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The pelvis is the means by which the weight of the erect posture is transferred to the lower limbs. Its shape and function enables the individual to perform a range of activities, such as sedentary sitting and standing, walking and running. These activities distinguish humans from their relatives on the ancestral tree, yet the literature tends to discuss the components of the pelvis in isolation.

There is considerable controversy as to the types of joints that exist in the pelvis, as well as the number of ligaments. In addition, there is debate over joint dysfunction, axes of rotation and translation, unilateral joint dysfunction, short leg syndromes, asymmetry of bones, joint innervation, accessory joints, patterns of pain, and the role of the muscles spanning the joint.

The pelvis has been overlooked by many as a potential site of dysfunction causing low back pain. During the dynasty of the disc, for most of this century, the sacroiliac articulation was virtually ignored. For many years the joint was considered immovable. When Gonstead graduated as a chiropractor in 1923, the pelvis was not considered movable or regarded as a potential site for a subluxation. Repeatedly, he observed patients with pain and edema over the sacroiliac joints after falls and lifting strains. By observing and correlating observations with x-ray findings, he developed the concept of pelvic listings to confirm the clinical observation of a sacroiliac subluxation. Indeed, Gonstead was the first to describe pelvic listings and the adjustments for their correction.

The following presentation will summarize the generally accepted view of the pelvis anatomically, functionally and clinically. More importantly, it will outline a thorough approach to what is regarded by many as the most common site for the origin of back pain.

**ANATOMY**

The pelvis is made up of the sacrum, two innominate bones, the coccyx, and connective tissues. It serves as a support for the vertebral column and as such, is strongly constructed to withstand the compressive forces of the trunk via the fifth lumbar vertebra. The pelvis supports and protects to some degree the viscera of the region, such as the uterus, ovaries and lower intestines, and acts as the means by which the trunk articulates with the lower limbs, thus absorbing the ground reaction forces via the acetabulae (1). The pelvis includes all structures between the fifth lumbar vertebra and the femoral heads (2) (Fig. 6.1).

In a normal fully functional pelvis, the trunk weight passes through the body of the fifth lumbar vertebra (L5) via the alae of the sacrum to the acetabulum. Ground reaction forces are transferred via each femur to its acetabulum, with some of the force passing horizontally to the pubic ramus, meeting at the pubic symphysis (3,4). The ability of the pelvis to function in this manner and provide mobility for upright movements, depends on the strength and stability of both sacroiliac joints and the pubic symphysis. The latter is universally regarded as an amphiarthrodial joint where the two osseous surfaces are connected by an elastic fibrocartilage. This allows very slight movement in all directions, depending on the elasticity of the cartilage (1,2,5).

**Sacroiliac Joint**

The sacroiliac joint has undergone a checkered history of description. It has been described as being amphiarthrodial and diarthrodial. The diarthrodial joint is a true synovial joint. These joints possess a cavity and are specialized to permit movement (5).

![Figure 6.1. A, The trunk weight passes through the body of the fifth lumbar via the alae of the sacrum to the acetabulum. B, Ground reaction forces are transferred by each femur to its acetabulum. C, Some of the force passes horizontally to the pubic ramus, meeting at the pubic symphysis. Modified from Kapandji IA. The physiology of the joints. Vol 3. Edinburgh: Churchill Livingstone 1978:57.](image)
The articular surfaces of the bones are covered with hyaline cartilage and united by an articular capsule. The inner surface of the capsule is lined by a synovial membrane that produces synovial fluid for lubrication of the joint cavity.

According to Cichoke (6), the sacroiliac joint was regarded as a diarthrodial joint in the 18th and 19th centuries by at least six authors and only regarded as amphiarthrodial in the 20th century. By the mid 20th century the joints were being described as diarthro-amphiarthrodial.

