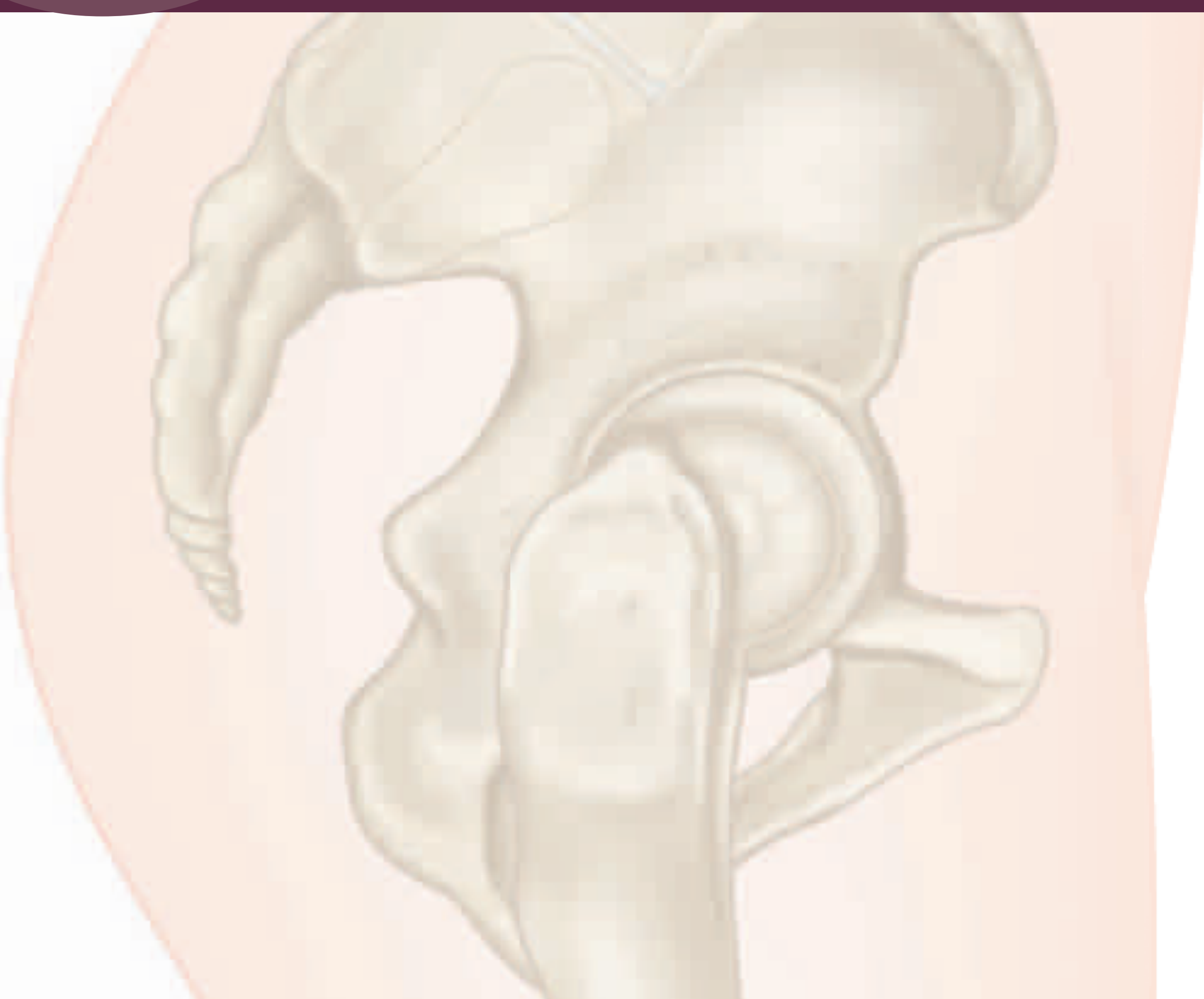
8

The Hip Joint and Its Relationship to the Pelvis



Almost every time I give a lecture on the areas of the pelvic girdle, hip, and groin, or even on the knee and ankle joint complex, I always hear myself saying the following to my students:

"If one has an underlying pathology within the complexity of the hip joint, then this will eventually become a potential site for pain and dysfunction in distant sites of the body, especially in certain areas of the pelvis and lower back, and even in the knee joint and lower limb."

After saying this I tend to remind the students of the famous words of Dr. Ida Rolf:

"Where the pain is, the problem is not."

This chapter will hopefully highlight those wise words of Dr. Rolf, which relate to not focusing our treatment where the pain is (i.e. the patient's presenting symptoms). We as physical therapists (who I call "detectives of therapy") should try to isolate the underlying cause of a patient's presenting pain and try not to simply "rub where it hurts."

I have seen a great many patients who have presented to the clinic with what has been defined or classified as the typical presentation of SIJ pain, mainly because the presenting pain is located in this particular area of the pelvis. At my sports injury and back pain clinic at the University of Oxford, I must have seen thousands of patients presenting with ongoing pain in the lumbar spine, lateral hip, groin, buttocks, adductor muscles, and hamstring muscles, as well as in the knee joint and lower limb; the underlying cause of their pain, however, is to be found in a completely different structure/tissue/source than the area of the body that suffers the pain.

Now when you read this, I don't want you to jump to any conclusions on the basis of what I have just said. I am not saying that every time your patient presents with pain somewhere in their body the primary cause of their symptoms relates to this specific chapter about the hip joint. However, occasionally it may well be that some underlying pathology located within the hip joint complex is actually the *key* to unlocking the patient's presenting symptoms. The focus of this chapter is naturally biased toward the hip joint, so the extra knowledge you will gain from reading it will potentially provide some of the answers to the questions you might have been asking yourself about your own patients, or even about some of the issues regarding your own presenting symptoms.

This chapter in itself will hopefully guide you along the right pathway. The extra information you will gain through reading it should at least assist you in providing the correct management strategy for your patients: this can be through either treating using manual therapy techniques or possibly even giving you the confidence to refer patients to a specialist for a second opinion.

The assessment processes that I will be demonstrating below will help you formulate an accurate hypothesis of what might be the underlying causative factor responsible for maintaining your patient's presenting symptoms. That is why I always like to "screen" the hip joints of almost every patient who walks through the clinic door—I personally want to make sure that there are no underlying pathological changes within this joint, especially when patients present with pain located in the areas of the pelvic girdle, lumbar spine, knee joint, and so on.

Hip Joint Anatomy

As I am sure you are aware, the hip joint (iliofemoral joint) is classified as a *synovial ball and socket joint*. This joint consists of the head of the femur articulating with the socket (acetabulum) of the pelvic girdle, which is made up of three bones—the ilium, ischium, and pubis. Because of the multiaxial motion that is possible at the hip joint, it will not come as a surprise that it is one of the most mobile joints of the body. Given its inherent architecture of a deep acetabulum (socket), however, the joint has a great deal of stability as well as mobility (Figure 8.1).

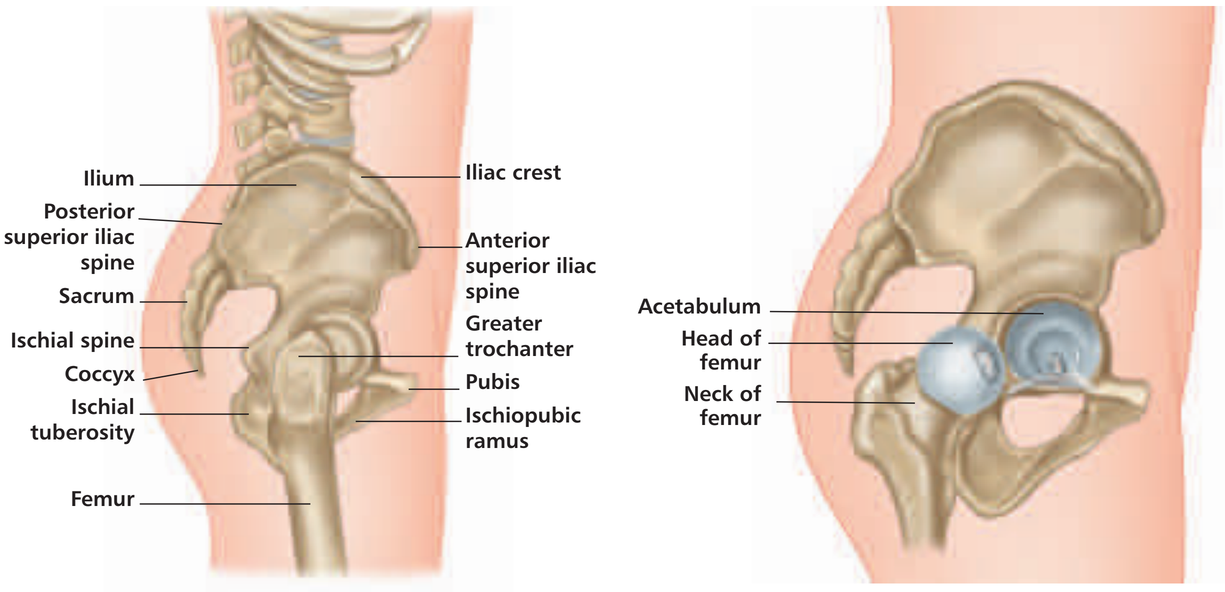


Figure 8.1. Anatomy of the hip joint (iliofemoral joint).

The motion possible at the hip joint can vary between individuals, but the normal ranges are:

- flexion: 0–130 degrees
- extension: 0–30 degrees
- internal rotation: 0–35 degrees
- external rotation: 0–45 degrees
- abduction: 0–45 degrees
- adduction: 0–25 degrees

As already explained in previous chapters, the pelvic girdle is capable of anterior and posterior rotation/tilt, while at the same time the lumbar spine is either flexing or extending. All pelvic girdle rotations/tilts/motions actually result from motion at one or more locations—the left hip, the right hip, or the lumbar spine. It is not essential for movement to occur in all three of these areas; however, motion must exist in one of them for the pelvis to rotate.

Table 8.1 highlights specific motion at the pelvic girdle and the associated motions of the lumbar spine and hip joints.

Pelvic motion/rotation	Lumbar spine motion	Right hip motion	Left hip motion
Anterior tilt	Extension	Flexion	Flexion
Posterior tilt	Flexion	Extension	Extension
Left lateral shift	Left side bending	Abduction	Adduction
Right lateral shift	Right side bending	Adduction	Abduction
Left transverse rotation	Right transverse rotation	External rotation	Internal rotation
Right transverse rotation	Left transverse rotation	Internal rotation	External rotation

Table 8.1. Pelvic, hip, and lumbar motion guidelines.

Screening the Hip Joint

With regard to screening, or assessing, the hip joint, I tend to have a few simple diagnostic tests that will either confirm or discount the presence of associated pathology within the joint:

1. Passive ROM for external rotation
2. Passive ROM for internal rotation
3. Passive ROM for flexion
4. Quadrant test
5. FABER test
6. FAIR test
7. Thomas test and modified Thomas test

These tests are simply used as guidelines in screening for any underlying pathology that might be associated with the hip joint. Remember, this book is all about the pelvis, not about the hip joint. Nevertheless, one needs to make sure that the hip joint in itself is not responsible, or even partly responsible, for dysfunction and pain in the pelvic girdle or lumbar spine regions. The tests I will be demonstrating for the hip joint are taken from my own experiences of treating thousands of patients, so much so that I have included some of my own thoughts on the way one might apply some of the tests. There are numerous other tests that can be used to screen the hip joint, but that will be the choice of the therapist at that time in their own clinic with their own patients; as I have said already, the tests I am demonstrating here have been selected on the basis of my own personal experience and preferences.

The specific passive ROM tests given in this chapter for screening the hip joints for pathology are used in particular for identifying the awareness one would feel through one's hands at the end range of the joint that is being tested; this technique is called the *joint end feel*. The end feel of a joint is basically the quality of movement that is perceived by the therapist at the very end of the available ROM. The joint end feel can reveal a great deal about the nature of various pathologies located within the joint that is being tested.

There are four common classifications of what is considered to be a "normal" joint end feel (or joint end range) and which are typically present within any synovial joint:

- Soft end feel, e.g. knee flexion
- Hard end feel, e.g. elbow extension
- Muscular end feel, e.g. hip flexion (hamstrings)
- Capsular end feel, e.g. external rotation of the shoulder joint

When you are assessing your patients/athletes, and especially when you are performing the passive ROM tests, you may experience (through your hands) a different type of joint end feel to what has already been described as a "normal end feel." In this case you can assume that there is what is called a *pathological end feel* present within the architecture of the joint; this positive test should be noted down, and further investigation, or even a referral to a specialist, might subsequently be necessary.

Please remember that patients have two legs and one should perform a comparison between the two, just to make sure that an actual pathology is indeed present. For example, if you passively take the patient's *left* hip into full flexion, with a range of at least 130 degrees being achieved with no pain or stiffness, and your patient is comfortable at the end of the available range, then one can assume that this movement is normal and no pathology is present. Suppose, on the other hand, only around 110 degrees of flexion or less can be achieved when the same movement (flexion) is performed on the *right* hip, and the end range of the joint also becomes particularly painful and/or feels restrictive to your patient (especially in the groin area); in addition, you perceive a "harder end feel" during the movement. From these findings, you can safely say that the ROM of the right hip is not normal; moreover, because of the restrictive/painful barrier, the end feel would be classified as *pathological*, meaning that the test is positive and further investigation is required.

Just a word of caution: in the past I have assessed relatively young patients who have actually demonstrated restrictions in some of the passive ROM tests for both of their hip joints; however, because the motion and the ROM are the same on both sides, we would still regard this movement as being normal in terms of ROM.

Another thing to consider when a hip joint has restricted internal/external rotation is the possibility that this is caused by a pelvic dysfunction. For instance, suppose a patient has a right anterior innominate rotation (the most common dysfunction): *internal* rotation of the *right* hip will usually be limited, compared with the left side, and *external* rotation of the *left* hip will be limited, compared with the right side. If the patient has a suspected *left* anterior innominate rotation, the opposite will be found: a *left* internal rotation restriction and a *right* external rotation restriction.

Rotational restrictions of the hip joint can occur when pelvic dysfunctions are present, even though the total passive ROM in internal/external rotation for each hip joint will be very similar. What I mean by that is the following. Take the case of a patient presenting with the most common malalignment syndrome of a right anterior innominate rotation, with a compensatory left posterior innominate rotation. Because of the pelvic malalignment, the right hip is restricted to, say, only 25 degrees (35 degrees is classified as *normal*) on testing passive internal rotation, and it has an increased range of 55 degrees (45 degrees is classified as *normal*) on testing passive external rotation; this gives a total ROM of 80 degrees. The left hip, however, demonstrates an increased range of 55 degrees for internal rotation, but a limited range of only 25 degrees for external rotation, thus also giving a total ROM of 80 degrees.

The discrepancy between the two hip joints on passive testing arises mainly because of the altered malalignment position of the right and left innominate bones, which has a direct relationship to the position of the adjacent hip joint. Because of this relationship, a change in the position of the innominate bone will have a direct effect on the position of the corresponding acetabulum (hip).

On realignment of the pelvis, one usually finds an improvement in ROM to the extent that the findings for the rotational components for both the left and right hips are normal/equal, even if the total ROM remains the same (i.e. 80 degrees in this case). Pelvic corrections can, however, be very effective in improving overall hip ROM, provided there are no underlying structural pathologies present within the hip joint (corrections for pelvic girdle dysfunctions are explained in Chapter 13).

1. Passive ROM for External Rotation

The therapist passively flexes the patient's hip and knee to 90 degrees (I call it the 90/90 position), as shown in Figure 8.2(a); one hand is placed over the knee and the other hand at the ankle. The hip joint is then passively taken into external rotation. A normal joint end feel range of 45 degrees should be achieved, as shown overleaf in Figure 8.2(b).

Figure 8.2. Passive ROM tests: (a) The left hip and knee are passively taken into 90 degrees of flexion—the 90/90 position.

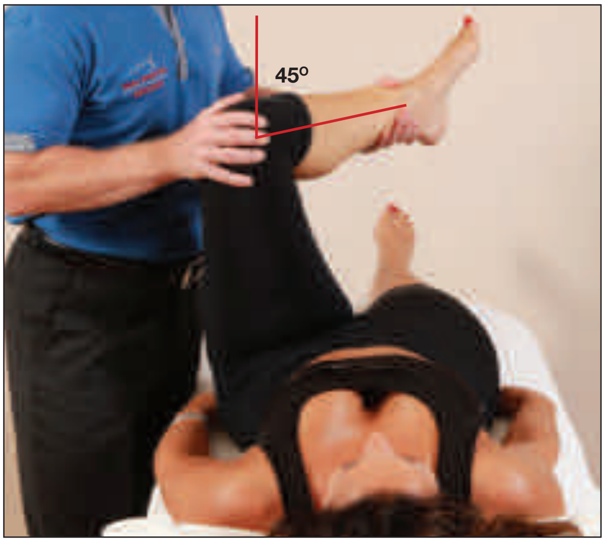


Figure 8.2. (b) The left hip is passively taken into external rotation through a normal range of 45 degrees.

2. Passive ROM for Internal Rotation

The therapist passively flexes the patient's hip and knee to 90 degrees (as above), with one hand placed over the knee and the other hand at the ankle. The hip joint is then passively taken into internal rotation. A normal joint end feel range of 35 degrees should be achieved, as shown in Figure 8.2(c).

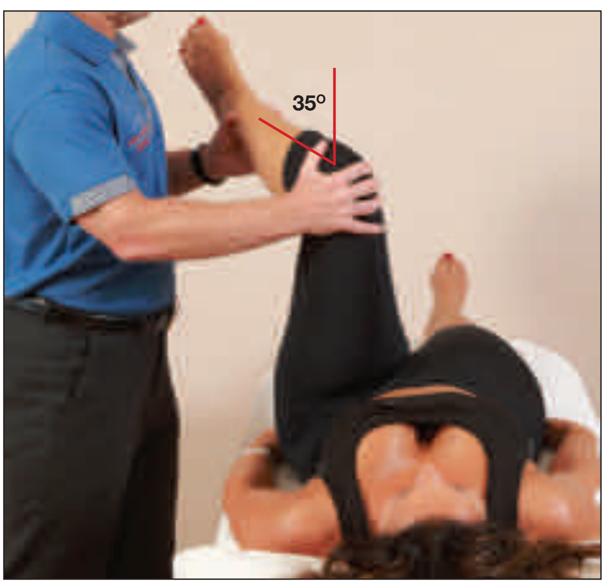


Figure 8.2. (c) The left hip is passively taken into internal rotation through a normal range of 35 degrees.

3. Passive ROM for Flexion

The hip joint is passively taken into full hip flexion. A normal joint end feel range of 130 degrees should be achieved, as shown in Figure 8.2(d).

Figure 8.2. (d) The left hip is passively taken into flexion through a normal range of 130 degrees.

Note: You can see from Figure 8.2(e) that the right leg has lifted off the couch during the movement; this potentially indicates a relative shortness of the right iliopsoas muscle. This test is also known as the Thomas test and is utilized to look for a fixed flexion deformity of the hip joint, normally caused by a tight iliopsoas.

Figure 8.2. (e) The right hip is seen to be held in flexion, indicating a short iliopsoas muscle (Thomas test).

4. Quadrant Test

The quadrant test is designed to assess the inner and outer quadrants of the hip joint. The therapist passively flexes the patient's hip to 90 degrees; one hand is placed over the knee and the other hand at the ankle. Next, the therapist applies a force longitudinally through the long axis of the femur, as shown in Figure 8.3(a). The therapist then *abducts* (with compression) the hip in order to assess the *outer* quadrant, as shown in Figure 8.3(b), and *adducts* the hip (with compression) to assess the *inner* quadrant, as shown in Figure 8.3(c).

If there were any underlying pathology located within the hip joint, this test would be positive, as indicated by the motion becoming resistant, as well as the patient perceiving some form of discomfort or even pain.

Figure 8.3. Quadrant test: (a) The left hip is compressed in neutral (90 degrees).

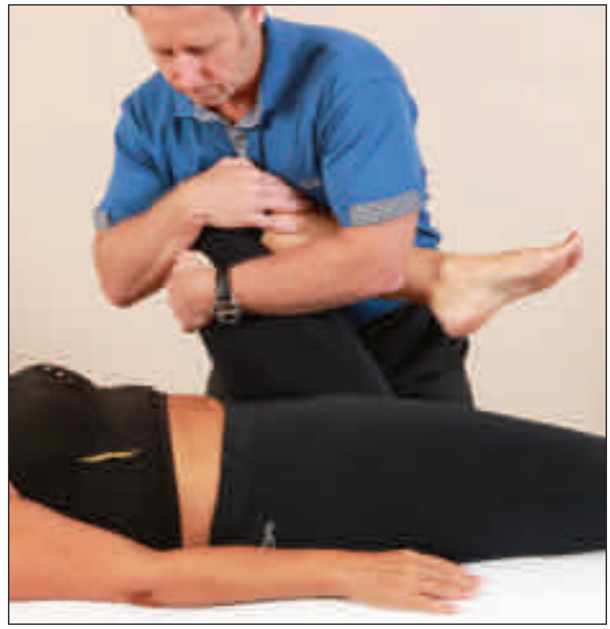


Figure 8.3. (b) The outer quadrant is tested through abducting and compressing.

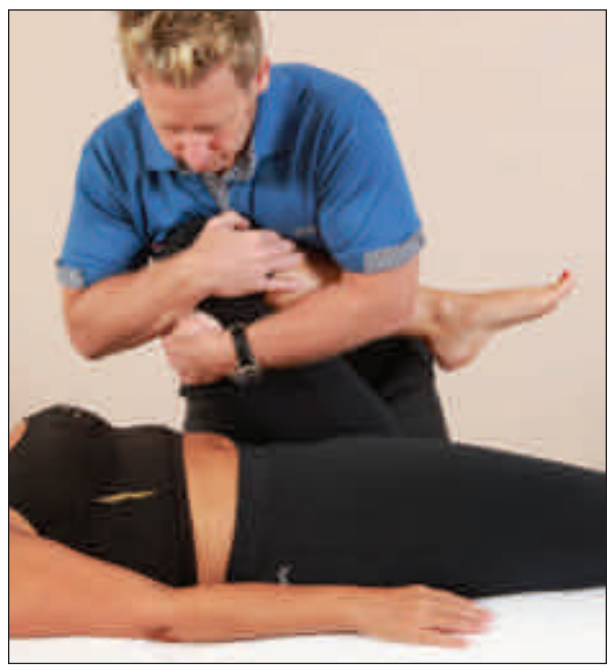


Figure 8.3. (c) The inner quadrant is tested through adducting and compressing.

5. FABER Test

The FABER test (or Patrick's test, named after Hugh Talbot Patrick) relates to the specific motion of **f**lexion, **ab**duction, and **e**xternal **r**otation.

The therapist places the patient's hip into a position of flexion, abduction, and external rotation, as shown in Figure 8.4. The presence of a restriction or pain might indicate a pathological change within the hip joint or possibly a pelvic (SIJ) dysfunction, especially if this motion is particularly painful to the SIJ. Let's look at an example. If you notice that the left side is restricted or painful (to the groin or lateral hip), while trying to simply place your patient into the FABER position of flexion, abduction, and external rotation, then this could be caused by a pathological condition within the left hip joint. Alternatively, the restriction/pain could actually be related to the right-side innominate being held in a position of anterior rotation and showing a positive FABER test on the left side; in this case a correction of the right anterior innominate (see Chapter 13) might improve the overall interpretation of the FABER test on the left side. However, if an innominate correction makes no difference whatsoever to the FABER position, one can assume that there is either an actual musculoskeletal issue present within the hip joint, or the SIJ is implicated (if there is pain in the area of the posterior part of the pelvis, near to the PSIS); both of these pathological conditions would require further investigation.

Figure 8.4. FABER test: testing the left hip.

6. FAIR Test

The FAIR test stands for **f**lexion, **a**dduction, and **i**nternal **r**otation and is commonly used to identify piriformis syndrome (this test is also known as the *FADIR test*—**f**lexion, **ad**duction, **i**nternal **r**otation). For the particular motion I will be demonstrating, however, I have modified the test to rule out any underlying pathology within the hip joint.

The patient adopts a supine position and the therapist places the patient's hip into a starting position of flexion, abduction, and external rotation, as shown in Figure 8.5(a); the therapist then continues the motion, with flexion, adduction, and internal rotation, as shown in Figure 8.5(b). If there is a restriction or pain present (normally felt within the groin area) during this test, then pathological changes within the hip joint might be indicated. However, if the patient perceives pain only to the central part of their buttocks, and not to the area of the groin, then the piriformis muscle would be implicated.

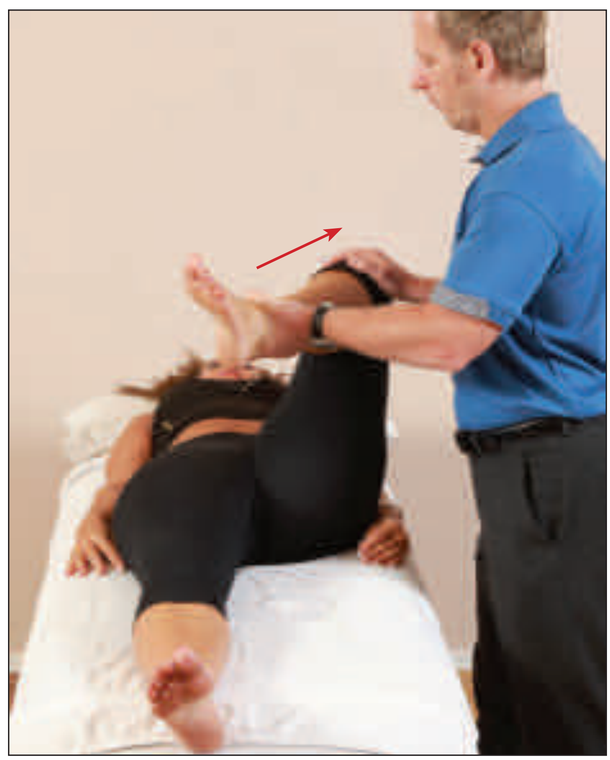


Figure 8.5. FAIR test: (a) Starting position for testing the left hip.

Figure 8.5. (b) Finishing position for testing the left hip.

7. Thomas Test and Modified Thomas Test

Thomas Test

This test is used to look for a *fixed flexion deformity* of the hip joint and the relationship to the apparent shortness of the hip flexors and in particular of the iliopsoas muscle.

The patient is asked to lie on their back on the couch and hold onto their left knee. As the patient rolls backward, they pull their left knee as far as they can toward their chest (the therapist can assist with this motion if needed), as shown in Figure 8.6(a). The full flexion of the hip encourages full posterior rotation of the innominate bone and helps to flatten the lumbar lordosis. A normal length of the iliopsoas, and a negative test, will be found where the right posterior thigh stays in actual contact with the couch, as shown in Figure 8.6(a).

Figure 8.6. Thomas test: (a) A normal length of the right iliopsoas, as indicated by the posterior part of the hip in contact with the couch.

A fixed flexion deformity, potentially caused by shortness of the right iliopsoas, is indicated if the patient's right hip has lifted off the couch, as shown by the arrow in Figure 8.6(b).

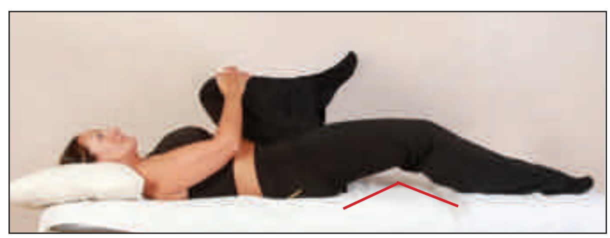


Figure 8.6. (b) The right hip is off the level of the couch, indicating a shortness of the iliopsoas.

Modified Thomas Test

You may recall that this test was demonstrated in Chapter 7 on METs; however, it is important to mention the test again, as I believe it is very relevant, especially as the specific muscles tested (iliopsoas/rectus femoris) will have a direct effect on the hip joint as well as on the pelvis.

The modified Thomas test is used to test for relative shortness of the iliopsoas, rectus femoris, adductors, and TFL/ITB. I always point out to my students that the iliopsoas muscle in particular (out of all the muscles mentioned) is always involved in one way or another in any pathological changes to the hip joint, as well as being an integral part of the functionality of the pelvis and lumbar spine.

To test the right hip, the patient is asked to lie back on the edge of a couch while holding onto their left knee. As they roll backward, the patient pulls their left knee as far as they can toward their chest, as shown in Figure 8.7(a). The full flexion of the hip encourages full posterior rotation of the innominate bone and helps to flatten the lumbar lordosis. In this position, the therapist looks at where the patient's right knee lies, relative to the right hip. The position of the knee should be just below the level of the hip; Figure 8.7(a) demonstrates a normal length of the right iliopsoas and rectus femoris.

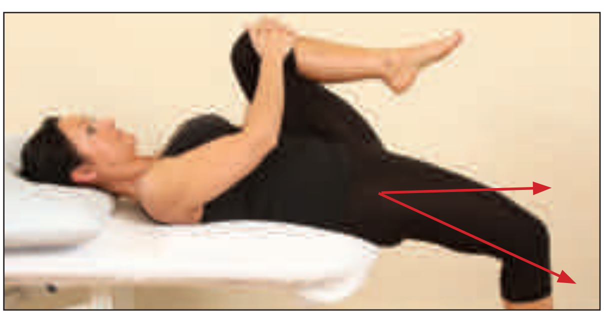


Figure 8.7. Modified Thomas test: (a) The right knee is below the level of the hip, indicating a normal length of the iliopsoas and rectus femoris.

In Figure 8.7(b) the therapist is demonstrating with their arms the position of the right hip compared with the right knee. You can see that the hip is held in a flexed position, which confirms the tightness of the right iliopsoas in this case. A tight rectus femoris muscle can also be seen, because the knee is held in extension.

Figure 8.7. (b) A tight right iliopsoas is confirmed. Because the knee is held in extension, a tight rectus femoris is also evident.

With the patient in the modified Thomas test position, the therapist can apply an abduction of the hip (Figure 8.8), and an adduction of the hip (Figure 8.9). A ROM of 10–15 degrees for each of these is commonly accepted to be normal.

If the hip is restricted in *abduction*, i.e. a bind occurs at an angle of less than 10–15 degrees, the *adductor* muscles are held in a shortened position; if the *adduction* movement is restricted, the *ITB* and the *TFL* are held in a shortened position.

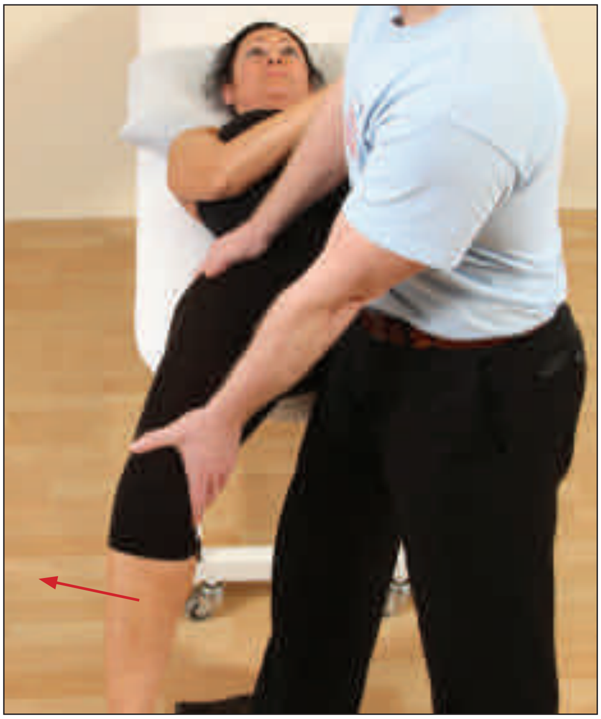


Figure 8.8. Restricted hip abduction, indicating tight adductors.

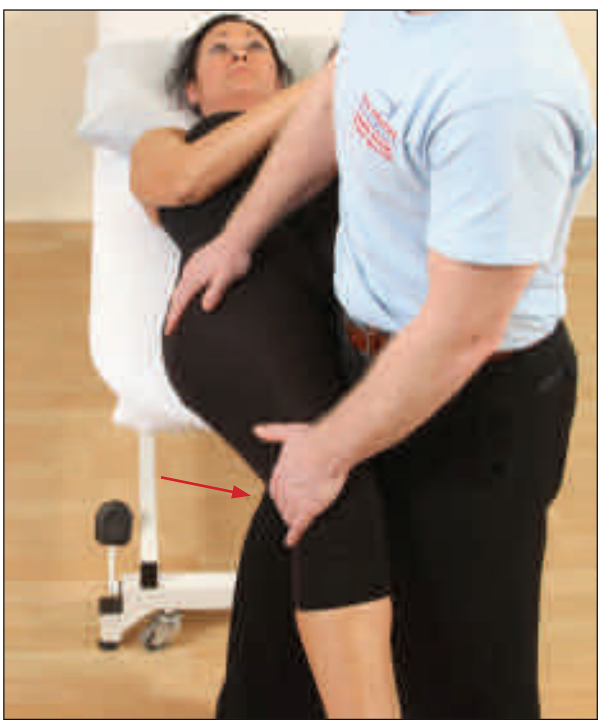


Figure 8.9. Restricted hip adduction, indicating a tight ITB/TFL.

Hip Joint Pathology

Mitchell et al. (2003) carried out a study entitled "Hip joint pathology: Clinical presentation and correlation between magnetic resonance arthrography, ultrasound, and arthroscopic findings in 25 consecutive cases." They discussed that the hip joint is becoming increasingly recognized as a source of groin pain as well as buttock and lower back pain.

In their study they found that *all* of the subjects' hips had undergone an arthroscopy at some stage, and that they had some underlying pathology; furthermore, 72% of the patients examined reported pain in the lumbar spine and also in the groin area. Some of the patients, however, presented with pain in the buttocks (36%), lateral side of knee (20%), thigh (16%), hamstring (12%), and sciatic nerve (16%), and even in the area of the abdomen (8%).

Those authors mentioned that, although back pain is a very common musculoskeletal symptom, a possible cause of the back pain seen with hip joint pathology is the close association of the psoas muscle with the anterior surface of the hip joint.

The only consistently positive clinical test result was a restricted and painful hip quadrant compared with the contralateral hip (the pain in this test could be in the groin, lateral hip, buttock, or lower back). It should be noted that a painful hip quadrant can also arise from some other local pathology (such as a psoas bursitis or tendinopathy), and that a tight hip quadrant can arise from tight gluteal muscles. A positive FABER test result was found in 88% of the subjects examined, with pain usually in the lateral hip, but occasionally in the groin or buttock. The differential diagnosis of a positive FABER test result is SIJ pathology, especially if it refers to the contralateral buttock.

The conclusion was that hip pathology, particularly acetabular labral pathology (68% diagnosed with labral tears), might be more common than had previously been thought. In those patients with chronic groin and lower back pain, especially where there is a history of an acute injury, a high index of suspicion should be maintained. Clinical signs of a painful, restricted hip quadrant and a positive FABER test result should suggest magnetic resonance

(MR) arthrography in the first instance, and the consideration of hip arthroscopy if positive.

Acetabular Labral Tear

The *acetabular labrum* is a ring of fibrocartilage that connects around the rim of the acetabulum; its main function is to help deepen the socket to assist in preventing dislocations. It is similar to the glenoid labrum located within the shoulder joint.

Some patients and athletes (mostly women) who I have seen have torn the labrum mainly through a rotatory type of sporting motion, e.g. aerobics, skiing, or hockey. However, I have also come across a lady who tore her right acetabular labrum (Figure 8.10) by forcefully trying to pull her wellington boot out of the mud when it got stuck. There are other types of injury mechanism, such as a fall; as discussed in the case study later, this trauma caused the person in question to sustain a tear of the labrum.

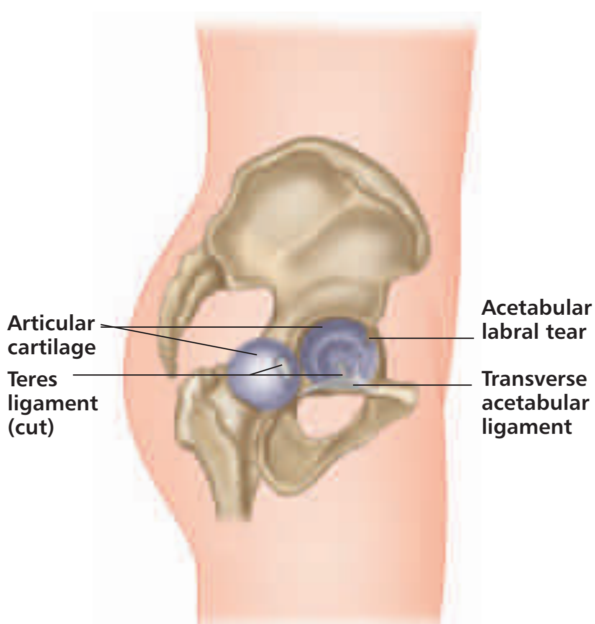


Figure 8.10. Acetabular labral tear.

Patients generally tend to have some discomfort in the area of the groin. This is not always true, however—some have pain in all sorts of places (think back to the Mitchell research article), and one would not even consider the hip joint to be the responsible structure in those cases.

It has been said that patients who have an acetabular labral tear do not get diagnosed for at least 18 months to two years; I believe the likely reason for this is that the majority of physical therapists have difficulty in confirming the tear. This must also be true of me, especially in my clinic at Oxford, as the majority of patients who I consider to be presenting with a suspect labral tear have had pain, as well as a restricted motion of the hip joint, for well over a year. What I have also noticed in the past is that most of my patients diagnosed with an acetabular labral tear are female.

I remember once discussing with a patient on the telephone the pain she was suffering around the hip and groin areas. The next bit may sound rather strange, but while I was chatting to her I asked her to lie on the floor on her back and bring her knee all the way toward her chest on her non-symptomatic side. She reported back, saying that the movement was no problem and that no pain or stiffness was felt. I then asked her to repeat the same movement on the symptomatic side; this time she said it was a struggle to perform the movement without pain, and her groin area was particularly stiff. I told her to go for an MRI scan of her hip joint, as I said it was probably a labral tear. My theory of her hip problem was correct, as she emailed me a few weeks later to tell me the news and to also say that she was being scheduled for an arthroscopy to resolve the tear.

A clicking sensation and even a locking type of feeling in the groin area are some of the symptoms that patients have mentioned to me. I strongly believe that the longer the labral tear is left (without treatment), the more the hip joint will accumulate deterioration and permanent damage, e.g. osteoarthritis, especially later on in life.

Case Study

An osteopath friend of mine asked me if I could have a look at her, as she was suffering from pain that she felt was located in the right lower part of her buttock, near to the area of the ischial tuberosity. However, she also mentioned that sometimes she would feel the pain in other areas of her body, for example to the upper part of her right hamstrings; at other times, she would feel the pain in the central aspect of her right buttock. Weirdly, on yet another day, the pain was felt in the greater trochanter of her right hip—very confusing or what?

The history was very important, as the initial injury sustained occurred well over four months previously. It happened while she was running and she fell on some ice, landing heavily on the right side of her body; she said it was a nasty fall, because at the time, she experienced a lot of pain, and there was substantial bruising around the right hip and thigh.

She rested for a week or so, but every time she went for a run she felt pain in one of the four areas that I have already mentioned. She had consulted a few practitioners during that time and received various opinions on the diagnosis. Some said the pain originated from a disc prolapse, while others said it was caused by a hamstring tendinopathy, piriformis syndrome, trochanteric and ischial bursitis, a sacrotuberous ligament sprain, and even facet joint syndrome, to name but a few conditions. She had an MRI scan of her lumbar spine and pelvis, but nothing of relevance was found.

I must admit that when I palpated the potential sites of pain, the areas of the ischial tuberosity, sacrotuberous ligament, piriformis, and trochanteric bursa were particularly tender. One might suspect any of these structures to be responsible for her pain; I even considered that the lumbar spine might be responsible, as after initially screening her hip joint, I found nothing of concern at the time of the examination.

