ANATOMY OF THE PELVIS/SACROILIAC JOINT

Joint Anatomy

The pelvic girdle consists of the two innominate bones, the sacrum, and the bones of the coccyx. Six joints lie within the pelvic girdle, which include the two sacroiliac joints (SIJ), the sacrococcygeal, in many cases the intercoccygeal, and the pubic symphysis. The sacroiliac joint is a synovial joint with the sacral surface covered with hyaline cartilage and the iliac surface covered with a type of fibrocartilage (1)(Table 11.1). The anterior portion is synovial and the posterior-superior portion is classified as a typical syndesmosis joint (2). These articular surfaces are different from any other joint within the body (3). The surfaces are designed for stability versus mobility; the persistence of selected furrows and ridges create an extremely rough integrated surface of congruency (4).

Table 11.1: General Information about the Sacroiliac Joint.

<table>
<thead>
<tr>
<th>Topic</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint type</td>
<td>Diarthrodial joint (synovial) surrounded anteriorly and posteriorly by a joint capsule with inner synovial membranes and hyaline cartilage on both joint surfaces</td>
</tr>
<tr>
<td>Surface regions</td>
<td>Only a superficial layer of hyaline cartilage covers the iliac surface, and its roughened surface is suggested to increase the friction coefficient of the joint, thus increasing joint stability</td>
</tr>
<tr>
<td>Shape of the joint</td>
<td>The SIJ is roughly L-shaped with a short superiorly orientated joint and a longer A-P orientated arm, which intersects at approximately the S2 level</td>
</tr>
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</table>

Figure 11.1: The Sacroiliac Joint
Wilder et al. (5) reported that the topography of the SIJ encourages the function of shock incorporation through energy absorption of the ligamentous structures. However, the topography of the SIJ includes flat joints that encumber very large forces, which is a recipe for shear-related instability (6). Without some form of external passive or active stabilization, the SIJ would allow considerable unorganized movement.

It has long been noted that women have a greater prevalence of SIJ pain than men, a problem that is theoretically associated with joint architecture and functional needs. Ebraheim et al. (7) reported that average females exhibit 12.8 percent less joint surface contact than males, a finding that contrasted the report of Sgambati et al. (2). Other investigators have reported similar gross movements between males and females (8) but notable differences in adolescent anatomy (9). Age-related changes appear to be similar as well (8).

The pubic symphysis is a nonsynovial amphiarthrodial joint (10). The joint exhibits a thick intrapubic fibrocartilaginous disc between the two hyaline covered pubis bones. Dysfunction to the symphysis pubis generally results in groin pain and/or inflammatory involvement with adjacent structures (11,12). As with the cervical spine, most fibrocartilaginous discs exhibit a cavity within the structure, which is thought to be evidence of degeneration of the disc (1). Injury to the pubic symphysis may be the result of direct injurious force or microtrauma related to repetitious activity (12,13).
The sacrococcygeal joint is a synovial symphysis connection (1) and can be an origin site for coccygeal pain (14). Similar to the pubic symphysis, a fibrocartilaginous disc between the sacrum and the first coccyx bone develops and assists in allowing movement to the structures. When present, the intercoccygeal joint also presents with a fibrocartilaginous disc.

**Osseous Structures**

The sacroiliac joint consists of the articulations of sacrum and the innominate bones. The innominate bones are composed of the ilium, the pubis, and the ischium. The ilium is the superior-most structure that forms the articulation with the sacrum and two-fifths of the surface of the acetabulum (1). The pubis is the inferomedial aspect of the innominate and constitutes one-fifth of the articulation with the acetabulum of the hip. The ischium is the inferolateral aspect of the innominate that provides the floor of the acetabulum and the posterior two-fifths of the articular surface of the acetabulum rim. The sacral-coccyx articulation (sacrococcygeal joint) includes the union of the coccyx and the sacrum (1). The pubic symphysis includes the articulations of the two left and right pubic bones.

![Medial and Lateral View of the Innominates](image)

**Figure 11.3**: Medial and Lateral View of the Innominates

The sacrum is a triangular-shaped bone that articulates with the ilia of the innominates. The sacrum is formed by the fusion of five sacral vertebrae (15), a process that results in a very strong and stable keystone. In addition to the articulation with the innominates, the sacrum articulates with the fifth lumbar process at the base and at the two superior articular processes. The sacrum serves as an attachment site for multiple ligaments such as the sacrotuberous ligament, the ventral sacroiliac
ligament, the sacrospinous ligament, and the iliolumbar ligament and muscles including the piriformis, the multifidi, the erector spinae, and the gluteus maximus.