Currently, there is a consensus that the sacroiliac joint is a true diarthrodial joint. The shape has been described as auricular, facing posterolaterally on the cephalad half of the sacrum. It has an upper vertical and lower horizontal portion. The latter approaches the posterior border of the sacrum directly medial to the posterior superior iliac spine (PSIS) (7) (Fig. 6.2)

The hyaline cartilage on the sacral surface is three times as thick as the fibrocartilage on the iliac surface (8). The joint cavity is formed during the second fetal month. Grooves and ridges develop on the articular surfaces of the sacrum first, and then the ilium after puberty. The joints of the male are built for strength and have extra and intraarticular tubercles (ridges), whereas the female articulation is for mobility and parturition (6,9). Modelling of the joint progressively occurs with age. Stability increases with the hypolordotic lumbar spine. The hyperlordotic lumbar spine and female pelvis is regarded as being more diarthrodial and therefore more mobile (7,10) (Fig. 6.3).

The ventral or anterior portion of the joint (the lower two thirds) is lined by synovial membrane. The dorsal or posterior portion of the joint (the upper third) is joined by fibrous attachments and does not contain synovial tissue. The most common sacral segments articulating with the ilium are S1, S2, and S3 (11).

Bowen and Cassidy (8) demonstrated that degenerative changes occur early in life and progress with age, until by the fourth and fifth decade, the groove on the sacrum has deepened, and marginal osteophytes have developed.

Otter (3) concluded that asymmetry of the joints intra-pelvically is common, and changes in the joint occur in response to imposed stress with age. He adds that during a lifetime, the sacroiliac joint probably displays a spectrum of diarthrosis, amphiarthrosis and ankylosis. The latter being rare (8). Denton (3,12) studied A-P plain radiographic films of the sacro-iliac joints and put them into 5 broad categories (Fig. 6.4 A-E).

**Ligaments**

The ventral sacroiliac ligament is a thickening of the anterior and inferior parts of the fibrous capsule. It is thickest where it connects the sacrum and ilium at the third sacral segment.

The intersosseous sacroiliac ligament is the main connecting ligament. Its fibers are short, very strong, and run from bone to bone within the confines of the narrow cleft. Illi's ligament has been confirmed by Janse (13) and most recently by Freeman et al. (14). It courses from a posterosuperior attachment on the ilium to an anteroinferior attachment on the sacrum and is considered an anterior

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**Figure 6.2.** The sacroiliac joint is auricular in shape when viewed laterally having an upper vertical and lower horizontal portion. It faces posterolaterally on the cephalad half of the sacrum. The lower horizontal portion approaches the posterior border of the sacrum medial to the PSIS. Modified from Kapandji IA. The physiology of the joints. Vol 3. Edinburgh: Churchill Livingstone 1978:59.

**Figure 6.3.** A. The more mobile, female sacroiliac joint is associated with a hyperlordotic lumbar spine. B. The stronger, less mobile, male sacroiliac joint has extra and intra articular ridges and is associated with a hypolordotic lumbar spine. Modified from Kapandji IA. The physiology of the joints. Vol 3. Edinburgh: Churchill Livingstone 1978:61.
extension of the interosseous ligament. It limits anterior inferior movement of the sacrum.

The dorsal sacroiliac ligament overlies the interosseous ligament and between them lie the sacral spinal nerves and vessels. The upper fibers pass from the intermediate and lateral crests of the sacrum to the posterior superior iliac spine. The lower fibers pass from the third and fourth segments of the sacrum, and divide and travel obliquely to the posterior superior iliac spine, and laterally with fibers of the sacrotuberous ligament.

The sacrotuberosus ligament extends from the posterior iliac spine (blends with the dorsal sacroiliac ligament) to the lower transverse tubercles of the sacrum and coccyx, and runs caudally and laterally to insert on the medial aspect of the ischial tuberosity. The falciform process is an anterior extension from this insertion along the ramus. The ligament is pierced by the coccgeal branches of the inferior gluteal artery and perforating cutaneous nerve. Vleeming et al. (15) note that gluteus maximus, piriformis, and the long head of biceps femoris attach to the sacrotuberosus ligament and conclude therefore, that these muscles, via the sacrotuberosus ligament, may influence movement of the sacroiliac joint.

The sacrospinous ligament is anterior to the sacrotuberosus ligament. It extends from the lateral margins of the apex of the sacrum and the base of the coccyx to the spine of the ischium.