A few weeks passed, and after a long run of approximately 10 miles (16km), the patient felt pain in her groin and started to run with a limp because of the discomfort. Her GP was a little frustrated, as the MRI of her lumbar spine and pelvis confirmed no pathology was present, so a local corticosteroid was injected into the hip joint, just to see if the symptoms would change. The pain seemed to reduce almost immediately, especially over the following few days; she was therefore scheduled for an MR arthrogram of her hip joint, and a *posterior labral tear* of the acetabulum was eventually diagnosed. The labral tear was quite substantial, so an arthroscopy was performed and the labrum repaired. The patient is now able to run with no pain in any of the areas initially reported as problematic.

This case study hopefully reinforces Dr. Ida Rolf's words regarding not treating where the pain is. If the area of the above patient's presenting pain had been treated, then without a doubt she would not have gotten any better unless she had simply rested completely from running, which in this case she definitely did not want to do.

Femoroacetabular Impingement

Another pathological problem associated with the hip joint that I have come across many times in my patients is a condition called *femoroacetabular impingement (FAI)*. This condition can also be responsible for causing a referred type of pain to various sites of the body, similarly to the presenting symptoms of an acetabular labral tear.

The words "femoroacetabular impingement" relate to an area of entrapment between the femur (thigh bone) and the acetabulum (socket). This is a condition whereby some of the soft tissues around the hip joint are being compressed (impinged), and this pathology is generally considered to be caused by abnormally shaped bones at this joint. Because of the altered shape, the femur and the acetabulum do not fit together perfectly, hence the reason why they start to rub against each other and cause damage in the joint.

With femoroacetabular impingement, bone spurs tend to develop around the femoral head (ball) and/or along the acetabulum (socket) of the hip bone. The extra bone overgrowth causes these bones to rub against each other, rather than gliding smoothly. Over time, this can result in the tearing of the labrum and the breakdown of articular cartilage, which can eventually cause degenerative changes that can later lead to osteoarthritis.

Types of FAI

There are three main types of FAI: cam, pincer, and combined cam and pincer.

1. Cam-Type FAI

Cam-type FAI is generally more frequent in men than in women. With this condition the femoral head is not as round as it naturally should be and cannot rotate smoothly inside the acetabulum. A bump forms on the edge of the femoral head that can have the appearance of a "pistol grip" (Figure 8.11). As a result of this extra growth of bone spur, increased shearing-type forces are placed on the articular cartilage and also on the acetabular labrum.

Figure 8.11. Cam-type impingement.

2. Pincer-Type FAI

A pincer-type impingement occurs more often in women than in men. In this case an extra bone growth extends out over the normal rim of the acetabulum (Figure 8.12). As a result of this pincer-type impingement, the labrum can be forcefully compressed and subsequently torn under the prominent rim of the acetabulum.

Figure 8.12. Pincer-type impingement.

3. Combined Cam-Type and Pincer-Type FAI

Combined impingement just means that both the pincer and the cam types are present simultaneously (Figure 8.13).

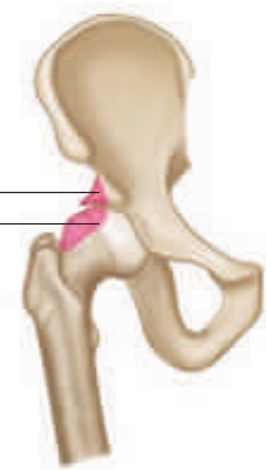
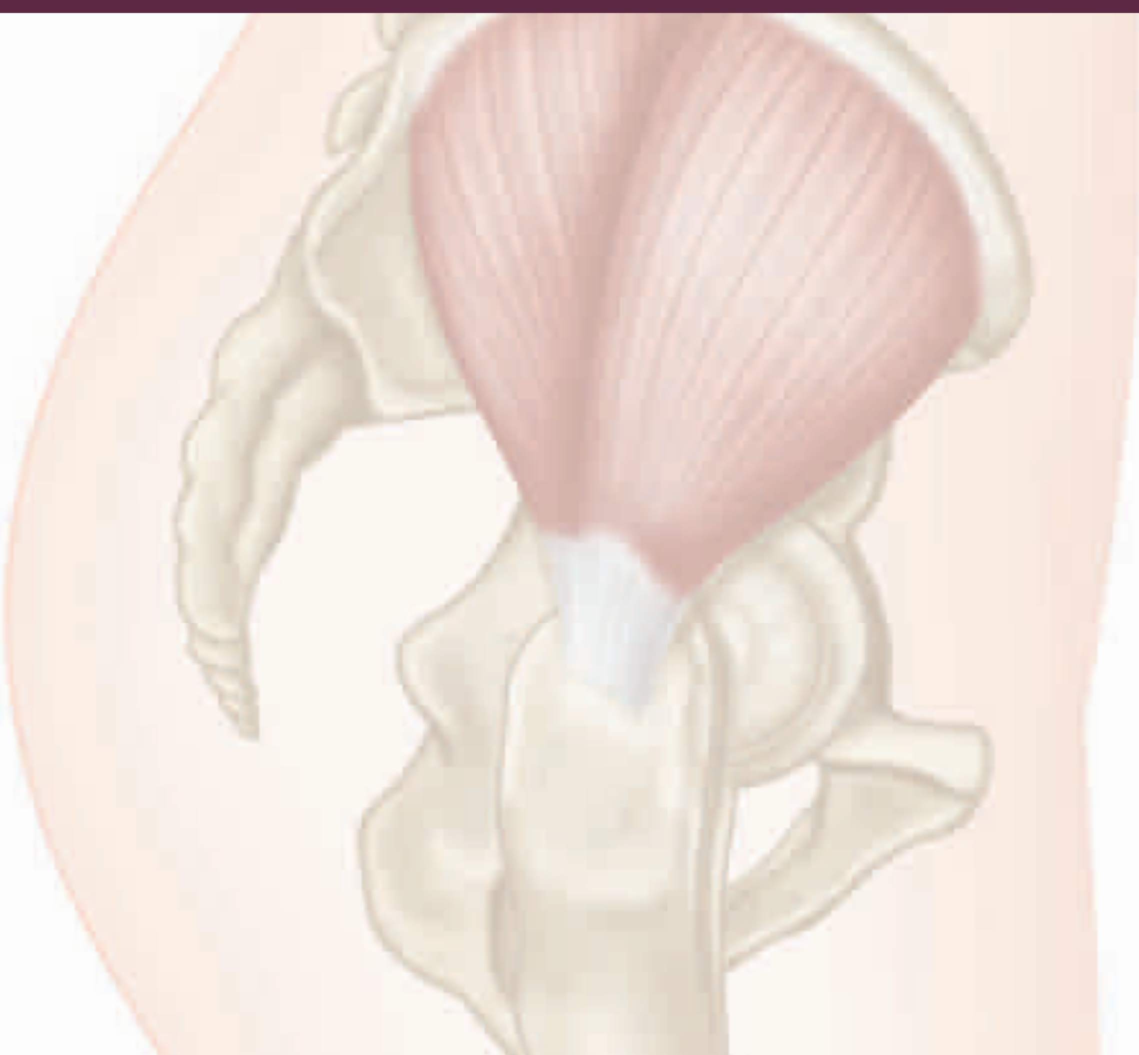


Figure 8.13. Combined cam-type and pincer-type impingement.

With femoroacetabular impingement, patients tend to have pain initially in their groin; this is normally associated with symptoms of clicking, locking, or catching, especially when chronic impingement has resulted in an acetabular labral tear. When a labral tear and FAI both exist at the same time, the presenting symptoms tend to get worse, usually with prolonged periods of standing, sitting, or walking, but particularly with pivotal movements on the affected leg. Because of the chronicity of the condition, secondary problems naturally tend to be present: for example, some patients may limp because of the pain and stiffness, and some may present a *Trendelenburg sign*. Other patients can experience ongoing pain in their buttocks, lower back, and SIJs, as well as in their thighs and knees.

9

The Gluteal Muscles and Their Relationship to the Pelvis



This book is obviously focused on the pelvic girdle and the sacroiliac joint; however, I think I ought to mention the role of the glutes in this text, as these specific muscles are a core component of the overall function and stability of the pelvic girdle.

The objectives of this chapter are to look at the specific relationship of the gluteal muscles to the area of the pelvis, and how any dysfunction that might be present within the pelvic girdle can cause a misfiring or potential weakness inhibition of the activation of the gluteal musculature.

For this chapter I will concentrate on the anatomy, function, assessment, and relationship to the pelvis of only the gluteus medius (Gmed) and gluteus maximus (Gmax) muscles.

Gluteus Medius (Gmed)

Figure 9.1. Origin, insertion, action, and nerve innervation of the Gmed.

Origin

Outer surface of the ilium, inferior to the iliac crest, between the posterior gluteal line and the anterior gluteal line.

Insertion

Oblique ridge on the lateral surface of the greater trochanter of the femur.

Action

Upper fibers: Laterally rotate and may assist in abduction of the hip joint.

Anterior fibers: Medially rotate and may assist in flexion of the hip joint.

Posterior fibers: Laterally rotate and extend the hip joint.

Nerve

Superior gluteal nerve (L4, L5, S1).

Function of the Gmed

If you think back to Chapter 4 just for a moment, you may recall that when we initiate standing on one leg, we activate what is called the *lateral sling system*; as already explained, this system consists of the Gmed, Gmin, adductors on the ipsilateral side (same side), and the QL on the contralateral side (opposite side), as shown in Figure 9.2.

Potential weakness in the Gmed probably results from the overactivation of other muscles, because of the compensation process (which will be discussed below). Patients who present with weakness in their Gmed, particularly in the posterior fibers, tend to have overactive adductor muscles and ITB through the connection with the TFL; the piriformis can also play an overactive role if the Gmed posterior fibers are shown to be weak.

The Gmed is thought of as the muscle that is *key* to dynamic pelvic stability. For example, in my experience, patients who like to run for pleasure, or even competitively, and who have poor dynamic pelvic stability because of a possible weakness of the Gmed, will tend to shorten their stride length; they will adopt a more shuffling type of pattern, thereby reducing the ground reaction force at heel contact and decreasing the amount of muscle control required for maintaining pelvic posture.

Assessment of the Gmed

Whenever I look at patients who present with knee, lower lumbar spine, or pelvic pain, part of my assessment process includes checking the strength of the gluteal muscles and in particular the Gmed. In this chapter, as well as discussing the functional roles of this muscle and the Gmax and their relationships to the pelvis, I will also include the hip abduction and hip extension firing pattern tests, which are used for determining the correct muscle firing sequences of the hip abductors/extensors (including the Gmed/Gmax muscles).

In my opinion, the Gmed (and also the Gmax) should be assessed for every single patient and athlete who presents with pain in the areas of the lumbar spine and pelvis, and even in the lower and upper limbs. Many athletes present to my clinic with running-related overuse types of injury to the lower limb as well as to the trunk, and the majority of them also present with what I consider to be poor Gmed or Gmax (or both) function. I have come to the conclusion that the strength and control of these muscles is probably the most important overall component in achieving a biomechanically efficient pattern, especially in sports like running. This is not so surprising when you consider that during running you are always either completely in the air or dynamically balanced on one leg. All physical therapist practitioners should be able

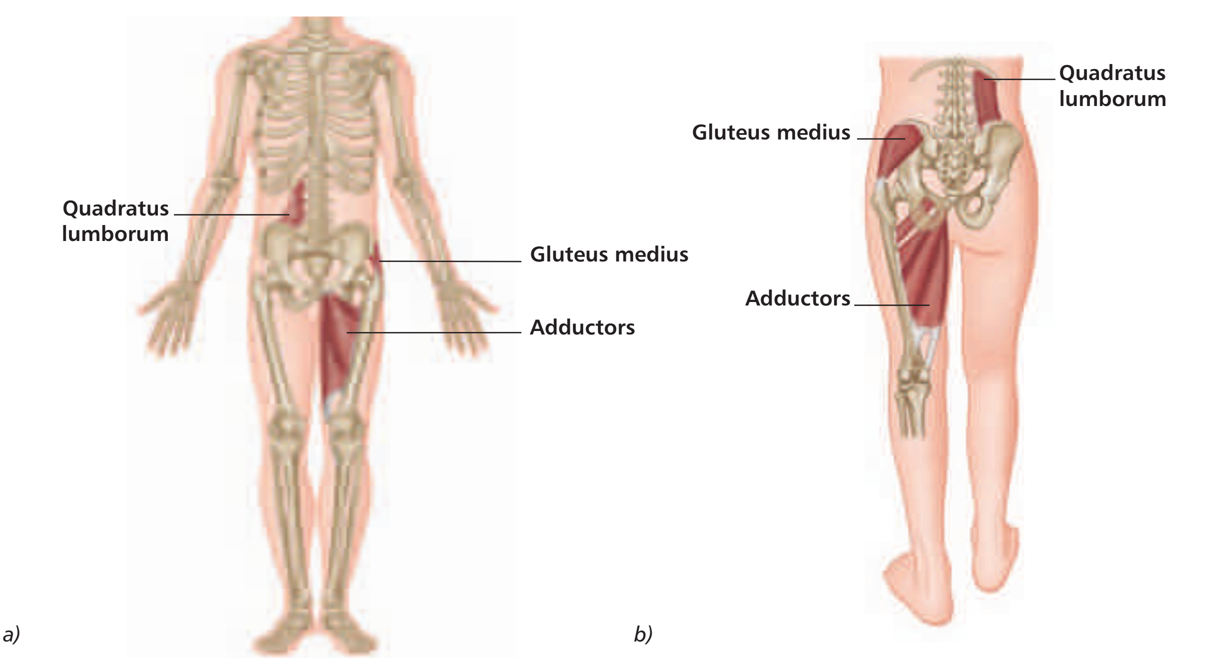


Fig 9.2. (a) Lateral sling system. (b) Lateral sling muscles activated during the gait/walking cycle.

to assess and restore the function of both the Gmed and the Gmax.

Let's take a closer look at the anatomy of the Gmed: the muscle attaches to the entire length of the iliac crest, to the external ilium between the posterior and anterior gluteal lines, to the gluteal fascia, to the posterior border of the TFL, and to the overlying ITB. The Gmed is divided into three distinct portions—anterior, middle, and posterior—which collectively form a broad conjoined tendon that wraps around, and inserts onto, the greater trochanter of the femur. The more vertical anterior and middle portions of the Gmed appear to be in a better position for abducting the hip than the more horizontal posterior portions.

As mentioned above, the Gmed contains a posterior fiber component in its structure as well as an anterior component; it is the posterior fibers that we as therapists are concerned with. The Gmed posterior fibers work in conjunction with the Gmax, and these two muscles in particular control the position of the hip into an external rotation, which helps to align the hip, knee, and lower limb as the gait cycle is initiated.

As an example, consider a patient who is asked to walk while the therapist observes the process. When the patient puts their weight on their *left* leg at the initial contact phase of the gait cycle, the Gmed is responsible in part for the stability mechanism acting on the lower limb; this will also assist in the overall alignment of the lower limb. The patient continues with the gait cycle and now enters the stance phase. Contraction of the left Gmed in this phase of the gait cycle is responsible in part for allowing abduction; think of it as a hitching type of motion to the *right* hip, even though the *left* Gmed is contracting. The right side of the hip is then seen to start to lift slightly higher than the *left* side. This process is very important, as it allows the *right* leg to lift a small distance off the floor and will naturally allow the *swing* motion of the right leg during the swing phase of the gait cycle.

If there is any weakness in the *left* Gmed, the body will respond in one of two ways during the gait cycle: either the pelvis will tip down on the contralateral side to the stance leg (*right* in this case), giving the appearance of a Trendelenburg pattern of gait (Figure 9.3(a)); or a compensatory Trendelenburg pattern will be adopted, in which the patient will be observed to shift their whole trunk excessively to the weaker hip (Figure 9.3(b)).

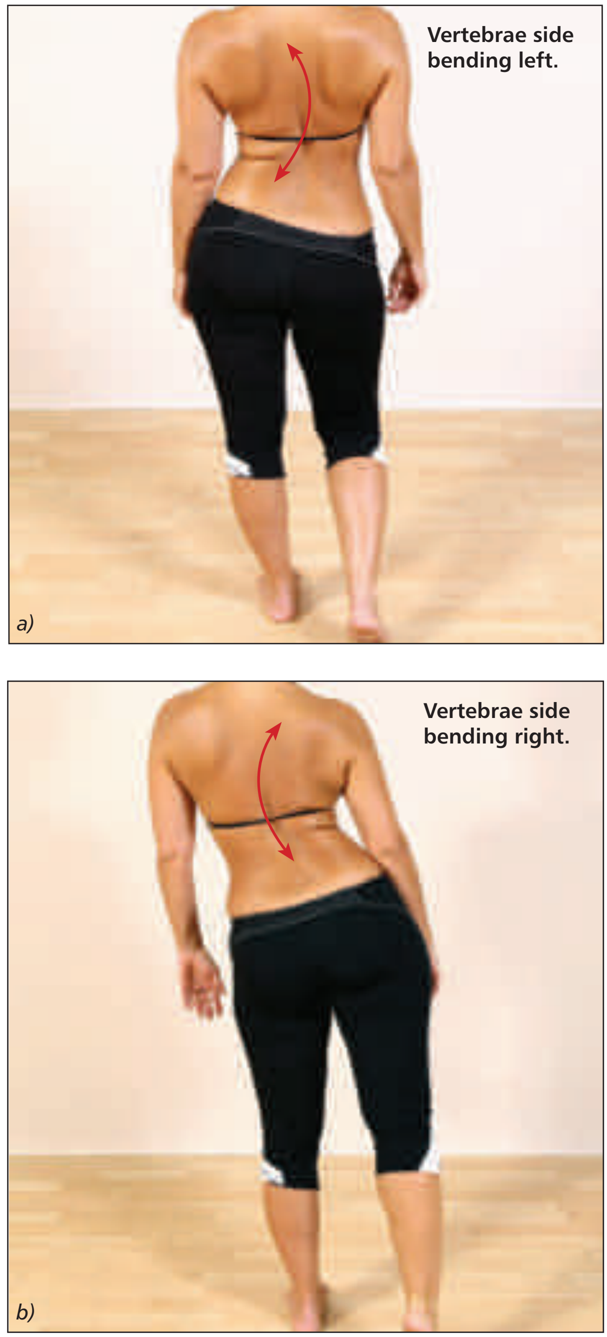


Figure 9.3. (a) Trendelenburg gait. (b) Compensatory Trendelenburg gait.

Gmed weakness will not only have implications for the overall stability of the pelvic girdle and lumbar spine, but also have an effect all the way down the kinetic chain, from heel contact to the mid-stance phase. A weakness of the Gmed can cause:

- Trendelenburg or compensatory Trendelenburg pattern of gait
- Lumbar spine pathology and sacral torsions
- Hypertonicity in the contralateral (opposite side) QL
- Hypertonicity in the ipsilateral (same side) piriformis and TFL muscles and the ITB
- Excessive adduction and internal rotation of the femur
- Drifting of the knee into a valgus or possibly varus position, causing a patella mal-tracking syndrome
- Internal rotation of the lower limb (tibia), relative to the position of the foot
- Increased weight transfer to the medial aspect of the foot
- Excessive pronation of the subtalar joint (STJ)

As you can see from the above list of consequences of a weakness in the function of the Gmed, an athlete/patient is at continual risk of any sports-related injury condition that is somehow caused by increased side bending/rotation of the lumbar spine (potentially because of Trendelenburg gait patterns), as well as by other biomechanical effects to the kinetic chain. An increased lumbar motion of side bending, coupled with rotation (normally to the opposite side), will subsequently cause the sacrum to rotate and side bend in directions opposite to the motion of the lumbar spine; as a result, a forward sacral torsion might now exist, for example a L-on-L or a R-on-R, as explained in Chapter 2.

The weakness of the Gmed can also cause prolonged over-pronation of the STJ, resulting in conditions such as patellofemoral pain syndrome, medial tibial stress syndrome (shin splints), plantar fasciitis, or Achilles tendinopathy.

Hip Abduction Firing Pattern Test

To check the firing sequence on the left side, the patient adopts a side-lying posture with both legs together and their left leg on top. In this sequence, three muscles will be tested: Gmed, TFL, and QL. The therapist palpates the QL muscle by placing their right hand lightly on the muscle. Next, to palpate the Gmed and TFL, the therapist places their finger on the TFL and their thumb on the Gmed, as shown in Figures 9.4(a) and (b).

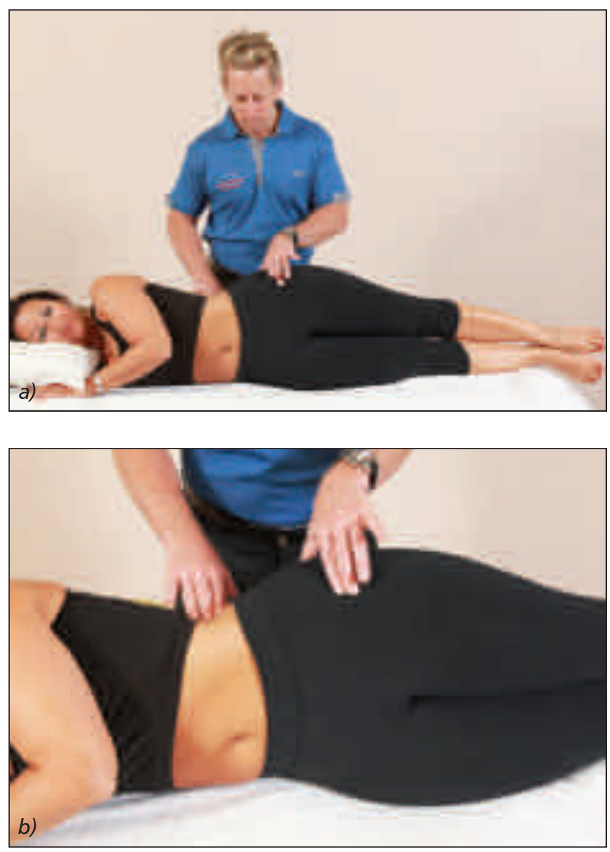


Figure 9.4. (a) Palpation of the QL, Gmed, and TFL. (b) Close-up of the hand position.

The patient is asked to lift their left leg into abduction, a few inches from their right leg, while the therapist notes the firing sequence (Figure 9.5). It is important to check for any compensatory or cheating recruitment. The idea of this test is that the patient must be able to abduct their hip without: (1) hitching the left side of their pelvis (hip hitching would mean they were activating the left QL muscle); (2) falling into an anterior pelvic tilt; or (3) allowing their pelvis to tip backward.

Figure 9.5. As the patient abducts their left hip, the therapist notes the firing sequence.

The correct firing sequence should be Gmed, followed by TFL, and finally QL at around 25 degrees of pelvis elevation. If the QL or the TFL fires first, this indicates a misfiring sequence, potentially resulting in adaptive shortness of these muscles.

Once we have ascertained the firing sequence for hip abduction, we have to decide on the next step. Most patients feel that they need to strengthen the weak Gmed muscle by going to the gym, especially if they have been told this muscle is weak, and they do lots of side-lying abduction exercises. The difficulty in strengthening the apparent weak Gmed muscle is that this particular exercise will not, I repeat *not*, strengthen the Gmed, especially if the TFL and QL are the dominant abductors. The piriformis will also get involved, as it is a weak abductor, which can cause a pelvic/sacroiliac dysfunction, further complicating the underlying issue.

So the answer is to initially postpone the strengthening of the Gmed and focus on the shortened/tight tissues of the adductors, TFL, and QL. In theory, by lengthening the tight tissues through METs as explained in Chapter 7, the lengthened and weakened tissue will become shorter and automatically regain its strength. If, after a period of time (two weeks has been recommended), the Gmed has not regained its strength, specific and functional strength exercises for this muscle can be added.

Gmed "Anterior Fibers" Strength Test

To test the anterior fibers of the left Gmed, the patient adopts a side-lying posture with their left leg uppermost. The therapist palpates the patient's Gmed with their right hand, and the patient is asked to raise their left leg into abduction, a few inches away from the right leg, and hold this position isometrically to start with. Placing their left hand near the patient's knee, the therapist applies a downward pressure to the leg. The patient is asked to resist the pressure (Figure 9.6); if they are able to do so, the anterior fibers of the Gmed are classified as *normal*.

Figure 9.6. The patient abducts their left hip against resistance from the therapist.

Gmed "Posterior Fibers" Strength Test

In testing the left side, to put more emphasis on the posterior fibers of the Gmed, the therapist controls the patient's left hip into slight extension and external rotation, as shown in Figure 9.7. The therapist applies a downward pressure as before (Figure 9.8); if the patient is able to resist this external force, the Gmed posterior fibers are classified as *normal*. If you want to assess muscular endurance as opposed to strength, ask the patient to hold the abducted leg and maintain the position for at least 30 seconds.

Figure 9.7. External rotation and slight extension of the hip, which emphasizes the posterior fibers of the Gmed.

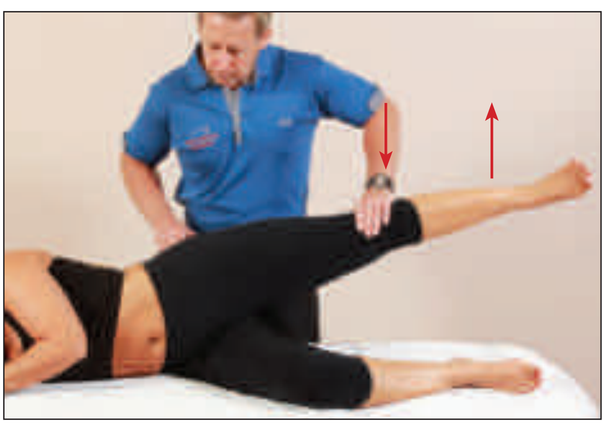


Figure 9.8. The therapist applies a downward pressure to the patient's abducted hip.

Recall, from the earlier discussion of the role of the Gmed during the gait cycle, that a weakness of the Gmed can cause either a Trendelenburg or a compensatory Trendelenburg pattern of gait. Think about this, and the possible consequences of this weakness, for a second! As you step onto your left leg, the lateral sling has to come into play: the left Gmed is the main muscle responsible for the control of the height of the right side of the pelvis as you try to stabilize on the left leg. If the Gmed muscle on the left is weak, the pelvis will dip (to the right) as you bear weight. The dipping action will typically cause the lumbar spine to side bend (to the left) and rotate to the right (Type I spinal mechanics) and the facet joints on the left side, as well as the intervertebral disc and the exiting nerve root, to compress, resulting in pain. This side bending motion to the left can also cause the iliolumbar ligament on the right side of the spine, as well as other structures such as the joint capsule of the facet joints, to be placed in a stretched position, which can also be a source of pain (local or referred).

I also mentioned sacral torsion earlier—if the left Gmed muscle is weak, then because of the side bending of the lumbar spine to the left and rotation to the right, the effect will be to cause an opposite motion to the sacrum; thus, the sacrum will side bend to the right and rotate to the left, as in a L-on-L sacral torsion.

Let's look at another example. If the left Gmed is weak, the opposite (right) side QL will compensate and work harder as it tries to take on the role of the weak muscle. This increased compensatory pattern will over time cause an adaptive shortening of the right QL, which can result in the formation of trigger points and subsequently lead to pain.

Case Study

Consider the following scenario: a patient presents to the clinic with pain located in the right lower side of their lumbar spine/superior ilium (QL area), which is exacerbated especially by walking/running for a certain length of time. After palpating the right side of the patient's lower back/QL area, the physical therapist says the muscle is tight and proceeds to release the trigger points that might have developed within. A contract/relax type of technique, such as an MET, might then be used to encourage normality of the length of the QL. The patient and therapist are very happy with the treatment, as most of the presenting symptoms have now subsided. However, as the patient walks the 10-minute journey back to their car the QL pain resumes—why? Because a weak left Gmed is forcing the right QL to work a lot harder than it has been designed to do, and the therapist has only treated the presenting symptoms and not the underlying cause! Remember the wise old words of Dr. Rolf—where the pain is, the problem is not!

Please note that any pelvic dysfunction found in your patient or athlete (as outlined in Chapter 12) can also be one of the main underlying causative factors for the presentation of a weakness/inhibition of the gluteal musculature. The malalignment position of the pelvis can be the key to the problem, as this dysfunction can naturally induce an overcompensatory mechanism in other muscles of the body. This is because the altered pelvic position can now cause a misfiring sequence in the specific activation of the gluteal muscles, rather than these muscles simply being weak and misfiring because of the antagonistic muscles being held in a shortened and tightened position.

In terms of treatment, this suggests that the gluteal muscles will not resume their normal firing sequence capability, or even develop their inherent strength, until the pelvis has been realigned. One might find that the gluteal muscles resume their normal firing sequence and regain their strength simply by realigning the position of the pelvis. After the correction of the pelvic girdle, it is recommended to lengthen the antagonistic muscles (but only if you feel it is still appropriate), before promoting strength-based exercises for these muscles.

Let's quickly recap the above. The first thing I suggest is to correct any presenting pelvic dysfunctions (Chapter 13). Next, if you still find short antagonistic muscles, I would suggest lengthening these through METs (Chapter 7). Finally, I recommend simple strength-based outer core exercises, to encourage and maintain the realigned position of the pelvis (Chapter 3).

Gluteus Maximus (Gmax)

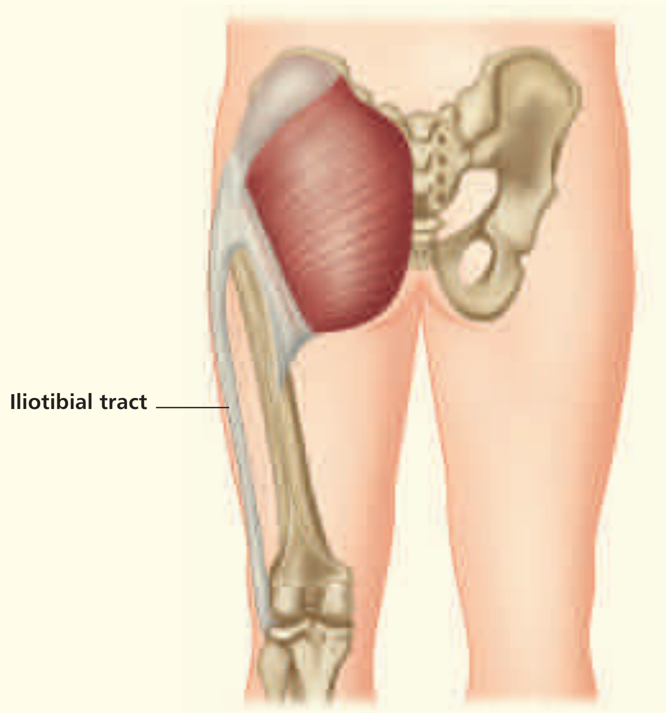


Figure 9.9. Origin, insertion, action, and nerve innervation of the Gmax.

Origin

Outer surface of the ilium behind the posterior gluteal line and a portion of the bone superior and posterior to it. Adjacent posterior surface of the sacrum and coccyx. Sacrotuberous ligament. Aponeurosis of the erector spinae.

Insertion

Deep fibers of the distal portion: Gluteal tuberosity of the femur.

Remaining fibers: Iliotibial tract of the fasciae latae.

Action

Assists in adduction of the hip joint. Through its insertion into the iliotibial tract, helps to stabilize the knee in extension.

Upper fibers: Laterally rotate and may assist in abduction of the hip joint.

Lower fibers: Extend and laterally rotate the hip joint (forceful extension, as in running or standing up from sitting). Extend the trunk.

Nerve

Inferior gluteal nerve (L5, S1, S2).

Function of the Gmax

From a functional perspective, the Gmax performs several key roles in controlling the relationship between the pelvis, trunk, and femur. This muscle is capable of abducting and laterally rotating the hip, which helps to control the alignment of the knee with the lower limb. For example, in stair climbing, the Gmax will laterally rotate and abduct the hip to keep the lower limb in optimal alignment, while at the same time the hip extends to carry the body upward onto the next step. When the Gmax is weak or misfiring, the knee can be seen to deviate medially and the pelvis can also be observed to tip laterally.

The Gmax also has a role in stabilizing the SIJs and has been described as one of the force closure muscles. Some of the Gmax fibers directly attach to the sacrotuberous ligament and the thoracolumbar fascia, which is a very strong, non-contractile connective tissue that is tensioned by the activation of muscles connecting to it. One of the connections to this fascia is the latissimus dorsi, and the Gmax forms a partnership with the contralateral (opposite) latissimus dorsi via the thoracolumbar fascia— this partnership connection is known as the *posterior oblique sling* (see Figure 9.10), which was discussed in Chapter 3. This sling increases the compression force to the SIJ during the weight-bearing single-leg stance in the gait/walking cycle.

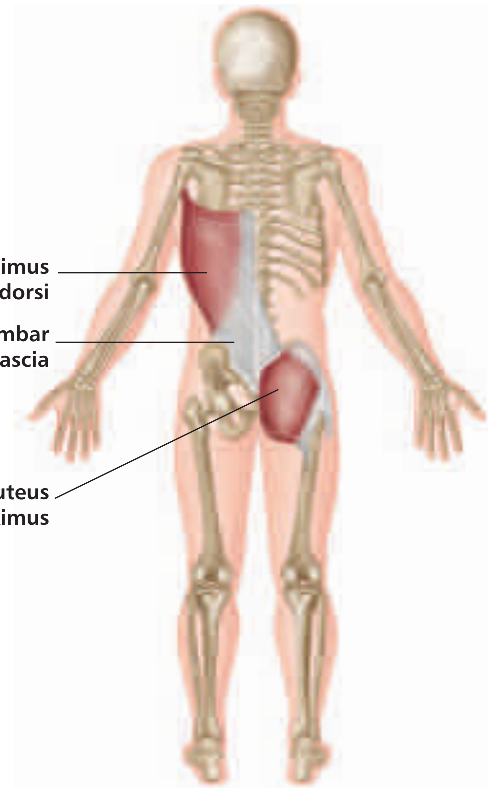


Figure 9.10. Posterior oblique sling and the connection with the latissimus dorsi.

Misfiring or weakness in the Gmax reduces the effectiveness of the posterior oblique sling; this will predispose the SIJs to subsequent injury. The body will then try to compensate for this weakness by increasing tension via the thoracolumbar fascia by in turn increasing the activation of the contralateral latissimus dorsi. As with any compensatory mechanism, "structure affects function" and "function affects structure." This means that other areas of the body are affected: for example, the shoulder mechanics are altered, since the latissimus dorsi has attachments on the humerus and scapula. If the latissimus dorsi is particularly active because of the compensation, this can be observed as one shoulder appearing lower than the other during a step-up or a lunge type of motion.

As explained in Chapter 4, the Gmax plays a significant role in the gait cycle, working in conjunction with the hamstrings. Just before heel-strike, the hamstrings will activate, which will increase the tension to the SIJs via the attachment on the sacrotuberous ligament. This connection assists in the self-locking mechanism of the SIJs for the weight-bearing cycle. The interval of the gait cycle from heel-strike to mid-stance is where the tension in the hamstrings should decrease through the natural anterior rotation of the innominate, as well as through the slackening of the sacrotuberous ligament. The activation of the Gmax now increases while that of the hamstrings decreases in order to initiate the action of hip extension. The Gmax significantly increases the stabilization of the SIJs during the early and mid-stance phases through the attachments of the posterior oblique sling.

Weakness or misfiring in the Gmax will cause the hamstrings to remain active during the gait cycle in order to maintain stability of the SIJs and the position of the pelvis. The resultant overactivation of the hamstrings will subject them to continual and abnormal strain.

As I mentioned earlier, the focus of this chapter is to look at what happens to the function of the pelvis when the glutes become weakened through inhibition; we looked at the Gmin earlier, so in this section we will concentrate on the Gmax. This phasic muscle has a tendency to follow a trait of becoming weakened if the antagonistic muscles have become short and tight or if there are any underlying pelvic malalignments. However, the Gmax can also test weak if there is a neurological disorder, such as a herniated disc (Chapter 10), affecting the L5 and S1 nerve root (which innervates the Gmax muscle). Any type of hip joint pathology—for example an acetabular labral tear (Chapter 8) or joint capsulitis—can also cause an inhibition weakness in the Gmax.

The main muscles that can potentially cause a weakness inhibition in the Gmax are the iliopsoas, rectus femoris, and adductors, as they all are classified as *hip flexors*, which are the antagonistic muscles to the hip extension action of the Gmax.

The assessment of the iliopsoas and other associated shortened antagonistic muscles using the modified Thomas test has already been discussed in Chapter 7. Once that assessment has been fully understood, you will need to normalize the tight and shortened antagonistic muscles by the use of METs. After mastering and applying these advanced techniques, the physical therapist will be able to incorporate them into their own treatment modality, with the aim of encouraging the lengthening of the tight tissues. This will then promote a normal neutral position of the pelvis and lumbar spine, and in turn hopefully have the effect of "switching" the weakened Gmax back on.

Assessment of the Gmax

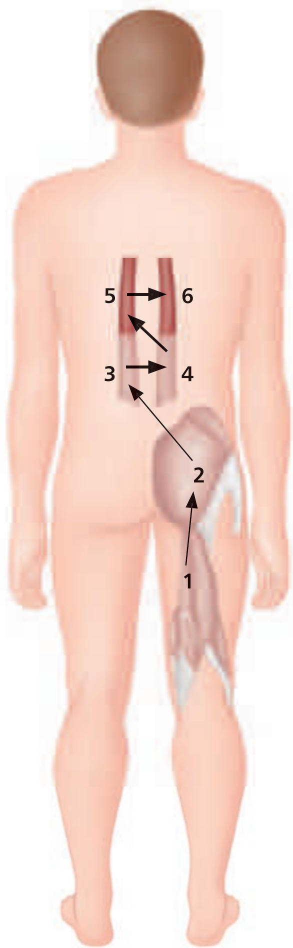
In this section I will discuss the hip extension firing pattern test, which is used for determining the correct firing order of the hip extensors (including the Gmax muscle). The aim of the test is to ascertain the actual firing sequence of a group of muscles, to ensure that all are firing correctly, just like the cylinders of an engine. A misfiring pattern will commonly be found in athletes and patients.

Figure 9.11 shows the correct firing pattern in hip joint extension. The normal muscle activation sequence is:

- Gmax
- Hamstrings
- Contralateral lumbar extensors
- Ipsilateral lumbar extensors
- Contralateral thoracolumbar extensors
- Ipsilateral thoracolumbar extensors

The hip extension firing pattern test is unique in its application. Think of yourself as a car with six cylinders in your engine: basically that is what your body is—an engine. The engine has a certain way of firing and so does your body. For example, the engine in a car will not fire its individual cylinders in the numerical order 1–2–3–4–5–6; it will fire in a predefined optimum sequence, say 1–3–5–6–4–2. If we have our car serviced and the mechanic mistakes two of the spark plug leads and puts them back incorrectly, the engine will still work but not very efficiently; moreover, it will eventually break down. Our bodies are no different: in our case, if we are particularly active but have a misfiring dysfunction, our bodies will also break down, ultimately causing us pain.

Hip Extension Firing Pattern Test



Muscle activation sequence

1.	Hamstrings	*Either group may normally activate first*
2.	Gluteus maximus	
3.	Contralateral lumbar extensors	
4.	Ipsilateral lumbar extensors	
5.	Contralateral thoracolumbar extensors	
6.	Ipsilateral thoracolumbar extensors	

Figure 9.11. Correct firing pattern in hip joint extension.

Sequence 1

The therapist places their fingertips lightly on the patient's left hamstrings and left Gmax (Figures 9.12(a) and (b)), and the patient is asked to lift their left leg 2" (5cm) off the couch (Figure 9.12(c)). The therapist tries to identify which muscle fires first and notes the result of this first sequence (Table A1.1 in Appendix 1 can be used for this).

