muscles:
Lumbar erectors, QL, iliopsoas, piriformis, rectus femoris, TFL, thigh adductors.

Taut Hamstrings:
Taut means lengthened, but hypertonic. They are stretched by being the only muscle holding the pelvis from rotating further anteriorly and, over time, contracture to this length.

Weak & Inhibited Muscles:
Rectus abdominus, transversus abdominus, gluteals, vastus medialis, vastus lateralis.

INSIGHTS

Supine Postural Exam
It is best to normalize the hips prior to landmarking and palpating structures around the pelvis and hip as the client may not be lying straight on the table. Do the following, if the client is able (see postural assessment photos in the Introduction chapter).

Have the client crook-lying (supine with hips and knees bent). This position is usually comfortable for the client. Have them lift their pelvis off the table a few inches for just a few seconds and then instruct them to let their hips drop back down to the table. Have them relax and let you move their legs. Proceed to extend the legs one at a time. The active lifting of the pelvis off the table engages the musculature in and around the pelvis which will pull the hips into what is the normal position for that client.

Once the client lets the hips drop back to the table, the musculature can relax and the client should then allow the therapist to passively straighten the legs. This has the effect of aligning the client into what is the neutral position for them, so that you can more accurately palpate for asymmetries that are actually present in the body, and not be misled by those that are just an accident of how the client happens to be laying on your table at that moment.

Note: This normalizing of the hips is useful prior to any testing that takes place with the client in supine, since it usually places the client in a position where the musculature and joints want to hold their hips and pelvis. Hence, the tension being placed through specific structures during testing will more accurately test those structures for impairments.

Testing For Leg Length Discrepancy

1. Note Medial Malleoli Levels

Landmark malleoli at their inferior border (underneath malleoli). Compare levels.

2. Check ASISs

Landmark underneath ASISs for horizontal level. Compare.

Compare any differences between the level of the malleoli and the ASISs: do they roughly match? For example, if the right malleolus was an inch lower than the left, is the right ASIS also lower?

Signs Of Innominate Rotations (Using Examples)
Having had a positive stork test on the right (see stork test that follows details):
• Right malleolus lower than left; matched by right ASIS lower than left. Implies right innominate is anteriorly rotated, the right leg will act as if long.
Having had a positive stork test on the left:
• Conversely, the left malleolus is higher than the right and the left ASIS is higher than the right. Implies the left innominate is posteriorly rotated.

Other possibilities:
• The right malleoli is lower but the right ASIS is level with the left or even higher. The suspicion is that the right leg has a bony length difference, where the femur or tibia on the right is actually longer than its paired bone on the left. Also, a hemi pelvis (where the whole pelvis on one side is larger) could produce a longer leg. You could have no positive stork test, or you could have a positive on either side. Actual bony leg length differences can produce a variety of impairments in the pelvis, not to mention the legs themselves.

A shoe lift may be the appropriate answer for clients with an anatomically short leg, and they should be referred to a podiatrist. But, there still may well be other issues or impairments that need to be addressed. Temporary palliative relief can be given until the client gets a corrective lift or, once they have a corrective lift, chronic changes, compensations and persistent impairments from the leg length discrepancy may well need to be addressed by the massage therapist in an effort to help the body re-adjust to a newly levelled leg/pelvis condition.

Other observations to be made while the client is supine are:
• Heights of ASIS from table (pelvic rotation to the right or left);
• Distance from mid-line (inflare/out-flare).

INSIGHTS

Functional Long/Short Leg
Remember that the functional long leg or the functional short leg can be on either side. However, clinical experience shows that most right-handed people whose lead foot is also on the right will tend to have an anterior innominate on the right. When a right lead foot person has the long leg on the left (or short on right) they often have more acute symptoms in the lumbopelvic girdle. Left-lead-foot persons, however, do not share the reverse pattern as they live in a right-handed/footed world where they are forced to be more ambidextrous. How do you know which is a lead foot for a specific person? Ask them which foot they would use to kick a soccer ball that was rolling by.

Note: Even though a person has a rotated innominate on one side (example, seen supine) they could have had a negative stork test. This negative test is due to a muscle imbalance, but the innominate, as part of an iliosacral joint, still retains its mobility. Changing the imbalance by correcting a low back or hip joint impairment results in the innominate usually being re-balanced automatically. However, always check to see if this has occurred. For more on rotated innominates, see the Hip and Innominate chapter.

Assessing For Inflares & Outflares
Remember: An inflare is when the ASIS on one side is closer to the mid-line of the body, and usually accompanies an anteriorly rotated innominate. Conversely, an out-flare is when the ASIS is further from the mid-line, commonly found with a posteriorly rotated innominate. How can we tell which of the two is occurring? It is the innominate which will have a positive stork test, described later.

Checking For Inflares & Outflares

Landmarks ASISs and take index finger tips to umbilicus. Compare distances of ASISs from mid-line.

Placing Innominate Orientation In Context Of Trunk & Head
With the testing that follows, you can collect, through your clinical experiences, many insights into the numerous correlations of tissues and structures of the pelvis, spine, shoulder girdle and heel.

Check rotations (fascial exam) with the client supine:
• Compare heights from table of hips (ASISs, as above), then lower rib cage, upper ribs, anterior shoulders, left and right occiputs. Compare heights from table to normal and to the other bilaterally, and then compare directions of rotation from one set of landmarks to the next.