The iliolumbar ligament is attached to the tip and anterior and inferior portions of the transverse process of the fifth lumbar vertebra (with a weak attachment to the fourth lumbar vertebra transverse process) and extends via two main bands. The upper band attaches to the iliac crest and forms part of the origin of the quadratus lumborum muscle. The lower band attaches to the anterior part of the upper surface of the lateral part of the sacrum and blends with the ventral sacroiliac ligament. This ligament is actually the iliocostalis lumborum muscle in the young and gradually differentiates into a ligament (16).

The ventral, intersosseous, and dorsal sacroiliac ligaments are called capsular ligaments. The iliolumbar, sacrotuberous and sacrospinous ligaments are termed accessory ligaments (3).

**Innervation**

Sacroiliac joint innervation is derived from the sacral and lumbar plexuses (3). Asymmetry in supply is common (17).

Lumbosacral facet joint capsules are supplied by the L5 posterior primary division, which also supplies the multifidus muscle.

The anterior aspects of the sacroiliac joint are supplied by L2–4. The actual branch, which supplies the joint, has not been identified.

Posterior and intersosseous ligaments and the posterior joint are supplied by the posterior rami of S1, S2, and branches from the superior gluteal nerve (L4–S1). A plexiform network from the posterior primary rami of S1 and
S2, plus L5 and S4, covers the posterior aspect of the joint and is embedded in the dense ligamentous mass (3,18).

The sacrotuberous and sacrospinous ligaments receive fibers from S1–3. The sacrotuberous ligament receives additional branches from the anterior division of S4, from the gluteal nerve (L5–S2), and from the branches to the piriformis muscle (S1–2) and lateral head of biceps femoris (S1–2).

The iliolumbar ligament is supplied by L1 (15) with the posterior aspect supplied by the L4 lateral posterior primary division and possibly L5 (14). In summary, the sacroiliac joint innervation includes origins from L1 to S4.

**PUBIC SYMPHYSIS**

There are three joints in the pelvic ring; the two sacroiliac joints plus the pubic symphysis. Malfunction in one will have a destabilizing effect on the other two.

As mentioned earlier, the pubic symphyses is an amphiarthrodial joint. Under weight bearing, Kapandji (4) states that its role is to maintain the hold of the iliac bones on the sacrum via a pincer movement. The sacrum is fitted into the pelvic ring under considerable tension by the interosseous ligaments and the ligaments of the pubic symphysis (10) (Fig. 6.5).

There are arguments to suggest that the pubic symphysis is actually under traction forces during weight bearing (10). Sandoz (10) postulates that traction forces would be a maximum when supine and that this traction force would be partially counteracted by a compression force transmitted from the ground, laterally from the femoral heads when standing.

Sandoz further points out that an uneven leg length can cause unilateral torsion to the pelvic ring, thus resulting in a posterior rotation of the innominate on the long leg side, which is evidenced by an elevated pubic bone on the A-P plain film radiograph.

**Innervation**

The pubic symphysis receives its innervation from L1-S4.

**BIOMECHANICS**

The sacroiliac joints allow an independent movement of the ilia and sacrum. It is this movement that distinguishes humans from other animals and allows them to walk upright and hold their head relatively stationary in the anteroposterior projection. The pelvis is a three joint complex, with the symphysis pubis anteriorly and the sacroiliac joints posteriorly. Because L5 is so intimately connected with the sacrum and ilium, it must also be considered when discussing the biomechanics of the pelvis.

**Lumbosacral Motion**

As stated previously, the coronally orientated facets, combined with the iliolumbar ligaments, allow, but control lateroflexion and rotation between L5 and sacrum and results in the hinge disc being L4–5. During flexion and extension, the hinge disc is L5-S1. If the sacrum rotates anteriorly and inferiorly on one side with the ilia, the L5 vertebral body rotates in the opposite direction. This is largely due to the restraint of the iliolumbar ligaments. Congenital anomalies, such as asymmetrical facets and transitional vertebrae, have a destabilizing influence on the pelvis and lumbar spine (3).