The triangular-shaped coccyx includes the complete or partial fusion of four bones (15). Of the four segments, the first is the largest; and each vertebra progressively is smaller distally. The coccyx provides an attachment for the sacrociatic ligaments, the coccygeus muscles, and the tendon of the external sphincter muscle.

**Ligaments and Fascia**

Several structures are involved in the control of movements and/or stabilization of the sacroiliac and pelvic complex (Table 11.2). The primary ligaments associated with the sacroiliac joint include the ventral sacroiliac ligament, the interosseous sacroiliac ligament, the long dorsal sacroiliac ligament, the iliolumbar ligament, the sacrotuberous ligament, and the sacrospinous ligament (1). The ligaments of the sacroiliac joint provide afferent output from the joint capsule and are innervated by the dorsal rami of the sacral nerves S1-S4 (16).

**Table 11.2: The Ligaments of the Sacroiliac Joint Region.**

<table>
<thead>
<tr>
<th>Ligament</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interosseous ligament and posterior SI ligament</td>
<td>Lie directly posterior to the SIJ and form a strong link between the sacrum and ilium that limits nutation and inferior shear of the sacrum</td>
</tr>
<tr>
<td>Long dorsal SI ligament</td>
<td>From posterior superior iliac spine to S2 and S3 sacral crests. This ligament limits sacral counternutation and is commonly a source of pain in patients with SIJ symptoms.</td>
</tr>
<tr>
<td>Sacrotuberous ligament</td>
<td>Attaches from the ischeal tuberosity to the inferior lateral angle (ILA) of sacrum. The sacrotuberous ligament limits sacral nutation and will be tensioned by hamstrings contraction or stretch due to fascial linkage between biceps femoris and the lateral portion of the sacrotuberous ligament. The sacrotuberous ligament has also been shown to have fascial connections to the posterior layer of thoracolumbar fascia, gluteus maximus, and piriformis</td>
</tr>
<tr>
<td>Iliolumbar ligaments</td>
<td>Runs from the TP of L4 and L5 to the anterior surface of the iliac crest</td>
</tr>
<tr>
<td>Sacrospinous ligament</td>
<td>Runs from the ILA to the ischial spine</td>
</tr>
</tbody>
</table>

The ventral sacroiliac ligament and the interosseous sacroiliac ligament are less studied and are poorly understood. Bowen and Cassidy (17) report that the ventral sacroiliac ligament is primarily
a thickening of the anterior aspect of the SIJ capsule. Although it is reported to be very strong, the interosseous ligament is not suspected as a cause of clinically determined low back pain (17,18).

The sacrotuberous ligament has extensive connections posteriorly with the gluteus maximus, the long head of the biceps femoris, and the sacrospinous ligament and anteriorly with the iliococcygeus muscle (19). During loading or tension to the sacrotuberous ligament, the amount of available movement (posterior rotation of the ilium to the sacrum or anterior rotation of the sacrum with relation to the ilium) is restricted. Conversely, during counternutation (anterior rotation of the ilium to the sacrum or posterior rotation of the sacrum with relation to the ilium), a slackening of the sacrotuberous ligament occurs allowing freer movement and less stability contribution from this ligament (19).

The long dorsal ligament can be palpated directly caudal to the posterior superior iliac spine. The long dorsal ligament is closely integrated with the erector spinae, the posterior layer of the thoracolumbar fascia, and the sacrotuberous ligament. The ligament contributes to the movement stability of the SIJ, specifically counternutation (19). During counternutation, the tension is increased in the long dorsal ligament and is slackened during nutation, a finding in opposition to the sacrotuberous ligament (Table 11.3). Although both ligaments are physiologically connected, each performs contradictory stabilization tasks for the SIJ.

**Table 11.3: Nutation and Counternutation of the Sacroiliac Joint**

<table>
<thead>
<tr>
<th>Movement</th>
<th>Plane of Motion</th>
<th>Biomechanical Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacral flexion</td>
<td>Sagittal</td>
<td>Sacral nutation: sacral promontory tilts anteriorly and inferiorly</td>
</tr>
<tr>
<td>Sacral extension</td>
<td>Sagittal</td>
<td>Sacral counternutation: sacral promontory back to the neutral position from an anterior-tilted position</td>
</tr>
</tbody>
</table>

The sacrospinous ligament originates on the sacrum and coccyx and inserts on the ischial spine of the innominate (1). This ligament has been associated with numerous pelvic floor dysfunctions including pudendal nerve entrapment (20), vaginal vault prolapse (21), and urinary incontinence (22).