A compensatory pattern would have the hips rotated in one direction, with the lumbar spine rotated in the opposite direction continuing in an alternating pattern all the way to the head. This compensatory (alternating) pattern was seen by Gordon Zink, D.O. (Pope) in clinical situations where the client usually suffered only minor to moderate impairments amenable to treatment. He observed, however, that a non-compensatory (non-alternating) pattern often accompanied more serious impairments (especially from trauma) and/or that the client suffers from some pathology/illness.

Compare the above rotations with these sidebending patterns, done while gently pushing the following areas of the body side-to-side comparing ease and bind:
• At the waist (lumbars);
• Mid-ribs (thoracic);
• Neck (cervicals).

2) Motion Palpation Of Innominates
Two tests, the stork test and the standing flexion test, are presented next for the sake of thoroughness. The stork test is preferred by the author because it removes hamstring tautness that could hide positive results which may occur during the standing flexion test. This second test can be used as an alternative if the client has difficulty performing the stork test (problems standing on one leg).

• A positive motion test only tells us which side has impaired function. What type of innominate impairment there is depends on the postural palpatory findings as described above.

Stork Test (Fowler's Test/Gillet's Test)
This test works by fixing the sacrum and moving the innominate: The S.I. joint can be thought of as functioning as a clutch: when a leg is weight-bearing, the S.I. joint on that side closes or becomes fixed or more stable (see force closure, earlier in this chapter). Meanwhile, the non-weight-bearing side gaps slightly and is left free to permit a small amount of movement, allowing the innominate on that side to rotate anteriorly or posteriorly.

Have the client standing at arms' distance from a wall. They should have their fingertips or hands on the wall to retain their balance during the testing. The elbows should be slightly bent and the client should not be leaning forward or backward! Palpate the PSISs. Have the client then flex their hip as you continue to palpate PSISs, bringing their knee up toward their shoulder. It is important to ask the client to bring the knee up as high as possible because, even though you will feel movement and can get a result with modest flexion of the hip, you will always get a significantly clearer result when the hip passes 90°. Normally, the PSIS should move down on the non-weight-bearing side.

The positive sign is the PSIS not moving inferiorly, but staying at the same level or even moving slightly superiorly. Some therapists will landmark as follows: palpate one PSIS with one thumb, and palpate S2 (approximately) with the other thumb. Have the client then flex their hip on the side of the PSIS you are palpating.

Errors in testing can occur with having the client doing the test with only one hand resting on your table or the back of a chair. This can invalidate the test, as the client is then more likely to sidebend the low back when lifting one or the other leg. They will certainly not move symmetrically one side to the other. This can also occur if the client is standing at 90° to the wall and is using only one hand to stabilize themselves. If balancing with unilateral support, the average client will inevitably sidebend quite a lot to keep their balance, and may do so more on one side than the other.

1. Positioning For Stork Test

Landmark PSISs while client stands arm's distance from wall.

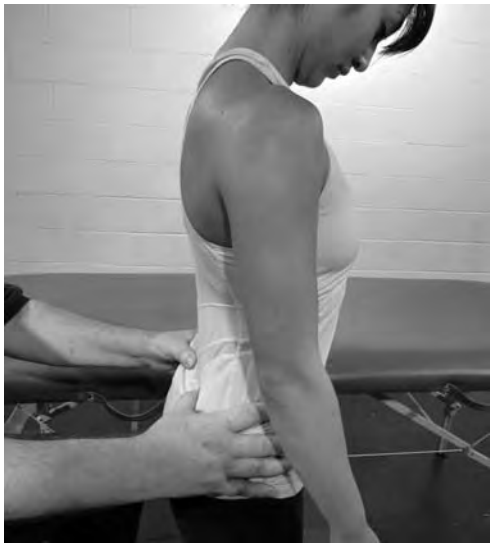
2. Performing Stork Test

Palpate landmarks with hip flexion, first one leg, then the other.

To repeat, if all is functioning well during the testing the PSIS on the flexed hip side will move slightly inferiorly. However, if the PSIS does not move inferiorly, and even moves superiorly, then the test is positive. This implies impaired motion between the innominate and the sacrum on that side.

Standing Flexion Test
Primarily used as a test for innominate dysfunctions. It is presented here because of its common usage. However, note the reservations about this test mentioned above and those mentioned below.
We are looking for similar movements of the PSISs as in the stork test.

1. Standing Flexion Test



2. Standing Flexion Test

Landmark PSISs and have client bend forward: first tucking chin in, then slumping thoracic spine, then flexing lumbar spine until bending from hips.

When one side "rides higher," that is the side of the dysfunction but it can indicate either impairment to the innominate or to the sacrum. However, one could generalize about the results of testing and postulate that, in general:
• A positive sign for an impairment of innominate motion (an iliosacral dysfunction) is when a PSIS very quickly moves superiorly, relative to the other side, at the beginning of forward flexion.
• However, it can be a positive sign for a hypomobile S.I. joint (a sacroiliac dysfunction) when, at the end of forward flexion, the PSIS rides high in comparison to the other PSIS. This implies that the innominate on the side that rides up is being dragged along by the sacrum as it counter-nutates (moves posteriorly and superiorly).

Negative Standing Flexion Test

Positive Standing Flexion Test

Standing Leg Extension Test
Testing for innominate anterior rotation problems.
Many see this as a redundant test, but it may well be wise to use it when clarification of results from either the stork test or standing flexion test is needed. Some feel that it will accurately reveal when the innominate is fixed in a posteriorly rotated position.

Have the client standing arms' distance from a wall. They should have their hands on the wall to maintain their balance during the testing. Palpate the PSISs with your thumbs. Have the client extend a leg while you sit or kneel off to one side. Ensure that your dominant eye is the eye closest to the mid-line of the client's back.