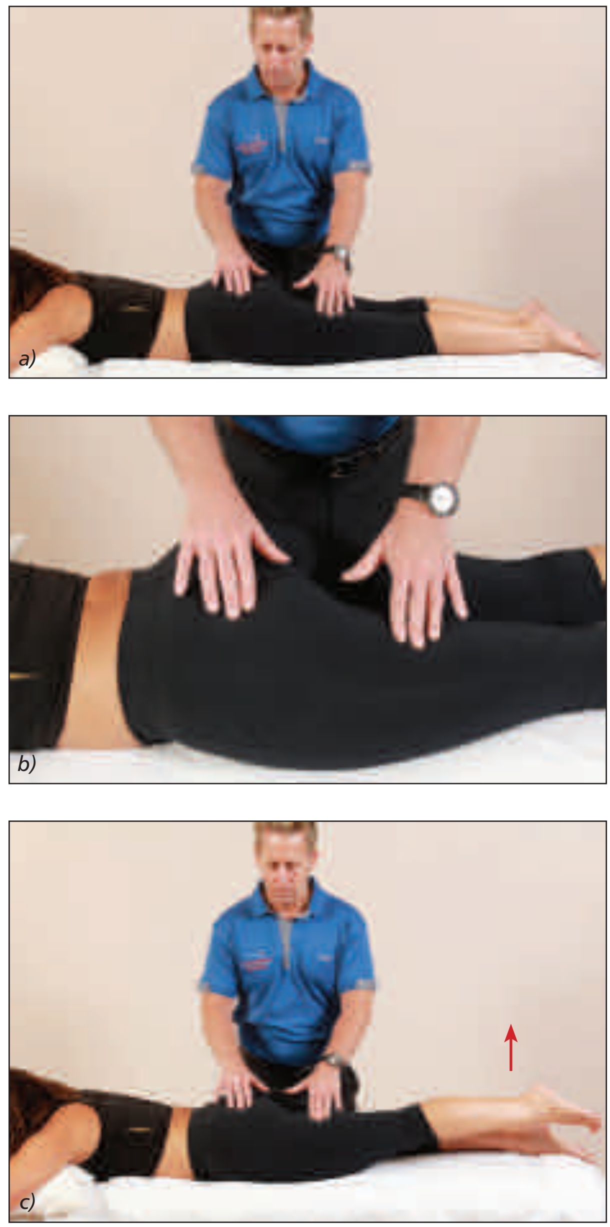


Figure 9.12. Hip extension firing pattern—sequence 1: (a) The therapist lightly palpates the patient's left hamstrings and Gmax; (b) Close-up view of the therapist's hand position; (c) The patient lifts their left leg off the couch.

Sequence 2

The therapist places their thumbs lightly on the patient's erector spinae, and the patient is asked to lift their left leg 2" off the couch (Figure 9.13(a) and (b)). The therapist identifies and notes (in Table A1.1 in Appendix 1) which erector muscle fires first.

Figure 9.13. Hip extension firing pattern—sequence 2: (a) The therapist lightly palpates the patient's erector spinae; (b) The patient lifts their left leg off the couch.

Sequences 1 and 2 are then repeated with the right leg, and the results recorded (in Table A1.2 in Appendix 1). Having done this, the therapist can determine whether or not the muscles are firing correctly. The firing pattern should be: (1) Gmax, (2) hamstrings, (3) contralateral erector spinae, and (4) ipsilateral erector spinae.

If, when palpating in sequence 1, the Gmax is found to fire first, you can safely say that this is correct. The same applies in sequence 2: if the contralateral erector spinae contracts first, this is also the correct sequence.

	1st	**2nd**	**3rd**	**4th**
Gluteus maximus	○	○	○	○
Hamstrings	○	○	○	○
Contralateral erector spinae	○	○	○	○
Ipsilateral erector spinae	○	○	○	○

Table 9.1: Hip extension firing pattern—left side.

	1st	**2nd**	**3rd**	**4th**
Gluteus maximus	○	○	○	○
Hamstrings	○	○	○	○
Contralateral erector spinae	○	○	○	○
Ipsilateral erector spinae	○	○	○	○

Table 9.2: Hip extension firing pattern—right side.

However, if you feel that the hamstrings are number 1 in the sequence, or that the ipsilateral erector spinae is number 1 and the Gmax is not felt to contract, you can deduce that this is a misfiring pattern. If the misfiring dysfunction is not corrected, the body (like the engine) will start to break down and a compensatory pattern of dysfunction will be created.

In my experience, I have found that in a lot of patients, the hamstrings and the ipsilateral erector spinae are typically first to contract and the Gmax is fourth in the sequence. In these cases the erector spinae and the hamstrings will become the dominant muscles in assisting the hip in an extension movement. This can cause excessive anterior tilting of the pelvis, with a resultant hyperlordosis, which can lead to inflammation of the lower lumbar facet joints.

> **Note:** The firing patterns of muscles 5 and 6 have not been discussed in this chapter, because we need to make sure that the correct firing order of muscles 1–4 is established. I also find that when the muscle 1–4 firing sequence has been corrected, the firing pattern of muscles 5 and 6 is generally self-correcting and tends to follow the normal firing pattern sequence.

Another factor that can affect firing order is a previous injury. Bullock-Saxton et al. (1994) investigated the timing of the posterior trunk and leg muscles during hip extension firing, and the influence of a previous ankle sprain on the firing order. Those authors found a significant difference in the onset of Gmax activity (delayed onset) in the group with ankle sprain history compared with the control group.

Gait Cycle Continued

A weak or misfiring Gmax might lead to the creation of several compensatory patterns. First of all, let's look at the case where a patient has a weak Gmax, potentially caused by weakness inhibition, commonly known as *reciprocal inhibition (RI)*, through the antagonistic tightness of the iliopsoas, rectus femoris, and adductors. This soft tissue tightness of the anterior muscles will limit the amount of extension of the hip joint during the gait cycle. As compensatory reactions the innominate bone will be forced to rotate more into an anterior position, and the contralateral innominate will be forced to rotate further into a posterior position. The hamstrings, and in particular the biceps femoris, will be part of the compensation pattern by assisting the increased anterior rotation of the innominate as a result of the weakness of the Gmax. Sahrman (2002) suggested that if the hamstrings are dominant because of inhibition of the Gmax, an anterior shear of the trochanter could be palpated during the prone leg extension.

This now gets a little complex (but has already been explained in previous chapters), as the bit in between the two innominate bones, i.e. the sacrum, will now have to rotate and side bend a bit more than normal because of the increased innominate rotation. The sacrum will now have to compensate by increasing its torsion (rotate one way and side bend the other) in one direction; this will be either a L-on-L sacral torsion (left rotation on the left oblique axis), as shown in Figure 9.14(a), or a R-on-R sacral torsion (right rotation on the right oblique axis), as shown in Figure 9.14(b). The lumbar spine will also have to compensate by potentially counter-rotating a bit more in the opposite direction to the sacrum, as shown in the two Figures.

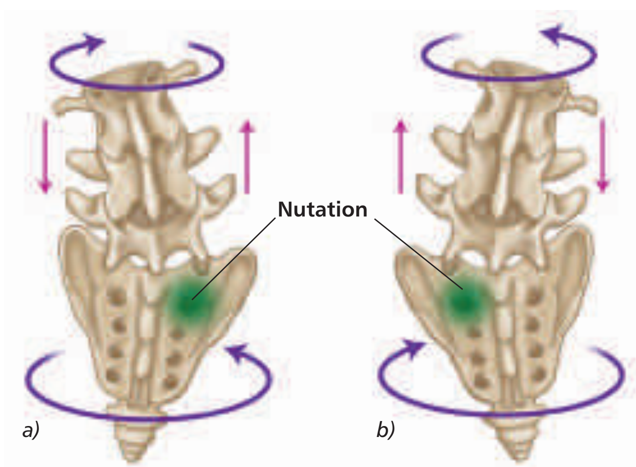


Figure 9.14. Sacral torsion: (a) L-on-L; (b) R-on-R.

There is a natural rotation of the sacral and lumbar spines during the gait cycle; however, because of the increased innominate rotation, the sacrum and lumbar spines have no choice but to compensate as well. In between the lumbar spine and the sacrum (L5 and S1) there lies an intervertebral disc (Chapter 10); imagine now this disc being "torqued" between the two spinal segments. This action will have a negative effect on the disc—it is like squeezing water out of a sponge, and discs do not like that type of increased motion!

One way of potentially correcting the misfiring sequence is as follows. Through muscle length testing (modified Thomas test), we need to first determine which muscles are actually held in a shortened position; METs (Chapter 7) and specific myofascial release techniques (see Gibbons (2014) for demonstrations of these) can then be used to treat and normalize these shortened and tight tissues.

Remember what I talked about earlier: any underlying malalignment position of the pelvic girdle can be another causative factor in the weakness inhibition of the Gmax. Bear that in mind, especially when trying to correct the misfiring sequence.

Thoracolumbar Fascia and Its Relationship to the Gmax and Pelvis

The thoracolumbar fascia is a thick, strong sheet of a ligamentous type of connective tissue, which connects with, and covers, the muscles of the trunk, hips, and shoulders. The normal function of the Gmax will be to exert a pulling action on the fascia, thereby tensing its lower end, as shown in Figure 9.15; you can see from the diagram that there is a connection between the Gmax and the contralateral latissimus dorsi muscle by means of the posterior layer of the thoracolumbar fascia. Both of these muscles conduct the forces contralaterally (i.e. to the opposite side) during the gait cycle (via the posterior oblique sling), which then causes increased tension through the thoracolumbar fascia. This function is very important for rotation of the trunk and for force closure stabilization of the lower lumbar spine and the SIJ.

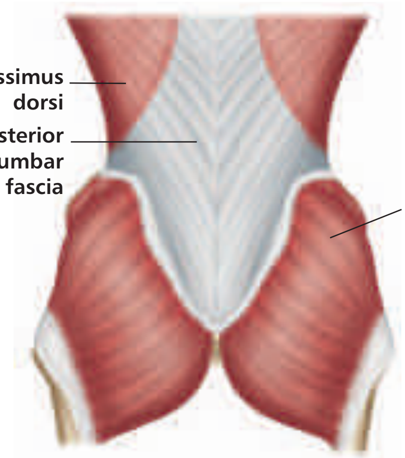


Figure 9.15. The thoracolumbar fascia and the connection to the Gmax.

There is also a co-contraction of the deeper muscles of lumbar stability—i.e. the TVA and the multifidus. These muscles co-contract when you move a limb and were discussed in Chapter 3. As far as I am aware, there has been nothing published recently about the TVA and multifidus being specifically triggered by engagement of the Gmax. However, I personally believe that the TVA muscle definitely responds to Gmax contraction, and I suspect that the multifidus does too, as they all have an association with the sacrotuberous ligament of the pelvis (either directly or indirectly), which assists in force closure of the SIJ.

Case Study

This case study, I hope, emphasizes that the relationship of the glutes to the SIJ is the key link in the patient's presenting symptoms.

The patient was a 34-year-old woman and a physical trainer for the Royal Air Force. She presented to the clinic with pain near the superior aspect of her left scapula (Figure 9.16). The pain would come on four miles (6.5km) into a run, forcing her to stop because it was so intense. The discomfort would then subside, but quickly return if she attempted to start running again. Running was the only activity that caused the pain. Her complaint had been ongoing for eight months, had worsened over the past three, and was starting to affect her work. There was no previous history or related trauma to trigger the complaint.

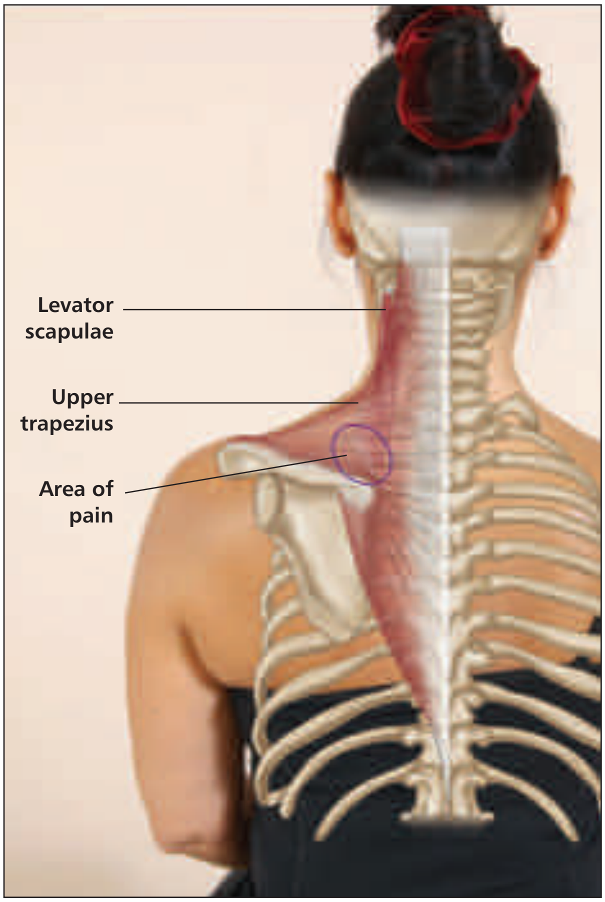


Figure 9.16. Diagram of the patient's painful area—left superior scapula.

After seeing different practitioners, who all focused their treatment on the upper trapezius, she visited an osteopath who treated her cervical spine and rib area. The treatments she had received were biased toward the application of soft tissue techniques to the affected area, namely the trapezius, levator scapulae, sternocleidomastoid (SCM), scalenes, and so on. The osteopath had also used manipulative techniques on the facet joints of her cervical spine—C4/5 and C5/6. METs and trigger point releases were used in a localized area, which offered relief at the time but made no difference when she attempted to run more than four miles. She had not undergone any scans (e.g. MRI or X-ray).

Taking a Holistic Approach

Let's now assess the case study patient globally rather than locally, remembering that the pain only comes on after running four miles.

When I see a new patient for the first time, no matter what the presenting pain is, I normally assess the pelvis for position and movement, as I consider this area of the body in particular to be the "foundation" for everything that connects to it. I often find in the clinic that when I correct a dysfunctional pelvis, my client's presenting symptoms tend to settle down. However, when I assessed this particular patient, I found her pelvis was level and moving correctly.

I then went on to test the firing patterns of the Gmax (explained earlier), which I often do with patients and athletes who participate in regular sporting activities. However, I only test the firing pattern sequence once I feel that the pelvis is in its correct position; the logic here is that you often get a positive result of the muscle misfiring when the pelvis is slightly out of position.

With the patient in question, I found a bilateral weakness/misfiring of the Gmax, but the firing on the right side seemed a bit slower than on her left side. As I had not found any dysfunction in the pelvis, I pursued this line of approach a little further.

Before we continue I would like to put a few questions to you to think about:

- How does a weakness of the Gmax on the right side cause pain in the left trapezius?
- Is there a link between the Gmax and the trapezius, and if so, how is this possible?
- What can be done to correct the issue?
- What has happened to cause it in the first place?

Gmax Function

Remember from earlier, the Gmax operates mainly as a powerful hip extensor and a lateral rotator, but it also plays a part in stabilizing the SIJ by helping it to force close while going through the gait cycle. Some of the Gmax muscular fibers attach to the sacrotuberous ligament, which runs from the sacrum to the ischial tuberosity, and this ligament has been termed the *key ligament* in helping to stabilize the SIJ.

Linking it All Together

So what do we know? We know that the right side of the patient's Gmax is slightly slower in terms of its firing pattern and that this muscle plays a role in the force closure process of the SIJ. This tells us that if the Gmax cannot perform this function of stabilizing the SIJ, then something else will assist in stabilizing the joint. The left latissimus dorsi is the synergist that helps stabilize the right Gmax (Figure 9.10) and, more importantly, the SIJ. As the patient participates in running, every time her right leg contacts the ground and goes through the gait cycle, the left latissimus dorsi is over-contracting. This causes the left scapula to depress, and the muscles that resist the downward depressive pull will be the upper trapezius and the levator scapulae. Subsequently, these muscles start to fatigue; for the patient in question, this occurs at approximately four miles, at which point she feels pain in her left superior scapula.

Treatment

You might think the easy way to treat the weakness in the Gmax is to simply prescribe strength-based exercises. However, in practice this is not always the correct solution, as sometimes the tighter antagonistic muscle is responsible for the apparent weakness. The muscle in this case is the iliopsoas (hip flexor), and its shortening can result in a weakness inhibition of the Gmax. My answer to this puzzle was to lengthen the patient's right iliopsoas muscle (Chapter 7) to see if it promoted the firing activation of the Gmax, while at the same time introducing simple strength exercises for the Gmax.

Prognosis

I advised the patient to abstain from running and to get her partner to assist in lengthening the iliopsoas, rectus femoris, and adductors using METs (Chapter 7) twice a day. Strength and stability exercises for the outer core muscles (Chapter 3) were also advised once daily until the follow-on treatment. I reassessed her 10 days later and found the firing sequence of the Gmax to be normal in the hip extension firing pattern test, and a reduction in the tightness of the associated iliopsoas, rectus femoris, and adductors. Because of these encouraging results, I advised her to run as far as felt comfortable. I was not sure if my treatment was going to correct the problem, but she reported that she had no pain during or after a six-mile (10km) run. The patient is still pain free and continues to regularly use the strengthening exercises for the Gmax and the lengthening techniques for the short/tight muscles.

Conclusion

This case study demonstrates that very often the underlying cause of a condition or problem may not be local to where the symptoms/pain presents, which means that all avenues need to be fully considered.

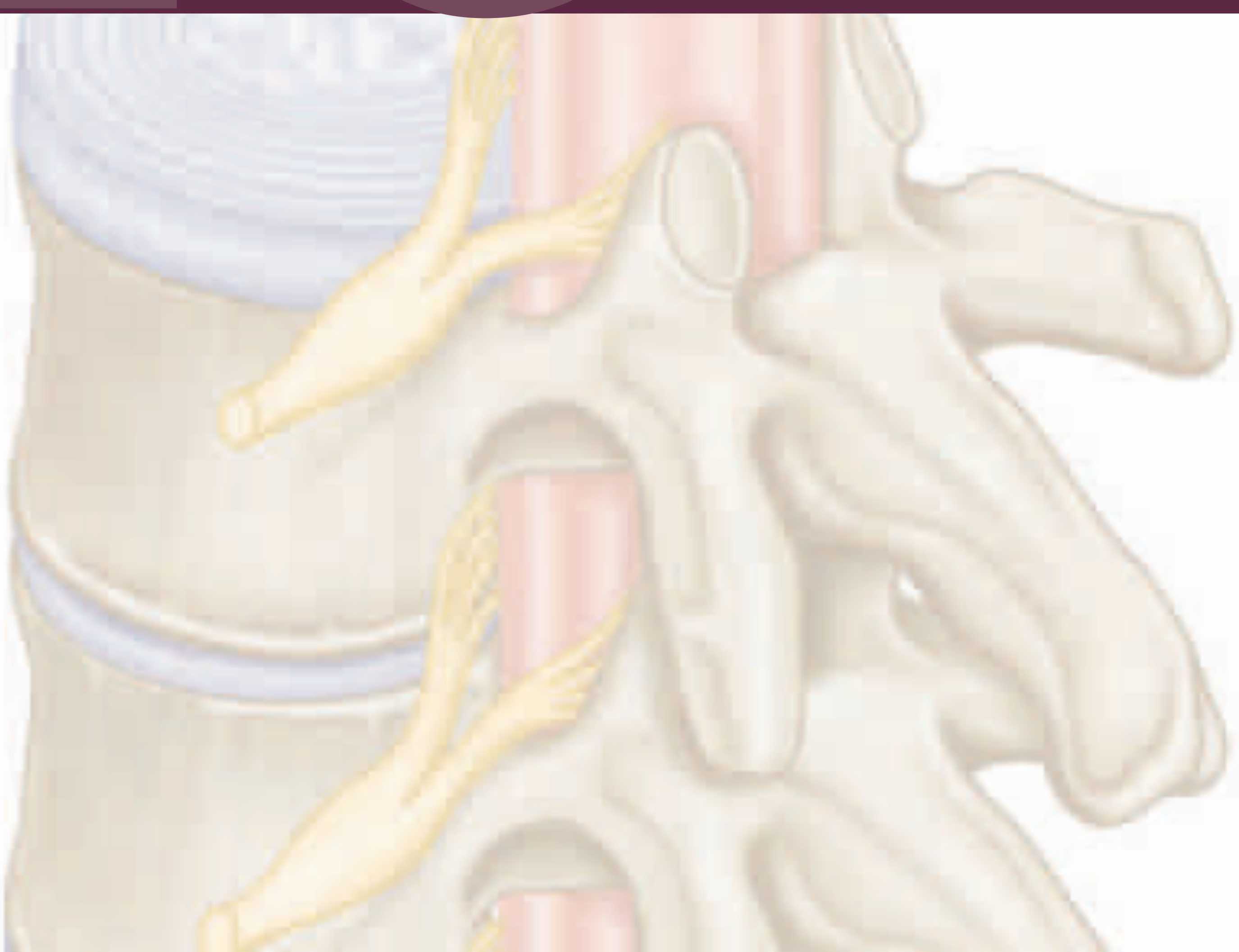
I hope that the information from this case study has intrigued you enough to continue reading. I would like to think that when you next assess and treat one of your patients, you will look at them in a slightly different way to what you normally would.

I think of this book (and all the books I have written) as taking you on what I call a *jigsaw puzzle journey*—if you stick with it, the picture will eventually become a lot clearer.

After reading this chapter and the above case study, you should have a better understanding of the situation that if the glutes are weak or misfiring, their function (the Gmax's in particular) of tensing the thoracolumbar fascia is reduced, which will cause a natural overactivation of the contralateral latissimus and the ipsilateral multifidus. A weakness inhibition of the Gmax and Gmed will over-stimulate other compensatory mechanisms throughout the whole of the kinetic chain, all of which will naturally in some way or other have an effect on the functionality and stability of the pelvis.

10

The Lumbar Spine and Its Relationship to the Pelvis



The aim of this chapter is to give the reader an insight into some of the skeletal pathologies that can manifest in the lumbar spine, as well as the potential underlying causes. Let me give you an example: a patient presents to your clinic with localized pain in the muscles of the lumbar erector spinae. On examination you find that the right innominate bone is fixed in an anteriorly rotated position (the most common), which could be caused by an overactivation and subsequent shortness of the right iliopsoas and rectus femoris muscles (as demonstrated in Chapter 7 by the modified Thomas test). The origin of the rectus femoris muscle is on the AIIS of the ilium; because of this attachment, the muscle can naturally "pull" the innominate bone in an anterior and inferior direction. This fixed anterior position of the innominate can cause an inhibition (switching-off) weakness in the right Gmax and was explained in more detail in Chapter 9.

If the Gmax becomes inhibited because of the anteriorly rotated position of the right innominate bone, it will not be able to provide the correct activation sequence when a hip extension action is demanded by the patient (e.g. in walking or running); the lumbar spine erector muscle will be one of many areas that will start to overcompensate for this inhibition weakness of the Gmax (see Chapter 9). In time, an overcompensatory mechanism of the lumbar spine erector musculature in particular will cause the patient to feel tightness in the lower back, as well as potential pain.

There are many different options for treating this particular pelvis dysfunction. One way (and which works very well for me personally) is to utilize a soft tissue method, namely an MET, to normalize the iliopsoas and rectus femoris (this technique is demonstrated in Chapter 7 on METs), in addition to performing a specific MET to correct the anterior position of the innominate (see Chapter 13 on treatment of the pelvis). After having normalized both the muscles and the innominate, you would retest the Gmax firing; if the Gmax is still inhibited, a corrective firing pattern sequence can be initiated to promote the reactivation of the glutes. (For more information on glutes activation and correction, the reader is referred to Gibbons (2014).)

It would be logical to first correct (see Chapters 11 and 12) any/all of the pelvis dysfunctions (iliosacral, sacroiliac, and symphysis pubis) that are found, before continuing, assessing, and treating dysfunction of the lumbar spine (unless the spinal rotation is the primary dysfunction). Perhaps think about why I say this, before reading any further.

Hopefully, you will come to the conclusion that it is essential to address any issues with an underpinning structure before tackling problems in other areas that depend on that structure. For example, I regard the pelvis as being similar to the foundations that are laid before building a house; we would not want to build on top of the foundations if they were not level. I try to use the same analogy when I look at and assess the lumbar spine area. If the pelvis is not level to start with, then the lumbar spine cannot be level either; this area of the spinal column will therefore automatically compensate in some way through changing its natural spinal curvatures, which could result in functional/structural scoliosis. This unnatural positional change to the lumbar spine as a compensation mechanism can only lead to one thing, and you will easily guess what that is—pain, of course!

I am convinced that most of the spinal pathologies discussed in this chapter are a direct or indirect consequence of the overall position and stability integration of the pelvic girdle. It is very difficult, however, to prove this, especially since I haven't been able to find any recent clinical research to back up what I am saying. What I have stated has to be correct in one way or another, however, because the *fundamental foundation* (i.e. the pelvis) must be the main area of compensation for all of the various types of dysfunction that might be present within the body; this will have a direct knock-on effect on the entire kinetic chain, and the lumbar spine is clearly part of that compensatory chain mechanism.

Let's be a little realistic here for a moment. By the time a patient who presents with what might be diagnosed as a *specific* or *non-specific* back pain comes to see you, they probably already have some spinal pathology present. The patient might also have had confirmation of their spinal pathology by an MRI scan, X-ray, or some other diagnostic measures. Put simply, what I am saying in the above statement is therefore the following: the patient's presenting spinal pathology already *exists,* even before they walk through your clinic door!

Of the thousands of patients I have seen as a practicing sports osteopath and sports therapist, I can probably count on one hand those who have consulted me for an initial osteopathic assessment and treatment to actually *prevent* the onset of spinal and pelvic pathology, or indeed any other structural and soft tissue ailment. Let me reiterate what I mean by that. I believe that 99.9% of the patients and athletes who have visited my clinic *already* have a presentation of symptoms of pain/dysfunction somewhere in their body, and more than likely have some underlying form of spinal or pelvic dysfunction/pathology already present—and this is even before we have been formally introduced.

Lumbar Spine Anatomy

There are five individual spinal segments that make up the lumbar vertebrae, and each vertebra comprises the following structures (Figure 10.1):

- Vertebral body
- Spinous process
- Transverse process (TP)
- Superior/inferior facet joint
- Intervertebral foramen
- Spinal canal
- Lamina
- Pedicle
- Intervertebral disc: nucleus pulposus/ annulus fibrosus

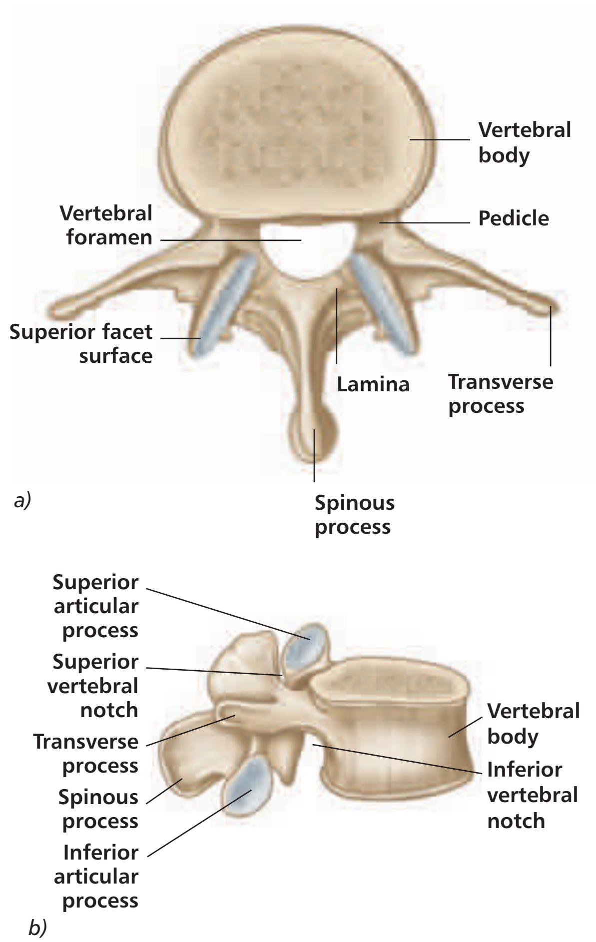


Figure 10.1. General anatomy of a lumbar vertebra (L3); a) superior view, b) lateral view.

Intervertebral Discs

Between adjacent lumbar vertebrae there is a structure known as an *intervertebral disc*; in total we have 23 of these soft tissue structures in the human vertebral column. A disc is made up of three components: a tough outer shell, called the *annulus fibrosus*; an inner gel-like substance in the center, called the *nucleus pulposus*; and an attachment to the vertebral bodies, called the *vertebral end plate*. As we get older, the center of the disc starts to lose water content, a process that will naturally make the disc less elastic and less effective as a cushion or shock absorber.

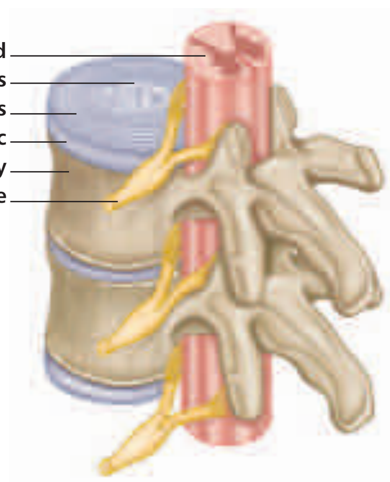


Figure 10.2. Anatomy of the lumbar spine and the intervertebral discs.

Nerve roots exit the spinal canal through small passageways between the vertebrae and the discs: such a passageway is known as an *intervertebral foramen*. Pain and other symptoms can develop when a damaged disc pushes into the spinal canal or nerve roots—a condition commonly referred to as a *herniated disc*.

Disc Herniation

Herniated discs are often referred to as *bulging discs*, *prolapsed discs*, or even *slipped discs*. These terms are derived from the nature of the action of the gel-like content of the nucleus pulposus being forced out of the center of the disc. Just to clarify, the disc itself does not slip; however, the nucleus pulposus tissue that is located in the center of the disc can be placed under so much pressure that it can cause the annulus fibrosus to herniate or even rupture, as shown in Figure 10.3. The severity of the disc herniation may cause the bulging tissue to press against one or more of the spinal nerves, which can cause local and referred pain, numbness, or weakness in the lower back, leg, or even ankle and foot. Approximately 85–95% of lumbar disc herniations will occur either at the lumbar segments L4–L5 or at L5–S1; the nerve compression caused by the contact with the disc contents will possibly result in perceived pain along the L4, L5, or S1 nerve root pathway, as shown in Figure 10.4.

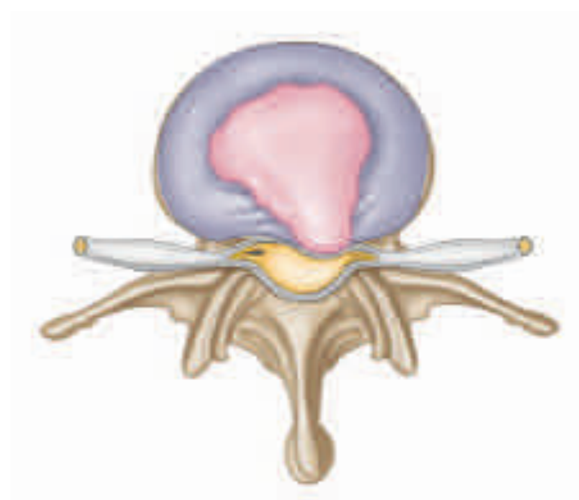
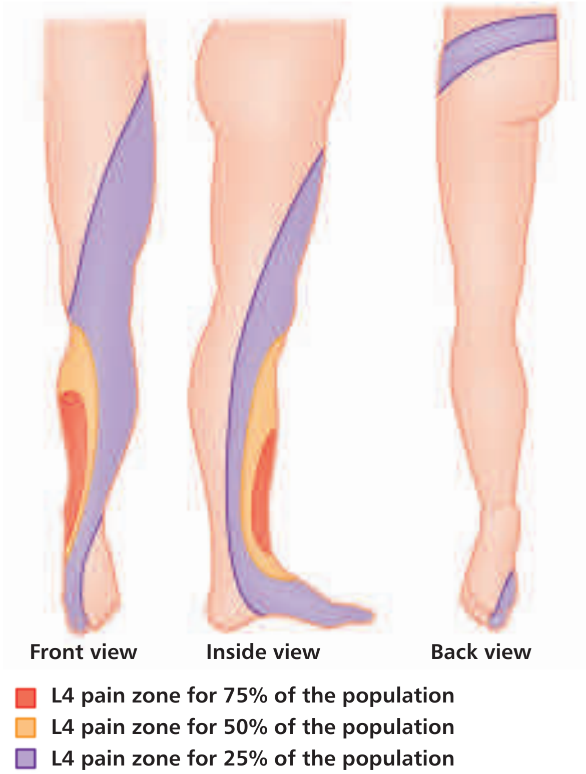
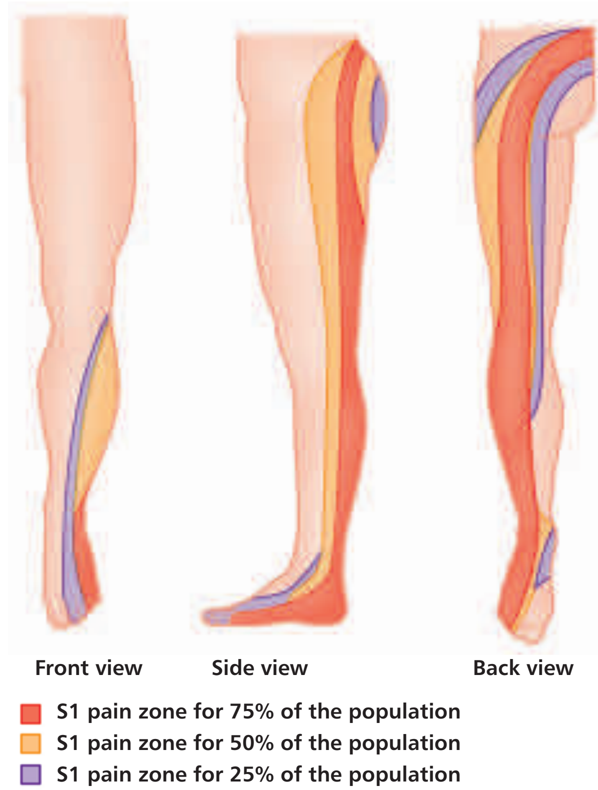


Figure 10.3. Disc herniation.





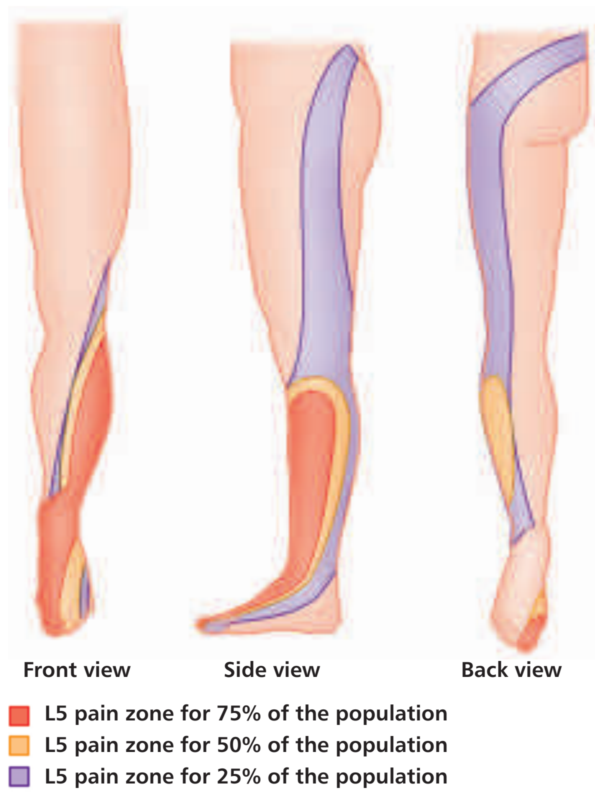


Figure 10.4. Dermatome pathway of pain for L4, L5 and S1 nerve root.

Degenerative Disc Disease

Degenerative disc disease (DDD) tends to be linked to the aging process and refers to a syndrome in which a painful disc can cause associated chronic lower back pain, which can radiate to the hip region. The condition generally occurs as a consequence of some form of injury to the lower back and the associated structures, such as the intervertebral discs. A sustained injury can cause an inflammatory process and subsequent weakness of the outer substance of the disc (annulus fibrosus), which will then have a pronounced effect on the inner nucleus pulposus. This reactive mechanism will create excessive movement, because the disc can no longer control the motion of the vertebral bodies that are located above and below the disc. This excessive movement, combined with the natural inflammatory response, will produce chemicals that will irritate the local area, which will commonly produce symptoms of chronic lower back pain.

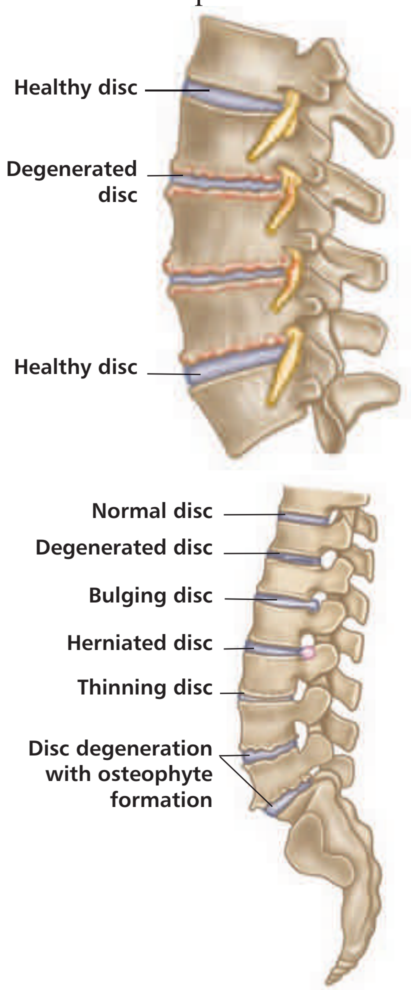


Figure 10.5. Degenerative disc disease (DDD).

DDD has been shown to cause an increase in the number of clusters of chondrocytes (cells that form the cartilaginous matrix and consist mainly of collagen) in the annulus fibrosus (consisting of fibrocartilage). Over a prolonged period of time the inner gelatinous nucleus pulposus can change to fibrocartilage, and it has been shown that the outer annulus can become damaged in areas that allow some of the nucleus material to herniate through, causing the disc to shrink and eventually leading to the formation of bony spurs called *osteophytes*.

Unlike the muscles in the back, the discs of the lumbar spine do not have a natural blood supply and therefore cannot heal themselves; the painful symptoms of DDD can therefore become chronic, eventually leading to further problems, such as discal herniation, facet joint pain, nerve root compression, spondylolysis (defect of the pars interarticularis), and spinal stenosis (narrowing of the spinal canal).

Facet Joints

Located within the lumbar spine are the facet joints (anatomically known as the *zygapophyseal joints*); these structures can be responsible for provoking a lot of pain. The facet joints lie posterior to the vertebral body, and their role is to assist the spine in performing movements such as flexion, extension, side bending, and rotation. Depending on their location and orientation, these joints will allow certain types of motion but restrict others: for example, the lumbar spine is limited in rotation, but flexion and extension are freely permitted. In the thoracic spine, rotation and flexion are freely permitted; extension, however, is limited by the facet joints (but also by the ribs).

Each individual vertebra has two facet joints: the *superior articular facet*, which faces upward and works similarly to a hinge, and the *inferior articular facet* located below it. The L4 inferior facet joint, for example, articulates with the L5 superior facet joint.

Like all other synovial joints in the body, each facet joint is surrounded by a capsule of connective tissue and produces synovial fluid to nourish and lubricate the joint. The surfaces of the joint are coated with cartilage, which helps each joint to move (articulate) smoothly. The facet joint is highly innervated with pain receptors, making it susceptible to producing back pain.

Facet Joint Syndrome/Disease

Facet joints have a tendency to slide over each other, so they are naturally in constant motion with the spine; like all types of weight-bearing joint, they can simply wear out and start to degenerate over time. When facet joints become irritated (the cartilage can even tear), this will cause the bone of the joint underneath the facet joint to start producing osteophytes, leading to facet joint hypertrophy, which is the precursor of *facet joint syndrome/disease* (Figure 10.6) and eventually leads to a condition called *spondylosis*. This type of syndrome or disease process is very common in many patients presenting with ongoing chronic back pain.

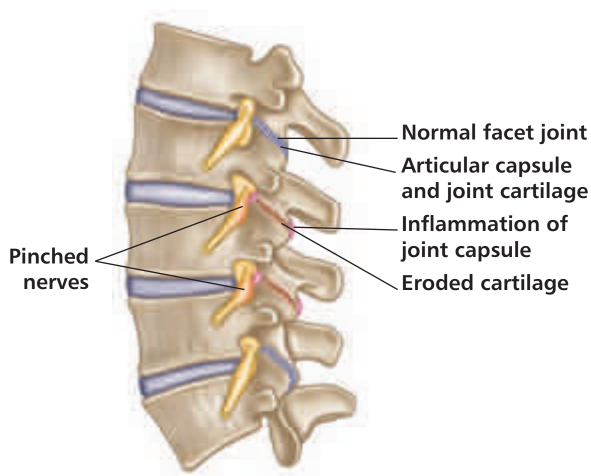


Figure 10.6. Facet joint syndrome and spondylosis.