The iliolumbar ligament is one of a few structures that actually cross the sacroiliac joint. Bogduk and Twomey (23) outlined five separate bands of the iliolumbar ligament, which traverse from the transverse process of L5 to the quadratus lumborum, the iliac crest, and the posterior aspect of the iliac tuberosity. The iliolumbar ligament ossifies by the fifth decade and is demarcated from the quadratus lumborum muscle (24).

The iliolumbar ligament appears to restrict sagittal nutation and counternutation of the SIJ (25,26). The ligament is able to perform a function of stabilization to the SIJ whenever the stability of L5 is in tact. In situations where L5 is not stabilized, the SIJ may demonstrate corresponding increased movement and decreased stability. This finding lends credence to the supposition that lumbar and pelvic stability are inter-related. It is proposed that the ventral bands provide greater SIJ stability in the sagittal plane versus the dorsal bands (26).

The ligaments of the pubic symphysis and the sacrococcygeal joint are less studied. The ligaments associated with the pubic symphysis include the superior pubic ligament and the interior arcuate ligament. The stabilization contributions of these ligaments and the associated symphysis...
joint create a typically stable structure (1). The ligaments associated with the sacrococcygeal joint are the ventral, dorsal, and lateral sacrococcygeal ligaments. The ventral sacrococcygeal ligament is a continuation of the anterior longitudinal ligament, whereas the dorsal ligament is a continuation of the posterior longitudinal ligament of the spine (1).

The thoracolumbar fascia envelopes the dorsal muscles of the trunk and forms an attachment for several upper limb and trunk muscles, including the latissimus dorsi, the gluteus maximus, the transversus abdominis, and internal oblique musculature (27). The thoracolumbar fascia transmits forces between the spine, pelvis, and legs, and may play a role in trunk stabilization during rotation and flexion-based activities (28). Vleeming et al. (29) purported that increased tension within the thoracolumbar fascia leads to increased force closure and subsequent increased stability.

**Summary**

- The pelvic girdle consists of the two innominate bones, the sacrum, and the bones of the coccyx.
- The sacroiliac joint is a synovial joint with the sacral surface covered with hyaline cartilage and the iliac surface covered with a type of fibrocartilage.
- The primary ligaments associated with the sacroiliac joint include the ventral sacroiliac ligament, the interosseous sacroiliac ligament, the long dorsal sacroiliac ligament, the iliolumbar ligament, the sacrotuberous ligament, and the sacrospinous ligament.

**BIOMECHANICS OF THE PELVIS/SACROILIAC JOINT**

**Movement Analysis**

The mobile sacroiliac joints function as shock absorbers (28) even during older ages (30–31). Mooney (3) suggests that the principle function of the SIJ is to “dissipate or attenuate the loads of the torso to the lower extremities and vice versa.” The amount of movement has been debated for decades by clinicians and a number of assumptions have prevailed through clinical proviso.

A 2008 study by Goode et al. (32) analyzed actual three-dimensional (3-D) Cartesian movements in studies that limited analysis to Roentgen stereophotogrammetric analysis (RSA). Because SIJ movement is 3-D, the Cartesian system more accurately defines movement by rotations and translations within the six degrees of freedom. RSA involves a 3-D mapping of movements and is much more accurate than use of skin markers or other measures that have a
high degree of error. The review captured data from seven manuscripts, which were also evaluated for study quality.

SIJ rotation ranged between −1.1 to 2.2 degrees along the X–axis, −0.8 to 4.0 degrees along the Y-axis, and −0.5 to 8.0 degrees along the Z-axis during a number of functional movements such as bending over, squatting, or sitting to standing. During the same functional movements, the measures of SIJ translation ranged between −0.3 to 8.0 millimeters (mm) along the X-axis, −0.2 to 7.0 mm along the Y-axis, and −0.3 to 6.0 mm along the Z-axis. The studies that reported the largest degree of motion also presented with the largest degree of instrument measurement error. The review summary suggested that the motion of the SIJ is limited to minute amounts of rotation and of translation, suggesting that clinical methods using palpation for diagnosing SIJ pathology may have limited clinical utility.