Standing Extension Test

Position client as in stork test. Landmark and follow PSISs as leg is extended.

You watch to see if the PSIS will rise; i.e., will the testing side of the pelvis anteriorly rotate. If there is no motion, or the results are not clear, have the client first flex the knee and then extend the hip (in case a hypertonic/spasming and short hamstring is preventing movement). A positive test is when the PSIS on the side of the extending leg does not rise up, which means that the innominate is held in posterior rotation.

We now have enough information to conclude whether we have impaired innominate function, and on which side. We proceed, as follows, to see if there is any accompanying sacroiliac malfunction. A negative at this point allows us to focus on the innominate and its supportive tissues as the source of the impairments. However, if we get a positive for sacroiliac impaired motion, then we will have to re-check this once the innominate has been treated. If it remains positive, and/or the innominate impairments do not resolve with treatment, then we need to fully test for sacroiliac dysfunction.

3) Palpation Exercises & Inspection Palpation Of Sacral Motion
These exercises can be used as tests to locate impaired motion between the sacrum and the innominate.

This testing is done after completing the palpation and landmarking along with the stork test so that we can see if impairment of innominate motion is accompanied by impaired S.I. joint motion. (Note, however, that the S.I. joint may be fine, but we can still have an innominate impairment.) The following are used both as palpation exercises to increase sensitivity to motion at the S.I. joint, and also as a testing procedures for confirming sacroiliac motion impairments. (Greenman) These palpations can become testing procedures only once the therapist becomes familiar with the feel of the normal motion and 'springiness' of the S.I. joints. Doing these palpations with a variety of clients is the only way to develop this sensitivity.

4-Point Test
With the client prone, place the finger pads of the thumbs over the Inferior Lateral Angles (ILAs), index finger's pads over the sacral sulcus (S1 area). Palpate the motion of the sacrum as the client breathes. As the client takes in a very deep breath, the sacral base should go posterior while ILAs go anterior. This is counter-nutation. The lumbar spine also flattens somewhat. Then, as the client forcibly exhales, the sacral base should go anterior, and ILAs go posterior: the sacrum goes into nutation, and the lumbar lordosis increases. Have the client exaggerate their breathing through 3 or 4 cycles. Now, tell the client to start breathing normally, and continue to palpate. Usually, after a few normal breaths, the client further relaxes and their breath goes quieter and more shallow. See if you can still palpate this much more subtle movement. This 4-Point test is to help confirm impairment of movement between the innominate and the sacrum.

4-Point Test Of Sacral Motion

Place thumbs on ILAs, index fingers at sacral sulcus. Have client take several deep breaths. Palpate for restriction and symmetry of motion.

Once this is practiced for a while, the therapist can begin to practice palpating the motions during the client's breathing by lightly placing the whole of their hand lightly on the client's sacrum. Place the thenar eminences of the hand on the two ILAs, with the palm of the hand over most of the body of the sacrum, and the tips of the fingers (depending on the size of the therapist's hand) extended over onto the lumbar spine. Keep the elbow bent and loose, and have the shoulder relaxed. When we feel that one side is not moving, or not moving as well as the other, then we may have impaired motion at that S.I. joint.

This advanced version of the 4-Point test (at right) is used instead of the preliminary version above once you have gained the skill of palpating the rocking of the sacrum into nutation and into counter-nutation. You can always return to the earlier version if you have difficulty palpating motion with a particular client. (Osteopaths often refer to this test as the rock test).

Palpate for restriction and asymmetry of motion.

The next two exercises also increase the therapist's palpatory and landmarking skills. Though presented here as palpatory exercises to practice, they can also be used to further investigate and, so, clarify if there is a problem with the S.I. joint. Note: The tests combined can also become a possible treatment modality for sacroiliac dysfunction. Gapping the joint can provide enough laxity so that appropriate springing of the ILAs, or of the sacral base, can move the sacrum back into neutral.

Spring Test
Spring the ILA anteriorly (i.e., push anteriorly on the ILA in a slow, rhythmic on/off manner) while palpating, first the ipsilateral and then the contralateral sulcus, for the sacral base to counter-nutate. In other words: while springing the right ILA, palpate the right sacral sulcus for movement; then palpate the left sulcus and look for movement while you continue to spring the right ILA. As you push down on the ILA, you should feel the sacral base (at the sacral sulcus) move posteriorly (or up into your palpating finger). Now, spring the left ILA and palpate the left sacral sulcus; then the right sulcus. Finding one side of the sacral base not moving implies impaired function at that S.I. joint. This more "aggressive" test can be used if the 4-Point test does not present a clear result.

Spring Test of Sacrum

Press down on ILA and palpate at both sacral sulcus areas. Change ILA and repeat.

Gapping Test
Flex the knee and internally rotate the femur while palpating for motion between the sacrum and the innominate (at S.I. joint line). You are palpating to see when the innominate begins moving away from the sacrum before being pulled along by its ligamentous and muscular ties with the innominate. This is referred to as gapping the S.I. joint. Slow, incremental motion (external rotation of hip) is needed to feel the gapping. Once found, gently rock back and forth from internal to external rotation, feeling the quality and quantity of motion available within the gap. This is the same as laxity or potential joint space available in any synovial joint.

An inability to gap the joint – to always have the sacrum move immediately along with the innominate – implies restriction of motion in that S.I. joint.