Lumbar Spine as a Cause of Pelvis Dysfunctions

I have mentioned on numerous occasions the concept of the pelvis and possibly the hip joint being the key areas that are responsible for the presentation of pain in the lumbar spine and pelvic girdle regions. However, there have to be certain times (and, of course, there are) that some other structures (apart from those already mentioned) might need to be incorporated into the bigger picture in order to solve the problem; the structures that I am going to talk about might actually play an even greater role. Once you understand the next concept, I hope it will help you to place the jigsaw puzzle pieces in the correct sequence, so that a clearer picture will begin to appear.

It could be that the underlying issue is hidden and dormant and not showing itself as a dysfunction: the musculoskeletal problem is lying quietly in the grass and minding its own business. Let's consider for a moment the possibility that the problem is actually within the lumbar spine, and this structure could be the key to solving the mystery, as well as being the main reason for maintaining the pelvic dysfunctions.

For example, a patient has ongoing recurrent pelvic dysfunctions that you have been correcting time and time again to no avail; you constantly feel as if you are banging your head against the wall, because what you are doing (in terms of treatment) does not seem to be the key to solving the problem, whereas it might have been with other patients you have treated in the past. The problem potentially lies within the lumbar spine, and it is this skeletal structure that is the underlying causative factor maintaining and controlling the ongoing dysfunctional pelvic pattern. If there is a rotational component at the lumbosacral junction (L5/S1), this has been recognized as one of the causes of recurrent pelvic malalignment.

Let's look at an example where the lumbar spine is the root cause. If we have a clockwise rotation (i.e. to the right) of the 5th lumbar vertebra (L5), the right-sided TP will rotate backward (posteriorly). There are soft tissue attachments onto the L4 and L5 TPs for the iliolumbar ligament, and this ligamentous tissue attaches directly to the iliac crest. The induced rotation increases the tension within the iliolumbar ligament, and also the L5 rotation to the right will force the right innominate to rotate posteriorly; the left TP of L5 is rotating anteriorly and this creates an anterior position (anterior rotation) of the left innominate (Figure 10.7). Farfan (1973) reasoned that the shorter the TP, the longer the iliolumbar ligament and the greater the torsional force.

The L5 *right* inferior facet will be in a relatively open position on the superior facet of the 1st sacral vertebra (S1); the *left* inferior facet, however, will be in a closed position on the superior facet of S1. If the left facet joint is compressed, and the position is maintained and continued, it can now become a pivot point (fulcrum). This fixation (left) of the L5/S1 facet joint will now start to encourage the sacrum to rotate to the right axis (R-on-R), which will eventually force the whole pelvis unit into a right rotated position, as shown in Figure 10.7.

So how do we go about correcting a dysfunction of the lumbar spine? Well, the assessment of the pelvis in Chapter 12 contains snippets of valuable information that will help you ascertain if a lumbar dysfunction exists. Once you have read and understood how to determine a lumbar dysfunction in your patient, you will then need to read the appropriate text in Chapter 13, which explains in detail how to correct any possible dysfunctions that may be found within the lumbar spine complex.

Note: I would still recommend that you first treat any pelvic dysfunctions, before embarking on realigning specific dysfunctions that you find within the lumbar spine complex.

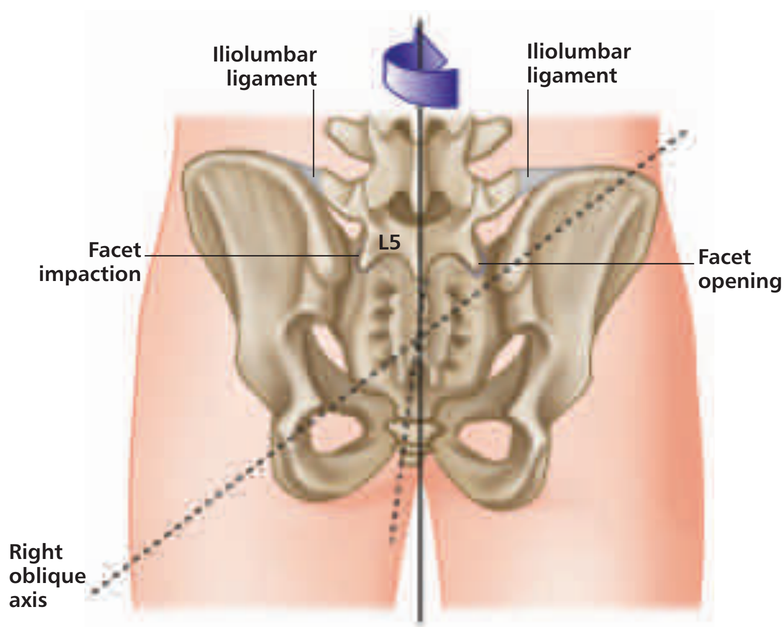


Figure 10.7. Rotational effect of L5 on the sacrum and on the innominate (via the attachment to the iliolumbar ligament).

11

Sacroiliac Joint Screening

Before I set about guiding you through a comprehensive assessment protocol for the pelvis, I believe that it makes sense to look first at the standard testing procedures for screening the SIJ. In this way we might be able to determine if the actual SIJ is responsible (or partly responsible) for a patient's presenting symptoms; the screening process, on the other hand, may lead us to conclude that the SIJ is not involved.

Let me give you an example of why I might do the screening tests for the SIJ first. When patients present to my clinic with pain in the area of, let's say, the lower lumbar spine and/or pelvis, I will naturally always screen the hip joints for any underlying pathology (as I demonstrated in Chapter 7 on the hip joint), because I personally consider this area of the body (hip joint) to potentially be responsible in part for their presenting symptoms of back or pelvic pain. In this case I can at least then decide if I need to investigate the hip pathology/dysfunction a little further. These clinical findings would probably make me reconsider and alter my treatment strategy to now focus on the area of the hip joint complex rather than specifically on the area of the lumbar spine or pelvis, especially if I wanted my treatment to have a longer-lasting effect of reducing my patient's ongoing painful symptoms in their lower back and pelvis.

Schamberger (2013) talks about the concept of malalignment syndrome and considers that 80–90% of all adults present with their pelvis out of alignment. Rotational malalignment is by far the most frequently seen, with an anterior rotation to the right innominate bone and a compensatory posterior rotation to the left innominate bone by far the most common (in approximately 80% of patients). This type of rotational malalignment can occur either on its own or in combination with other presentations (upslip/out-flare/in-flare; see "Pelvic Girdle Dysfunctions" section in Chapter 12). An upslip presents on its own in around 10% of patients, and in combination with the other types (rotational/out-flare/in-flare) in another 5–10% of patients. Out-flares and/or in-flares are present in approximately 40–45%, either in isolation or in combination with one or both of the other types.

Klein (1973) also shows that malalignment of the pelvis is present in 80–90% of high-school graduates. Of these, around one-third are asymptomatic and two-thirds are symptomatic, where they present with, for example, lower back or groin pain. Klein talks about three common presentations that account for 90–95% of those subjects found to be out of alignment:

1. Rotational malalignment—either an anterior or a posterior innominate rotation, or a combination of both (approximately 80–85%).

2. Out-flare/in-flare (40–50%).

3. Upslip (15–20%).

Remember, the history taking for your patient is one of the most important components when trying to decide on what you consider to be the actual condition/dysfunction that the patient is presenting with. It is very common for an examiner during a consultation to ask a patient where their pain is. Suppose, in the particular case of assessing the pelvis, the patient points to the area inferior and medial to the PSIS (Figure 11.1(a)), and is able to do this consistently twice and also within a radius of 0.4" (1cm) each time; according to Fortin and Falco (1997), this is a positive sign of SIJ dysfunction.

Figure 11.1. (a) The Fortin finger test, as demonstrated by the patient pointing to the area of pain.

The above is an example of what is commonly called the *Fortin finger test*; I consider this test to be of value, but only in combination with the provocation tests described below, especially the FABER (Patrick's) test.

Schamberger (2013) mentions that localized pain may arise from one or both SIJs: those with hypomobility or "locking" of one SIJ not infrequently complain of pain from the region of the other, supposedly "normal," SIJ. One explanation for this pain is the increased stress placed on this "normal" joint and its capsule and ligaments as it tries to compensate for the lack of mobility of the impaired SIJ.

In the 1997 study, the Fortin finger test was used as a means of identifying patients with lower back pain and SIJ dysfunction. Provocation-positive SIJ injections were used to confirm or discount the applicability of this clinical sign for the identification of patients with SIJ dysfunction. A total of 16 subjects were chosen from 54 consecutive patients by using the Fortin finger test. All 16 patients subsequently had provocation-positive joint injections, validating SIJ abnormalities. These results indicate that a positive finding of the Fortin finger test, a simple diagnostic measure, successfully identifies patients with SIJ dysfunction.

Fortin et al. (1994) carried out an earlier study on pain pattern mapping for the SIJ and injected the contrast material Xylocaine into the actual SIJ in 10 volunteers. These authors reported that their sensory examination immediately after the injection revealed an area of buttock hypoesthesia extending approximately 4" (10cm) caudally (inferiorly) and 1.2" (3cm) laterally to the PSIS, as shown in Figure 11.1(b). This area of hypoesthesia corresponded to the area of maximal pain noted upon administration of the injection.

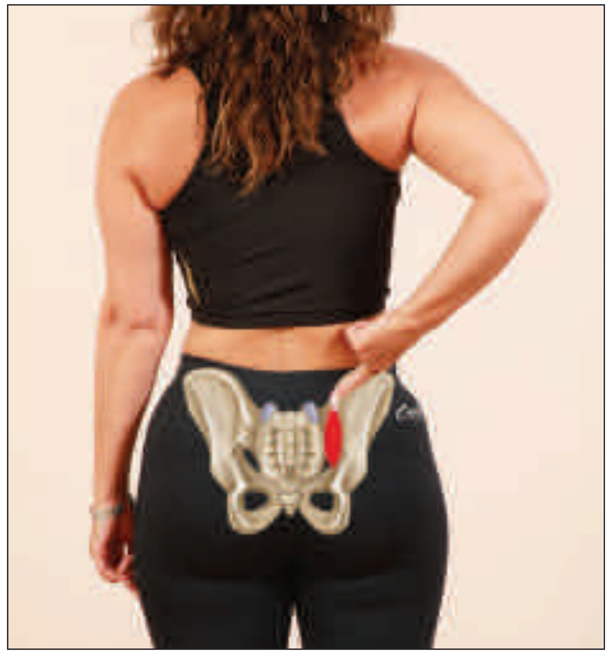


Figure 11.1. (b) The referral pattern of the SIJ from Fortin et al.'s 1994 study.

In terms of SIJ referral patterns, however, there has been a lot of debate about the exact location to which the SIJ refers: Fortin said 4" (10cm) caudally by 1.2" (3cm) laterally to the PSIS. In contrast, a study conducted by Slipman et al. (2000) called "Sacroiliac joint pain referral zones" recorded significant differences from Fortin's findings. Using fifty consecutive patients who satisfied clinical criteria and demonstrated a positive diagnostic response to a fluoroscopically guided SIJ injection, Slipman's study yielded the following results. Forty-seven patients (94.0%) described buttock pain, and thirty-six (72.0%) described lower lumbar pain. Twenty-five patients (50.0%) described associated lower-extremity pain. Fourteen patients (28.0%) described leg pain distal to the knee, groin pain was described in seven patients (14.0%), and six patients (12.0%) reported foot pain. Eighteen patterns of pain referral were observed. A statistically significant relationship was identified between pain location and age, with younger patients more likely to describe pain distal to the knee. It was concluded that pain referral from the SIJ does not appear to be limited to the lumbar region and buttock.

SIJ Provocative/Screening Tests

Based on very rigorously reviewed research, there are numerous ways of screening the SIJ. I, however, currently utilize only five of these provocation tests—those which I consider to be of real value to the clinician and which are used on a day-to-day basis throughout the UK (and the rest of the world) to commonly diagnose SIJ disorders. These SIJ provocation tests, when used in combination rather than in isolation, can be very accurate, as the feedback response from the SIJ can be very sensitive and specific, especially when giving information about the potential effectiveness of an SIJ dysfunction. These tests are not all specific in their application to the SIJ, because they also stress the hip joint and the lumbosacral region. Compressive types of testing motion are more likely to ascertain pain directly from within the joint, whereas distraction types of testing will provoke pain from the corresponding ligaments and joint capsule.

The presence of an SIJ dysfunction can be assumed if one achieves three out of five positive results with the following tests:

1. FABER
2. Compression
3. Thigh thrust
4. Distraction
5. Gaenslen

1. FABER Test

You may recall that I discussed the FABER (flexion, abduction, external rotation) test in Chapter 7, as it is commonly used to screen for any underlying hip pathology; however, it is also a very effective test for ascertaining SIJ dysfunction. The main reason why this test can help the therapist identify the presence of an SIJ dysfunction is the fact that the test induces a motion of the innominate bone in a posterior and external direction relative to the sacrum; this innominate motion encourages sacral nutation and subsequently stresses the associated ligaments (sacrotuberous, sacrospinous, and interosseous). The posteriorly rotated innominate position also becomes a lever that can be used to compress the SIJ posteriorly and open the joint anteriorly, which will then stretch the anterior capsule and associated ligaments.

The therapist places the patient's hip into a position of flexion, abduction, and external rotation. The opposite side of the pelvis (at the ASIS) is stabilized, and a gentle, steadily increasing pressure is applied to the same-side knee of the patient, exaggerating the motion of hip flexion, abduction, and external rotation, as shown in Figure 11.2. If there is a restriction (in the hip joint mainly) or pain posteriorly in the area of the SIJ, a pathological change/dysfunction within the SIJ might be indicated.

Figure 11.2. FABER test to screen for SIJ dysfunction.

2. Compression Test

The patient is placed in a side-lying position, facing away from the therapist, with a pillow between the knees for comfort. The therapist applies a gradual downward pressure through the anterior aspect of the innominate, between the greater trochanter of the femur and the iliac crest, to check if pain in the corresponding SIJ is present, as shown in Figure 11.3(a–b).

Figure 11.3. (a) Compression test to screen for SIJ dysfunction.

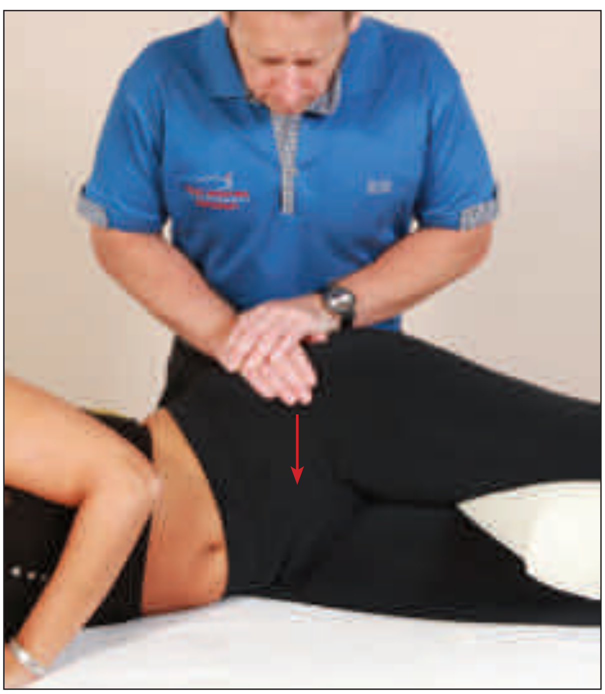


Figure 11.3. (b) Close-up view of the compression test.

3. Thigh Thrust Test

The patient lies in a supine position with one hip flexed to 90 degrees. The therapist stands on the same side as the flexed leg and stabilizes the patient's pelvis by applying pressure to the opposite ASIS. Gradually increasing pressure is then applied through the axis of the femur, to determine if pain is present within the SIJ, as shown in Figure 11.4(a–b).

Figure 11.4. (a) Thigh thrust test to screen for SIJ dysfunction.

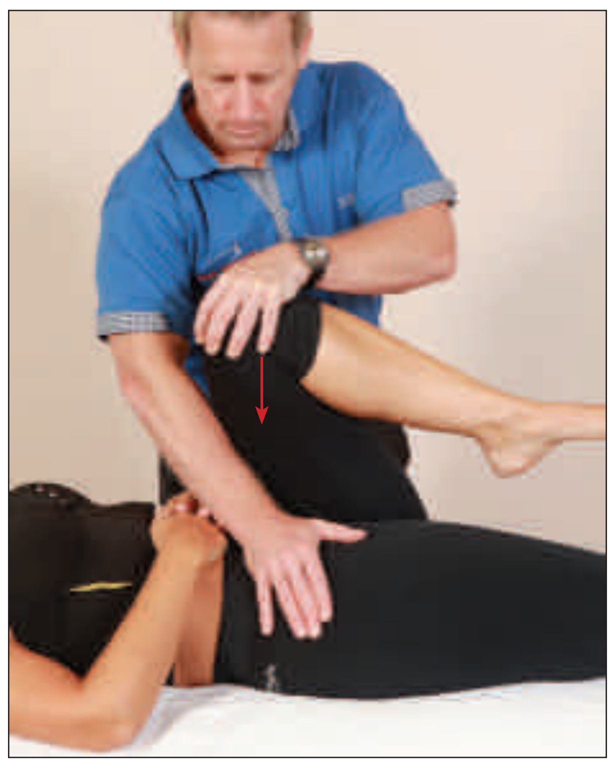


Figure 11.4. (b) Close-up view of the thigh thrust test.

4. Distraction Test

The patient lies in a supine position with a pillow under their knees for support. With arms crossed and elbows relatively straight, the therapist places their hands on the anterior aspects of the patient's left and right ASISs of the innominate bones. A gradual pressure is then applied laterally, to encourage a distraction of the SIJ, as shown in Figure 11.5(a–b). The presence of any pain is noted.

Figure 11.5. (a) Distraction test to screen for SIJ dysfunction.

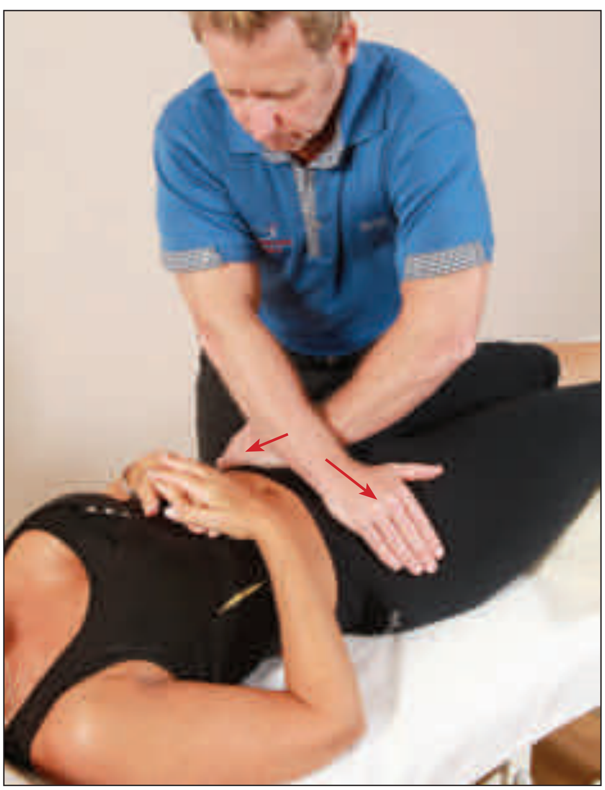


Figure 11.5. (b) Close-up view of the distraction test.

5. Gaenslen Test

The patient lies in a supine position near the left edge of the couch. They are asked to flex the right hip by pulling their right knee to their chest, a movement which rotates the right innominate posteriorly, while allowing the left innominate to rotate anteriorly; this particular action has the effect of locking the SIJ at the same time. The therapist slides the left lower leg off the couch and applies a gradual extension force to the already extended left leg, while simultaneously applying (through the patient's hands) a flexion force through the right leg, as shown in Figure 11.6(a–b).

Figure 11.6. (a) Gaenslen test to screen for SIJ dysfunction.

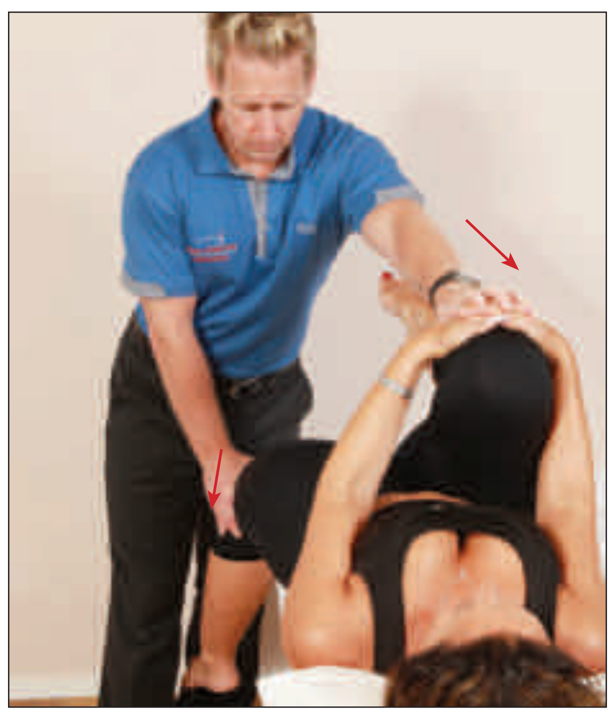


Figure 11.6. (b) Close-up view of the Gaenslen test.

12 Assessment of the Pelvis

Once you have screened the SIJ by following the five provocation tests as recommended in Chapter 11, you will at least be able to confirm or discount the presence of pain and possible dysfunction directly located within the SIJ. The next step will be to carry out an assessment of the pelvis.

The assessment procedure I will present in this chapter is very similar to the examination protocol that I personally follow with my own patients at my clinic in Oxford; however, you are not expected to initially follow every single process, especially during the first consultation. It could take a lot of time for you to gather all the information from the individual tests; moreover, once that has been done, you would need to assimilate all that necessary information in order to come up with a plan of action.

I am sure that there are numerous therapists out there who can help patients with only one session, and I believe that is the same for me. That said, I think it still takes a few physical therapy sessions to truly have a good understanding of the patient's individual musculoskeletal biomechanical framework. That is why I might not include all the tests I demonstrate in this chapter during my initial consultation, as some of the specific testing criteria might be more relevant in the second, or even third or fourth, follow-on session.

I hope that you will use this text, and specifically this chapter, time and time again as a reference point, especially when you are faced with a patient for the first time who presents with pelvis and lumbar spine pathology. I would love to think that this book will assist you greatly in trying to understand this fascinating area as well as in correcting any presenting pelvic malalignments.

Assessment Procedure: Part 1

The following assessment tests will be covered in this section:

- Pelvic balance
- Mens active straight leg raise
- Standing forward flexion
- Backward bending
- Seated forward flexion
- Stork
- Hip extension
- Lumbar side bending
- Pelvic rotation

Table A1.3 in Appendix 1 will be useful for noting down the relevant positional landmarks for your patient in the standing position. Similarly, Table A1.4 can be used to record the clinical findings for any type of pelvic dysfunction that exists.

Pelvic Balance Test

With the patient standing, the comparative levels of the following are noted:

- Pelvic crest (posterior view)
- Posterior superior iliac spine (PSIS)
- Greater trochanter
- Lumbar spine
- Gluteal folds
- Popliteal folds
- Leg, foot, and ankle position (anterior/posterior view)
- Pelvic crest (anterior view)
- Anterior superior iliac spine (ASIS)
- Pubic tubercle

Posterior View

The patient is asked to stand with their weight equally distributed on both legs. The therapist sits or kneels behind the patient, and places their hands on the top of the iliac crest to ascertain the level, as shown in Figure 12.1(a–b).

It is very common to find the right innominate slightly higher if there is a presentation of a right-sided anterior rotation (the most common finding) or an iliosacral upslip. Be careful, however—the right-side innominate could actually appear lower, even though it is still in an anterior rotation: this could be because of an anatomically longer left leg (true LLD). In the sitting and the lying prone positions, on the other hand, the iliac crest might actually be higher on the right side that is fixed in an anteriorly rotated position, because the effect of the LLD has now been removed from the equation.

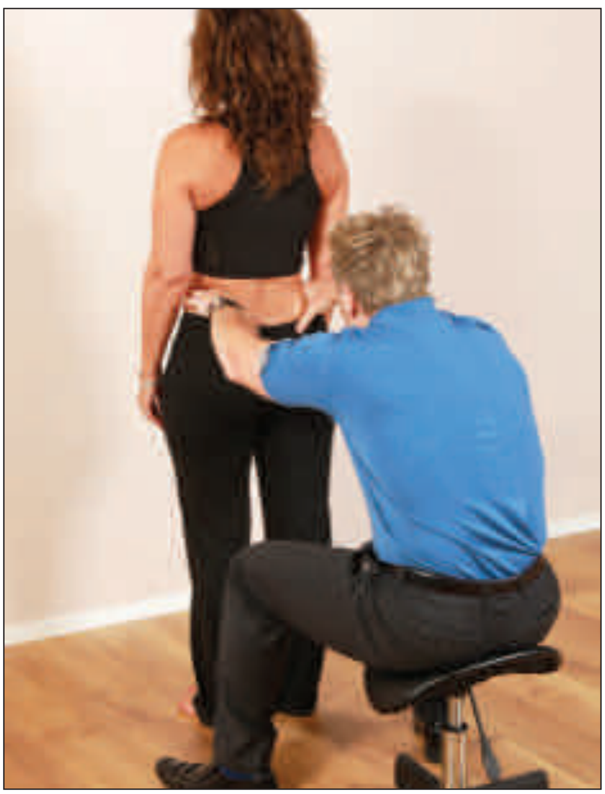


Figure 12.1. Pelvic balance test: (a) Posterior view of the pelvic crest—hand position for ascertaining the level.

Figure 12.1. (b) Close-up view of the hand position.

The therapist then places the pads of their thumbs under the PSIS and compares the levels, as shown in Figure 12.1(c).

Figure 12.1. (c) Hand position for comparing the height of the PSIS on the left and right sides.

Next, the therapist places their hands (fingertips) on top of the greater trochanters, again to determine the height, as shown in Figure 12.1(d). The therapist then palpates the gluteal folds and the ischial tuberosities, as shown in Figure 12.1(e).

Figure 12.1. (d) Hand position for ascertaining the height of the greater trochanter.

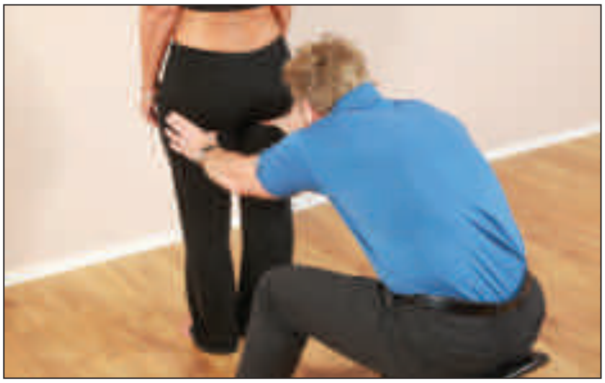


Figure 12.1. (e) Hand position for ascertaining the level of the gluteal fold and the position of the ischial tuberosity.

The therapist observes the position of the lumbar spine, gluteal folds, and popliteal (knee) folds for asymmetry, then observes the relative position of the leg, foot, and ankle, as shown in Figure 12.1(f), looking in particular for an external rotation of the lower leg and for over-pronation (pes planus), supination (pes cavus), or a neutral position (pes rectus). (Think back to Chapter 5 on LLD.)

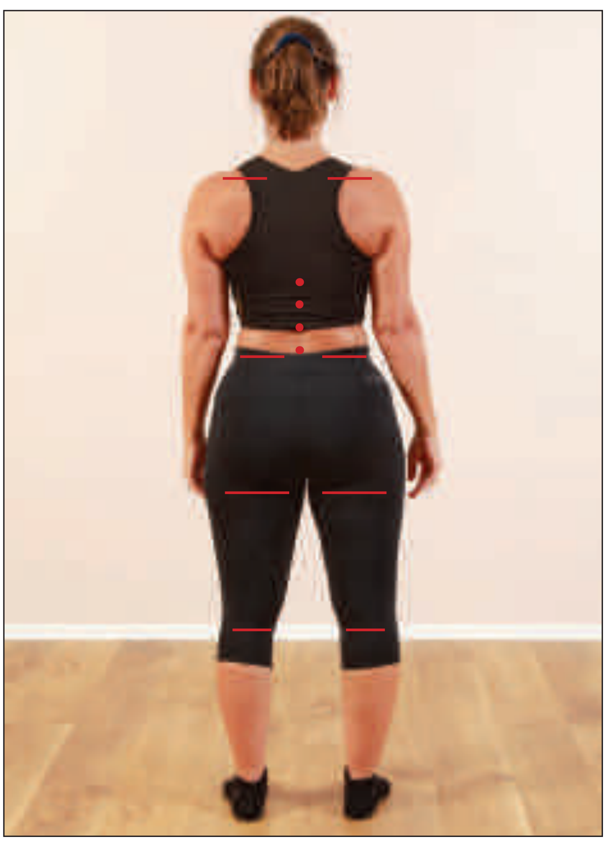


Figure 12.1. (f) Observation of the lumbar spine, gluteal fold, and popliteal fold, as well as the relative position of the leg, foot, and ankle.

Anterior View

The patient is asked to stand with their weight equally distributed on both legs. The therapist sits or kneels in front of the patient, and places their hands on the top of the iliac crest to ascertain the level, as shown in Figure 12.1(g).

Figure 12.1. (g) Anterior view of the pelvic crest—hand position for ascertaining the level.

The therapist then places the pads of their thumbs under the ASIS and compares the levels, as shown in Figure 12.1(h).

Figure 12.1. (h) Hand position for comparing the height of the ASIS on the left and right sides.

The therapist can also palpate the height/level of the pubic tubercles to ascertain their position, as shown in Figure 12.1(i).

Figure 12.1. (i) Hand position for ascertaining the height of the pubic tubercle.

> **Note:** The most common finding in terms of initial observation is the right leg in a slight position of external rotation and the right foot in a relative position of pronation, compared with the left side (relative supination). If these observations are made, it is possible that a rotational malalignment dysfunction of a right anterior innominate rotation, with a compensatory left posterior innominate rotation is present. If you obtain similar findings on the opposite (left) side, a left anterior innominate rotation with a right posterior innominate rotation dysfunction possibly exists (less common).

If either the iliac crest or the greater trochanter is lower on one side, this means an anatomically shorter leg; if the greater trochanters are level but the iliac crest is asymmetric, this can equate to a pelvic dysfunction.

Mens Active Straight Leg Raise Test

Mens et al. (1999, 2001, 2002) have developed a diagnostic test for SIJ dysfunction. They studied the relationship between the active straight leg raise (ASLR) test and mobility of the pelvic joints with and without the application of a pelvic belt. The sensitivity and specificity of the test proved to be high for patients with pelvic girdle pain (PGP). They also found that the test was suitable for discriminating between patients with PGP and healthy individuals.

Test Procedure

The patient is asked to adopt a supine position; when they are relaxed, they are asked to lift one of their legs an inch (2.5cm) or so off the couch. This is repeated on the contralateral side (opposite side) and then back on the ipsilateral side (same side) approximately three or four times, as shown in Figure 12.2. The patient is then requested to say whether or not the movement of the individual leg lift increases their SIJ symptoms. The patient is also asked which leg feels *heavier* or simply *harder* to lift off the couch.

The starting movement of the leg lift is performed by the contraction of the iliacus and rectus femoris muscles, which initially induces an anterior rotation of the innominate; this movement reduces the tension in the corresponding sacrotuberous ligament and hence decreases form closure. The anterior rotation could also indicate decreased activation of the dynamic stabilizers (force closure).

Mens et al. (1997) described how a decreased ability to actively perform a straight leg raise while lying supine seemed to correlate with an abnormally increased mobility of the pelvic girdle.

Figure 12.2. Mens ASLR: the patient alternately lifts each leg and indicates which feels heavier.

To continue with the assessment process, I will add six components to assist in the form and force closure. However, before I demonstrate these, I need to go through an example to help you understand the following process. Imagine that when you initially observed the patient lifting their leg, the *left* leg was deemed to be the *heavier* leg; that simply means the contralateral side will now be the right leg (lighter leg) and the ipsilateral side will obviously be the left leg (heavier leg) in this particular case.

Snijders et al. (1993a) made the following observation. Provided the local and global systems (inner and outer cores) are functioning normally, the overall effect of carrying out a right-sided ASLR is a stabilization of both the lumbosacral junction and the right SIJ, which in turn allows a more effective load transfer from the spine to the leg on that side.

The six additional components are:

1. Contralateral (opposite side) contraction of the right latissimus dorsi of the posterior oblique sling increases force closure, as shown in Figure 12.3. With simultaneous contraction of the right latissimus muscle, the left leg should now feel *lighter* when lifted.

Figure 12.3. Posterior oblique sling activation while lifting the left leg.

2. Contralateral (opposite side) contraction of the right anterior oblique sling increases force closure, as shown in Figure 12.4. With simultaneous contraction of the right oblique muscles, the left leg should now feel *lighter* when lifted.

Figure 12.4. Anterior oblique sling activation while lifting the left leg.

3. Activation of the inner core muscles, TVA, increases force closure, as shown in Figure 12.5. With simultaneous contraction of the TVA, the left leg should now feel *lighter* when lifted.

Figure 12.5. Inner core activation while lifting the left leg.

4. Contralateral (opposite side) posterior rotation of the right innominate bone (opposite side) decreases force closure, as shown in Figure 12.6. The left leg should now feel *heavier* to lift.

Figure 12.6. Posterior innominate rotation (opposite side) while lifting the left leg.

5. Ipsilateral (same side) posterior rotation of the left innominate bone (same side) increases force closure, as shown in Figure 12.7. The left leg should now feel *lighter* when lifted.

Figure 12.7. Posterior innominate rotation (same side) while lifting the left leg.

6. Bilateral compression of the innominate bones will increase form closure, as shown in Figure 12.8. The left leg should now feel *lighter* when lifted.

Figure 12.8. Bilateral compression of the innominate while lifting the left leg.

Without appropriate bracing of the deep abdominal muscles, the hip flexor muscles (such as the iliacus) can pull the ilium anteriorly, creating a counter-nutated position of the SIJ. Counter-nutation is typical for unloaded situations such as when lying supine, as demonstrated by Mens et al. (1999).

Shadmehr (2012) suggested there is reduced tonicity in the erector spinae, Gmax, biceps femoris, and external oblique muscles during ASLR testing of patients with SIJ pain.

Standing Forward Flexion Test (Iliosacral Dysfunction)

During forward bending of the trunk, the left and right innominate bones and the pelvic girdle rotate as a whole in an anterior direction on the femur, as I explained in Chapter 2. Initially, the innominate bones rotate anteriorly to roughly 60 degrees as the sacrum goes through nutation. This ROM is normal and occurs because the posterior structures (posterior oblique muscles, sacrotuberous ligament, thoracolumbar fascia, and hamstrings) become taut and will naturally limit sacral nutation. The sacrum is now held in what is known as *relative counter-nutation*, which causes an unstable position of the SIJ. The common reason for excessive counter-nutation, and the subsequent instability of the SIJ, is generally shortened and tight hamstrings.

Test Procedure

The patient is asked to stand with equal weight on both legs. The therapist places their hands onto the patient's innominate bones, with the pads of the thumbs lightly placed just inferior to the level of the PSIS, as shown in Figure 12.9.

Figure 12.9. Standing forward flexion test: the therapist places their thumbs inferior to the PSIS.

The patient is then asked to fully flex the trunk slowly toward the floor, as far as they can without bending the knees, while the therapist's contact to the PSIS is maintained. The therapist observes the motion of the innominate bones, but pays extra attention to the motion of each PSIS, as shown in Figure 12.10.

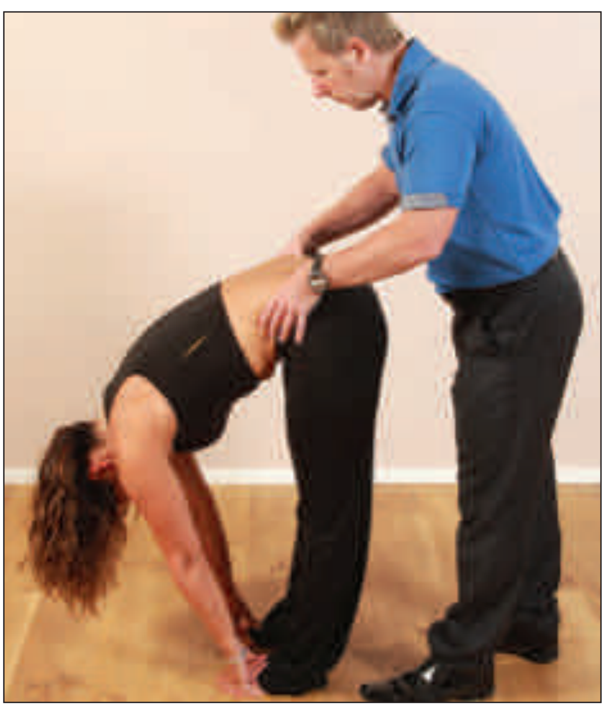


Figure 12.10. The therapist observes their thumbs as the patient forward bends.

Flexion of the spine carries the base of the sacrum anteriorly, and motion is then introduced to the SIJs. There is a natural pause before the sacrum takes the innominate into anterior rotation; this is why you should feel the left and right PSISs rise equally in a cephalic (superior) direction, as shown in Figure 12.11.

Figure 12.11. Close-up view of the therapist's thumbs as the patient adopts a forward-bent position.

If one thumb is seen to move more superiorly (cephalically) during flexion, this could be an indication that the innominate bone is fixed to the sacrum on that side, as shown in Figure 12.12; this is known as an *iliosacral dysfunction*. Another way that this has been described is that the iliosacral joint has locked too early on that side, causing the PSIS to rise sooner than normal, compared with the other side.

Figure 12.12. The right thumb is seen to be in a higher (cephalic) position, compared with the opposite side, indicating an iliosacral dysfunction on the right side.

False-Positive Result

A false-positive result might be noted if the contralateral (opposite side) hamstring is held in a shortened and subsequently tight position, thus limiting the motion of the opposite innominate bone. For example, the right-side PSIS traveling further than that on the left during the standing forward flexion test could be caused by the left hamstrings being held in a shortened and tight position; in other words, the left innominate bone is being held back (fixed) by the short hamstring muscles.

Moreover, if the ipsilateral (same side) QL muscle is held in a shortened and tight position, this too will also give a false-positive result, but on the same side. For example, if the right-side PSIS was seen to travel further, the QL on the right side might be held in a shortened position; as a result, this muscle will be pulling the innominate bone forward sooner rather than later, as shown in Figure 12.13.

Figure 12.13. The position of the right thumb is higher than that on the opposite side, possibly indicating a tightness of the right QL muscle.

Note: The standing forward flexion test does not tell you the actual nature of the dysfunction, i.e. whether it is a rotation, flare, or slip; it only guides the examiner as to the side on which the innominate bone is fixed in relation to the sacrum. We will decide later on in this chapter, through further testing and palpation, what type of iliosacral dysfunction exists. Chapter 13 will then show you how to correct all these iliosacral dysfunctions that are commonly found in patients. For now, I would simply get used to practicing the standing forward flexion test, as I consider this to be one of the main tests to use in your own clinic setting.

Backward Bending Test

The patient is asked to stand with equal weight on both legs. The therapist places their hands on the patient's innominate bones, with the pads of the left and right thumbs lightly placed just inferior to the level of the PSIS. The patient is then asked to fully extend their trunk backward, while the therapist's contact to the PSIS is maintained. The therapist observes the motion of the innominate bones, but pays extra attention to the motion of each PSIS. Normally, the PSIS is seen to move very slightly caudally (inferiorly), as shown in Figure 12.14(a–b).

Figure 12.14. Backward bending test: (a) The therapist places their thumbs inferior to the PSIS and asks the patient to backward bend.

Figure 12.14. (b) Close-up view of the therapist's thumbs as the patient backward bends.