Movement of the pubic symphysis has also been investigated. Walheim and Selvik (33) indicated the pubic symphysis rotates 3 degrees and translates 2 degrees. During single-legged stance, the symphyseal can move vertically 2.6 mm and sagittally 1.3 mm on the weight-bearing side (34). During walking, the pubic symphysis can piston (move up and down) up to 2.2 mm in the vertical direction and 1.3 mm in the sagittal direction. Because hypermobility beyond this normal range could lead to pubis instability, several investigators have examined the diagnostic utility of a standing x-ray to determine vertical displacement (12,35,36). Berezin et al. (35) reported movements up to 5.9 mm (s.d. 3.3 mm) in a population of patients with pelvic pain versus only 2 mm in an asymptomatic population. Rieger and colleagues (37) reported that fail rates during externally applied loads generally resulted in disruption in a vertical direction, typically at the pubic symphysis.

Because the movements of the pelvis, even when displaced, are so small, the most discriminatory radiographic analysis appears to be the Chamberlain x-ray (38,39). The Chamberlain x-ray involves an x-ray performed while the patient is standing on a box on the involved lower limb, while the other lower limb is non–weight-bearing. This maneuver allows a vertical migration of the weight-bearing side (pubic symphysis) and has been associated with pelvic instability (36).
Summary

- The mobile sacroiliac joints function as shock absorbers during younger and older ages (with a principle function to dissipate or attenuate the loads of the torso to the lower extremities and vice versa.
- During single-legged stance, the symphyseal can move vertically 2.6 mm and sagittally 1.3 mm on the weight-bearing side.

Muscular Contribution

Thirty-five muscles attach to the pelvis and/or sacrum and have a direct or indirect role in stabilizing this region (15). Muscular contribution is necessary for both form and force closure at the SIJ/pelvis. Form closure includes the passive stabilization contributions of interlocking ridges and grooves on the joint surfaces (28) and ligamentous stabilization. Force closure is a term that corresponds to increased SIJ/pelvis stiffness by isolated contraction of selected muscle groups. Key muscles of force closure are the gluteus maximus, biceps femoris, erector spinae, and latissimus dorsi (4,38,40–43). Other muscles, commonly identified as local muscles, are responsible for the preset tension on the pelvis prior to initiation of movement. These muscles include the transversus abdominis, the multifidi, the piriformis, and the pelvic floor muscles.

The transversus abdominis is a key muscle for stabilization of the sacroiliac joint (44,45). Others have found the feed-forward temporal contraction of the multifidus and obliquus internus abdominis a necessity prior to pelvic stabilization during hip flexion in standing (46,47). Pain of the SIJ was associated with delays of these muscles.

The multifidi originations of the lower lumbar spine insert onto the articular processes of the sacrum, the posterior thoracodorsal fascia, and the sacrotuberous ligament (15). The deep fibers of the muscle span from one segment to the adjacent segment, while the superficial fibers span three segmental levels. The deep fibers of the multifidi are considered the most significant stabilizers of the pelvis and lumbar spine.

The piriformis originates from the anterior aspect of the sacrum, the anterior aspect of the posterior inferior iliac spine, the upper aspect of the sacrotuberous ligament, and the capsule of the sacroiliac joint (15) and inserts on the greater trochanter of the femur. Snijders et al. (6) suggest that the piriformis plays an important role during force closure of the SIJ. The muscle is implicated as a
contributor for chronic buttock pain (48) and can refer pain to the sacroiliac region (15). Often, imaging of the pelvis and lumbar spine performed on patients with suspected piriformis syndrome is unremarkable (49).

The pelvic floor muscles such as the levator ani and coccygeus muscles have shown to contribute considerably to pelvic ring stability. In a study by Pool-Goudzwaard et al. (50), simulated tension in the pelvic floor muscles increases SIJ stiffness by 8.5 percent. Selected authors have outlined the contribution of the pelvic floor muscles to increasing intra-abdominal pressure and an increase in lumbar spinal stiffness (51,52). The muscle functions to stabilize the SIJ through force closure and the capacity to provide counterforce stiffness on the ligaments of the SIJ (29). O’Sullivan et al. (53) outlined inappropriate pelvic floor descent (versus ascent) during altered motor control recruitment of the pelvic muscles in patients with SIJ pain during the active straight leg raise.