Gapping is very subtle movement. The S.I. joint will gap with very little internal rotation (5-10°). Perform the test in a slow motion. Start with the hip in external rotation (10°), slowly move to neutral, then into internal rotation. This lets you find the soft gap point easily and gently oscillate the innominate laterally away from the sacrum. This is referred to as joint mobilization, increasing the joint play or gapping within the joint.

If the client has knee problems preventing you from using the leg for internally rotating the innominate, place a pillow above the ankle and the palm of the movement hand over the greater trochanter. Push trochanter toward the table to have the femur and the innominate internally rotate.

Gapping S.I. Joint

Palpate S.I. joint line. Have hip in slight external rotation. Pull ankle toward you slowly. Stop when you feel innominate begin to move but sacrum has not yet moved.

Pelvic Challenge For Pubic Symphysis Impairments
This technique uses the adductors and abductors of the hip to provoke symptoms. It is used when the therapist does not palpate and evaluate positions of pubic rami at the pubic symphysis. Any shift in innominate positioning will have to impact on the pubic symphysis joint: even if this joint is the axis of movement, there will be rotational stress within the cartilaginous disc (often drawing the pubic rami toward each other, i.e., compressing the joint).

With the client supine, have them bend their knees. Tell them to keep their feet together but let their knees fall apart. Place your forearm between their knees, with the thenar eminences on the medial side of the knee farthest from you and your elbow on the medial side of the knee closest to you. Instruct the client to try to bring their knees back together with minimal strength, and slowly increase the effort until they are using full strength. Remind them, however, to stop if, and when, they feel any pain. Pain at the pubic symphysis area is a positive sign.

Part 1 Of Pelvic Challenge

Client tries to bring knees together, starting with minimal effort, building to full effort.

This test stresses the adductor muscles that attach to the pubic rami, and will stress the joint by gapping it. If the joint is mis-aligned or impaired, this test will usually generate pain.

Part 2 Of Pelvic Challenge

Therapist holds client's knees together as client tries to draw knees apart. Client should start with minimal effort, slowly building to full effort.

This test stresses the symphysis pubis by compressing it. This action also gaps the posterior S.I. joints; therefore, pain felt at these joints means they must be evaluated, if that has not already been done.

Interpreting Results Of Motion Testing & Palpatory Findings

Unilateral Anterior Rotation Of The Innominate
- Positive (+) stork test (notes impaired side)
- ASIS lower on impaired side, and medial[1]; PSIS higher on impaired side and lateral[2]
- Possible confirming 4-Point Test (4-PtT) for decreased (↓) S.I. joint motion[3]
- Leg will appear longer on impaired side

Unilateral Posterior Rotation Of The Innominate
- + stork test
- ASIS higher on impaired side, and lateral[4]; PSIS lower on impaired side and medial[4]
- Possible confirming 4-PtT for ↓ S.I. joint motion
- Leg will appear shorter on impaired side.

Unilateral Inflare
- Possible + stork test, or it may be inconclusive
- ASIS more medial on impaired side
- Possible confirming 4-PtT for ↓ S.I. joint motion
- Leg may present as internally rotated on impaired side, but neither significantly longer nor shorter.

Unilateral Outflare
- Possible + stork test (or it may be inconclusive)
- ASIS more lateral on impaired side
- Possible confirming 4PtT for ↓ sacroiliac joint motion
- Leg may present as externally rotated on impaired side, but neither significantly longer nor shorter.

Superior Shear Of Innominate
- + stork test
- ASIS, PSIS, pubic ramus, ischial tuberosity all higher on impaired side
- Possible confirming 4-PtT for ↓ S.I. joint motion
- Leg may present shorter on impaired side (greater trochanter higher on impaired side)

Inferior Shear Of Innominate
- + stork test
- ASIS, PSIS, ischial tuberosity all lower on impaired side
- Possible confirming 4-PtT for ↓ S.I. joint motion
- Leg may present as longer on impaired side (Greater Trochanter lower on impaired side)

Testing To Examine Strength/Length Of Muscles Around Hip & Innominates
- If we have impairments to an innominate, we must check the muscle length of the principal muscles in and around the hip and innominates to clarify the innominate dysfunctions. This is especially important, as muscle imbalance is the most common cause of impairments to innominate positioning and motion.

- **Modified Thomas Test**
Can tell about the length of several muscles around the hip by changing the way the test is done slightly and by observing several potential movements or positions that the tested leg may display.
- **Differential Muscle Tests**
Strength testing of gluteus medius and minimus (painful S.I. joint may reflexively inhibit the ipsilateral gluteus medius), gluteus maximus, tensor fascia lata, lateral rotators, especially palpating the piriformis, erector spinae, quadratus lumborum, psoas, and abdominals.
- For more on these tests, see part VI.

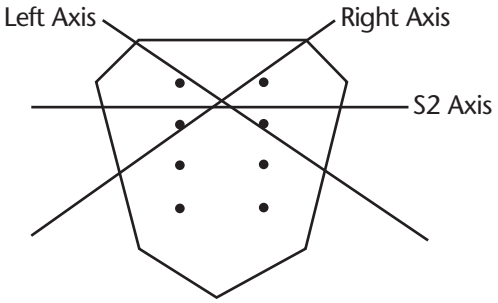
Strain To The Symphysis Pubis
Shears through the pubic symphysis can be found in a full innominate shear. At the symphysis pubis, they can also arise when an innominate rotates anteriorly. The pubic bone on that side may move inferiorly, resulting in an inferior shear. Conversely, a superior shear follows a posterior rotation of the innominate. If sustained, this can put a strain on the cartilaginous joint. Inferior and superior shears can also come from muscle imbalances, such as unilateral adductor or abdominal muscle spasms or shortness. The joint can also be gapped when the innominates are in an outflare position, unilaterally or bilaterally; or the joint can be compressed by an inflare.