During backward bending, the innominate bones and sacrum remain in the same position, and so there should be no relative change felt in the position of the thumbs; however, the sacrum should be seen and felt to nutate slightly in order to maintain stability of the SIJ during the backward bending motion.

Seated Forward Flexion Test (Sacroiliac Dysfunction)

Before one performs the seated forward flexion test, it is very important to ascertain the position of the iliac crest, as shown in Figure 12.15(a). Schamberger (2013) mentions that sitting is likely to present problems, as the ischial tuberosities are at different levels, raised on the side of the anterior rotation and/or an upslip, and lower on the side of the posterior rotation and/or a downslip. It has been suggested that, with a right anterior rotation or an upslip, the right ischial tuberosity can easily end up 0.4" (1cm) off the seating surface, the weight now being borne primarily by the left tuberosity.

Figure 12.15. Seated forward flexion test: (a) The therapist places their fingers on top of the iliac crest to ascertain the position.

Position 1

The patient is asked to sit on the edge of a couch, with their feet flat on the floor, or in a comfortable position on the couch. The therapist places their hands on the patient's innominate bones, with the pads of the thumbs lightly placed just below the level of the left and right PSIS, as shown in Figure 12.15(b).

Figure 12.15. (b) The therapist places their thumbs inferior to the left and right PSIS.

The patient is then asked to slowly fully flex their trunk, by rolling their chin to their chest, and continue as far as they can, with their hands on their knees for support, as shown in Figure 12.15(c).

Figure 12.15. (c) The therapist observes their thumbs as the patient forward bends in the seated position.

The therapist observes the motion of the innominate bones, as well as focusing on the specific motion of the PSIS. If one of the thumbs, which is located inferior to the PSIS, is seen to move more superiorly (cephalically) during flexion, this could mean that the sacrum is fixed to the innominate bone on that side, as shown in Figure 12.15(d); this is known as a *unilateral sacroiliac dysfunction*.

Figure 12.15. (d) The therapist observes that their right thumb travels more cephalically than their left thumb, indicating an SIJ dysfunction on the right side.

Position 2

With the patient in the neutral position, the therapist moves the pads of their thumbs from the original position (inferior to the PSIS) to the posterior aspect of the sacral apex, and in particular to the ILA, in order to ascertain the level/position, as shown in Figure 12.16(a).

Figure 12.16. (a) The therapist places their thumbs on the sacral apex and observes the relative position of the ILA.

Note if one side of the ILA is asymmetric compared with the opposite ILA; this information will be used as part of the process of assessing for sacroiliac dysfunction. The patient is then asked to forward bend and the motion/position of the ILA is observed, as shown in Figure 12.16(b).

Figure 12.16. (b) The therapist observes the relative position of the ILA as the patient forward bends.

Note: The seated forward flexion test does not tell you what type of SIJ dysfunction is present: it only guides you as to which side the sacrum is fixed (in relation to the innominate bone). The test removes the influence of the legs and pelvis on the sacrum (because of the sitting position), and allows you to decide if an actual SIJ fixation is present. (Please be aware that the QL muscle, if held in a shortened position, is still capable of giving a false-positive result for the same side.)

Iliosacral or Sacroiliac

Suppose your right thumb, which is located inferior to the PSIS, travels further (cephalically) than the left thumb in both the standing forward flexion test and the seated forward flexion test; in other words, the left thumb remains lower than the right thumb. This means you have found both an iliosacral and a sacroiliac dysfunction on the right side at the same time. If the right thumb is seen to move only during the standing forward flexion test, however, this indicates the presence of an *iliosacral* dysfunction on the right side. On the other hand, if the right thumb is seen to move only during the seated forward flexion test, then a *sacroiliac* dysfunction on the right side is present.

Stork Test (One-Legged)

The stork test (also known as the *Gillet test*) consists of two elements: the upper pole and the lower pole.

Test 1: Upper Pole

With the patient standing, the therapist sits or kneels behind the patient. The therapist places their left hand on top of the patient's left innominate bone, and the pad of their left thumb under the inferior part of the PSIS. The therapist's right hand is positioned on the right innominate bone, while the pad of the right thumb is in contact with the level of S2 (this is in line with the corresponding PSIS), as shown in Figure 12.17.

Figure 12.17. Stork test—upper pole: the therapist places their left thumb inferior to the PSIS, and their right thumb on S2.

The patient is asked to lift their left hip into full flexion, to at least above the level of the hip joint. The therapist's left hand remains in contact with the left innominate and monitors the movement: the left thumb on the PSIS should be seen to rotate posteriorly, medially, and inferiorly (caudally), with respect to the right thumb, which still maintains contact with S2, as shown in Figure 12.18(a–b).

Figure 12.18. (a) The therapist observes for normal inferior motion of the innominate bone while the patient flexes their hip.

Figure 12.18. (b) Close-up view of the therapist's hand and thumb in contact with the PSIS and S2.

> **Note:** I consider that the specific movement of the stork test indicates the ability of the innominate bone to posteriorly rotate on the sacrum, even though research does not actually confirm this hypothesis. Most therapists I have talked to in the past say that when they perform the stork test, they simply look for the movement described earlier (inferior motion of the thumb), and if the movement is restricted in any way, then an iliosacral dysfunction is present. Again, this test does not tell you the type of the iliosacral dysfunction; it only signals that one is present and that it is located on the side that tests positive in the stork test.

If the standing forward flexion test and also the stork test are positive on the same side, you know that there is an iliosacral dysfunction present; the following tests in this chapter will help you determine the type of this dysfunction. The contralateral (opposite) side is then tested for comparison.

A test is positive when the thumb located on the PSIS is not seen to move medially and inferiorly, or is seen to move in a cephalic direction, as shown in Figure 12.19(a–b).

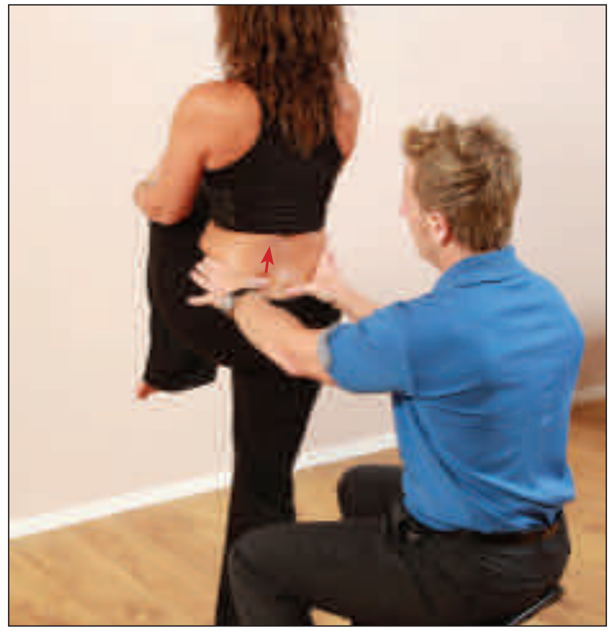


Figure 12.19. (a) The altered motion of the innominate bone shows a dysfunction is present.

Figure 12.19. (b) Close-up view of the altered motion of the left innominate bone.

Test 2: Lower Pole

With the patient standing, the therapist sits or kneels behind the patient. The therapist places their left hand on top of the patient's left innominate bone, while placing the pad of their left thumb under the inferior part of the posterior inferior iliac spine (PIIS). The therapist's right hand is positioned on the right innominate bone, while the pad of the right thumb is in contact with the level of the S4 (near to the sacral hiatus), as shown in Figure 12.20.

Figure 12.20. Stork test—lower pole: the therapist places their left thumb inferior to the PIIS, and their right thumb on S4.

The patient is asked to lift the left hip into full flexion, to at least above the level of the hip joint. The therapist's left hand remains in contact with the left innominate and monitors the movement: the left thumb on the PIIS should be seen to rotate anteriorly and laterally, with respect to the right thumb, which is palpating the level of the S4, as shown in Figure 12.21.

Figure 12.21. The therapist observes for normal anterior and lateral motion of the innominate bone while the patient flexes their hip.

A test is positive when the thumb located on the PIIS is not seen to move, or is seen to move in a cephalic direction, as shown in Figure 12.22.

Figure 12.22. The altered motion of the innominate bone shows a dysfunction is present.

Note: These specific tests for the upper and lower poles are sensitive to the motion of the SIJ as well as to the motion of the iliosacral joint (as mentioned earlier). Other authors consider that if the upper pole tests positive, a posterior (backward) torsion of the SIJ dysfunction is present, and if the lower pole tests positive, an anterior (forward) torsion of the sacroiliac dysfunction exists. However, it is very difficult to prove with these tests that an SIJ dysfunction is actually present, as the research regarding their validity is currently limited. Even so, I think that these tests will give the therapist some important palpatory feedback that might be useful in making an overall diagnosis and developing a subsequent treatment plan.

Hip Extension Test

With the patient standing, the therapist sits or kneels behind the patient. The therapist places their right hand on top of the patient's right innominate, while placing the pad of their right thumb under the inferior part of the right PSIS. The therapist's left hand is positioned on the left innominate, while the pad of the left thumb is in contact with the level of S2 (this is in line with the corresponding PSIS), as shown earlier in Figure 12.17.

The patient is asked to lift their right hip into full extension, as far as comfortable. The therapist's hand remains in contact with the right innominate bone and monitors the movement: the right thumb on the PSIS should be seen to rotate superiorly and laterally (cephalically), with respect to the left thumb, which is palpating the level of S2, as shown in Figure 12.23. This indicates the ability of the innominate bone to anteriorly rotate with respect to the sacrum. The contralateral (opposite) side is then tested for comparison.

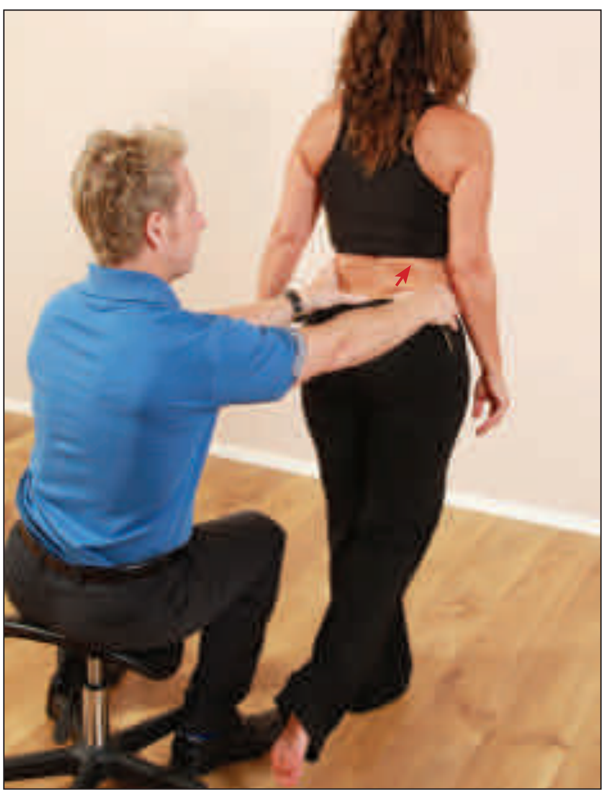


Figure 12.23. Hip extension test: with their right thumb inferior to the PSIS, the therapist observes for normal superior and lateral motion of the innominate bone while the patient extends their hip.

A test is positive when the thumb located on the PSIS is not seen to move superiorly and laterally, or is seen to move in a caudal direction, as shown in Figure 12.24.

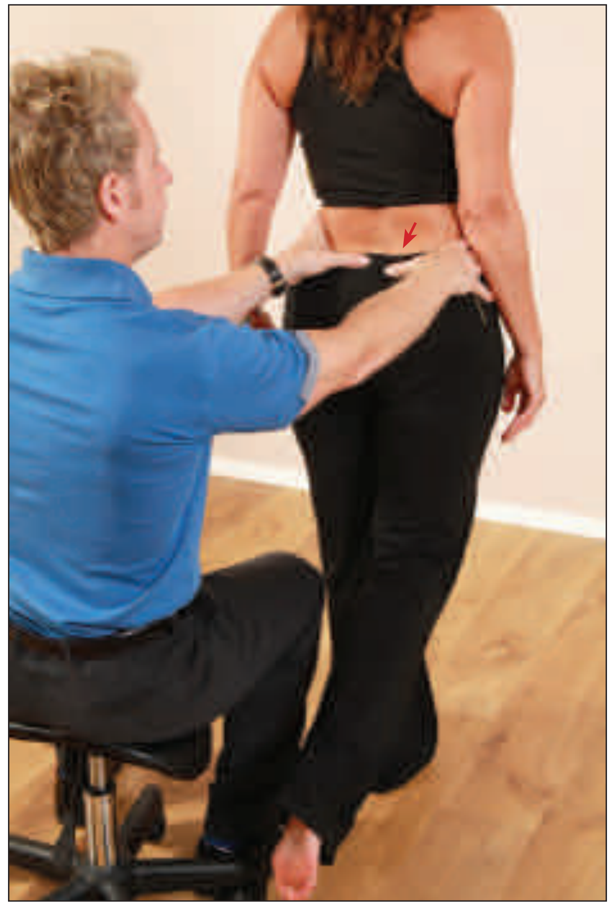


Figure 12.24. The altered motion of the innominate bone shows a dysfunction is present.

Lumbar Side Bending Test

The patient is asked to stand with their feet shoulder-width apart. The therapist sits or kneels behind the patient, and places their hands on top of the patient's iliac crests, with the pads of the thumbs on the posterior part of the PSIS.

The patient is asked to side bend to the left (without forward flexing their spine) as far as comfortable. The therapist observes the lumbar spine and looks for a smooth "C" curve with a fullness of the erector spinae on the side of the convexity (right side in this case); this fullness is seen on the side opposite to the induced side bending, because of Type I, or neutral, spinal mechanics, as shown in Figure 12.25(a).

Figure 12.25. Lumbar side bending test: (a) A normal motion is seen by a fullness of the erector spinae on the right side as the patient side bends to the left.

A positive finding during the observation is either fullness on the side of the concavity (same side as the side bending), as shown in Figure 12.25(b), or a possible straightening of the lumbar curve. These positive findings tend to indicate a non-neutral spinal mechanics type of dysfunction (Type II).

Figure 12.25. (b) An altered motion is seen by a fullness of the erector spinae on the left side (same side) as the patient side bends to the left.

Note: When looking at the lumbar curvature, the therapist should also be aware of the palpatory findings for the PSIS. The normal motion of trunk side bending to the right will induce a lumbar rotation to the left, and this in turn will induce (through the normal Type I neutral spinal mechanics) a rotation of the sacrum to the opposite (right) side.

In simple terms, if the patient has normal lumbosacral motion, when they side bend their lumbar spine to the right side, a coupled rotation to the left side (Type I mechanics/ neutral) is induced. As a result of the lumbar spine side bending right and rotating left, the sacrum should also be felt to go through the opposite motion, i.e. a side bending to the left, which will induce a rotation this time to the right. This movement of the sacrum can be palpated through the light contact of your right thumb, which is positioned on the right-side PSIS. This is all because of the fact that the lumbar spine will have rotated to the left (opposite side to the bending, because of Type I mechanics).

Pelvic Rotation Test

When you assess the patient in the standing-erect position, it is very common to consider the pelvis to be in an asymmetrical position. If the patient presents with a typical rotational malalignment syndrome, you may notice the pelvis to have rotated in an anticlockwise (left) direction, especially if they present with the most common finding of a right anteriorly rotated innominate and a left posteriorly rotated innominate, as shown in Figure 12.26(a); it is usual for this increased rotation to be anywhere between 5 and 10 degrees. If you now ask your patient to rotate their trunk to the right, as shown in Figure 12.26(b), you will notice further right rotation (approximately 45 degrees), compared with a left rotation of around 35 degrees when the trunk is rotated to the left, as shown in Figure 12.26(c).

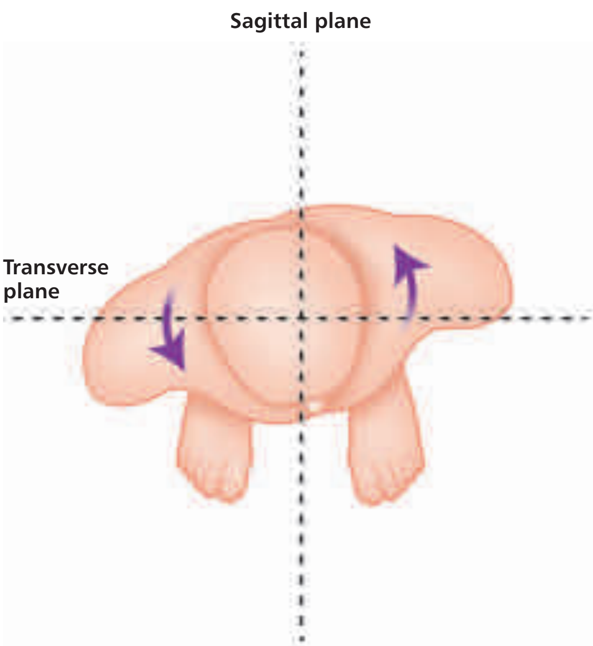


Figure 12.26. Pelvic rotation test: (a) The most common malalignment type of syndrome—right anterior innominate rotation with a compensatory left posterior innominate rotation.

Figure 12.26. (b) The patient is asked to rotate to the right side (clockwise) and approximately 45 degrees is seen.

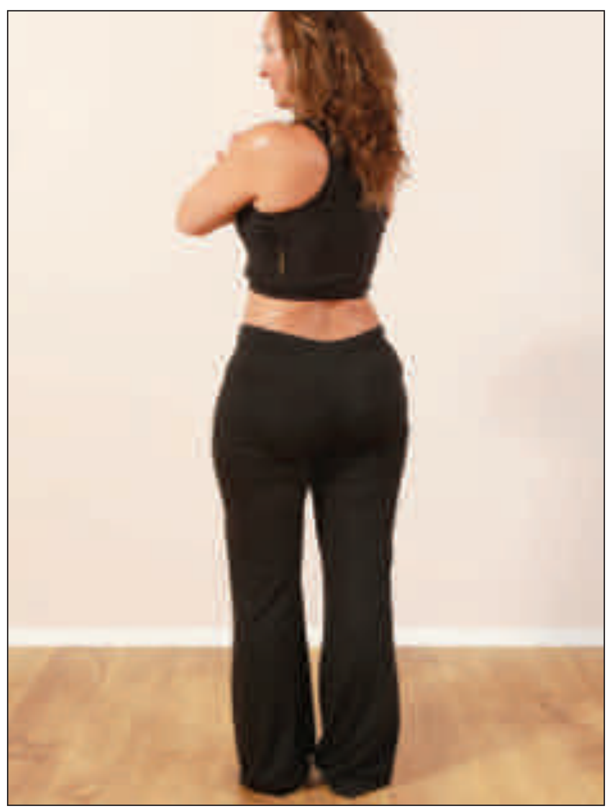


Figure 12.26. (c) The patient is asked to rotate to the left side (anticlockwise) and approximately 35 degrees is seen.

In the above example, the reason why rotation of the trunk to the right side (clockwise) is greater than to the left (even though the pelvis has rotated slightly to the left side because of the presenting dysfunction) is that the left innominate bone already starts out in a posteriorly rotated position (because of the dysfunctional pattern). This basically means that the left-side innominate is capable of rotating further in an anterior direction, to its available end ROM, than it would if it actually started out in a normal position. The same is true for the right-side innominate, which has already anteriorly rotated; the right side is now capable of traveling through a greater ROM in a posterior direction, giving the appearance of further rotation to the right side (clockwise).

Schamberger (2013) also says that on account of the wedging of the sacrum, the left innominate already flares slightly inward, and the right slightly outward. Overall, this translates into more degrees of clockwise rotation.

Note: If the pelvis position appeared to be neutral, with no obvious asymmetry/rotation present (contrary to the example above), one would expect pelvic rotation of the trunk to the left side (anticlockwise) to equal the available rotation of the trunk to the right side (clockwise).

Assessment Procedure: Part 2

Palpatory Assessment—Patient Prone

In this part of the assessment criteria we will be looking for asymmetry of the anatomical landmarks, as outlined below. The patient is asked to adopt a prone position on the couch. The therapist stands next to the patient and observes for the levels of the following areas using their dominant eye:

- Gluteal fold
- Ischial tuberosity
- Sacrotuberous ligament
- Inferior lateral angle (ILA) of the sacrum
- Posterior superior iliac spine (PSIS)
- Sacral sulcus
- Lumbar spine (L5)
- Iliac crest
- Greater trochanter

Table A1.5 in Appendix 1 can be of value to the therapist for noting down any asymmetries found during the prone palpatory assessment.

Gluteal Fold and Ischial Tuberosity

First observe the level of the gluteal fold and then lightly palpate this area to ascertain the position. From the gluteal fold, move your thumbs in a cephalic direction until contact with the ischial tuberosity is made. Place your thumbs in a horizontal plane against the inferior aspect of the ischial tuberosity, and note the level, as shown in Figure 12.27.

Figure 12.27. Palpation of the gluteal fold and ischial tuberosity for symmetry.

Sacrotuberous Ligament

After the ischial tuberosity has been palpated, the thumbs are now directed medially and cephalically until the sacrotuberous ligament is found, as shown in Figure 12.28. Gently palpate the ligament, feeling for increased tension or laxity as well as increased tenderness, as these can be associated with sacroiliac or iliosacral dysfunction.

Figure 12.28. Palpation of the sacrotuberous ligament.

ILA of the Sacrum

Next, if you lightly palpate the ischial tuberosity and follow it toward the proximal component of the sacrotuberous ligament, it will naturally take you to the ILA. Another way of finding it is to locate the sacral hiatus and palpate approximately 0.8” (2cm) lateral to this area—this will be the ILA landmark. Place the pads of your thumbs over the posterior area of the ILA to check for asymmetry, as shown in Figure 12.29.

Figure 12.29. Palpation of the inferior lateral angle (ILA) for symmetry.

PSIS

From the landmark of the ILA, now place your thumbs in a cephalic direction until they make contact with the bony landmarks on either side—i.e. the PSIS, as shown in Figure 12.30(a). From this position, look at each of the contact thumbs on the PSIS and note down any asymmetry that is found.

Figure 12.30. (a) Palpation of the PSIS for symmetry.

Iliac Crest

From the PSIS, it is advisable to ascertain the position of the iliac crest to check the level by lightly placing the fingers on top of the crest, as shown in Figure 12.30(b).

Figure 12.30. (b) Palpation of the iliac crest for symmetry.

Sacral Sulcus

The sacral sulcus is the area that is naturally formed by the junction of the sacral base with the corresponding ilium on either side. You might notice an overlying dimple that will correspond to the sacral sulcus: these left and right dimples are known as the *dimples of Venus*. From the position of the PSIS, the thumbs are now directed (gently) at an angle of 45 degrees medially toward the junction of L5/S1, until the sacral base is contacted. It is best to wait a moment for the tissues to settle down before deciding on the appropriate position. You are trying to determine what is termed the *depth* of the sacral sulcus (located between the sacral base and the PSIS); the normal depth is approximately 0.4–0.6” (1.0–1.5cm), but it is usually less, because of the soft tissues overlying the sulcus. Normal findings are that the thumbs palpate as equal, or level, within the sacral sulcus/base, as shown in Figure 12.31.

Figure 12.31. Palpation of the sacral sulcus for symmetry/depth.

Sacral Rotation

Imagine for a moment that when you palpate the sacral sulcus you convince yourself that your thumbs look asymmetric: for example, the right thumb seems to sink (palpate) deeper and the left thumb palpates shallow within the sacral base. This finding might possibly indicate either an *anterior* (or forward) sacral base (nutated) on the deeper *right* side, or a *posterior* (or backward) sacral base (counter-nutated) on the shallower *left* side. Either way, the sacrum in this case would still be “rotated” to the *left*, as shown in Figure 12.32.

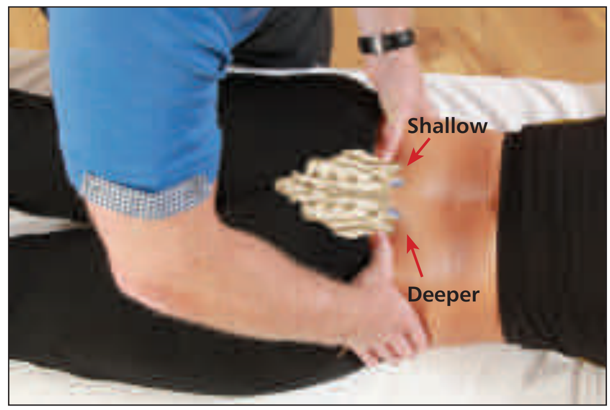


Figure 12.32. Palpation of the sacral sulcus for symmetry—the right thumb (in this case) appears deeper and the left thumb appears shallower.

In the article “Sacroiliac joint mechanics revisited” by Jordan (2006), I was very interested to read in particular about the area of palpation for identifying the depth of the sacral sulcus. The clinician mentioned that when one palpates into the sacral sulci and checks for the relative sacral sulcus depth, the relative depth does not reflect the sacral position, but rather the multifidus muscle thickness, even in petite patients. In addition, overlying the multifidus is the lumbosacral fascia, a very thick layer of collagenous connective tissue, which can feel quite solid and be mistaken for bone. If one side of the multifidus muscle is more contracted than the other, a greater cross-sectional area is produced, and consequently the sacral sulcus will naturally appear *shallower*.

True though this may be, please remember that palpation of the sacral sulcus is only one component of the assessment process. You can think of the assessment process as a jigsaw puzzle, and palpation of this sulcus will only be one piece of the puzzle. As I have said before, there are lots of other pieces in the puzzle, so try not to rely on just one piece.

While I am on the subject of the relative depth of the sacral sulci, one also has to consider the position of the innominate bone. For example, if the right sacral sulcus palpated as *shallow,* this could indicate an *anteriorly* rotated innominate on the right (iliosacral dysfunction, and a common finding). A different type of rotational malalignment can also relate to the opposite finding: if the sacral sulcus palpated as *deeper* on the right side, this could correspond to a *posteriorly* rotated innominate bone on the right (a less common finding).

Remember from earlier that the most common malalignment condition found is *rotational*, and typically this will be a right anterior rotation, along with a compensatory left posterior innominate rotation. In terms of palpation for the depth of the sacral sulci with this common finding, the right thumb would palpate shallow and the left thumb would palpate deep, even though the sacrum is in a relatively neutral position by comparison. In this case it is the innominate bone that is the dysfunctional (iliosacral) structure, but the impression of a right rotated sacrum is given (even though it is not right rotated), mainly because the left side of the sacral sulcus palpates as deeper as a result of the posteriorly rotated left innominate bone.

I have already discussed in Chapters 2 and 4 that we know the sacrum is capable of side bending with a coupled motion of rotation, since this is what your sacrum undergoes during the walking cycle, as you shift your weight from one leg to the other. The sacral motion follows Type I motion, and side bending and rotation are coupled to the opposite side: we call this type of movement *torsion.* So, for example, if the left sacral base is posterior, the sacrum will be left rotated, or left torsioned, and side bent to the right. If, when we palpate the sacral base as well as the position of the ILA in a neutral position (patient prone), we find asymmetry of the sacral base and also of the ILA, then we can safely say a dysfunction occurs and there is some SIJ fixation.

The question I ask you is this: how do you determine which is the fixed side? Well, you have already partly answered this question without actually realizing it. Why? Because you have already performed the seated forward flexion test, and this particular SIJ test will indicate the side of the body on which the dysfunction is located. Suppose, for example, the *left* side tests positive (left thumb travels cephalically, compared with the right thumb) during the seated forward flexion test; in addition, when you palpate the left sacral sulcus, the left thumb sinks further into the sulcus than the right thumb (i.e. it palpates *deeper* on the left side). You then know that the sacrum has to be in a position of anterior/forward nutation on the left side, because it has rotated to the right and side bent to the left, as in what we call a *R-on-R sacral torsion* (see Figure 12.33).

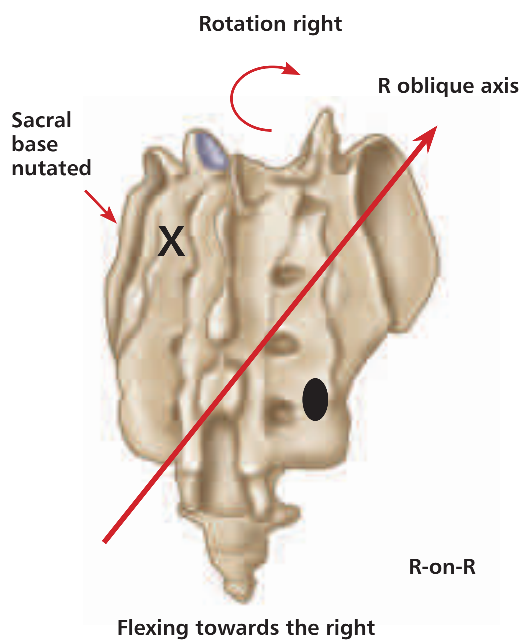


Figure 12.33. Anterior/forward (nutated) sacral torsion R-on-R. X = Anterior or deep. ● = Posterior or shallow.

Let's look at another scenario: the seated forward flexion test still gives a positive result on the left side, but this time the left sacral sulcus now palpates as *shallow* instead of deep. Hopefully, you now know that the left side of the sacrum is in a position of counter-nutation: the sacrum has rotated to the left and side bent to the right, as in a *L-on-R sacral torsion* (posterior/backward sacral torsion on the left), as shown in Figure 12.34 overleaf.

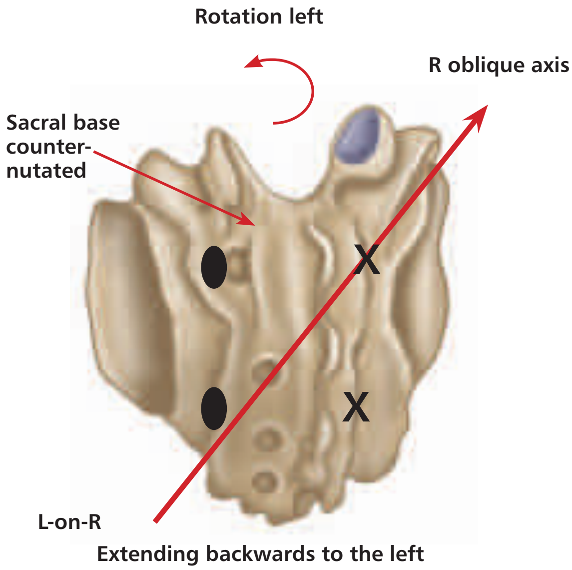


Figure 12.34. Posterior/backward (counter-nutated) sacral torsion L-on-R. X = Anterior or deep. ⬮ = Posterior or shallow.

Posterior/Backward (Counter-Nutated) Fixed Sacral Torsion

Let's move on to the next part of the assessment, which will continue on the theme of sacral torsion. We will now be looking at confirming or discounting the actual presence of a sacral dysfunction/torsion by asking the patient to simply backward and forward bend their trunk, to ascertain what happens to the depth of the sacral sulci.

Let's continue with the concept of the above example, where the left sacral base is posterior in neutral. From this position, you now ask your patient to forward bend their trunk, and the sacral dysfunction appears to disappear (your thumbs become level). When you ask your patient to perform a backward-bending motion (sphinx test—explained later) the rotation seems to increase: the position of the sacral base becomes worse—i.e. the left thumb appears shallower on the left side (or the sacral sulcus palpates as deeper on the right side). This will confirm that the left sacral base is fixed posteriorly, which is what we call a L-on-R sacral torsion. Why? Think about it for a minute. As you ask the patient to extend their lumbar spine, the sacrum should bilaterally anteriorly nutate (think "opposite motion to that of the lumbar spine"). If the left side is fixed in a backward/posterior position, this means that the left side will be unable to anteriorly nutate (to go forward), so it must be fixed in a counter-nutated position (posterior or backward sacral torsion). Another way of looking at it is that in backward bending, the left sacral base stays where it is—in a posterior fixed position; however, the right sacral base moves further into an anterior position as the patient backward bends, thereby making the rotation appear to worsen (increase).

When you ask the patient to perform a forward bending motion, the left sacral base will stay fixed posteriorly (counter-nutated on the left), as the right side of the sacrum is able to continue its motion and rotate back posteriorly (counter-nutate on the right); the sacral sulcus will now appear to become level, so that the rotation seems to disappear.

Sphinx Test/Trunk Extension

One maneuver I particularly like to ask my patients to perform, as a guide to ascertaining the presence of a posterior torsion of the sacrum, is the sphinx test. The patient is asked to adopt a prone position on the couch. Standing next to the patient, place the pads of your thumbs or index fingers directly over the left and right sacral bases, with your dominant eye facing the pelvis.

The test is rather simple: ask the patient to raise themselves onto their elbows (i.e. a sphinx position), as in reading a book. If a posterior sacral torsion exists, the sacral sulcus will be asymmetrical (posterior sacrum on the shallow side). The sacral torsion will be a L-on-R if the sacral sulcus is shallow on the left side (or the right sacral sulcus is deeper), as shown in Figure 12.35; likewise, the sacral torsion will be a R-on-L if the sacral sulcus is shallow on the right side (or the left sacral sulcus is deeper).

Figure 12.35. Sphinx test: a L-on-R (posterior/backward) sacral torsion is indicated (the left thumb becomes shallower in this case).

Note: If the sacral sulcus diminishes or normalizes (becomes level) during the sphinx test, an anterior sacral torsion is present. This forward torsion will either be a R-on-R or a L-on-L (this will be explained in the section "Anterior/Forward (Nutated) Fixed Sacral Dysfunction").

Lumbar Flexion Test

Let's continue with the case of a L-on-R sacral torsion (left side of the sulcus is fixed in counter-nutation). After the patient has adopted the sphinx position and the level of the sacral sulcus has been noted, you ask the patient to perform a forward bending motion of the trunk (lumbar flexion). Because the left sacral base in this example is fixed posteriorly, the right side of the sacrum is able to rotate back normally in a posterior direction (counter-nutation); this will make the sulci appear to become level, so that the rotation seems to disappear, as shown in Figure 12.36(a).

Figure 12.36. (a) Forward flexion test for the lumbar spine: a L-on-R (posterior/backward) sacral torsion is indicated (both thumbs now become level).

If you prefer the patient to flex their lumbar spine from a prone position rather than a sitting position, you can ask them to sit back onto their heels with their arms stretched forward, as shown in Figure 12.36(b).

Figure 12.36. (b) Alternative lumbar flexion test: a L-on-R (posterior/backward) sacral torsion is indicated (both thumbs now become level).

Anterior/Forward (Nutated) Fixed Sacral Dysfunction

Let's look at another example of a forward sacral torsion. This time, when we palpate the left sacral sulcus in a neutral position (patient prone), the thumb appears to sink deeper on that side; in addition, the seated forward flexion test is positive on the left side. Because of these two findings, we can almost conclude that a R-on-R forward sacral torsion is present. We will now confirm this by asking the patient to forward bend, with your thumbs in light contact with the patient's sacral sulci. The left sacral base appears to get worse (deeper) in this position, as shown in Figure 12.37, and becomes level in a backward-bent (sphinx) position, as shown in Figure 12.38.

This means that the opposite of what I said at the beginning is present: we have an anteriorly nutated fixation on the left side (R-on-R). Why? When your patient forward bends, their left sacral base stays fixed in an anteriorly nutated position, but their right sacral base moves further into posterior nutation (counter-nutation), which will thus make the rotation appear to worsen (left thumb appears to sink even deeper). When the patient is asked to backward bend, the left sacral base is still fixed in an anteriorly nutated position; however, the right sacral base is able to move into its normal anteriorly nutated position. This now shows that the dysfunctional rotation of the sacrum seems to disappear, and palpation of the sacral sulcus on each side now indicates they are level.

Figure 12.37. Forward flexion test, indicating a R-on-R (anterior/forward) sacral torsion (left thumb becomes deeper).

Figure 12.38. Sphinx test, indicating a R-on-R (anterior/forward) sacral torsion (both thumbs become level).

Lumbar Spine (L5)

Spring Test

The patient is asked to adopt a prone position on the couch, and the therapist stands facing the patient. The therapist observes the lumbar spine for the following positions: flat back (flexed), increased lordosis (extended), or neutral. If the patient has a relatively flat back, this indicates the lumbar spine is in a position of flexion, and the sacrum will be in a position of relative counter-nutation. If the patient has a lordotic posture, this means the lumbar spine is now in a position of extension, and the sacrum will be in a position of relative nutation. After observing the positions of the lumbar and sacral spines, the therapist places the heel of their dominant hand directly over the spinous process of L5 and exerts a gentle but firm pressure toward the couch, as shown in Figure 12.39.

A positive test is where there is firm resistance to the applied pressure to L5, with no obvious movement in the underlying tissues; a firm resistance indicates a locking of the L5 facets into a flexed position. This finding demonstrates that either the sacrum has bilaterally (on both sides) counter-nutated, or a unilateral (one-sided) posterior/backward sacral torsion (L-on-R or R-on-L) is present.

Figure 12.39. Lumbar (L5) spring test: either a posterior or an anterior sacral torsion is indicated.

If the spring test is negative (there is some available motion, i.e. spring) and the lumbar spine appears to have an increased lordosis (curvature increased), then either the sacrum has bilaterally nutated, or a unilateral anterior/forward sacral torsion (L-on-L or R-on-R) is present.

> **Note:** The spring test will also be negative if the patient is in a neutral position, as there is some natural lordosis of the lumbar spine in this case.

L5 Position—Neutral

Once you have decided on the relevant position of the sacral base for ascertaining any underlying sacral torsions, position your thumbs and direct them to the level of the L5 spinous process. From the spinous process of the L5 vertebra, direct the pads of the thumbs and place them equally and lateral (approximately 1–1.4”, or 2.5–3cm) to the L5 spinous process; this placement should be in line with the corresponding left and right TPs, so that the relevant position of L5 is identified. If a shallow side is palpated, let’s say on the right side, then in this particular case we know that the L5 vertebra has rotated to that side (right), as shown in Figure 12.40(a–b).

However, think back to Chapter 6: just because L5 has rotated to the right, we don't know whether the right-side facet joint of L5/S1 is fixed in a closed position, or whether the left-side facet joint of L5/S1 is fixed in an open position. As I have already explained in Chapter 6, we would need to ascertain the position of the L5/S1 facet joint by the use of specific motions, whereby the patient is asked to perform extension and flexion movements of the trunk.

Figure 12.40. (a) Palpation for the position of L5: the shallow side is seen on the right, indicating a right rotation of the L5 vertebra.

Figure 12.40. (b) Close-up view of the position of L5, with the shallow side on the right.

Note: Generally speaking, the position of L5 is particularly dependent on the position of the sacral base. The L5 vertebra will be in a different position for each of the four sacral torsion positions discussed in earlier chapters.

Remember from earlier that L-on-L and R-on-R sacral motions are classified as *normal* physiological motions of the sacrum, which will elicit typical Type I spinal mechanics (side bending and rotation are coupled to the opposite side) of the lumbar spine during the gait cycle. However, my own thought process tells me that if the sacrum is fixed in a forward/ nutated (Examples 1–2 below) or backward/ counter-nutated (Examples 3–4 below) torsional position for a significant period of time, then through the natural compensatory processes the lumbar spine in some way has to alter its position and possibly adopt Type II spinal mechanics; in this case the side bending and rotation are now coupled to the same side (either in flexion or in extension), as explained by the following examples.

Example 1

A *L-on-L* sacral torsion typically causes the L5 vertebra to adopt neutral Type I spinal mechanics of right rotation with left side bending. If the sacral dysfunction has become chronic, however, the altered position of the sacrum can potentially change the position of the L5 vertebra: this is known as an *ERS(R)*—the L5/S1 facet joint is closed on the right side.

Why? The motion of the L5 vertebra will be opposite (right) to the nutated motion of the sacrum (left), which means the L5 vertebra will be in a position of extension, side bending, and rotation to the right side, i.e. an ERS(R). Put simply, the sacrum is rotating in an anterior (nutated) direction to the left, so L5 will rotate in a posterior direction to the right. This right rotation of the lumbar spine is in part classified as normal Type I mechanics because of the induced left rotation of the sacrum; however, if the lumbar spine increases its lordotic curvature as a result of the forward (nutated) sacral torsion, the L5 vertebra will be forced into Type II mechanics and subsequently develop the position of an ERS(R).

Example 2
A *R-on-R s*acral torsion potentially causes the L5 vertebra to adopt a position known as an *ERS(L*)—the L5/S1 facet joint is closed on the left side.