Hungerford et al. (46) indirectly lent evidence to the importance of the contribution of these muscles to stability through their report of delayed onsets of the multifidus, the internal obliques, and the gluteus maximus in patients with sacroiliac joint pain. Multiple authors (47,51,54,55) have reported that a feed-forward mechanism of selected pelvic stabilization exists in asymptomatic individuals and is absent in patients with lumbopelvic pain. O’Sullivan et al. (53) suggested abnormalities in stabilization of the diaphragm and the pelvic floor muscles during an active straight leg raise in patients with known pelvic dysfunction. This finding demonstrates the critical role these local muscles play in concert with ligamentous attachments for preset stability, a role very similar to the one played in the lumbar spine.

The erector spinae is a complex muscle group that originates on multiple lumbar segments and inserts into the medial aspect of the posterior superior iliac spine (PSIS) bilaterally and the intermuscular aponeurosis (15). The muscle can provide lumbar extension–based movements or unilateral side flexion when contracted on one side only.

The quadratus lumborum is thought to contribute to stability by increasing the tension of the iliolumbar ligament. The transversus abdominis, psoas, quadratus lumborum and multifidus were each noted to have segmental attachment patterns in the lumbar spine (56). As a group, these muscles surround the lumbar motion segments from the anterolateral aspect of a vertebral body to
the spinous process. Generally, the quadratus lumborum is considered a strong ipsilateral flexor (57). McGill et al. (58) suggest that electromyographic evidence, together with architectural features such as attachment location and activity during selected movements make the quadratus lumborum a better stabilizer of the spine than the psoas.

Using surface electromyographic (EMG) analysis, van Wingerden et al. (59) analyzed a battery of muscle groups to determine which muscles most significantly contributed to force closure. Their findings outlined the significant contribution of the erector spinae, the biceps femoris, and the gluteus maximus to increased stiffness and decreased shear at the SIJ. To a lesser extent, the latissimus dorsi also contributed. Notable were the contralateral and simultaneous contractions of the erector spinae with the gluteus maximus and the contractions of the biceps femoris ipsilaterally, with the gluteus maximus. The aspect of the erector spinae that contributed most was the distal aspect, specifically the multifidus, hypothetically contributing with the attachments to the sacral ligamentous structures.

**Summary**

- Stabilization of the SIJ occurs through form and force closure. Form closure includes the passive stabilization contributions of interlocking ridges and grooves on the joint surfaces and ligamentous stabilization. Force closure is a term that corresponds to increased SIJ/pelvis stiffness by isolated contraction of selected muscle groups.
- Thirty-five muscles attach to the pelvis and/or sacrum and have a direct or indirect role in stabilizing this region. Muscular contribution is necessary for both form and force closure at the SIJ/pelvis.
- Key muscles of force closure are the gluteus maximus, biceps femoris, erector spinae, and latissimus dorsi; however, contribution of the local muscles, such as the transversus abdominis, the multifidi, the piriformis, and the pelvic floor muscles are responsible for the preset tension on the pelvis prior to initiation of movement.

**Dysfunction versus Pain**

Clinicians often use a number of identifiers during implication of the SIJ region. The first identifier used involves the term *dysfunction*, which proposes that the joint is malfunctioning in some manner resulting in movement abnormalities and mal-positions. The second identifier involves the term *pain*, which assumes the SIJ is the pain generator. Unfortunately, the terms SIJ *dysfunction* and SIJ *pain* are commonly used interchangeably, as though each has the same meaning, which they do not (60).
SIJ Dysfunction

In essence, a dysfunction of the pelvic girdle occurs when stabilization is lost or when asymmetric stabilization is present between the two sides of the SIJ (61). Normally, a predictable biomechanical sequence occurs in asymptomatic patients within the lumbopelvic region that stabilizes the pelvis and prepares the structure for weight bearing. This process occurs through two different methods—movement initiation and muscular contraction. Muscle contraction of the multifidi, the gluteus maximus, and the piriformis creates initial tension in the sacrotuberous ligament and thoracolumbar fascia prior to nutation, pre-engaging the ligaments for stability (28). During movement, nutation (posterior rotation of the ilium with respect to the sacrum) tensions the majority of the largest SIJ ligaments such as the sacrospinosus and sacrotuberous ligaments (19). The contact area of the sacroiliac joint is the lowest during posterosuperior displacement of ilium on the sacrum (7), thus requires the greatest amount of force closure. Because of the muscle connections to the ligaments and due to the nature of nutation’s increase in force closure during ligamentous tension, the SIJ demonstrates increased stiffness. Anterior rotation of the innominate on the sacrum (counternutation) appears to be a primary source of pain and instability in patients with chronic pelvic pain (37). Causal displacement that occurs during counternutation (anterior rotation of the innominate on the sacrum) places stress on the long dorsal ligament, which is normally taut during neutral positions (40).