1. Likely, but not necessarily, an inflare of the innominate.
2. PSIS may or may not shift laterally – does so if there is an in-flare present.
3. Remember: The function of the S.I. joint may be affected by the mal-positioning of the innominate when it is impaired. This speaks to the possible compensatory problems resulting from impaired innominate function and mis-alignment. But, the presence of an innominate impairment does not in itself mean that there necessarily is a sacroiliac dysfunction (like those discussed in Part IV).
4. Again, as with anterior rotated innominate, likely, but not necessarily so.

Part IV: Introduction To Sacral Dysfunctions

Gait: The Innominates & Sacroiliac Joints
What follows is meant to be just enough to help us to understand the dysfunctions outlined below. For a more detailed look at what is thought to be happening to the sacrum, innominates, and muscles during gait, see the Appendix at the end of this chapter. The detail in the appendix can give many valuable palpatory clues by describing and explaining:
• What muscles are contracting when we walk or run (or go into spasm);
• What positions the sacral base will be in during certain phases of the gait cycle and, hence, its position in certain dysfunctions;
• What position the lumbar spine may present in.

Oblique Axes: These are named for their superior pole. The left oblique axis runs from the left sacral sulcus (or superior joint surface of the left S.I. joint) to the right inferior joint surface (the R inferior pole above the inferior lateral angle, or ILA). The right oblique axis runs from the right sacral sulcus area to the left inferior joint surface (the L inferior pole).



These axes are in use when walking or running. During gait, the innominates rotate posteriorly when a leg goes forward into "heel strike," and anteriorly when a leg extends in "toe-off." This creates torsional forces through the sacrum. A "torsion" motion means that we are speaking about movement around an oblique axis.

Normal Physiological Motions Of The Sacrum During Gait
During gait, the normal motion is for one side of the sacral base to nutate over or around an oblique axis during heel strike while the other side (toeing off) remains basically neutral.

For example, on a right heel strike, the right sacral base nutates (nods) around an oblique axis running from the upper portion of the left joint to the lower portion of the right joint. This is accompanied by the left ILA moving posteriorly. This is to say that the right sacral base nutates as it rolls over the axis that runs from the upper left to lower right. Therefore, the anterior surface of the sacrum turns slightly to face the left. This action, and positioning of the sacrum at this point in the gait cycle, is called a Left on Left (L on L): it describes the condition of the anterior surface of the sacrum turning to face the left on a left oblique axis.

Of course, the reverse positioning occurs when the left foot is at the heel strike position. Now, it is the left sacral base that nutates around a right oblique axis that runs from the upper right to the lower left of the S.I. joint. The nutating of the left sacral base, in turn, causes the right ILA to move posteriorly. Therefore, the anterior surface of the sacrum is now described as turning to the right on a right axis. The short form for this is a Right on Right motion of the sacrum (R on R).

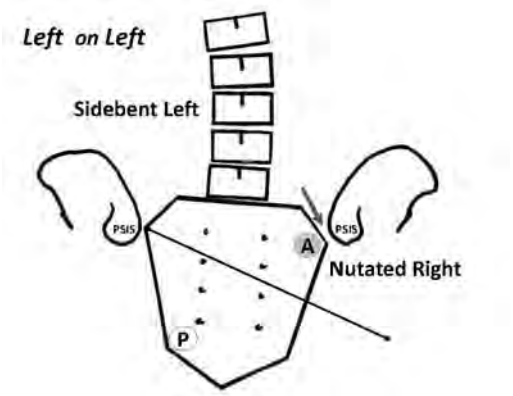
Impairments To The S.I. Joint, In Brief
The following impairments to the S.I. joint are only brief definitions and descriptions. What is given below is just enough information to allow you to proceed to testing.

Physiological Motions Where The Sacrum Can Become Fixed

For more detail on these, see this chapter's Appendix.

Impaired Nutation On Oblique Axis (Torsions)

1. Left Facing Sacrum On Left Oblique Axis (L on L Impairment)

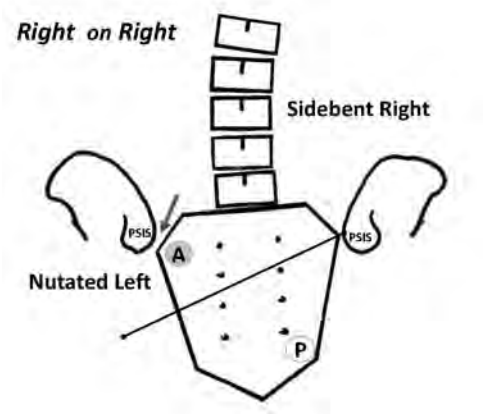


- The right sacral base is stuck forward and inferior in nutation on a left oblique axis. This leaves the ILA on the left more posterior than the one on the right.
- This leaves the anterior surface of the sacrum facing left.
- Hence, the left facing sacrum is fixed in place on a left oblique axis: an L on L dysfunction
- This is the most commonly occurring torsional impairment found.

A = anterior/deeper P = posterior/higher

Note: With everything being equal, the lumbar spine needs to sidebend toward the side of the sacral base which is higher, to compensate for the unleveling of the sacral base. Therefore, the lumbar spine and lower thoracic sidebends left, while it rotates right. An error around establishing the direction of sidebending occurs when a therapist only palpates the L5 TVPs. It would seem that L5, during an L on L, would be sidebend right as the right TVP of L5 is lower than its left. However, L5 is tilted to the right, as is the sacral base, but it is still participating in the left sidebending of the lumbar spine.