The motion of L5 will be opposite to that of the sacrum, so the vertebra will be in an ERS(L) position. Why? Put simply, the sacrum is rotating in an anterior direction to the right side, which means L5 will rotate in a posterior direction to the left side.

Example 3
A *L-on-R* sacral torsion sacral torsion potentially causes the L5 vertebra to adopt a position known as an *FRS(R*)—the L5/S1 facet joint is open on the left side (remember, it is the side opposite to the side of rotation).

The motion of the L5 vertebra will be opposite to that of the sacrum, so the vertebra will be in an FRS(R) position. Why? Put simply, the sacrum is rotating in a posterior (counter-nutated) direction to the left side, which means the L5 vertebra will rotate in an anterior direction to the right side.

Example 4
A *R-on-L* sacral torsion sacral torsion potentially causes the L5 vertebra to adopt a position known as an *FRS(L)*—the L5/S1 facet joint is open on the right side (remember, it is side opposite to the side of rotation).

The motion of the L5 vertebra will be opposite to that of the sacrum, so the vertebra will be in an FRS(L) position. Why? Put simply, the sacrum is rotating in a posterior (counter-nutated) direction to the right side, which means the L5 vertebra will rotate in an anterior direction to the left side.

Exceptions to the Above Rule
Please bear in mind, from the discussion of spinal mechanics in Chapter 6, that in exceptional circumstances the motion of the L5 vertebra can also be to the same side as the sacral torsion. For instance, it is common with very chronic lumbar spine/pelvic dysfunctions to find the sacrum rotated to the right side and the L5 vertebra rotated to the same side; likewise, it is possible for a left rotation of the sacrum to cause the L5 vertebra to rotate to the same side. An example (explained in Chapter 10) of the above is where you have a primary lumbar spine dysfunction that causes the sacrum to rotate to the same side as the vertebral rotation; in this case the lumbar spine dysfunction will need to be treated first.

Iliac Crest—Posterior View
Place your hands on top of each of the patient's iliac crests and note the relevant positions. A higher side might indicate a shortness of the QL, a pelvic rotation, or even an iliosacral upslip, as shown in Figure 12.41.

Figure 12.41. Palpation for the position of the iliac crest: a higher side is indicated on the right.

Greater Trochanter
From palpating the iliac crests, next direct your hands to the greater trochanter, to check for relevant levels, as shown in Figure 12.42.

Figure 12.42. Palpation for the position of the greater trochanter.

Palpatory Assessment—Patient Supine

The patient is asked to adopt a supine position on the couch, and the therapist stands next to the patient and observes, using their dominant eye, for the levels in the following areas:

- Anterior superior iliac spine (ASIS)
- Iliac crest
- Pubic tubercle
- Inguinal ligament
- Medial malleolus

Table A1.6 in Appendix 1 can be used to note down any asymmetries found during the supine palpatory assessment.

ASIS

After initially observing the level of the ASIS, palpate the inferior aspect of the ASIS to ascertain the position, as shown in Figure 12.43.

Figure 12.43. Palpation for the position of the ASIS.

Iliac Crest—Anterior View

From the ASIS, place your hands on top of the iliac crests to check for the position, as shown in Figure 12.44.

Figure 12.44. Palpation for the position of the iliac crest.

Pubic Tubercle and Inguinal Ligament

Ask the patient to relax and inform them (also requesting their consent) about what is about to happen in this procedure. Using the heel of your hand, and starting with light contact from the abdominal area, gently move caudally down until the pubic tubercle is felt beneath the hand. Place the pads of the thumbs or index fingers on top of each of the pubic tubercles (symphysis pubis joint) and check for the position, as shown in Figure 12.45(a). A positive finding is if one of the pubic tubercles appears in either a superior or an inferior position, when comparing them with each other.

Figure 12.45. Palpation for the position of (a) the pubic tubercle.

Once you have palpated the left and right pubic tubercles, let your thumbs drift laterally and superiorly, to contact the inguinal ligament, which attaches from the pubic tubercle to the ASIS. Another positive finding for a dysfunction is if the soft tissue structure of the inguinal ligament is tender on palpation, as shown in Figure 12.45(b) overleaf.

Figure 12.45. Palpation for the position of (a) the pubic tubercle, and (b) the inguinal ligament.

Medial Malleolus (Leg Length)

Before the position of the medial malleoli (leg length) is ascertained, grasp the patient's legs above the ankles and ask the patient to bend both knees to 90 degrees. Next ask them to lift their pelvis off the couch two or three times, as shown in Figure 12.46(a), and then to straighten their legs (this has the effect of encouraging the pelvis to become level). After this, take hold of the patient's ankles and place your thumbs under their medial malleoli, to identify which leg appears longer, shorter, or level, as shown in Figure 12.46(b).

Figure 12.46. (a) Patient lifts their pelvis off the couch two or three times, to encourage leveling of the pelvis.

Figure 12.46. (b) Palpation for the position of the medial malleoli (leg length).

Supine to Long Sitting Test (Back to Supine)

The aim of this test is to determine the relevance of the SIJ to an apparent or true LLD. The patient lies in a supine position and the therapist compares the two medial malleoli, to see if there is any difference in position. Let's say, for instance, when the patient is in a supine lying position you notice that the left medial malleolus appears to be shorter and that the right medial malleolus appears to be longer, as shown in Figure 12.46(c).

Figure 12.46. (c) With the patient in the supine position the left medial malleolus appears shorter and the right medial malleolus appears longer.

Ask the patient to sit up, while keeping their legs extended. Compare the position of the medial malleoli again, to see if there is any change, as shown in Figure 12.46(d). If there is a *posterior* innominate present on the left side, the leg that appeared shorter will now *lengthen* as the patient sits up. If there is an *anterior* innominate present on the right, the leg that appeared longer will now *shorten* during the sitting-up motion.

Figure 12.46. (d) Observation of the positions of the medial malleoli (leg length) after the supine to long sitting test. The right leg appears shorter and the left leg appears longer, confirming right anterior and left posterior innominate rotations.

From the long sitting position, it would make sense to ask the patient to lie back down, so that they adopt the starting supine position, and to observe what happens to the medial malleoli during this maneuver. If you notice that the right leg in the *long sitting position* appears to be *shorter* than the left, and that the right leg appears to be *longer* than the left in the *supine lying position*, then you have probably confirmed a right anterior innominate rotation with a left posterior innominate rotation.

Schamberger (2013) has a general rule for remembering this process—the rule of the five Ls, which relates to the side of the anteriorly rotated innominate:

"**L**eg **L**engthens **L**ying, **L**andmarks **L**ower"

So let's recap on that thought process just for a moment. Schamberger (2013) calls the test the *sitting–lying test* rather than what I call it, the *supine to long sitting test*. What Schamberger says is basically the same, but in reverse. He looks at the patient's medial malleoli in a long sitting position to start with, noting the position, and observes if one malleolus appears to get "longer" when the patient lies back to adopt a supine position. If, for instance, it is found that the right-side malleolus appears to get longer (compared with the left side), as shown in Figure 12.46(e), then the right side is more than likely to be locked in an anteriorly rotated position (think back to the rule of the five Ls), with a compensatory left posteriorly rotated innominate.

Figure 12.46. (e) Observation of the positions of the medial malleoli. The right leg appears shorter in long sitting, and appears longer in supine lying, indicating a right anterior rotation.

True LLD

If a true LLD exists, the right leg will appear longer both in the supine position and in the long sitting position, as shown in Figure 12.46(f). Remember that all the pelvic landmarks are higher on the side of the longer leg, but only in a standing posture; the bony pelvic landmarks will be level when sitting and lying, as shown in the figure.

Figure 12.46. (f) Observation of the positions of the medial malleoli. The right leg appears longer both in long sitting and in supine lying, indicating a true LLD of the right leg.

Upslip

An upslip on the right side, for example, means that the right leg will appear shorter in the supine lying position, and subsequently shorter in the long sitting position, as shown in Figure 12.46(g). You will notice that the pelvic landmarks are all cephalic on the right side compared with the left side, indicating a possible right iliosacral upslip.

Figure 12.46. (g) Observation of the position of the medial malleolus for a right upslip. The right leg appears shorter in both the supine and long sitting position.

Out-Flare/In-Flare

When a patient presents with an out-flare or an in-flare iliosacral dysfunction, there will be no difference between the medial malleoli in the supine or long sitting positions.

The tests demonstrated above can help in differentiating between a true LLD and a sacroiliac/iliosacral dysfunction. The reason why the supine to long sitting and back to supine test is of value is that in a supine position the acetabulum lies in an anterior position relative to the ischial tuberosity, and that on moving from the supine to the long sitting position, the pelvis tilts forward and eventually pivots over the ischial tuberosity. As a result of this motion, the legs appear to lengthen equally if there is no dysfunction present. If a rotational dysfunction is present, however, the pelvis moves independently on each side rather than as a single unit, and hence the leg length appears to either shorten or lengthen.

Schamberger (2013) mentions that a shift in leg length demonstrated in the long sitting to supine lying test serves as a probable indicator of the presence of a "rotational malalignment" and is useful for differentiating it from an anatomical (true) LLD and an upslip; nevertheless, a coexisting anatomical LLD, an upslip, or both cannot be ruled out. The test also provides the person doing the assessment with an easy way of determining which side has rotated anteriorly or posteriorly.

Just to confuse the picture a little, as in reality it is never as straightforward as it seems (and I apologize for that), Schamberger (2013) also says: "A knowledge of which iliac crest is higher when standing is not helpful for predicting which leg will be longer in long sitting or supine lying. Nor does it help us to determine the side of an 'anterior rotation' or 'upslip'."

The fact of the matter is that differences as much as 0.8–1.6" (2–4cm) may be observed to reverse completely when changing from the long sitting position to the supine position; yet, with realignment, most of the people affected will turn out to have legs of equal length!

Remember that only 6–12% of us actually have evidence of an anatomical (true) LLD of 0.2" (5mm) or more, once in alignment, as demonstrated by Armour and Scott (1981) and by Schamberger (2002).

Pelvic Girdle Dysfunctions

According to some authors (myself included), at least 14 potential different dysfunctions can occur within the pelvic girdle complex. It is also common to find musculoskeletal dysfunctions coexisting between all of the three areas—iliosacral, sacroiliac, and symphysis pubis joints—and possibly all occurring at the same time.

Iliosacral Dysfunction (Fixation)

The following six iliosacral dysfunctions or fixations are possible:

- Anteriorly rotated innominate
- Posteriorly rotated innominate
- Superior shear (cephalic)—upslip
- Inferior shear (caudal)—downslip
- Innominate out-flare
- Innominate in-flare

Tables 12.1 and 12.2 overleaf summarize all of the specific testing and palpatory findings for each of the six types of iliosacral dysfunction.

Dysfunction	Left side	Standing flexion test	Medial malleolus	ASIS	PSIS	Sacral sulcus	Ischial tuberosity	Sacrotuberous ligament
Anterior rotation	Left	Left	Long left	Inferior	Superior	Shallow left	Superior	Lax left
Posterior rotation	Left	Left	Short left	Superior	Inferior	Deep left	Inferior	Taut left
Out-flare	Left	Left	No change	Lateral left	Medial left	Narrow left	No change	No change
In-flare	Left	Left	No change	Medial left	Lateral left	Wide left	No change	No change
Upslip	Left	Left	Short left	Superior left	Superior left	No change	Superior	Lax left
Downslip	Left	Left	Long left	Inferior left	Inferior left	No change	Inferior	Taut left

Table 12.1. Iliosacral dysfunctions—left side.

Dysfunction	Right side	Standing flexion test	Medial malleolus	ASIS	PSIS	Sacral sulcus	Ischial tuberosity	Sacrotuberous ligament
Anterior rotation	Right	Right	Long right	Inferior	Superior	Shallow right	Superior	Lax right
Posterior rotation	Right	Right	Short right	Superior	Inferior	Deep right	Inferior	Taut right
Out-flare	Right	Right	No change	Lateral right	Medial right	Narrow right	No change	No change
In-flare	Right	Right	No change	Medial right	Lateral right	Wide right	No change	No change
Upslip	Right	Right	Short right	Superior right	Superior right	No change	Superior	Lax right
Downslip	Right	Right	Long right	Inferior right	Inferior right	No change	Inferior	Taut right

Table 12.2. Iliosacral dysfunctions—right side.

Anteriorly/Posteriorly Rotated Innominate

Whenever I am giving lectures for my courses around the world, the terminology of anterior and posterior rotational components of the pelvis always crops up; we can therefore almost take it for granted that these rotations are a common dysfunctional pattern scenario for the innominate bone to follow. Hopefully, by now you will know that the rotation is classified as an *iliosacral* (and not sacroiliac) dysfunction, as it is the innominate bone that has rotated with respect to the sacrum.

If you look at Tables 12.1 and 12.2, you will notice that the indicated anterior and posterior rotations alter the positions of the ASIS, PSIS, and medial malleoli (leg length). These types of iliosacral dysfunction are initially found (as well as by observation and other testing procedures) by the key test known as the *standing forward flexion test*. For example, if the standing forward flexion test is positive on the left side, and on palpation, when compared with the opposite side, the left ASIS is superior, the left PSIS is inferior, and the left medial malleolus (leg length) is shorter, then you have now found a left posterior rotation of the innominate. This dysfunction would be classified as a *left iliosacral posterior rotation*, as shown in Figure 12.47. On the other hand, if the standing forward flexion test is positive on the right side, but this time the right ASIS is inferior, the right PSIS is superior, and the right medial malleolus (leg length) appears longer, then one can assume a *right iliosacral anterior rotation* (the most common) is present, as shown in Figure 12.48.

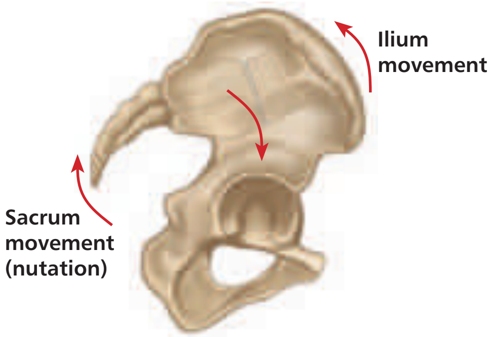


Figure 12.47. Posterior rotation of the innominate bone.

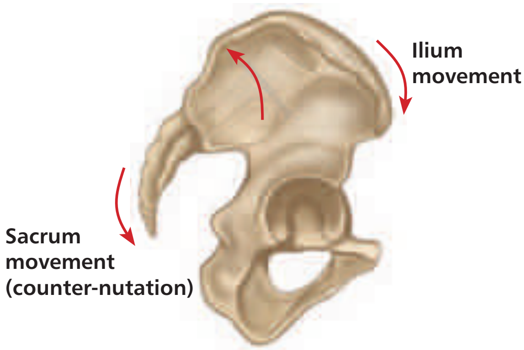


Figure 12.48. Anterior rotation of the innominate bone.

Let's go through a thought process for just a moment and assume that the patient has the most common presentation: a right anterior innominate rotation and a left compensatory posterior innominate rotation, so that the right SIJ is considered to be *locked*, as shown in Figure 12.49(a). In this Figure you can see three things: (1) the right pubic bone has displaced inferiorly (caudally) compared with the right side; (2) the sacrum has compensated for the rotational malalignment by rotating left on the left oblique axis (L-on-L); and (3) the lumbar spine has also compensated by rotating into the convexity to the left side.

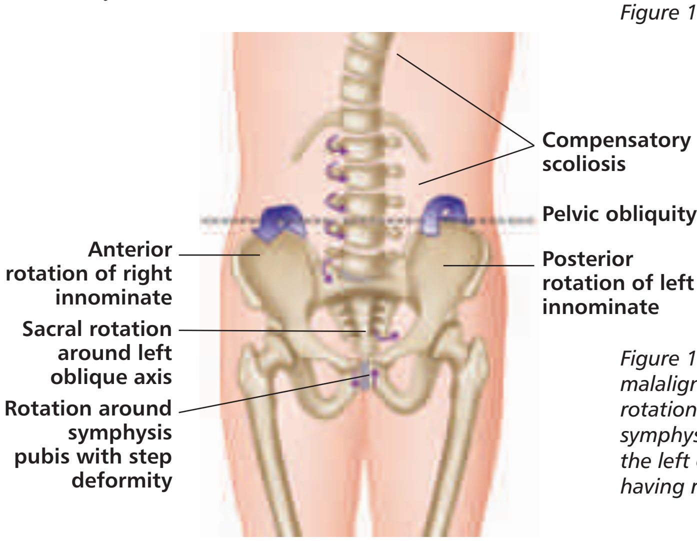


Figure 12.49. (a) Presentation of the most common rotational malalignment syndrome—right anterior and left posterior rotation. The compensations are shown by both the symphysis pubis joint and the sacrum having rotated left on the left oblique axis (L-on-L), and by the lumbar spine also having rotated left into the spinal convexity.

With the most common presentation of a right anterior innominate rotation and a compensatory left posterior rotation, you will see in Figure 12.49(b) that a patient demonstrating a reaching motion toward their toes on the right side is able to do this with no restriction; however, on the left side, as shown in Figure 12.49(c), the patient is clearly prevented from touching their toes.

Figure 12.49. (b) The patient's reach to the right is normal.

Figure 12.49. (c) The patient's reach to the left is impaired.

Figure 12.49. (d) After realignment treatment of the rotation of the right innominate bone, the patient can now reach to the left.

Figure 12.49(d) demonstrates an improvement after a realignment technique has been performed (Chapter 13). The reason why the patient had a restriction to the left side is that the left innominate is locked into a posterior rotation, and that the reaching forward type of motion (as shown in the figures) demands an anterior motion of the innominate bone. The treatment technique (as discussed in Chapter 13) is to correct the right anterior innominate rotation and not the left posterior innominate rotation; this will then encourage the compensatory left side (posteriorly rotated) to come back to a neutral position.

Case Study

On looking at the excellent book by Schamberger (2013) on malalignment syndrome, I was interested to read that the author was a very fit marathon runner, but he himself had suffered from right heel pain that had lasted many years. His ankle and foot were in a position of over-pronation, especially the right foot; he had tried orthoses but they failed to correct the position. Every time he ran, the pain impaired his heel-strike and push-off, and he began to notice wasting in all of his right leg muscles; moreover, his right thigh muscles—especially the quadriceps—would ache. He had an injection of local anesthetic into the area of the heel pain, but this did not even give him any short-term relief.

As time passed, the heel pain persisted. At some point he went to a medical conference, where one of the speakers talked about the sacrotuberous and sacrospinous ligaments referring pain to the leg, and especially to the heel, as shown in Figure 12.49(e). That same afternoon, Schamberger was checked out by an osteopath, who noticed that he was out of alignment and said that his right innominate was rotated anteriorly; the osteopath proceeded to perform a corrective MET technique (Chapter 13) to correct the right anterior rotation. The applied technique was very simple and miraculously made the heel pain disappear completely, because of the fact that Schamberger was now realigned. The best part was to come, as later that day he ran for 12 miles (20km) and, for the first time in years, finished the run without an ache in his right thigh muscles or any pain in his heel.

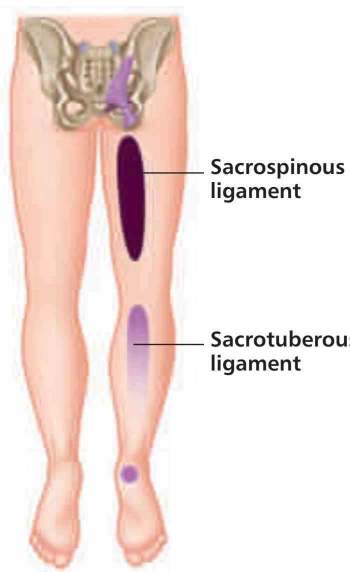


Figure 12.49 (e). Referral pattern for the sacrotuberous and sacrospinous ligaments, specific in particular to the area of the heel bone.

Superior/Inferior Shear—Upslip/Downslip

An iliosacral *upslip* (superior shear, also known as *hipbone shear*) dysfunction normally relates to some type of trauma or accident: perhaps the person in question has had a motor accident, tumbled down some stairs from a height and landed on one side of their ischial tuberosity, fallen from a height (such as from a horse), or even simply missed a step when running or walking. It has even been considered that a strain of the QL muscle sustained while picking up a heavy load from the floor could be responsible for an upslip.

Williams and Warwick (1980) found that the degrees of freedom of the SIJ normally permit approximately 2 degrees of upward (cephalic) and downward (caudal) translation of the innominate relative to the sacrum. These dysfunctions tend to be less common (approximately 10–20%, compared with around 80% for innominate rotations) in patients who present with chronic back and pelvic pain. This type of dysfunction needs to be corrected by treatment, as it is very difficult for the patient to self-correct it (a very effective treatment protocol for this will be demonstrated in Chapter 13).

The initial diagnosis is indicated by the standing forward flexion test. In addition, on the side that tested positive in this test, the anatomical landmarks of the ASIS, PSIS, iliac crest, and pubic bone (potentially a 0.08–0.12", or 2–3mm, step deformity could be palpated at the symphysis pubis joint), as well as the ischial tuberosity, will all appear to be *cephalic* or *superior* (compared with the opposite side), as shown in Figure 12.50(a). On the higher (dysfunctional) side, the sacrotuberous ligament will be lax and the medial malleolus (leg length) will appear to be shorter.

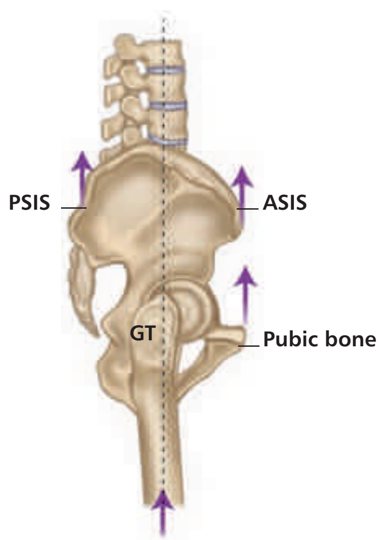


Figure 12.50. (a) Upslip (superior shear) of the innominate bone.

An upslip can coexist with a rotation (anterior) and/or an out-flare/in-flare of the innominate bone, which means that some of the palpatory landmarks can be "hidden"; it will therefore be less obvious that an upslip is present, as shown in Figure 12.50(b). This type of dysfunction is possible, especially if the corresponding knee joint is straight but the hip is not in a neutral position when the trauma is sustained, as this might cause a rotational force to the innominate, as well as producing an upslip.

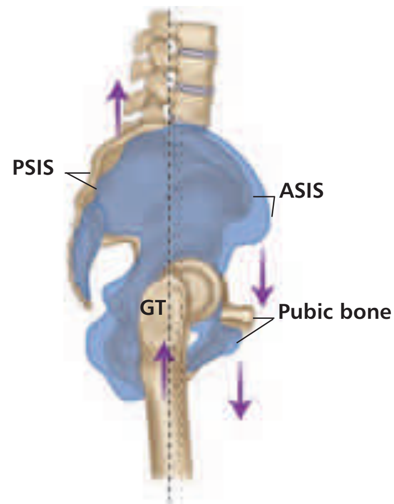


Figure 12.50. (b) Upslip is "hidden" as a result of the anterior rotation of the innominate bone.

Through his experiences, Schamberger (2013) discovered that the high side of the pelvis in standing or sitting does not always correspond with the side of the upslip. For example, the iliac crest is high on the right side in standing, sitting, and lying prone; in those with a left upslip present, with the left iliac crest high in lying, it is usually the right iliac crest that is high in standing and sitting. These findings suggest that the upslip may be associated with some rotation of the pelvis. In other words, if someone presents in this case with a right upslip, in combination with a right anterior and left posterior rotation, then some of the landmarks may alter: the step deformity of the symphysis pubis joint disappears, the ASIS becomes level compared with the opposite side, and the PSIS on the right becomes accentuated compared with the left side. Schamberger says that a correction of the rotational malalignment will reveal the underlying right upslip, with all the landmarks on the right side of the pelvis now in a superior position relative to those on the left.

If you suspect that your patient has an iliosacral *downslip* (inferior shear), the initial diagnosis is carried out through a standing forward flexion test: on the side that tests positive, the anatomical landmarks of the ASIS, PSIS, iliac crest, and ischial tuberosity will all appear to be *caudal* or *inferior* (compared with the opposite side). On the low (dysfunctional) side, the sacrotuberous ligament will be taut and the medial malleolus (leg length) will appear to be longer, as shown in Figure 12.51 overleaf.

Dysfunctions of this type tend to be self-correcting when you walk. If you think about it logically, if a downslip is suspected on the right side, when the weight is placed onto the right leg, the right-side back of the pelvis is naturally pushed to a neutral position; in general, therefore, no treatment is actually required.

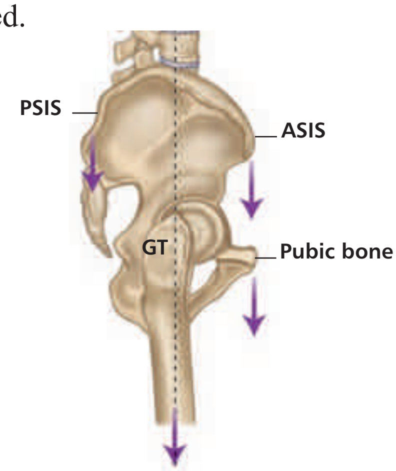


Figure 12.51. Downslip (inferior shear) of the innominate bone.

Innominate Out-Flare/In-Flare

Out-flare and in-flare refer to the movement of the innominate bones in outward and inward directions respectively. An out-flare motion is considered to be combined with the anterior rotation of the innominate bone, while an in-flare motion is considered to be combined with a posterior rotation of the innominate bone; this is because the innominates need to perform this specific type of rotary motion during the gait cycle, as well as during forward bending of the trunk.

DonTigny (2007) stated that SIJ dysfunction is essentially caused by an anterior rotation of the innominate bones and an out-flare relative to the sacrum. In-flare occurs with a posterior rotation of the innominate bone relative to the sacrum and with sacral nutation. According to Kapandji (1974), during the initial 50–60 degrees forward flexion of the trunk when standing up, the sacrum nutates and the ilia rotate anteriorly and flare outward.

Think back to earlier when you were palpating the ASIS: I mentioned that it is important to look at your thumbs for equal symmetry of the two bony landmarks of the innominate bones, and to note down if you found any asymmetry. If you notice a difference between the two sides, you now need to imagine a straight line down the center of the body, which typically passes through the area of the umbilical (belly button). Now compare how far each thumb is from the centerline of the umbilicus. If you observe that your left thumb on the patient's right ASIS seems further away from the umbilicus than the opposite side, you have probably discovered an in-flare or an out-flare, as shown in Figure 12.52(a).

How do you decide what type of dysfunction is present? Yes, you have guessed correctly—the good old standing forward flexion test and also the stork test. If these two tests are positive, for example on the patient's right side, you have now found an *iliosacral out-flare*, as shown in Figure 12.52(b). Conversely, if the standing forward flexion test and the stork test were positive on the left side, you would conclude that an *iliosacral in-flare* is present, as shown in Figure 12.52(c).

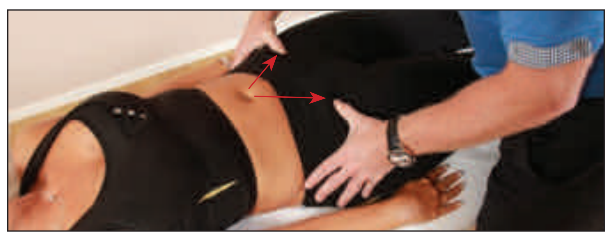
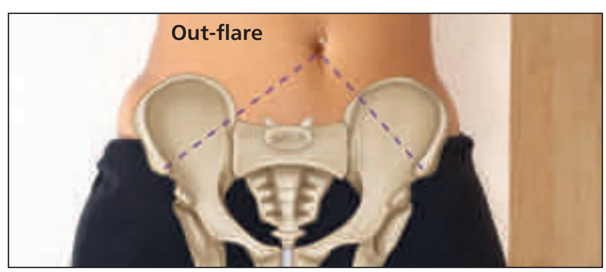


Figure 12.52. (a) Palpation assessment from the ASIS to the umbilicus, looking for an out-flare/in-flare.



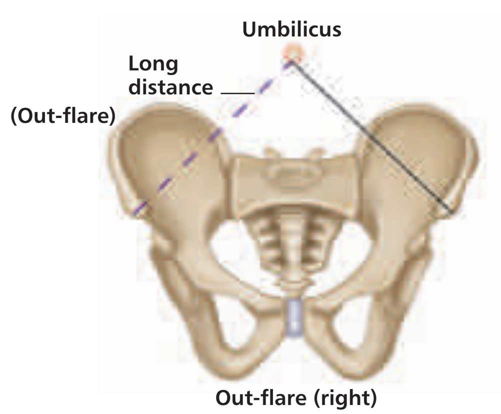


Figure 12.52. (b) Iliosacral out-flare of the innominate bone.

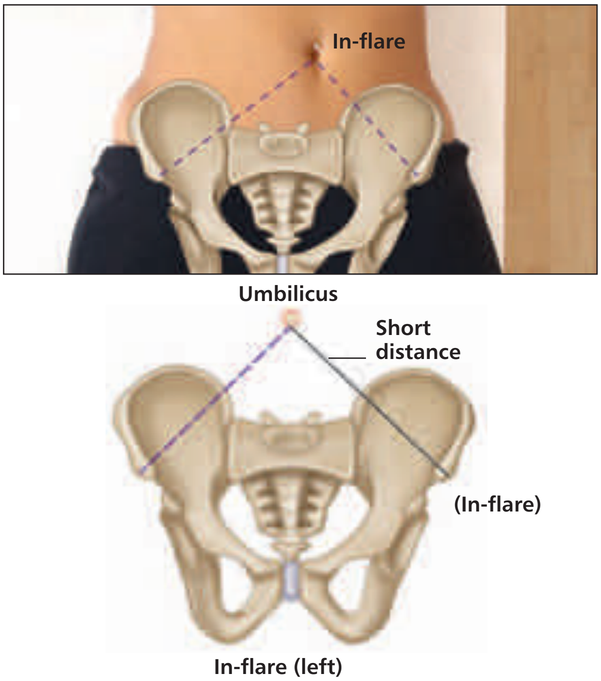


Figure 12.52. (c) Iliosacral in-flare of the innominate bone.

DeStefano (2011) is a particularly interesting read, and includes the following abstract:

"The two dysfunctions out-flare and in-flare are quite rare and they are only found in those SIJs that have altered convex-to-concave relationships to S2 with convexity on the sacral side and concavity on the ilia side. They can only be diagnosed after the correction of any hipbone rotational dysfunction that is present."

Sacroiliac Dysfunction

The following sacroiliac dysfunctions are possible:

- L-on-L anterior sacral torsion
- R-on-R anterior sacral torsion
- L-on-R posterior sacral torsion
- R-on-L posterior sacral torsion
- Bilaterally nutated sacrum
- Bilaterally counter-nutated sacrum

Tables 12.3, 12.4 and 12.5 summarize all of the specific testing and palpatory findings for all of the sacral torsions and sacral dysfunctions.

	L-on-L sacral torsion (forward/nutation)	R-on-R sacral torsion (forward/nutation)
Deep sacral sulcus	Right	Left
Shallow sacral sulcus	Left	Right
ILA posterior	Left	Right
L5 rotation	Right—ERS(R)	Left—ERS(L)
Seated flexion test	Right	Left
Lumbar spring	Negative	Negative
Sphinx (extension) test	Sulci level	Sulci level
Lumbar flexion test	Right sacral sulcus deep	Left sacral sulcus deep
Lumbar lordosis	Increased	Increased
Medial malleolus (leg length)	Short left	Short right

Table 12.3. Anterior/forward sacral torsions (normal physiological motion).

	L-on-R sacral torsion (backward/counter-nutation)	R-on-L sacral torsion (backward/counter-nutation)
Deep sacral sulcus	Right	Left
Shallow sacral sulcus	Left	Right
ILA posterior	Left	Right
L5 rotation	Right—FRS(R)	Left—FRS(L)
Seated flexion test	Left	Right
Lumbar spring	Positive	Positive
Sphinx (extension) test	Left sacral sulcus shallow (right sacral sulcus deeper)	Right sacral sulcus shallow (left sacral sulcus deeper)
Lumbar flexion test	Sulci level	Sulci level
Lumbar lordosis	Decreased	Decreased
Medial malleolus (leg length)	Short left	Short right

Table 12.4. Posterior/backward sacral torsion (non-physiological motion).

	Bilaterally nutated sacrum (forward)	Bilaterally counter-nutated sacrum (backward)
Standing flexion test	Negative	Negative
Seated flexion test	Positive bilateral	Positive bilateral
Stork (Gillet) test	Positive on both sides	Positive on both sides
Sacral base	Left and right anterior	Left and right posterior
ILA	Left and right posterior	Left and right anterior
Lumbar spring test	Negative	Positive
Lumbar lordosis	Increased	Decreased
Medial malleolus (leg length)	Equal	Equal

Table 12.5. Bilaterally nutated and counter-nutated sacrum.

I would like to recap just for a moment. By the time you have got to this stage of the book you should know that a dysfunction of the SIJ can result from how the pelvis (innominates) impacts on the sacrum, and, vice versa, from how the sacrum impacts on the pelvis (innominates). If the pelvis is fixed on the SIJ, then (as explained in previous chapters) we call it an *iliosacral dysfunction*; if the sacrum is fixed on the pelvis, then we call it a *sacroiliac joint dysfunction*.

Let's look at trying to find sacral torsions in a way that is different from (but hopefully simpler than) the one I have already explained. Your patient is lying in a prone position, and hopefully in a position of neutral; your thumbs are sitting nicely within the left and right sacral sulci. In this position, you feel that your right thumb is *shallow* and your left thumb is *deeper.* What does this mean? Think about it before reading on—yes, either the right side of the sacral base is posterior and also right rotated, or the left side is anterior but again right rotated. If the sacral base is rotated in neutral, it therefore has to be dysfunctional: either the right side is fixed posteriorly (counter-nutation) or the left (deeper) side is fixed anteriorly (nutation).

How to Decide on the Fixation?

With the patient still prone and our thumbs sitting on the left and right sacral sulci, we can ask the patient to backward bend (come up onto the elbows, as in reading a book), and forward bend (ask the patient to tilt their pelvis posteriorly or to perform the lumbar flexion test, as shown previously) from the position they are in. If the rotation increases (gets worse) in a backward-bent position (right thumb becomes shallower and left thumb becomes deeper), and then the rotation is seen to disappear in a forward-bent position, you know that the right side has to be fixed in a posterior position and rotated to the right, as in a R-on-L sacral torsion. This is because when you ask your patient to backward bend, the sacrum has to be able to go in an anterior direction, which it cannot do. The right fixed sacrum therefore now becomes a fixed pivot point, and so is unable to perform this forward motion because of the fact that the right sacral base is fixed posteriorly; hence the rotation looks worse.

With these types of posterior fixation you will notice a reduction in lumbar lordosis (back flattens), and the L5 spring test will feel firm to palpation when pressure is applied (positive test).

Let's look at the other scenario whereby the left sacral base is fixed in an anterior position (nutation). We again ask the patient to perform backward bending and forward bending motions. This time, however, the forward-bent position gives the appearance of the rotation increasing, and the backward-bent position seems to make the sacral base become level. This is because during the forward bending motion, the left sacral base stays fixed anteriorly, so it cannot move in a posterior direction; it therefore becomes a pivot point, but the patient's right sacral base moves further in a posterior direction and subsequently makes the rotation appear to become worse. This type of dysfunction is called a *R-on-R sacral torsion*.

With these types of anterior fixation, you will notice an increase in lumbar lordosis, and the L5 spring test will indicate some spring when pressure is applied (negative test).

> **Tip:** A simple rule of thumb for determining which side is fixed is as follows. If the sacral rotation increases when the patient backward bends, then the side that the sacrum has rotated to (the shallow side) will be the side that is fixed posteriorly. This dysfunction is a counter-nutated sacral torsion as in a L-on-R sacral torsion or a R-on-L sacral torsion.

If, however, with your patient still in the backward-bent position, the sacral rotation becomes level (it seems to disappear), then the side opposite to the side of rotation (think back to the neutral test of sacral sulcus) is the side that is fixed anteriorly. This is a nutated sacral torsion as in a *R-on-R sacral torsion* or a *L-on-L sacral torsion*.

I like the way this is interpreted in DeStefano (2011), which contains the following statement (overleaf) regarding sacral torsions:

"Forward torsions become asymmetric in forward bending and become symmetric in backward bending. The posterior torsions are the reverse, they get more asymmetric in backward bending and symmetric in forward bending."

Bilaterally Nutated/Counter-Nutated Sacrum

I have left bilateral sacral nutation (forward) and bilateral sacral counter-nutation (backward) till the end of the discussion, since they only occur very rarely and are also often missed by an examiner. Most of the initial tests (such as the standing forward flexion test) will turn out to be negative, and also the levels of the sacral base and the ILA will be level; however, the stork test will demonstrate a bilateral restriction and is of value to the overall diagnosis. These sacral dysfunctions are generally related to the 5th lumbar vertebra (L5); for instance, if the sacrum is bilaterally nutated, it will cause an extension position of L5, whereas if the sacrum is bilaterally counter-nutated, L5 will be held in a flexed position. The consequences will be the change in lordosis curvature and the positive or negative result from the lumbar spring test.

Symphysis Pubis Dysfunction

The pubic bone tends to be either superior or inferior, although some authors discuss other types of potential symphysis pubis dysfunction (SPD). Here we will focus on:

- Superior pubis
- Inferior pubis

Tables 12.6 and 12.7 summarize all of the specific testing and palpatory findings for SPDs.

	Superior pubis	Inferior pubis
Standing forward flexion test	Left	Left
Pubic tubercle	Superior	Inferior
Inguinal ligament	Tender on palpation	Tender on palpation

Table 12.6. Symphysis pubis dysfunctions—left side.

	Superior pubis	Inferior pubis
Standing forward flexion test	Right	Right
Pubic tubercle	Superior	Inferior
Inguinal ligament	Tender on palpation	Tender on palpation

Table 12.7. Symphysis pubis dysfunctions—right side.

To be honest, I feel that this area of the pelvic girdle (the symphysis pubis) is probably the least assessed and consequently the least treated, and this also applies to me, especially when I am with my own patients. I would say that some therapists more than likely tend to focus on the area of the pain, without realizing that part of the problem potentially lies in a different area. Recall the wise words of Dr. Ida Rolf: "Where the pain is, the problem is not." This could not be any truer than when looking for dysfunction within the SPJ.

Case Study

When an excellent physiotherapist and a personal friend of mine called Gordon Bosworth was mentoring me in my early osteopathy studies, I remember him assessing a young male who was part of the Olympic bobsleigh team; he had what had been diagnosed as a typical groin strain of the adductor longus muscle and the team doctor had recommended treatment through the use of a steroid injection.

The patient decided not to have the injection but to see the team's physiotherapist (Gordon) instead. I remember actually watching the patient being assessed (in a similar way to that mentioned in this chapter); Gordon came to the decision that this patient had an iliosacral dysfunction on the right side and corrected that dysfunction using the techniques I will be demonstrating in Chapter 13. I then watched Gordon assess the SPJ and once again he said a dysfunction was present and then proceeded to correct the underling issue by using a specific MET for the SPJ (also explained in Chapter 13). After performing the realignment techniques, he retested the area of the pain by doing a resisted adductor test; to my surprise, the pain had completely disappeared. From that moment on, I knew that this joint demanded a bit more love and attention, as it could just be the key to solving the overall problem.

When trying to decide on the side that is dysfunctional, the first thing that is relevant is the standing forward flexion test. So if, let's say, the standing forward flexion test is positive on the left side, you know that a dysfunction is present and that it is located specifically on the left side. The second thing to consider is palpation of the bony landmarks: if you palpate the area of the pubic tubercle and you determine the level to be cephalic/superior compared with the opposite side, you know that a superior pubis condition exists (only if the standing forward flexion test is positive on that side). The third thing that also confirms the diagnosis is tenderness of the inguinal ligament on palpation.

How to Decide Which Dysfunction Exists

Out of all the tests I have shown you, I consider the key ones to be the standing and seated forward flexion. I say that because these tests specifically indicate the side of the body on which the dysfunction is present. If your patient bends forward in the standing position, and the left side of the PSIS travels further than the right side, the conclusion is that they have either an iliosacral dysfunction or a SPD on the left side. However, if the standing flexion test is negative (i.e. the thumbs move symmetrically when the patient forward bends), but you notice that your left thumb moves more cephalically than your right thumb during the seated forward flexion test, the indications are that a sacroiliac dysfunction is present on the left side.