Problems associated with feed-forward failures of ligament laxity discourage the process of form and force closure and lead to SIJ/pelvic instability. This is the primary dysfunction associated with SIJ and pubic symphysis pain. Instability is defined as “the inability of the joint and surrounding structures to bear load without uncontrolled displacements” (25). Many patients report pain during movements of the lower extremity and describe a feeling of paralysis during painful provocation (36). Additionally, an instable pelvis has been associated with the inability to move the lower limbs (36).

Instability of the sacroiliac joints has long been suspected as a cause of low back pain and lumbopelvic dysfunction (47). Stabilization of the SIJ is accomplished through increased friction throughout the joint during tension of selected muscles and ligaments (62). More specifically, Pool-Goudzwaard et al. (28) suggest that the SIJ is protected from traumatic shear forces in three ways.
First, because the joint is wedge shaped, the sacrum is stabilized during weight bearing by locking into the innominate like a keystone. Second, the cartilage surfaces of the SIJ are not smooth as in other synovial joints, thus this encourages stability, specifically in men. Men demonstrate more cartilage abnormalities than women, thus providing greater passive stability based on structural interface (17); however, in situations that do not involve pregnancy, ranges are similar between sexes (8). Third, multiple furrows and ridges within the joint itself encourage a locking function during weight bearing. This complementary system creates ‘form closure’ secondary to a closely congruent passive locking system that is further enhanced during weight bearing (4).

Force closure involves the active element of controlled stability (28). Vleeming et al. (4) identified this process as a ‘self-locking’ or ‘self-bracing’ mechanism that allows enough functional movement but controlled stability to appropriately transfer large forces from the legs to the trunk. To accomplish this challenging task, several ligaments, muscles, and fascial elements are critical. As discussed previously, the force closure muscular contributions of the multifidi, transversus abdominis, and other surrounding musculature are critical.

In 2002, Damen et al. (61) reported that instability is not necessarily a requisite for SIJ dysfunction, rather that asymmetric stability is more likely the cause. Normal subjects demonstrate large variations in laxity that is commonly stabilized by appropriate muscle contribution. Their study used a doppler imaging (DIV) method of measuring stiffness, which analyzes pelvic girdle mobility in vivo.

One notable consideration of the sacroiliac joint is the purported ability of the joint to assume a ‘subluxed’ position. Because of the surface irregularities, Vleeming et al. (41) have proposed that it is theoretically possible for the joint to move and assume a new position that is ‘locked’ into a position of displacement. Furthermore, the amount of displacement may be so minute that radiographic verification is unlikely (4,63). Consequently, a dysfunction may be present, which is typically associated with stability loss, but will not likely have palpable or identifiable mal-positions (or such subtle mal-positions that these cannot be identified) when involved. At present, the ability to palpate variations in SIJ stability has not been confirmed.
SIJ Pain

SIJ pain reflects a situation in which the SIJ is the pain-generating component. Studies have shown that the SIJ has more pain receptors than movement receptors embedded within the joint (64). A number of systematic problems may cause pain and inflammation and pain from a dysfunction may be present as well. What is worth noting is that pain can be present with a stability dysfunction; however, the dysfunction may be below a clinical threshold in its presentation.

Summary

- Dysfunction of the pelvic girdle occurs when stabilization is lost or when asymmetric stabilization is present between the two sides of the SIJ.
- Anterior rotation of the innominate on the sacrum (counternutation) appears to be a primary source of pain and instability in patients with chronic pelvic pain.
- A posterior rotated innominate tends to be a more stable position as compared to anterior rotation.
- The SIJ is protected from traumatic shear forces in three ways: 1) through the wedge-shaped anatomy, 2) through the interlocking furrows and ridges, and 3) through the shape of the surface cartilage.
- Because of the surface irregularities, it is theoretically possible for the joint to move and assume a new position that is 'locked' into a position of displacement, a position that is too small for radiographic verification.

ONLINE REFERENCES