2. Right Facing Sacrum On Right Oblique Axis (R on R Impairment)



- The left sacral base is stuck forward and inferior in nutation on a right oblique axis. The right ILA is more posterior than the left.
- This leaves the anterior surface of the sacrum facing right.
- Hence, it is a R on R dysfunction
- The lumbar spine sidebends over the right axis' origin and rotates left.

Impaired Motion On Transverse Axis

3. Bilateral Nutation Dysfunction
The sacrum is 'stuck' in nutation bilaterally on a transverse axis at S2. Usually due to excessive extension of the lumbar spine. Can be found in chronically hyperlordotic clients.

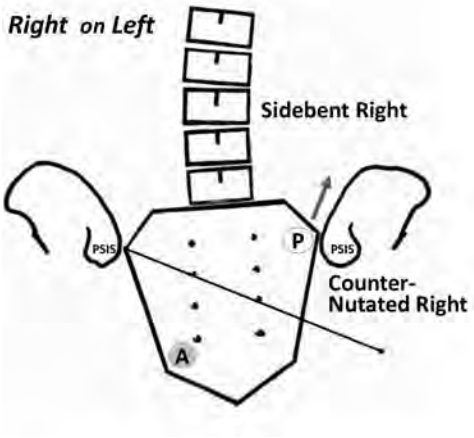
4. Bilateral Counter-Nutation Dysfunction
The sacrum is stuck in counter-nutation on a transverse axis bilaterally. Usually due to excessive flexion of the lumbar spine. Not common, but possible. A chronic flat-back could contribute to this.

Non-Physiological Motions Where Sacrum Can Become Fixed

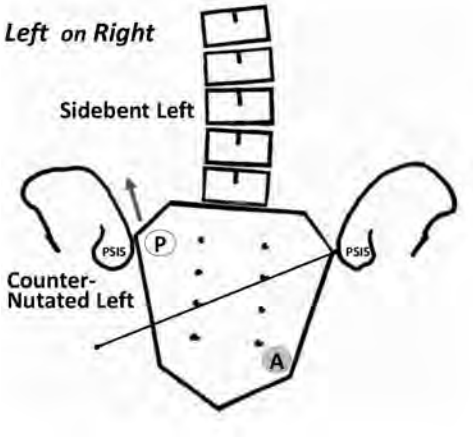
These usually occur when: a) the lumbar spine is flexed or extended, and then sidebending and rotation occurs, driving the sacrum into a position from which it cannot return, even when the client returns to an upright position; b) Mal-positioning of the innominates exacerbates the above forces, driving the sacrum from below.

Non-Physiological Impairments Occurring On Oblique Axis: Torsions
These usually occur in a lift-and-twist injury, i.e., when the spine is in flexion or extension. They can be the source of the problem when a client says, "I bent over, but could not straighten up."

Posterior Rotation (Counter-Nutation) On Oblique Axis



Right Rotation On Left Oblique Axis (R on L)
• The right sacral base comes back (and slightly superiorly) in counter-nutation while on a left axis; the sacral sulcus on the right will feel shallow compared to the left side, while the left ILA will be more anterior than the right one.
• This leaves the anterior surface of the sacrum facing right.
• Hence, the R on L designation for this dysfunction.
• The lower spine in general sidebends to the right side, over the high side of the sacral base.



Left Rotation On Right Oblique Axis (L on R)
• The left sacral base counter-nutates while on a right axis. The right ILA goes deeper/anteriorly.
• This leaves the sacrum facing left.
• Hence, we have an L on R dysfunction
• Therefore, the lumbar spine and lower thoracic sidebends left, while it rotates right.

Torsional Lesions, In General
Review all four torsional lesion diagrams. Note: 1. the axis (the superior pole for which it is named) is always on the opposite side of the lesion; 2. the piriformis that establishes the lower pole of the axis is always on the same side of the lesion, therefore, you should expect, in general, that the lesioned side's piriformis is short, tight (if chronic) and tender; 3. if there is no innominate dysfunction and the bones of the pelvis and legs are symmetrical, then the lumbar spine should be sidebent toward the higher side of the sacral tilt (in the sagittal plane). Nonetheless, never assume that this must always, and absolutely, be the case. The body is wonderful, but can work in mysterious ways!

Other Non-Physiological Impairments Of The S.I. Joints
There are non-physiological impairments that do not occur on an oblique axis, such as: shears of the S.I. joint or sidebending of the sacrum. This type of lesion can come from trauma and injuries due to forces acting on the body from without. They can also arise from lift-and-twist injuries or any injury that involves muscular exertion in and around the pelvis. They have also been referred to as a Unilaterally Flexed/Extended Sacrum, and we will use the latter names as well to avoid confusion with innominate shears and sidebending of the spine.

INSIGHTS

The following three descriptions are meant to help you see what may be happening at the S.I. joint when we have a unilaterally flexed or extended sacrum.
• Both the sacral base and the ILA on one side (unilaterally) are found to be either shifted anteriorly and inferiorly or shifted posteriorly and superiorly on the lesioned side's innominate. This has been called a shear.
• It is sometimes referred to as a sidebent sacrum. It is as if the sacrum got there by rotating around an anterior-posterior axis that is somewhere in the middle of the sacrum and around which the sacrum has been forced to move.
• Yet, it can also be imagined that the sacrum has been forcibly rotated around a vertical axis running down the middle of the sacrum. We can imagine one side of the sacrum rotating anteriorly: the sacral base moves anteriorly and inferiorly while its matching ILA is forced to move anteriorly and inferiorly as well.