The standing and seated forward flexion tests do not actually tell you what is wrong, in terms of the actual dysfunction that is present: they only give you some of the necessary information regarding the side on which the dysfunction exists. It therefore makes sense, especially as a starting point, to treat the side that tests positive in the standing/seated forward flexion tests. During the examination process, you may notice that what you consider to be the side of the fixation might not actually be the painful side for the patient's presenting symptoms. The side that is presenting with pain could be the side that is doing all the motion (hypermobile) and is compensating for the side that is fixed (hypomobile).

As a sort of recap (which I hope will help you to understand exactly what I am trying to put across), let's think about what I said in the previous paragraph. In general, if the standing flexion test is positive for the left side, then the dysfunction is present on that same side, possibly indicating an iliosacral or even an SPD. This test will be part of the process that will help you ascertain what the dysfunction is and formulate a treatment plan. If, however, the seated flexion test is positive, this indicates a *sacroiliac dysfunction* on the tested side and not an iliosacral dysfunction or SPD. Just to complicate matters somewhat, you can have a standing forward flexion test indicating positive on the left side (iliosacral/pubic dysfunction), and a seated forward flexion test indicating positive on the right (SIJ dysfunction), both at the same time.

Unfortunately, it is never as easy as it might seem. Remember what Schamberger (2013) says: an iliosacral upslip (in isolation) and a true LLD have no correlation to the standing forward flexion test. With a right upslip, for example, the right PSIS remains higher than the left to an equal extent throughout the full range of flexion carried out in either a standing or a sitting position. Basically, it would appear to be a false positive because of the motion of the right PSIS; however, the left PSIS traveled an equal distance, making the test negative. Please bear these things in mind when you are reading other texts about the lumbopelvic complex, and try to be a little open-minded, especially when you are assessing your own patients and athletes.

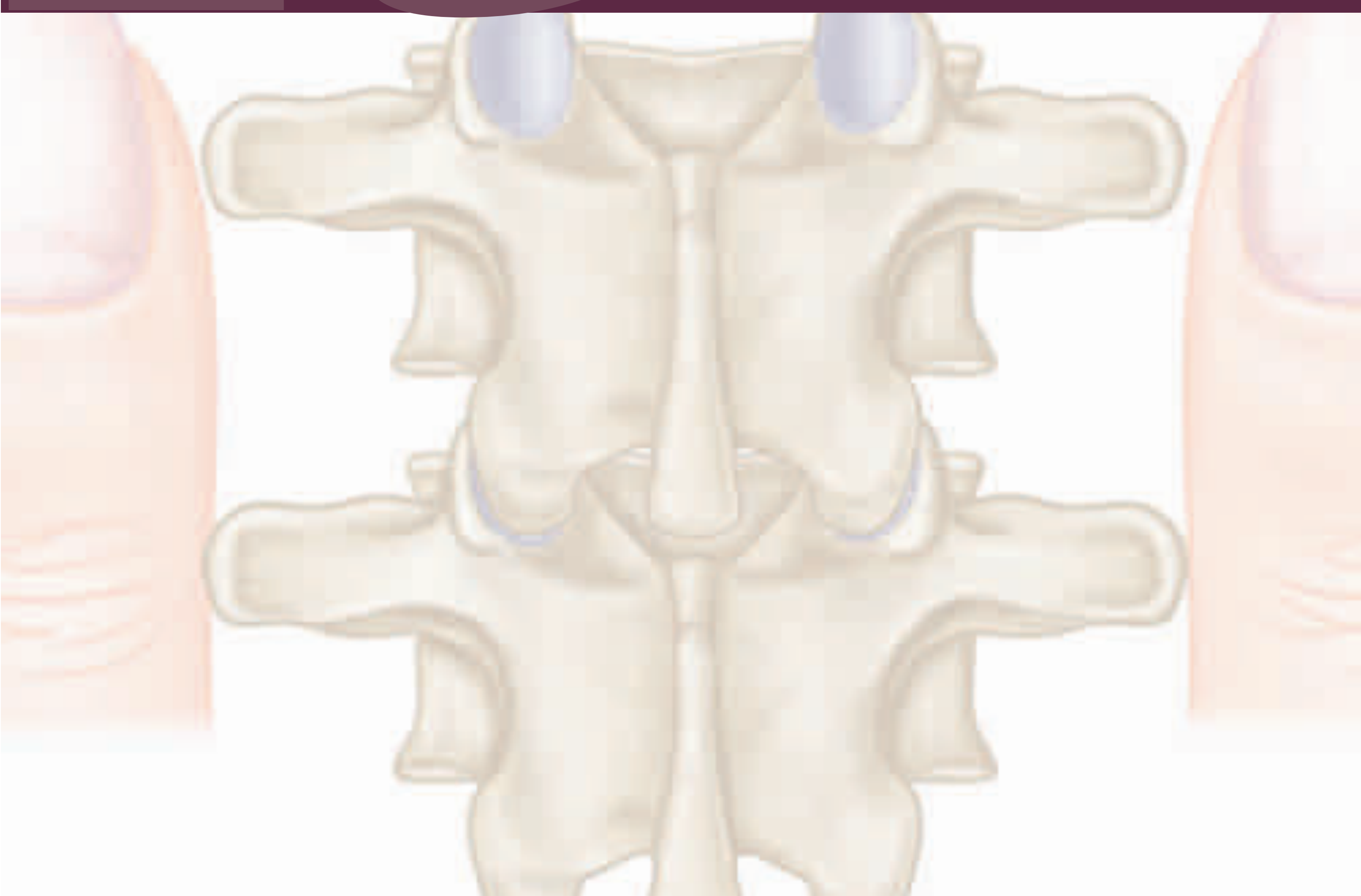
The Next Step

I hope that now you have reached this stage of the book, the jigsaw puzzle pieces are forming a recognizable picture. Perhaps the picture is not absolutely clear yet, but if you have understood what I am trying to say, then some image should at least have developed in your mind. Be honest with yourself: if you do not quite understand the content of each of the chapters, then I suggest you read them again, or at least certain parts, before continuing to Chapter 13 and beginning to actually treat common pelvic dysfunctions.

I say that because if you truly do not understand the concepts and the underlying biomechanics of the pelvic girdle, then how will you be able to treat patients effectively? That said, the techniques I demonstrate in the next chapter are very safe to perform, as the majority of them are soft tissue techniques, specifically METs. It would therefore be acceptable if you wanted to practice them on a colleague first, before actually using them on real patients with real symptoms. I would still recommend that you have a good understanding of all the potential dysfunctions that your patient could present with to your clinic, before you unreservedly say that you are an effective therapist and that what you plan to do in terms of treatment will be of value to your patient.

13

Treatment of the Pelvis



As you will probably have guessed by now, this is the final chapter of the book and I hope you have enjoyed reading all of the other chapters leading up to it. I think it makes perfect sense to finish the book with a chapter that concentrates on one of the most important areas, namely the treatment of all the various types of pelvic girdle and lumbar spine dysfunctions that have been previously covered and discussed extensively throughout this text.

The focus of this particular chapter will therefore be on the application of specific realignment techniques for treating the three main areas of the pelvis: symphysis pubis, iliosacral, and sacroiliac types of dysfunction. These are the most common presentations typically found when assessing athletes and patients.

At the end of this chapter I will also include a treatment strategy for the area of the lumbar spine, because the lumbar spine is a naturally occurring connection to the pelvis. I always say the following to my students: if you have a primary pelvic girdle dysfunction, there must be some form of compensatory mechanism continuing on throughout the area of the lumbar spine, and even the thoracic spine and the cervical spine will be involved in the compensation process; these areas could be a potential site of pain and a natural concern for your patients. Once you have applied some of the realignment techniques that I am about to demonstrate for the pelvic girdle, it would be sensible to make absolutely sure that the lumbar spine is also in a relatively level position through the appropriate treatment protocols discussed at the end of this chapter.

In previous chapters I discussed in great detail how to thoroughly assess the three areas of the pelvic girdle in order to confirm or discount the existence of any presenting malalignment syndromes. We now need to put everything that has been taught into practice by applying the following techniques to correct and normalize the various musculoskeletal dysfunctions that you might find during your initial assessment/screening process.

Treatment Strategy

Other experts in this complex field of manual medicine start the treatment strategy by initially correcting the position of the lumbar spine. They then move on to dysfunctions that are found within the iliosacral area, followed by the region of the sacroiliac, and finishing off with a treatment of the symphysis pubis joint.

In DeStefano (2011), Greenman's suggestion of the treatment sequence is: symphysis pubis, hipbone shear (upslip is considered a hipbone shear) dysfunction, sacroiliac dysfunction, and iliosacral dysfunction.

My personal preference is the following (and I like to think it is similar to Greenman's approach, as I was taught his manual medicine principles early on in my osteopathy training). I would recommend starting the corrective treatment with the symphysis pubis joint, followed by treatment of iliosacral dysfunctions (upslip first), and then moving on to sacroiliac dysfunctions. I would finish the treatment, if I felt it was necessary, with any compensatory dysfunctions that are present within the region of the lumbar spine.

Greenman in DeStefano (2011) recommends treating the symphysis pubis joint early on during the assessment process. The reason for this is that SIJ dysfunctions are typically found in a patient in the prone position; if a symphysis pubis dysfunction is present at the front of the body, the patient is not symmetric in the prone position, resting on the tripod formed by the two ASISs and the symphysis pubis.

Greenman also suggests treating superior shear (upslip) after the symphysis pubis, as he found that the presence of shear restricts all other motions within that SIJ: therefore, he says shear deserves attention early on in the treatment process. He mentions that you need to have two symmetric hipbones available in order to assess the position of the sacrum between these two bones.

In terms of assessing and treating patients, I consider my concept/approach to be similar to Greenman's. When I give lectures to my students about the pelvis and SIJ, I like to recommend *Greenman's Principles of Manual Medicine* (DeStefano 2011), as I think it is a great book for assisting students in learning about this area. However, I also highly recommend other physical therapy books to my students (see Bibliography), such as those by the experts Lee, Vleeming, and Schamberger. I would like to think that in time, if students of physical therapy endeavor to read some, or indeed all of the books I have recommended (as well as this book), they will hopefully be able to competently assess, identify, and treat their own patients and athletes in their own clinical settings.

Note: The realignment techniques demonstrated in this chapter mainly consist of soft tissue techniques, specifically METs, as explained in Chapter 7. However, since I am an osteopath and have trained in the skill of spinal manipulation, the word "thrust" or the words "high-velocity thrust" (or abbreviation HVT) will be mentioned from time to time. These advanced techniques should only be incorporated into the treatment plan if one has the necessary training and qualifications to perform them.

Most of the techniques I will show you are very safe to perform in your own clinic. If you are unsure of which technique (depending on your skill level and qualifications) is best applied to your patient, I would follow the soft tissue MET approach initially, as generally these techniques will cause no harm but are very effective at correcting any malalignment presentations, especially when used properly. However, there will come a time when you will feel a thrust technique (HVT) is needed, so you have a choice: either you can train in the appropriate field of manual therapy, e.g. osteopathy or chiropractic, or it might be easier (in my opinion) to simply refer your patient to a suitably qualified practitioner who is skilled in the art of spinal manipulation.

Part 1: Treatment Protocol for Symphysis Pubis Dysfunctions

Symphysis pubis dysfunctions (SPDs) are very common but are generally neglected in terms of treatment by the physical therapist; I feel that this is probably because of the lack of symptomatic pain within the SPJ. The pubic bone tends to be either superior or inferior (although other types of potential dysfunction are discussed by some authors). For this text, we will focus on:

- Superior/inferior SPD
- Left superior SPD
- Right inferior SPD

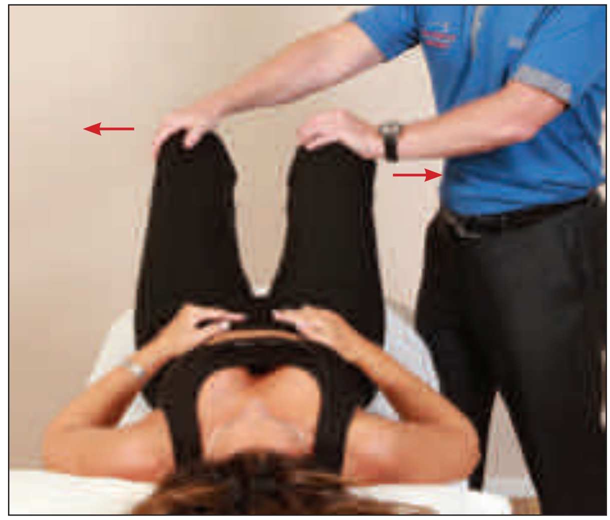


Figure 13.1. (a) The patient abducts their hips against a resistance applied by the therapist.

Diagnosis: Superior/Inferior SPD

Treatment: MET/Thrust technique (shotgun technique)

Position: Supine

The patient adopts a supine position with the knees and hips bent and the feet flat. The therapist stands at the side of the couch and places their hands on the outsides of the patient's knees.

The patient is asked to abduct their hips against a resistance for 10 seconds, as shown in Figure 13.1(a), which causes an RI effect in the adductors; this isometric contraction is repeated approximately three times. The therapist then places a clenched fist between the patient's knees, and the patient is asked to squeeze the fist tightly (adduction), as shown in Figure 13.1(b). This motion of adduction is generally enough to cause a realignment of the symphysis pubis joint—it is very common for a noise (due to cavitation) to be heard from the joint, indicating a release. There is no direct thrust involved with this technique, so it is very safe to perform.

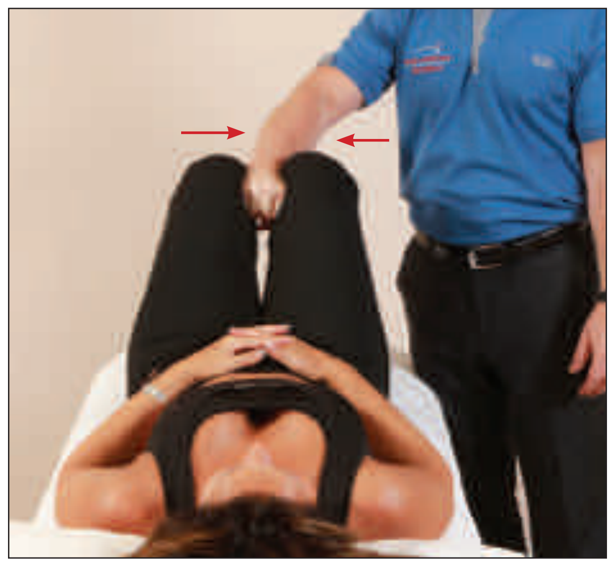


Figure 13.1. (b) The therapist places their clenched fist between the patient's knees as they adduct firmly.

If there is no sign of cavitation using the above technique, and you still consider the joint to be dysfunctional, a thrust/HVT technique is appropriate. After the patient has abducted the hip three times, as in Figure 13.1(a), the therapist places their hands on the insides of the patient's knees, as shown in Figure 13.2(a), or even their forearms (if easier), as shown in Figure 13.2(b). The patient is then asked to adduct quickly and strongly against the applied resistance. As the patient adducts, the therapist can apply a rapid abduction motion, as shown in Figure 13.3. If a dysfunction is present, this specific technique will cause a cavitation of the symphysis pubis joint; hence this technique is known as the *shotgun*.

Figure 13.2. (a) The therapist places their hands between the patient's knees as they adduct firmly.

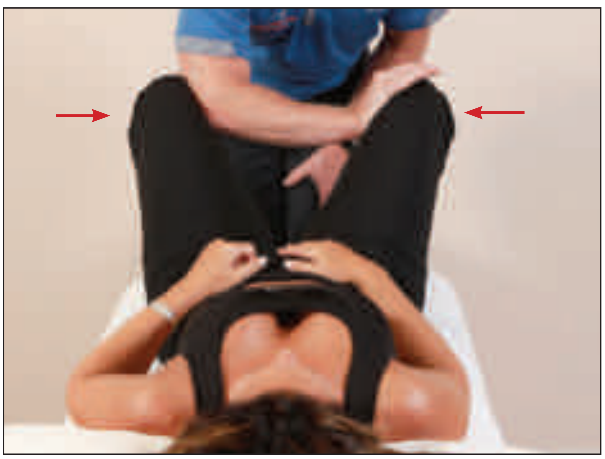


Figure 13.2. (b) The therapist places their forearms between the patient's knees as they adduct firmly.

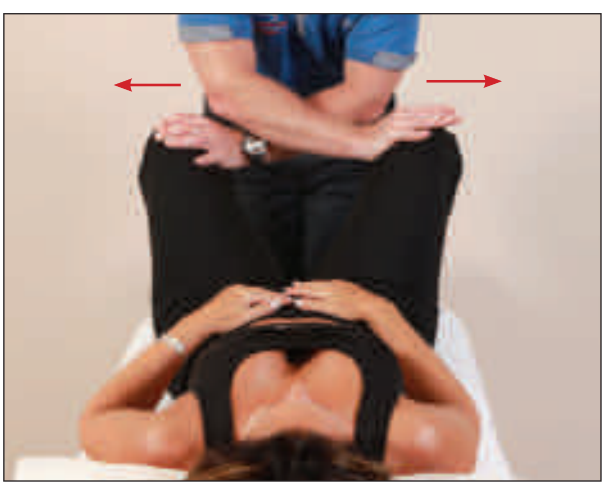


Figure 13.3. The therapist quickly separates the patient's knees while they are still adducting. A noise is sometimes heard as the symphysis pubis joint undergoes cavitation.

Diagnosis: Left Superior SPD

Treatment: MET

Position: Supine

The patient adopts a supine position and lies at the edge of the couch with their arms placed across their body for extra support. The therapist stands on the same side as the dysfunction and places the patient's left leg so that it hangs off the couch. The therapist stabilizes the right side of the patient's pelvis with their left hand, and places their right hand above the left patella, to stabilize the patient's left leg, as shown in Figure 13.4.

Figure 13.4. The therapist supports the patient, whose left leg hangs off the couch.

From this position, the patient is asked to flex their left hip against a resistance applied for 10 seconds by the therapist, as shown in Figure 13.5. On the relaxation phase, the therapist guides the patient's left leg into further extension, as this will encourage the left side of the symphysis pubis joint to move inferiorly, as shown in Figure 13.6.

Figure 13.5. The patient lifts their left hip into flexion against a resistance applied by the therapist.

Figure 13.6. After the 10-second contraction, the therapist takes the leg into further extension, which encourages the left side of symphysis pubis to move inferiorly.

Diagnosis: Right Inferior SPD

Treatment: MET

Position: Supine

The patient adopts a supine position and lies at the edge of the couch with their arms placed across their body for extra support. The therapist stands on the side opposite to the dysfunction.

The therapist then flexes and adducts, with a slight internal rotation, the patient's right leg; this motion will encourage superior motion of the right side of the symphysis pubis. Using the patient's leg as a lever, the therapist lifts the right side of the patient's pelvis off the couch, so that they can place their left hand on the patient's right PSIS while putting the heel of the same hand onto the ischial tuberosity, as shown in Figure 13.7.

Figure 13.7. The patient's right hip is guided into flexion, adduction, and internal rotation.

The therapist lowers the pelvis down onto their hand; from this position the patient is asked to extend their right hip against a resistance applied for 10 seconds by the therapist, as shown in Figure 13.8. On the relaxation phase, the therapist encourages the patient's right leg into further flexion, while at the same time pressure is applied to the ischial tuberosity, as shown in Figure 13.9; this will encourage the right side of the symphysis pubis joint to move superiorly.

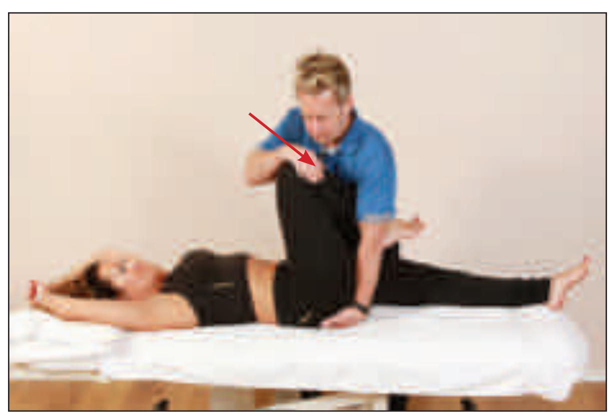


Figure 13.8. The patient extends their hip against a resistance applied by the therapist.

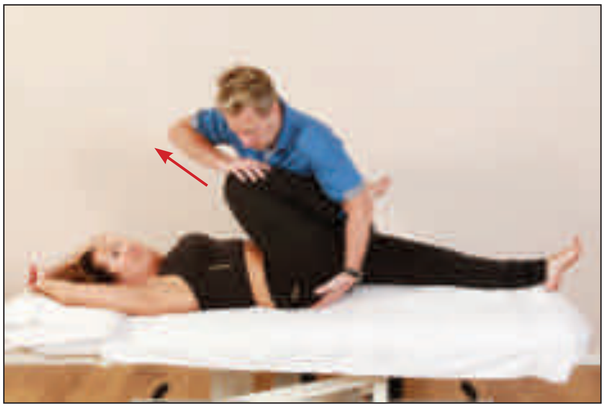


Figure 13.9. The therapist guides the patient's leg into further flexion while applying pressure to the ischial tuberosity.

Part 2: Treatment Protocol for Iliosacral Dysfunctions

The following iliosacral dysfunctions are possible:

- Anteriorly rotated innominate
- Posteriorly rotated innominate
- Superior shear (cephalic)—upslip
- Inferior shear (caudal)—downslip
- Iliosacral out-flare (lateral rotation of innominate)
- Iliosacral in-flare (medial rotation of innominate)

Diagnosis: Right Anteriorly Rotated Innominate (Most Common)

Treatment: MET

Position: Side lying

Technique 1
The patient adopts a side-lying position and the therapist stands on the same side as the dysfunction. The patient's hip and knee are flexed to approximately 90 degrees and brought over the edge of the couch. The therapist stabilizes the patient's right innominate with their left hand and palpates the patient's PSIS with their right hand, as shown in Figure 13.10(a).

Figure 13.10. (a) The therapist cradles the patient's knee and hip at 90 degrees while controlling the innominate bone.

The therapist fine-tunes this position by palpating the PSIS with their right hand as they flex the patient's hip until a barrier (point of bind) is felt at the level of the PSIS. From this position and using approximately 20% effort, the patient is asked to extend their hip (Gmax and hamstrings) against a resistance applied by the therapist for 10 seconds, as shown in Figure 13.10(b).

Figure 13.10. (b) The patient extends their hip against a resistance applied by the therapist.

After the contraction, and on complete relaxation, the right innominate bone is guided by the therapist's left hand into a posteriorly rotated position, while at the same time the hip and knee are being flexed, as shown in Figure 13.10(c). This is repeated (normally three times) until a new barrier has been achieved.

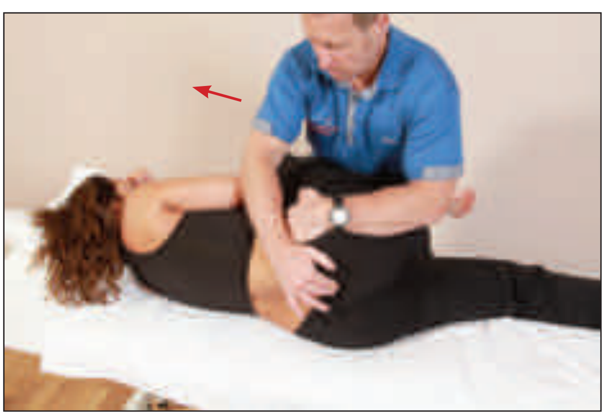


Figure 13.10. (c) The therapist guides the patient's innominate bone into a posteriorly rotated position as the knee and hip are being flexed.

Diagnosis: Left Anteriorly Rotated Innominate (Less Common)

Treatment: MET

Position: Side lying

Technique 2
(An alternative technique to correct a left anterior innominate rotation)

This is a similar technique to that explained above, with a few modifications: this time the dysfunction relates to a left anterior innominate rather than a right anterior innominate. The patient adopts a side-lying position and the therapist stands on the same side as the dysfunction. The patient's upper torso is placed in a right rotation, as this induces tension down to the lumbosacral junction and prevents unnecessary motion of the lumbar spine. Next, the therapist places the patient's left hip into flexion, and the patient's posterior thigh is rested against the therapist's hip (the patient hooks their left leg around the therapist), as shown in Figure 13.11(a). The patient's right lower leg is placed in an extended position.

Figure 13.11. (a) The patient's torso is placed in a right rotation. The therapist cradles the patient's hip at 90 degrees while palpating the left PSIS.

The therapist palpates the PSIS and encourages flexion of the hip until a point of bind is felt. From this position and using approximately 20% effort, the patient is then asked to extend their hip (Gmax and hamstrings) against a resistance applied for 10 seconds by the therapist, as shown in Figure 13.11(b).

Figure 13.11. (b) The patient extends their hip for 10 seconds while the therapist palpates the left PSIS.

On complete relaxation, the left innominate bone is guided into a posteriorly rotated position by the therapist's right hand, while at the same time the hip and knee are being flexed, as shown in Figure 13.11(c). This is repeated (normally three times) until a new barrier has been achieved.

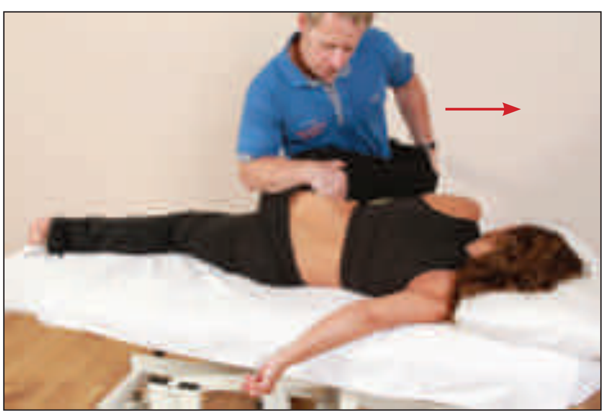


Figure 13.11. (c) The therapist guides the patient's innominate bone into a posteriorly rotated position as the knee and hip are being flexed.

Diagnosis: Right Anteriorly Rotated Innominate (More Common)

Treatment: MET

Position: Side lying

Technique 3
(An alternative technique to correct a right anteriorly rotated innominate)

The following technique is another alternative method for correcting anterior innominate rotation, in this case on the right side. This time the therapist stands behind the patient and cradles the right innominate with both hands, as the patient holds onto their knees at 90 degrees.

From this position, the therapist fines-tunes the innominate bone in a posterior rotation direction, in order to isolate the position of bind. The patient is then asked to resist hip extension against pressure applied by their own hands for 10 seconds, as shown in Figure 13.12.

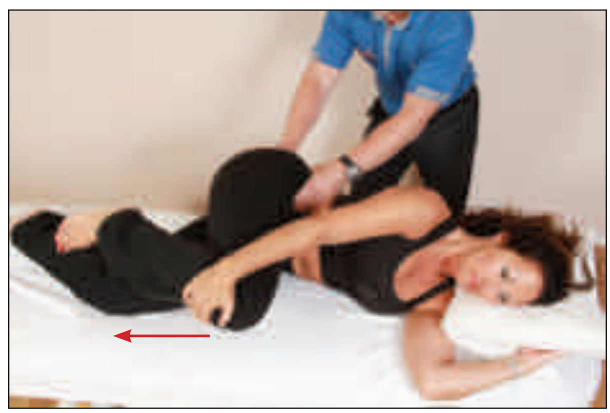


Figure 13.12. The therapist cradles the patient's innominate bone, and the patient holds their knees at 90 degrees. The patient then extends their hip against a resistance applied by their own hands.

After the 10-second contraction, and on complete relaxation, the patient is asked to slowly pull their right hip into full flexion at the same time as their right innominate is being guided by the therapist into a posteriorly rotated position, as shown in Figure 13.13.

Figure 13.13. The therapist guides the patient's innominate into a posteriorly rotated position, as the patient flexes their hip.

Diagnosis: Left Posteriorly Rotated Innominate (Common)

Treatment: MET

Position: Prone

Technique 1

The patient adopts a prone position and the therapist stands on the same side as the dysfunction. The patient is asked to lift their left leg a few inches, so that the therapist can place their right arm under the patient's left thigh; the therapist interlocks their hands, so that their forearm rests on the patient's left PSIS.

The therapist fine-tunes this position by slowly extending and adducting the patient's hip joint until a barrier is felt. From this barrier, the patient is then asked to gently flex the hip of the affected side against a resistance for 10 seconds, as shown in Figure 13.14.

Figure 13.14. The therapist supports the patient's leg while controlling the innominate bone with their forearm. The patient then flexes their hip against a resistance applied by the therapist.

On complete relaxation, the therapist takes the extended leg further into hip extension and adduction, while gently encouraging anterior innominate rotation with their forearm. This combined movement of the hip joint and pelvis induces an anterior rotation of the innominate bone, as shown in Figure 13.15. This is repeated (normally three times) until a new barrier has been achieved.

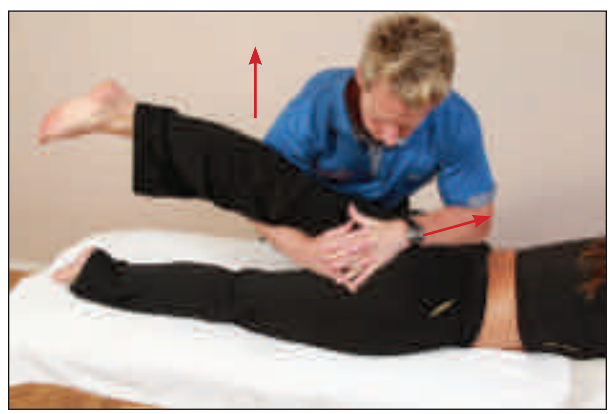


Figure 13.15. The therapist guides the patient's innominate bone in an anterior rotation direction, as the hip is extended and adducted at the same time.

Diagnosis: Right Posteriorly Rotated Innominate (Less Common)

Treatment: MET

Position: Prone

Technique 2
(An alternative technique, for a less common right posterior innominate rotation)

Some patients' legs can be extremely heavy; because of the increased weight of the leg in this case, I consider the following alternative technique a little easier to perform.

This time the therapist stands on the side (the left side) opposite to the dysfunction (the right side is fixed posteriorly). The patient is asked to lift their left leg a few inches, so that the therapist can place their right hand under the patient's right knee, while the left hand rests just at the level of the patient's right PSIS.

The therapist fine-tunes this position by slowly extending and adducting the right hip until a barrier is felt. From this barrier, the patient is asked to gently flex the right hip against a resistance applied by the therapist for 10 seconds, as shown in Figure 13.16.

Figure 13.16. The therapist supports the patient's leg, while controlling the innominate bone with their hand. The patient then flexes their hip against a resistance applied by the therapist.

On complete relaxation, the therapist takes the right leg further into hip extension and adduction, while applying pressure with their left hand to the patient's right PSIS. This combined movement induces an anterior rotation of the right innominate bone, as shown in Figure 13.17. This is repeated (normally three times) until a new barrier has been achieved.

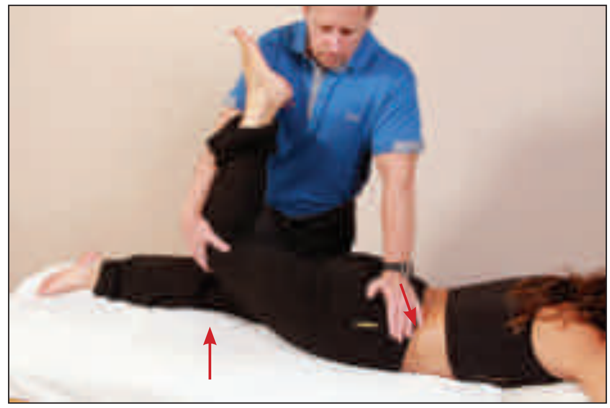


Figure 13.17. The therapist guides the patient's innominate in an anterior rotation direction, as the hip is extended and adducted at the same time.

Diagnosis: Right Superior Shear (Cephalic)—Upslip

Treatment: MET/Mobilization/Thrust technique

Position: Prone

The patient adopts a prone position and the therapist stands on the same side as the dysfunction. The patient is asked to slide down the couch until their knees are just off the edge. The patient is then asked to look to one side (any) and not to hold on to anything. The therapist straddles the patient's right leg and internally rotates the patient's thigh to cause a close-packed position of the hip joint, as shown in Figure 13.18.

Figure 13.18. The therapist straddles the patient's right leg and internally rotates their hip in order to establish a close-packed position of the hip joint.

The therapist's right hand palpates the patient's right PSIS as their left hand stabilizes either the sacrum or the left thigh. With their thigh, the therapist slowly starts to grip the patient's right leg, while applying some traction to the leg by inducing a caudal pull to the right leg until the barrier is reached.

At the barrier, an MET is applied by asking the patient to hitch their pelvis up by activating their QL muscle for 10 seconds against a resistance applied by the straddling of the therapist's legs, as shown in Figure 13.19.

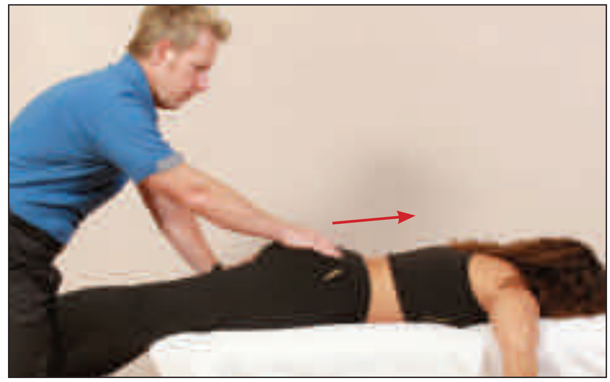


Figure 13.19. Using their QL muscle, the patient hitches the pelvis up in a cephalic/superior direction for 10 seconds.

After the contraction, and during the relaxation phase, a new barrier is found by gently applying a caudal/inferior traction to the leg, as shown in Figure 13.20. This technique is repeated three times. A mobilization or a manipulation (thrust) technique can also be performed from this position, to encourage a caudal/downward movement of the right innominate bone.

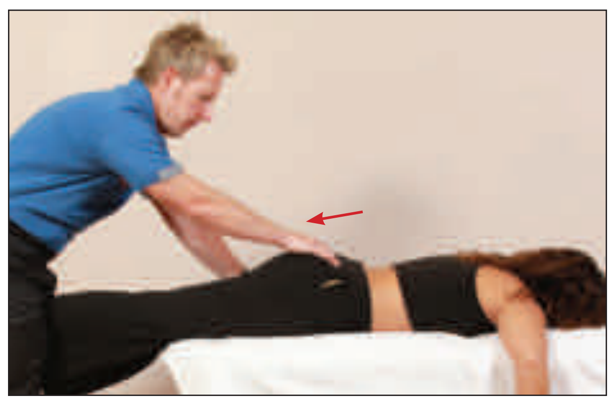


Figure 13.20. The therapist performs a traction/mobilization or a manipulation (thrust) technique to the leg in a caudal direction after the initial MET contraction/treatment.

Diagnosis: Left Superior Shear (Cephalic)—Upslip

Treatment: MET/Mobilization/Thrust technique

Position: Supine

The patient adopts a supine position, with their right knee bent at 90 degrees (this prevents unnecessary motion of the right innominate bone). The therapist stands on the same side as the dysfunction and internally rotates the patient's thigh to introduce a close-packed position of the left hip joint.

The therapist gently grips the patient's lower leg with their hands and starts to apply light traction to the left leg by inducing a caudal pull to engage the barrier. At the barrier, a mobilizing technique, MET, or high-velocity thrust (HVT) is performed to encourage a caudal/downward movement of the innominate bone, as shown in Figure 13.21.

Figure 13.21. The therapist has the choice of performing an MET, a mobilization, or a manipulation technique from this specific position.

Diagnosis: Right Iliosacral Out-Flare (Lateral Rotation of Innominate)

Treatment: MET

Position: Supine

The patient adopts a supine position and the therapist stands on the same side as the dysfunction. The therapist flexes the patient's right hip and knee, then lifts the pelvis to the left using the leg as a lever, so that they can place their hand on the patient's right PSIS. The therapist lowers the patient's pelvis down until it rests on their hand, and then adducts the patient's hip with their right hand until a barrier is felt for the internal rotation of the innominate bone.

From this position of bind, the patient is asked to externally rotate and abduct their hip for 10 seconds, as shown in Figure 13.22.

Figure 13.22. The therapist puts the patient's right hip into flexion and places their hand on the patient's PSIS. The patient then externally rotates against a resistance applied by the therapist.

On the relaxation phase, a new barrier of internal rotation is achieved, while at the same time the therapist is applying a traction technique to the patient's right PSIS, as shown in Figure 13.23

Figure 13.23. The therapist guides the patient's right hip into internal rotation while applying traction to the PSIS to encourage a neutral position of the innominate.

Diagnosis: Left Iliosacral In-Flare (Medial Rotation of Innominate)

Treatment: MET

Position: Supine

The patient adopts a supine position and the therapist stands on the same side as the dysfunction. The therapist externally rotates and flexes the patient's left hip; the patient's left foot is placed just above their right knee. Stabilizing the right side of the patient's pelvis with their right hand, and the patient's left knee with their left hand, the therapist encourages external rotation until a barrier is felt.

From this position of bind, the patient is asked to internally rotate their hip for 10 seconds, as shown in Figure 13.24.

Figure 13.24. The therapist places the patient's left hip into external rotation, and rests the patient's left foot on the opposite knee. The patient then internally rotates against a resistance applied by the therapist.

On the relaxation phase, a new barrier of external rotation is achieved, as shown in Figure 13.25.

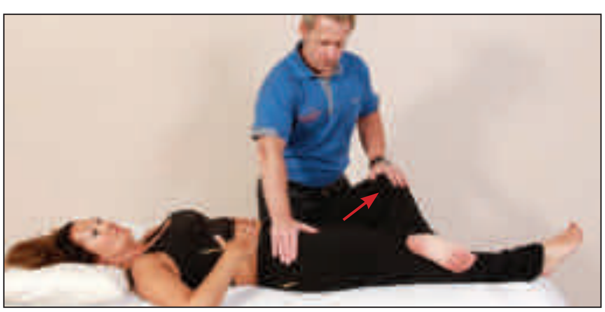


Figure 13.25. The therapist guides the hip into external rotation and encourages a neutral position of the innominate.

Part 3: Treatment Protocol for Sacroiliac Dysfunctions

The following sacroiliac dysfunctions are possible:

- L-on-L anterior (forward) sacral torsion
- R-on-R anterior (forward) sacral torsion
- L-on-R posterior (backward) sacral torsion
- R-on-L posterior (backward) sacral torsion
- Bilateral anterior sacrum (nutated)
- Bilateral posterior sacrum (counter-nutated)

Diagnosis: L-on-L Anterior (Forward) Sacral Torsion

Treatment: MET

Position: Sims

In this dysfunction the sacrum has rotated left (side bent right) on the left oblique axis, and the right sacral base has anteriorly nutated, as shown in Figure 13.26.

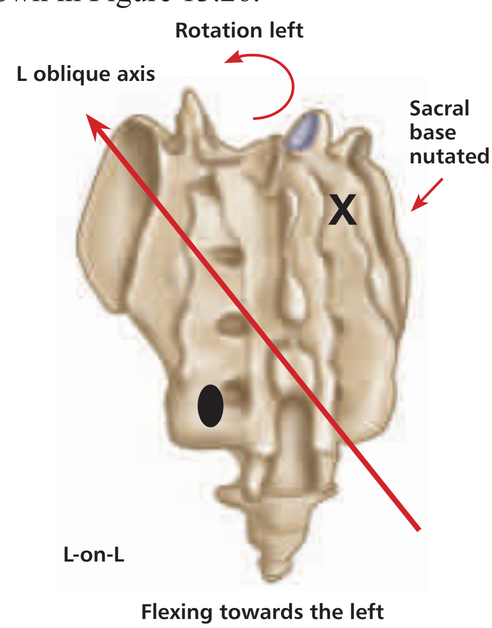


Figure 13.26. Left-on-left (L-on-L) sacral motion/torsion. X = Anterior or deep. ⬮ = Posterior or shallow.