Palpatory Landmarks
Unilaterally flexed or extended sacrum are not uncommon lesions to be found in the clinical setting and have the following palpatory landmarks:
• Unilaterally Flexed Sacrum: When compared with the unlesioned side, the lesioned side's sacral base is found to be anterior and inferior as if in nutation, or in other words found to be in flexion. However, the lesioned side's ILA is also found to be anterior and distinctly inferior.
• Unilaterally Extended Sacrum: When compared with the unlesioned side, the lesioned side's sacral base is found to be posterior and superior as if in counter-nutation, or, in other words, found to be in extension. However, the lesioned side's ILA is also found to be posterior and distinctly superior.
• What will help determine if we have a unilaterally flexed sacrum or a unilaterally extended sacrum is seeing which side is impaired when motion testing the S.I. joints. The test to find the lesioned side is discussed on the following page.

Translations (Dislocations) – Anterior/Posterior
These imply that the whole sacrum is pushed, either anteriorly or posteriorly. Hence, they are given the designation here of dislocation. Extreme pain and loss of mobility would be present.

CHAPTER V SACROILIAC JOINT & PELVIS

Part V: Testing For Sacral Dysfunctions

Protocol For Testing Sacroiliac Joints
- Observations
- Seated Flexion Test Of Sacroiliac Joint
- Prone Palpation
- Prone Extension Test (Sphinx Test)

Observations
Postural observations made while the client is standing are the same as those for innominate dysfunctions (see Part III). However, please note that if the sacrum is nutated (i.e., the sacral base is tipped further anteriorly), then the lumbar spine may have excessive lordosis due to an increase in the angle of the lumbosacral junction; if counter-nutated, then less lordosis could be due to a decrease in the anterior tilt of the sacrum. These changes to the lordosis of the lumbar spine can, therefore, occur even if the innominates appear to be in normal position (neither anteriorly nor posteriorly rotated). In fact, if we find hyper/hypolordosis present with no anterior/posterior rotation of the innominates, we should always investigate the orientation and function of the sacrum.

With the client seated, check for any changes in iliac crest heights and especially note any changes to asymmetries in the lumbar and shoulder area that may have been noted when the client was standing. If those asymmetries that were present in the trunk when standing disappear or change when the client sits, then we can assume that these postural deviations are from asymmetries in the lower limbs and from the asymmetrical position of the pelvis when standing. Note that the lumbopelvic girdle may compensate for lower limb asymmetries, yet it is free of serious impairments. If this is the case, the pelvic landmarks should level when the client sits.

Seated Flexion Testing Of S.I. Joint
Fixing the innominate and moving the sacrum.
The client is sitting on a stool; this fixes the innominates by the client having the weight of their trunk on their ischial tuberosities. Palpate both PSIS, and have the client bend forward to the point that their head is between their knees or as close to this as is possible for them. A positive sign for a hypomobile S.I. joint is when a PSIS will start in neutral, then, near the end of forward flexion, that PSIS will ride higher in comparison to the other PSIS. This implies that the innominate on that side that rides up is being dragged along by the sacrum as it counter-nutates and moves superiorly and posteriorly. For some therapists, the test is best done with the eyes closed, as the movement may be more perceptible with palpation than by sight – but use sight to confirm the difference between the start position and the end position.

Starting Seated Flexion Test

Palpate PSISs.

Performing & Completing Seated Flexion Test

Have client bend forward and observe symmetry of PSISs.

Again, as with the standing tests, the seated flexion test has only shown us what side is impaired, but not what the nature of that impairment is. Clarification comes with the tests that follow.

Prone Palpation
Six-Point landmarking of the sacrum. Bilaterally palpate and compare the symmetry of:
1. The depth of the sacral sulcus;
2. Whether the ILAs level with each other or whether one seem more anterior/posterior to the other;
3. Landmark the inferior borders of the ILAs. Note if one is superior/inferior to the other.

Steps 1 and 2 give information important to impairments that involve an oblique axis. Steps 1, 2 and 3 are necessary in determining the possibility of sacral shears or a unilaterally flexed/extended sacrum.

6-Point Landmarks Of Sacrum


Check symmetry of sacral sulcus.


Check symmetry of ILAs.


Check symmetry of inferior border.

These three palpations, 4-Point test, springing test and gapping test, should also be done at this time. They are the same palpations as described under innominate impairments. Pictures and descriptions of these palpations can be found in part III of this chapter.

Ask yourself as you palpate:
- Symmetry or asymmetry?
- Is the motion free?
- Is there restriction on one side?
- Is there restriction on both sides?

Prone Extension Test (Sphinx Test)
This test is meant to differentiate and ascertain if the sacrum is fixed in a nutated or counter-nutated torsion. The test works with impairments of the S.I. joint that involve an oblique axis. Once fixation is known, then joint play or other techniques can be applied after the soft tissue has been prepared.

Remember: Extension of the spine is expected to produce nutation of the sacrum! Hence, the sacral base should flex forward/nutate – go deeper during this test.

Palpate with thumbs deep to the sacral sulcus area on both sides (S1 area, just medial and superiorly to the PSIS). Note if one side feels deeper, or do they feel of equal depth. Once you have decided this, have the client extend their back and rest their chin on their elbows. Tell the client to relax their abdomen and let it sink into the table to slacken the connective tissue and musculature. Now, palpate the depth of each sulcus area and compare with your previous results.