The patient adopts a prone position on the couch, while the therapist stands on the right side of the couch and flexes the patient's knees to 90 degrees. The therapist turns the patient onto their left hip to achieve what is known as the *Sims position*, as shown in Figure 13.27. Note that the patient's left arm is held back and the right arm is held forward.

Figure 13.27. The therapist bends the patient's knees to 90 degrees and places the patient in the Sims position.

With the patient's knees placed on the therapist's left thigh, the lumbosacral junction is palpated using the left hand, while a left rotation of the patient's trunk is introduced until L5 is felt to rotate to the left, as shown in Figure 13.28.

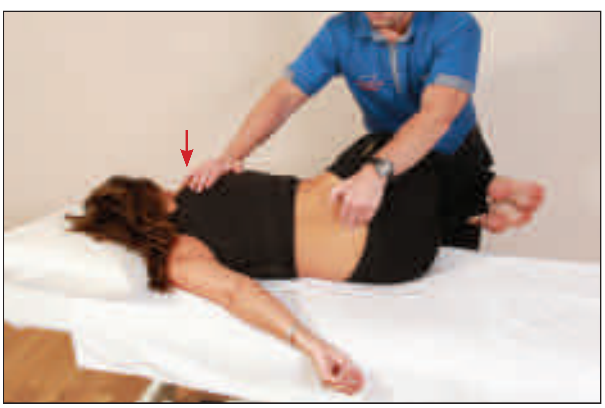


Figure 13.28. The therapist fine-tunes the position and introduces a rotation of L5 to the left.

From this position, the therapist palpates the lumbosacral junction and the right sacral base with their right hand, then, using the patient's legs as a lever, introduces a flexion motion to the trunk until a barrier is felt, as shown in Figure 13.29.

Figure 13.29. Using the patient's legs as a lever, the therapist flexes the patient's trunk until a barrier is felt at the lumbosacral junction.

The patient is asked to push their legs toward the ceiling against the therapist's resistance for 10 seconds (which activates the right piriformis muscle), as shown in Figure 13.30.

Figure 13.30. The patient pushes their legs toward the ceiling, as this motion activates the right piriformis muscle.

On the relaxation phase, the therapist takes the patient's legs toward the floor until they feel movement posterior to the right sacral base, as shown in Figure 13.31.

Figure 13.31. The therapist palpates the right sacral base and feels for posterior motion as the patient's legs are directed toward the floor.

> **Note:** The Sims technique works well, as it challenges the sacral position to correct itself by using the motion of the lumbar spine as well as the motion from the lower limbs to facilitate the correction. For example, with a L-on-L type of dysfunction, we know that the right sacral base has migrated forward into a fixed position of nutation, so the restriction is due to the right sacral base being unable to counter-nutate. The first process in the technique is flexion of the lumbar spine, which encourages an extension of the sacrum. Second, left rotation is introduced to the lumbar spine, which encourages right rotation of the sacrum (a movement it cannot perform). The third phase is the combination of the motion and MET of the legs; this introduces the right piriformis muscle, to assist in restoring the sacral position.

Diagnosis: R-on-R Anterior (Forward) Sacral Torsion

Treatment: MET

Position: Sims

In this dysfunction the sacrum has rotated right (side bent left) on the right oblique axis, and the left sacral base has anteriorly nutated, as shown in Figure 13.32.

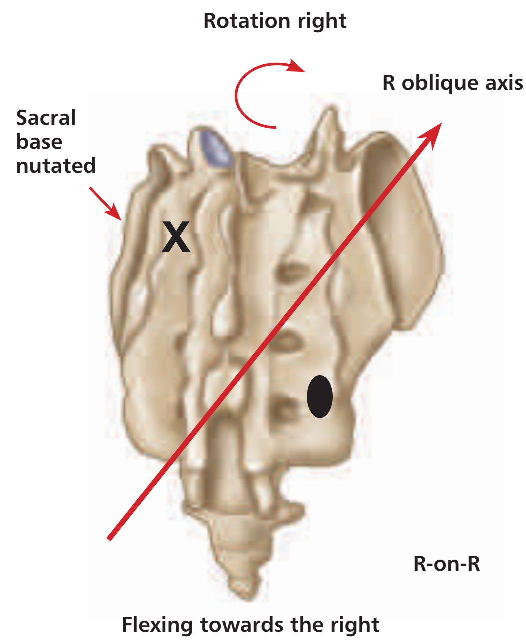


Figure 13.32. Right-on-right (R-on-R) sacral motion/torsion. X = Anterior or deep. ⬮ = Posterior or shallow.

The patient adopts a prone position on the couch, while the therapist stands on the left side of the couch and flexes the patient's knees to 90 degrees. The therapist turns the patient onto their right hip into the Sims position (left arm forward, right arm back), as shown in Figure 13.33.

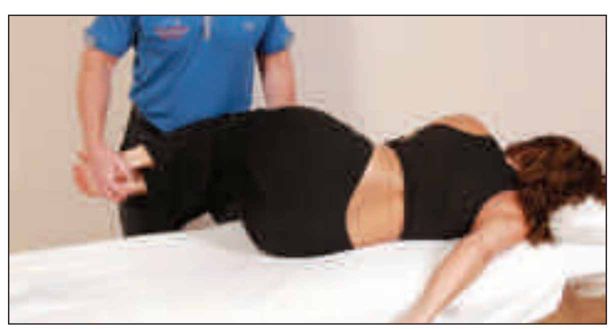


Figure 13.33. The therapist bends the patient's knees to 90 degrees and places the patient in the Sims position.

With the patient's knees placed on the therapist's right thigh, the lumbosacral junction is palpated using the right hand, while a right rotation of the patient's trunk is introduced until L5 is felt to rotate to the right, as shown in Figure 13.34.

Figure 13.34. The therapist fine-tunes the position and introduces a rotation of L5 to the right.

From this position, the therapist palpates the lumbosacral junction and the left sacral base with their left hand, then, using the patient's legs as a lever, introduces a flexion motion to the trunk until a barrier is felt, as shown in Figure 13.35.

Figure 13.35. Using the patient's legs as a lever, the therapist flexes the patient's trunk until a barrier is felt at the lumbosacral junction.

The patient is asked to push their legs toward the ceiling against the therapist's resistance for 10 seconds (which activates the left piriformis muscle), as shown in Figure 13.36.

Figure 13.36. The patient pushes their legs toward the ceiling, as this activates the left piriformis muscle.

On the relaxation phase, the therapist takes the patient's legs toward the floor until they feel movement posterior to the left sacral base, as shown in Figure 13.37.

Figure 13.37. The therapist palpates the left sacral base and feels for posterior motion as the patient's legs are directed toward the floor.

Note: The R-on-R sacral torsion is the same concept as the L-on-L sacral torsion. The Sims technique again works well, as it challenges the sacral position to correct itself by using the motion of the lumbar spine as well as the motion from the lower limbs to facilitate the correction. For example, with a R-on-R type of dysfunction, we know that this time the left sacral base is fixed forward in a position of nutation, so the restriction is due to the sacral base being unable to counter-nutate on the left side. The first process in the technique is to induce flexion of the lumbar spine, which encourages an extension of the sacrum. Second, right rotation is introduced to the lumbar spine, which encourages left rotation of the sacrum (remember, this is a movement it cannot perform). The third phase is the combined effect of the motion and the MET of the lower legs; this introduces the left piriformis muscle, to assist in restoring the sacral position.

Diagnosis: L-on-R Posterior (Backward) Sacral Torsion

Treatment: MET

Position: Side lying

In this dysfunction the sacrum has rotated left (side bent right) on the right oblique axis, and the left sacral base has posteriorly counter-nutated, as shown in Figure 13.38.

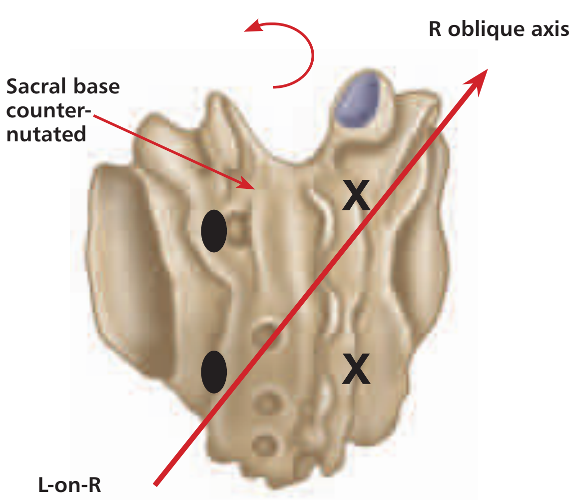


Figure 13.38. Left-on-right (L-on-R) sacral torsion. X = Anterior or deep. ⬮ = Posterior or shallow.

The patient adopts a side-lying position on their right side, with their knees initially flexed to approximately 45 degrees, while the therapist stands facing the patient. Palpating the lumbosacral junction with their right hand, the therapist gently pulls the patient's right arm caudally (which introduces some extension to the lumbar spine, as well as right side bending and left rotation to the trunk) until L5 is felt to begin to rotate to the left, as shown in Figure 13.39.

Figure 13.39. The therapist palpates L5 and feels for left rotation, as the patient is guided into position.

From this position, the therapist places the patient's right lower leg into extension with their right hand, while monitoring the left sacral base with their left hand until an anterior motion of the sacral base is felt, as shown in Figure 13.40.

Figure 13.40. The therapist palpates the left sacral base for anterior (forward) motion, as the patient's lower leg is guided into the extension position.

Next, the therapist maintains contact with L5 as they lower the patient's left (top) leg off the side of the couch, so that it faces toward the floor, and applies pressure to the distal femur, as shown in Figure 13.41.

Figure 13.41. The therapist palpates L5 as the patient's left leg is guided toward the floor.

The patient is then asked to push their left (top) leg toward the ceiling for 10 seconds against the therapist's resistance, as shown in Figure 13.42. On the relaxation phase, two components are introduced: (1) the therapist continues to encourage the left leg toward the treatment couch / floor for a few seconds, and (2) while still monitoring the left sacral base, the therapist places the patient's right (bottom) leg into further extension, as shown in Figure 13.43. This resistance/relaxation procedure is repeated three to five times until an anterior motion of the left sacral base is felt.

Figure 13.42. The patient lifts their left leg against the therapist's resistance, as this now introduces the left piriformis muscle, which will assist in restoring the sacral position. On the relaxation phase the therapist applies a downward pressure.

Figure *13.43. While monitoring the left sacral base, the therapist encourages further extension of the patient's right (bottom) leg.*

> **Note:** This technique works well, as it challenges the sacral position to correct itself by using the motion of the lumbar spine as well as the motion from the lower limbs to facilitate the correction. For example, with a L-on-R type of dysfunction, we know that the left sacral base has moved posteriorly, i.e. it has counter-nutated, so the restriction is due to the left sacral base being unable to nutate forward. The first process in the technique is to promote extension of the lumbar spine, which encourages a forward nutation motion of the sacrum. Second, left rotation is introduced to the lumbar spine, which encourages right rotation of the sacrum (the movement it cannot perform). In the third phase, we add the motion and the specific MET of the top leg being lowered (after the initial 10-second contraction), because this now introduces the left piriformis muscle as well as increasing side bending of the lumbar spine to the right, which will assist in restoring the sacral position. In addition, the extension of the lower leg promotes further nutation of the left sacral base and subsequent correction of the dysfunction.

Diagnosis: R-on-L Posterior (Backward) Sacral Torsion

Treatment: MET

Position: Side lying

In this dysfunction the sacrum has rotated right (side bent left) on the left oblique axis, and the right sacral base has posteriorly counter-nutated, as shown in Figure 13.44.

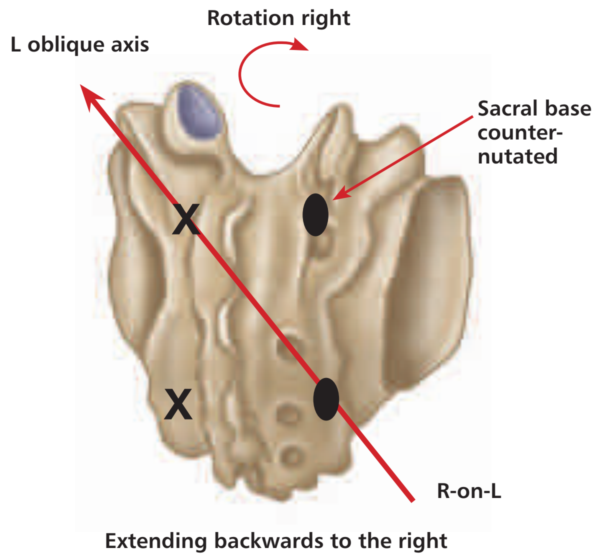


Figure 13.44. Right-on-left (R-on-L) sacral torsion. X = Anterior or deep. ● = Posterior or shallow.

The patient adopts a side-lying position on their left side, with their knees initially flexed to approximately 45 degrees, while the therapist stands facing the patient. Palpating the lumbosacral junction with their left hand, the therapist gently pulls the patient's left arm caudally (which introduces some extension to the lumbar spine, as well as left side bending and right rotation to the trunk) until L5 is felt to begin to rotate to the right, as shown in Figure 13.45.

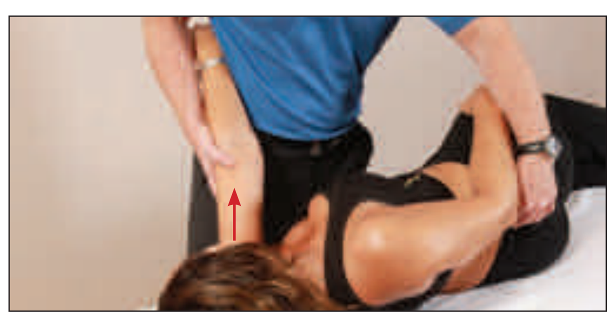


Figure 13.45. The therapist palpates L5 and feels for right rotation, as the patient is guided into position.

From this position, the therapist places the patient's left lower leg into extension with their left hand, while monitoring the right sacral base with their right hand until an anterior motion of the sacral base is felt, as shown in Figure 13.46.

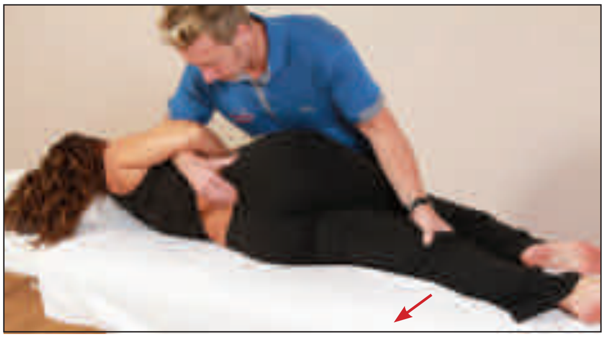


Figure 13.46. The therapist palpates the right sacral base for anterior (forward) motion, as the patient's lower leg is guided into the extension position.

Next, the therapist maintains contact with L5 as they lower the patient's right (top) leg off the side of the couch, so that it faces toward the floor, and applies pressure to the distal femur, as shown in Figure 13.47.

Figure 13.47. The therapist palpates L5 as the patient's right leg is guided toward the floor.

The patient is then asked to push their right (top) leg toward the ceiling for 10 seconds against the therapist's resistance, as shown in Figure 13.48. On the relaxation phase, two components are introduced: (1) the therapist continues to encourage the right leg toward the treatment couch / floor for a few seconds, and (2) while still monitoring the right sacral base, the therapist places the patient's left (bottom) leg into further extension, as shown in Figure 13.49. This resistance/relaxation procedure is repeated three to five times until an anterior motion of the right sacral base is felt.

Figure 13.48. The patient lifts their right leg against the therapist's resistance, as this now introduces the piriformis muscle, which will assist in restoring the sacral position. On the relaxation phase the therapist applies a downward pressure.

Figure 13.49. While monitoring the right sacral base, the therapist encourages further extension of the patient's left (bottom) leg.

Note: This technique works well, as it challenges the sacral position to correct itself by using the motion of the lumbar spine as well as the motion from the lower limbs to facilitate the correction. For example, with a R-on-L type of dysfunction, we know that the right sacral base has moved posteriorly, i.e. it has counter-nutated, so the restriction is due to the right sacral base being unable to nutate forward. The first process in the technique is to promote extension of the lumbar spine, which encourages a forward nutation motion of the sacrum. Second, right rotation is introduced to the lumbar spine, which encourages left rotation of the sacrum (the movement it cannot perform). In the third phase, we add the motion and the specific MET of the top leg being lowered (after the initial 10-second contraction), because this now introduces the right piriformis muscle as well as increasing side bending of the lumbar spine to the left, which will assist in restoring the sacral position. In addition, the extension of the lower leg promotes further nutation to the right sacral base and subsequent correction of the dysfunction.

Diagnosis: Bilateral Anterior Sacrum (Nutated)

Treatment: MET

Position: Sitting

In this dysfunction the sacrum has bilaterally nutated, as shown in Figure 13.50.

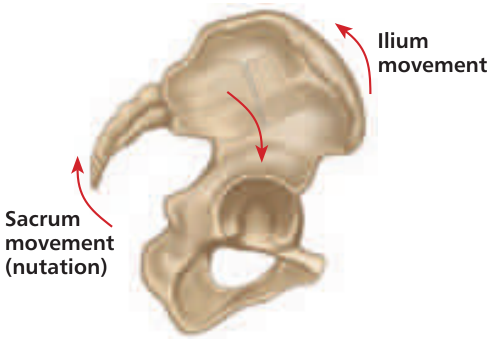


Figure 13.50. Bilateral nutation of the sacrum.

The patient adopts a sitting position on the couch, with their feet apart, while the therapist stands facing the patient's back. Palpating the sacral apex with their right hand, the therapist introduces flexion to the patient's trunk with their left hand until the sacrum is felt to begin to move, as shown in Figure 13.51.

Figure 13.51. The therapist palpates the sacral apex and monitors motion, as the trunk of the patient is being flexed.

From this position, the patient is asked to lift their upper back toward the ceiling against a resistance applied by the therapist, as shown in Figure 13.52.

Figure 13.52. The patient performs trunk extension against a resistance applied by the therapist.

After 10 seconds, and during the relaxation phase, the therapist introduces further trunk flexion, while at the same time encouraging posterior sacral motion (counter-nutation) with their right hand, as shown in Figure 13.53.

Figure 13.53. The therapist introduces further flexion and at the same time encourages the sacrum into counter-nutation.

Diagnosis: Bilateral Posterior Sacrum (Counter-Nutated)

Treatment: MET

Position: Sitting

In this dysfunction the sacrum has bilaterally counter-nutated, as shown in Figure 13.54.

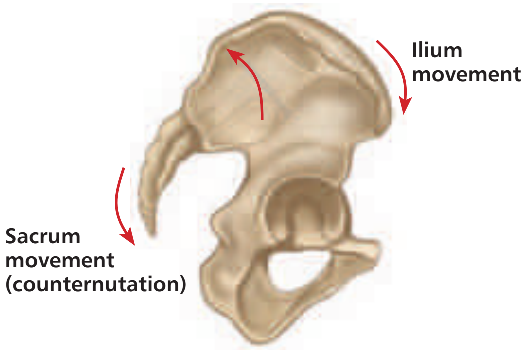


Figure 13.54. Bilateral counter-nutation of the sacrum.

The patient adopts a sitting position on the couch, with their feet apart, while the therapist stands facing the patient's back. Palpating the sacral base with their right hand, the therapist introduces extension to the patient's trunk with their left hand until the sacrum is felt to begin to move, as shown in Figure 13.55.

Figure 13.55. The therapist palpates the sacral base and monitors motion, as the trunk of the patient is being extended.

From this position, the patient is asked to flex their trunk against a resistance applied by the therapist, as shown in Figure 13.56.

Figure 13.56. The patient performs trunk flexion against a resistance applied by the therapist.

After 10 seconds, and during the relaxation phase, the therapist introduces further trunk extension and at the same time encourages anterior sacral motion (nutation) with their right hand, as shown in Figure 13.57.

Figure 13.57. The therapist introduces further extension and at the same time encourages the sacrum into nutation.

Part 4: Treatment Protocol for Lumbar Spine Dysfunctions

I mentioned earlier that I consider lumbar spine dysfunctions to be caused by a compensatory mechanism associated with underlying malalignments of the pelvis. In my opinion, dysfunctions of the lumbar spine are a secondary type of dysfunction resulting from a primary dysfunction within the pelvic girdle complex; hence the main reason why I leave treating the lumbar spine till the end. There are exceptions to the rules, of course, where the lumbar spine is the primary cause rather than the compensatory secondary cause. Either way, the realignment techniques I will demonstrate shortly will be of value, as they will assist you in correcting the presentations that will commonly be found within the lumbar spine.

I would like to keep things simple to start with, even though this subject matter is by no means simple to understand. For the first example, when I say that the facet joint is fixed in a closed position, this relates to the specific position of the inferior facet joint being closed in extension, side bending, and rotation (normally to one side) on the superior facet of the vertebra immediately below. Think back to the discussion of spinal mechanics in Chapter 6. I referred to this situation as an *ERS,* which is a Type II dysfunction (non-neutral mechanics), because the rotation and side bending are coupled to the same side but in an extended position, either to the left (ERS(L)) or to the right (ERS(R)).

The opposite motion, and the second example, therefore has to be where the facet joint is now fixed in an open position; in this case the motion is related to the specific position of the inferior facet joint being open in flexion, side bending, and rotation (normally to one side) on the superior facet of the vertebra immediately below. This type of spinal dysfunction is referred to as an *FRS*, which is also a Type II dysfunction (non-neutral mechanics), because the rotation and side bending are coupled to the same side but this time in a flexed position, either to the left (FRS(L)) or to the right (FRS(R)).

Note: Regarding the position of a facet joint which is fixed in an open position, remember from earlier chapters that the joint will be open on the opposite side. For example, an FRS(L), i.e. flexion, rotation, and side bending left, indicates that the facet joint is fixed open on the right side.

The following lumbar spine dysfunctions are discussed:

- L5 ERS(L)
- L4 ERS(R)
- L5 FRS(L)

Diagnosis: L5 ERS(L)

Treatment: MET

Position: Side lying

This specific spinal dysfunction relates to the inferior facet joint of the L5 vertebra being fixed in a position of extension, rotation, and side bending to the left side on the superior facet of the S1 vertebra. This basically means that the *left* facet joint of L5/S1 is fixed in a closed position, as shown in Figure 13.58. The subsequent motion restriction will affect movements on the side opposite the fixation, namely flexion, right rotation, and right side bending.

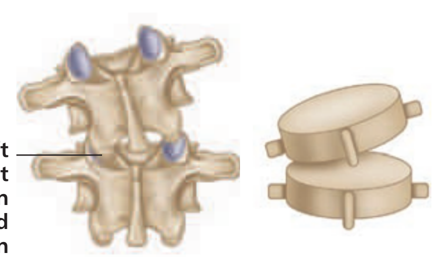


Figure 13.58. L5 ERS(L) on S1.

The patient adopts a side-lying position facing the therapist, with the posterior TP of the dysfunctional L5 toward the couch (i.e. dysfunction side down—in this case, left side down). While palpating the interspinous space of L4/5 with their left hand, the therapist cradles the patient's left arm and introduces flexion and right rotation of the patient's trunk down to the relevant lumbar level, as shown in Figure 13.59.

Figure 13.59. The therapist palpates the interspinous space of L4/L5 and introduces flexion and right rotation of the lumbar spine down to that level, to prevent over-locking of L5/S1.

The therapist cradles both of the patient's legs and introduces the hips into flexion, while at the same time palpating with the left hand the L5/S1 interspinous space for motion, as shown in Figure 13.60.

Figure 13.60. The therapist introduces hip flexion to both legs as they palpate the L5/S1 interspinous space for motion.

From this position, the patient is asked to push both their feet toward the floor (side bending left), as indicated by the arrow in Figure 13.61, for 10 seconds at a contraction of between 10 and 20% of maximum.

Figure 13.61. The patient pushes both feet toward the floor for 10 seconds.

After the contraction, and during the relaxation phase, the therapist encourages the patient's legs toward the ceiling, as this motion introduces right side bending of the lumbar spine, as shown in Figure 13.62. This movement subsequently has the ability to open the left L5/S1 facet joint, which is fixed in a closed position.

Figure 13.62. After the contraction the therapist introduces right side bending by using the motion from the legs toward the ceiling to open the left facet joint.

Diagnosis: L4 ERS(R)

Treatment: MET, Thrust technique (HVT)

Position: Side lying

This specific spinal dysfunction relates to the inferior facet joint of the L4 vertebra being fixed in a position of extension, right rotation, and right side bending on the superior facet of L5. This basically means that the *right* facet joint of L4/5 is fixed in a closed position, as shown in Figure 13.63. The subsequent motion restriction will affect movements on the side opposite the fixation, namely flexion, left rotation, and left side bending.

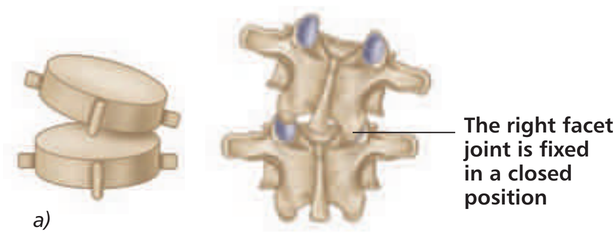


Figure 13.63. L4 ERS(R) on L5.

The patient adopts a side-lying position facing the therapist, with the posterior TP of L4 toward the ceiling (i.e. dysfunction side up—in this case, right side up). While palpating the interspinous space of L3/4 with their right hand, the therapist introduces flexion and right rotation of the lumbar spine down to L4 with their left hand, as shown in Figure 13.64.

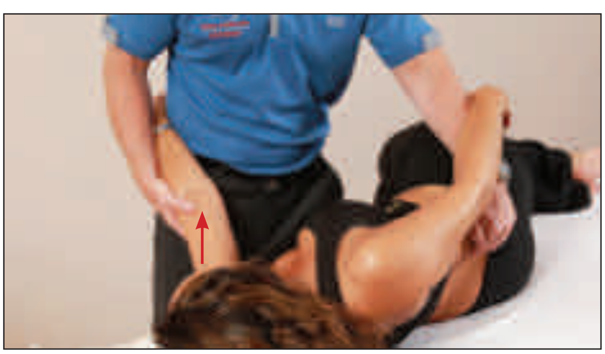


Figure 13.64. The therapist palpates the interspinous space of L3/L4 and introduces flexion and right rotation of the lumbar spine down to L4.

Next, the patient's right hand is placed onto their right hip to stabilize the position. The therapist palpates the L4/5 interspinous space with their right hand and feels for specific motion as the patient's bottom leg is taken into flexion.

The patient's top leg is flexed and the foot is placed in the crease of the left knee. The therapist places their right hand through the natural gap formed by the patient's hand on their hip and palpates the L4/5 interspinous space. The patient's trunk is guided gently toward the floor by the therapist's left hand, which is placed on the patient's left knee and controls the motion, as shown in Figure 13.65.

Figure 13.65. The therapist palpates L4 and fine-tunes the position by using the patient's top leg.

Once the position has been finely tuned, the patient is asked to abduct their right hip against a resistance applied by the therapist for 10 seconds, as shown in Figure 13.66.

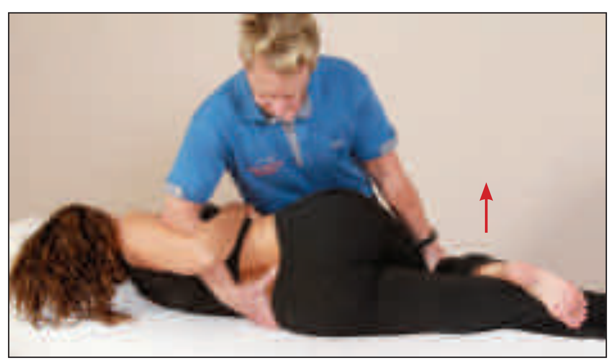


Figure 13.66. The patient abducts their right hip for 10 seconds.

After the contraction, and during the relaxation phase, the therapist encourages motion of the top leg toward the floor, as this type of movement introduces right side bending of the lumbar spine, as shown in Figure 13.67. This movement subsequently has the ability to open the right L4/5 facet joint, which is fixed in a closed position.

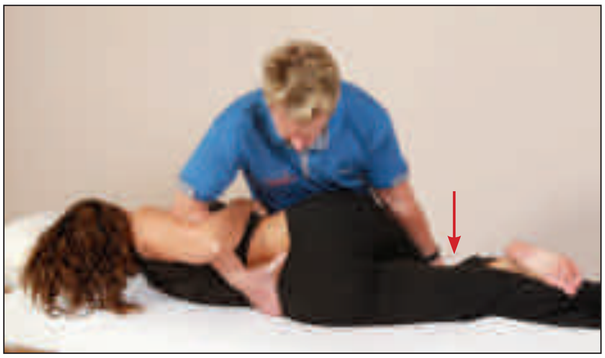


Figure 13.67. After the contraction the therapist introduces right side bending of the lumbar spine to open the right L4/5 facet joint.

If one is suitably qualified, then from the finely tuned position (as above) the therapist can apply a thrust technique (HVT) in the direction through the long lever of the femur toward the floor, as shown in Figure 13.68. This quick motion will cause a right side bending motion to L4/5, and a cavitation might be elicited from the joint.

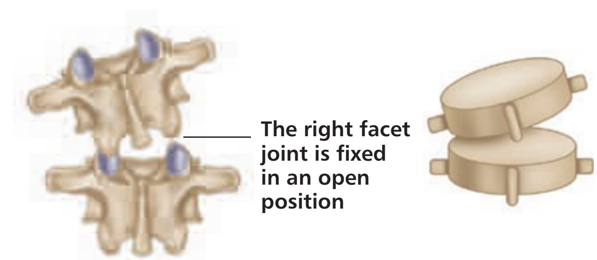
Figure 13.68. From the finely tuned position, the therapist applies a quick thrust technique to encourage right side bending of the lumbar spine, which may elicit a cavitation from the right L4/5 facet joint.

Diagnosis: L5 FRS(L)

Treatment: Soft tissue technique

Position: Prone

This specific spinal dysfunction relates to the inferior facet joint of the L5 vertebra having become fixed in a position of flexion, left rotation, and left side bending on the superior facet of S1. This basically means that the *right* facet joint of L5/S1 is fixed in an open position, as shown in Figure 13.69. The subsequent motion restriction will affect movements on the side opposite the fixation, namely extension, right rotation, and right side bending.



a)

Figure 13.69. L5 FRS(L) on S1.

With the patient lying prone, the therapist confirms by the position of the thumbs that the left TP of L5 is shallow and the right TP is deep, thus indicating a left rotation. When the patient backward bends, the left TP appearing shallower and the right TP becoming deeper confirms the presence of an FRS(L), where the right facet joint is fixed in an open position, as shown in Figure 13.70.

Figure 13.70. With the patient in a backward-bent position, the left thumb palpates shallow and the right thumb palpates deep, indicating an FRS(L).

The correction of this spinal dysfunction is very simple in some respects, as it can be treated from the backward-bent position. The therapist applies between 5 and 10lbs (2–4kg) of direct pressure directly onto the right L5 TP, either with a reinforced thumb as shown in Figure 13.71, or with the elbow as shown in Figure 13.72. The therapist then waits for the tissues to soften, before retesting the position to see if there has been any change.

Figure 13.71. With the patient in a backward-bent position, the therapist applies pressure with a reinforced thumb directly onto the right L5 TP, to encourage a closure of the right facet joint.

Figure 13.72. With the patient in a backward-bent position, the therapist applies pressure with their elbow directly onto the right L5 TP, to encourage a closure of the right facet joint.

In the case of an FRS(R), the opposite procedure would be performed.

If you have truly enjoyed reading this book and wish to continue on your journey toward understanding the pelvic girdle, along with all the complexities that naturally go with it, then I recommend in particular the following books to get you started: Schamberger (2002; 2013); Vleeming, Mooney, and Stoeckart (2007); Lee (2004); and DeStefano (2011). I wish you every success in your studies and practice in this fascinating area.

Appendix 1: Tables for Dysfunction Testing

The following tables can be used in the therapist's own clinical setting (permission to reproduce is granted).

Hip Extension Firing Pattern

Left Side	1st	2nd	3rd	4th
Gluteus maximus	○	○	○	○
Hamstrings	○	○	○	○
Contralateral erector spinae	○	○	○	○
Ipsilateral erector spinae	○	○	○	○

Table A1.1. Hip extension firing pattern—left side.

Right Side	1st	2nd	3rd	4th
Gluteus maximus	○	○	○	○
Hamstrings	○	○	○	○
Contralateral erector spinae	○	○	○	○
Ipsilateral erector spinae	○	○	○	○

Table A1.2. Hip extension firing pattern—right side.

Initial Observation—Patient Standing

Observation	Left side	Right side
Pelvic crest (posterior)		
PSIS		
Greater trochanter		
Lumbar spine		
Gluteal folds		
Popliteal folds		
Foot/ankle position		
Pelvic crest (anterior)		
ASIS		
Pubic tubercle		

Table A1.3. Observation assessment—standing.

Evaluation of Pelvic Dysfunction

Test	Left side	Right side
Mens		
Standing forward flexion		
Backward bending		
Seated forward flexion		
Stork (Gillet)—upper pole		
Stork (Gillet)—lower pole		
Hip extension		
Side bending (trunk)		
Pelvic rotation		

Table A1.4. Specific tests for the evaluation of pelvic dysfunction.

Palpatory Assessment

Prone

Palpation area	Left side	Right side
Gluteal fold		
Ischial tuberosity		
Sacrotuberous ligament		
ILA		
PSIS		
Sacral sulcus—neutral		
Sacral sulcus—extension (sphinx test)		
Sacral sulcus—flexion		
L5 spring test (neg. or pos.)		
L5 position		
Iliac crest		
Greater trochanter		

Table A1.5. Palpation assessment—prone.

Supine

Palpation area	Left side	Right side
ASIS		
Iliac crest		
Pubic tubercle		
Inguinal ligament		
Medial malleolus (leg length)		
Supine to long sitting test		
Long sitting to supine test		

Table A1.6. Palpation assessment—supine.

Summary of Iliosacral Dysfunctions

Dysfunction	Left side	Standing flexion test	Medial malleolus	ASIS	PSIS	Sacral sulcus	Ischial tuberosity	Sacrotuberous ligament
Anterior rotation	Left	Left	Long left	Inferior	Superior	Shallow left	Superior	Lax left
Posterior rotation	Left	Left	Short left	Superior	Inferior	Deep left	Inferior	Taut left
Out-flare	Left	Left	No change	Lateral left	Medial left	Narrow left	No change	No change
In-flare	Left	Left	No change	Medial left	Lateral left	Wide left	No change	No change
Upslip	Left	Left	Short left	Superior left	Superior left	No change	Superior	Lax left
Downslip	Left	Left	Long left	Inferior left	Inferior left	No change	Inferior	Taut left

Table A1.7. Iliosacral dysfunctions—left side.

Dysfunction	Right side	Standing flexion test	Medial malleolus	ASIS	PSIS	Sacral sulcus	Ischial tuberosity	Sacrotuberous ligament
Anterior rotation	Right	Right	Long right	Inferior	Superior	Shallow right	Superior	Lax right
Posterior rotation	Right	Right	Short right	Superior	Inferior	Deep right	Inferior	Taut right
Out-flare	Right	Right	No change	Lateral right	Medial right	Narrow right	No change	No change
In-flare	Right	Right	No change	Medial right	Lateral right	Wide right	No change	No change
Upslip	Right	Right	Short right	Superior right	Superior right	No change	Superior	Lax right
Downslip	Right	Right	Long right	Inferior right	Inferior right	No change	Inferior	Taut right

Table A1.8. Iliosacral dysfunctions—right side.

Summary of Sacral Dysfunctions

	L-on-L sacral torsion (forward/nutation)	R-on-R sacral torsion (forward/nutation)
Deep sacral sulcus	Right	Left
Shallow sacral sulcus	Left	Right
ILA posterior	Left	Right
L5 rotation	Right—ERS(R)	Left—ERS(L)
Seated flexion test	Right	Left
Lumbar spring	Negative	Negative
Sphinx (extension) test	Sulci level	Sulci level
Lumbar flexion test	Right sacral sulcus deep	Left sacral sulcus deep
Lumbar lordosis	Increased	Increased
Medial malleolus (leg length)	Short left	Short right

Table A1.9. Anterior/forward sacral torsions (normal physiological motion).

	L-on-R sacral torsion (backward/counter-nutation)	R-on-L sacral torsion (backward/counter-nutation)
Deep sacral sulcus	Right	Left
Shallow sacral sulcus	Left	Right
ILA posterior	Left	Right
L5 rotation	Right—FRS(R)	Left—FRS(L)
Seated flexion test	Left	Right
Lumbar spring	Positive	Positive
Sphinx (extension) test	Left sacral sulcus shallow (right sacral sulcus deeper)	Right sacral sulcus shallow (left sacral sulcus deeper)
Lumbar flexion test	Sulci level	Sulci level
Lumbar lordosis	Decreased	Decreased
Medial malleolus (leg length)	Short left	Short right

Table A1.10. Posterior/backward sacral torsion (non-physiological motion).

	Bilaterally nutated sacrum (forward)	Bilaterally counter-nutated sacrum (backward)
Standing flexion test	Negative	Negative
Seated flexion test	Positive bilateral	Positive bilateral
Stork (Gillet) test	Positive on both sides	Positive on both sides
Sacral base	Left and right anterior	Left and right posterior
ILA	Left and right posterior	Left and right anterior
Lumbar spring test	Negative	Positive
Lumbar lordosis	Increased	Decreased
Medial malleolus (leg length)	Equal	Equal

Table A1.11. Bilaterally nutated and counter-nutated sacrum.

Summary of Symphysis Pubis Dysfunctions

	Superior pubis	Inferior pubis
Standing forward flexion test	Left	Left
Pubic tubercle	Superior	Inferior
Inguinal ligament	Tender on palpation	Tender on palpation

Table A1.12. Symphysis pubis dysfunctions—left side.

	Superior pubis	Inferior pubis
Standing forward flexion test	Right	Right
Pubic tubercle	Superior	Inferior
Inguinal ligament	Tender on palpation	Tender on palpation

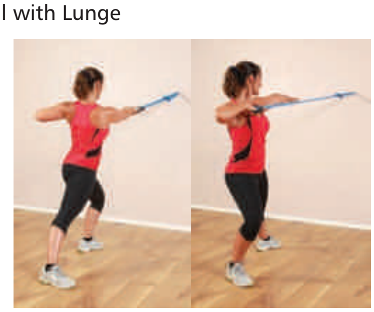
Table A1.13. Symphysis pubis dysfunctions—right side.

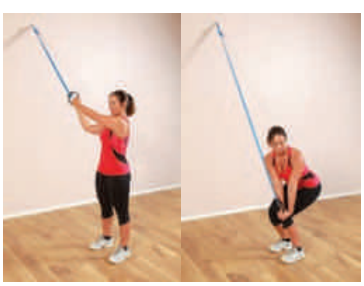
Appendix 2: Outer Core Stabilization Exercise Sheet

The following exercises can be used in the physical therapist's own clinical setting. For each exercise there is a blank space in which a patient's repetitions and sets can be recorded.

Exercise	SETS	REPS
1. Push 		
2. Pull 		
3. Squat—Bend to Extend  *Progression 1: With Weight* 		
Progression 2: With Weight and Without a Core Ball 		
4. Bend to Extend with Rotation 		

Exercise	SETS	REPS
5. Single-Leg Stance  Lateral Sling and Posterior Oblique Sling 		
6. Rotation  Posterior Rotation 		

Exercise	SETS	REPS
Exercise Variations Combined Push–Pull  Combined Push–Pull on One Leg  Push with Lunge  Pull with Lunge 		

Exercise	SETS	REPS
Push on Unstable Base 		
Pull on Unstable Base 		
Bend to Extend with Rotation on Unstable Base 		
Bend High to Low (Wood Chop) 		

Exercise	SETS	REPS
Bend Low to High (Reverse Wood Chop) 		
Bend Low to High (Single Arm) 		
Oblique Sling—Anterior Rotation on Unstable Base 		
Oblique Sling—Anterior Rotation on One Leg 		

Exercise	SETS	REPS
Anterior Rotation While Kneeling 		
Posterior Rotation While Kneeling 		

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