1. Sphinx Test Landmarking

Palpate sulci depths for symmetry.

2. Landmarking Sulcus Detail

Note symmetry of depth.

3. Final Position Of Sphinx Test

Re-evaluate depths for symmetry.

If all was normal, and there is no sacroiliac lesion, you should feel that the sacral base felt of equal depth when the client was prone and both may now feel deeper but still of equal depth. This means that the sacral base has nutated bilaterally. The depth of the two sulcus remains symmetrical. In turn, the inferior lateral angles (ILAs) will have both moved posteriorly.

If the test is positive, you may note the following:
1. Asymmetry in neutral which remains or increases in hyperextension, implying a counter-nutation lesion on the shallow side.
Explanation and elaboration: If the two sacral sulci feel unequal in neutral and remain or become more unequal in hyperextension, then the side that does not go deeper is said to be stuck in a counter-nutated position. In counter-nutated or non-physiological torsions, the two sides remain unequal, both in prone and in hyperextension, and the asymmetry may even increase between the two sides. This is said to be a non-physiological lesion.
• In other words: One may find that one side feels slightly deeper when the client is laying prone (in neutral), and then that side goes even deeper (anterior) on extension. This means that side is moving and is functioning. The side that stays shallow or posterior is stuck counter-nutated, and cannot move into nutation (i.e., move deeper). In counter-nutated torsions, the two sides often become even more unequal.
Or
2. Asymmetry in neutral which is replaced by symmetry when hyperextended implies a nutation lesion, and is on the side that was originally deeper when the client was lying in neutral.
Explanation and elaboration: The side that seemed shallow in prone seems to now go deeper as the spine extends. In hyperextension, the two sulci are now equal in depth. This means the side that felt shallow while the client lay prone in neutral but which in hyperextension became as deep as the other sulcus is the side of the sacral base that has moved, and so is functional. In this situation, the two sulci have become symmetrical. The lesioned side in this case is the side that felt deep originally – it is being held in nutation. This lesioned side did not move, but was already held in nutation. This is said to be a physiological lesion because nutation is a common action for the sacral base.
• In other words: If one side had felt deeper, and after hyperextension the other side came down to its level (moved deeper), then the side that had always felt deep is held anteriorly in nutation. In forward (physiological) torsions, the two sides become equal in extension and the asymmetry disappears.
In general, we can say that, during the sphinx test, changes in depth on a side means that the side that changes is moving – it is functioning normally.
Or
3. No change noted in the prone extension test, or it is unclear. Compare palpatory findings of landmarking. You could have a lesion that does not involve an oblique angle, such as a unilaterally flexed or extended sacrum. Or, you have an iliosacral lesion but not a sacroiliac lesion. Re-test for innominate impairment and correct any impairment found. Then, re-do the seated flexion test.

Prone flat (neutral): Starting position	Prone Extended (Sphinx): Finished Position of Test	Motion	Lesion
Sulcus are level = of equal depth = Symmetrical	Both feel deeper = Symmetrical	Both sides moved = Symmetrical motion	No lesion = Normal motion
Sulcus are level = equal depth = Symmetrical	One side deeper = asymmetrical	deeper side (is the one that that moved) – created asymmetry	Side that stayed shallow in extension is counter-nutated (minor torsional lesion)
Sulcus unlevel = one side deep, one shallow = Asymmetrical	Deeper side goes deeper = More asymmetrical	Deeper side moved deeper = asymmetry increased	Shallow side counter-nutated. (moderate to severe torsional lesion)
Sulcus unlevel = one side slightly deeper than the other = Asymmetry	Both sides go deeper and become equal in depth = Become symmetrical	Both sides moved, but the shallow side moved more = asymmetrical motion	The originally deeper side is nutated. (mild torsional lesion)
Sulcus unlevel = one side deep, one shallow = Asymmetrical	Shallow side goes deep = sulci become symmetrical	Shallow side moved - creating symmetry	The originally deeper side is nutated (moderate to severe torsion)
Sulcus unlevel = one side deep, one shallow = Asymmetrical	Remains unchanged = Same asymmetry	N/A	Non-torsional lesion

Summary Of Findings For Sacral Torsions

Physiological Torsions
(L on L; R on R)
• Seated flexion test + on side of lesion
• Palpation: Sacral sulcus deep on lesioned side; contralateral ILA posterior (Inspection palpation: confirms restricted motion on side of lesion)
• Prone extension test: Lesioned side feels deeper initially, and on extension both sides become symmetrical

Some further palpatory findings that may be found with physiological torsions; with respect to the lesioned side:
• The contralateral inferior lateral angle will be moved posteriorly, making that sacrotuberous ligament taut and probably tender if the lesion is chronic.
• The ipsilateral piriformis will be tight/tender (as it holds the axis in place).
• The contralateral QL will be tight/short (as that is the side to which the lumbar spine will bend).

Non-Physiological Torsions
(L on R; R on L)
• Seated flexion test + on side of lesion
• Palpation: sacral sulcus shallow on lesioned side; contralateral ILA anterior (Inspection palpation: confirms restricted motion on side of lesion)
• Prone extension test: Lesioned side feels shallow, and on extension both sides become even more asymmetrical

Some further palpatory findings that may be found with non-physiological torsions; with respect to the lesioned side:
• The contralateral inferior lateral angle will be moved anteriorly, thus slackening the contralateral sacrotuberous ligament.
• The ipsilateral piriformis will be tight/tender (as it holds the axis in place).
• The ipsilateral QL will be tight/short (as that is the side to which the lumbar spine will bend).