**Sacroiliac Motion**

The sacrum approaches static equilibrium in the slightly flexed, prone position (19,20). In this position, inferior and superior forces are removed.

When sitting or standing, forward flexion of the trunk causes the sacral base to pivot anteriorly and inferiorly, while the apex moves posteriorly and superiorly. At the same time, the posterior superior iliac spines move pos-

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**Figure 6.5.** The sacrum is fitted into the pelvic ring under considerable tension by the interosseous ligaments and the ligaments of the pubic symphysis. A, While supine, the pubic symphysis is under traction forces. If severed, it separates and the sacrum tends to subluxate posterior to anterior (+Z). B, Ground reaction forces create a counteracting compression force. Modified from Kapandji IA. The physiology of the joints. Vol 3. Edinburgh: Churchill Livingstone 1978:57.
teriorly, inferiorly, and medially, relative to the sacrum. The ischia move anteriorly, superiorly and laterally. Extension induces exactly the opposite motion (19–21).

While sitting, the weight-bearing ground reaction force is essentially via the ischial tuberosities. The ischia separate and the iliac crests approximate. This induces an anterior inferior glide of the sacral base and a simultaneous posterior superior glide of the sacral apex.

On rising to the standing position, ground reaction forces now act through the femoral heads to counteract the weight bearing forces through the sacrum. This brings the ischia closer together, the iliac crests flare, the sacral base moves posteriorly, while the apex rotates anteriorly. While in the standing position, unilateral hip flexion past 90° will result in the ipsilateral ilium rotating anterior to posterior about a horizontal axis of rotation. Whether the transverse axis is at the level of S2, symphysis pubis or is a shearing mechanism, is discussed later. This will lift the pubis upward in relation to the contralateral pubis. The posterior superior iliac spine can be palpated to move posteriorly and inferiorly in relation to the sacrum. The sacrum can be palpated to move posteriorly and inferiorly to the contralateral ilium. If hip flexion continues, the contralateral sacroiliac joint will reach its limit of movement and the whole pelvis will rotate posteriorly (19–21).

In the standing position, lateroflexion (sidebending) will induce a flaring away of the contralateral ilium. According to Grice (22) and Faye (19), the above parameters are invoked in the following manner. On right step, as the heel strikes, the right ilium rotates posteriorly and inferiorly, the sacral base rotates anteriorly and inferiorly on the right and the right transverse process of L5 is pulled back by the connection of the iliolumbar ligament (19,20). Greenman (23) states that the lumbar spine alternates with sidebend and rotation during gait. He points out that right heel strike, the sacrum and L5 have undergone +θY axial rotation. Faye, in contrast, claims that the lumbar regions remain relatively stable when walking, unless the pelvic biomechanics are hypomobile and further states that sacroiliac dysfunction in the young leads to abnormal gait and muscle development (19,20). Cichoke (6) reports that the strongest ligaments over the sacroiliac joint run in such a direction that the fibers tighten when the innominate rotates posteriorly and become loose when the innominate rotates anteriorly.

Gracovetsky (16), however, regards the spine as an engine transferring potential energy (from gravitational forces and that stored in muscles) plus elastic energy (in ligaments) to kinetic energy and thus forward motion during walking. This is achieved through the lordosis in the lumbar spine, producing an axial torque in side bending, called the coupled motion (See Chapter 2). This occurs at heel strike with the ground. The combination of cervical lordosis, thoracic kyphosis, and lumbar lordosis provides the axial torque that drives the pelvis, counter-rotates the shoulders, and maintains the head in a steady and neutral position. Gracovetsky concludes that the reaction of the joints in the spine and the pelvis distributes the power generated by the spinal engine. The redistribution of power caused by subluxation fixations (joint dyskinesia) is of paramount importance to chiropractors. Gracovetsky’s spinal engine theory lends further credence to the chiropractic theory that subluxations will affect nerve supply to muscles which in turn will affect spinal balance and gait patterns. His theory supports the approach that emphasizes full spinal assessment in patient care (16).

In spite of the above known biomechanics of the pelvis, controversy and confusion remains as to the axis of rotation to enable the sacroiliac joint movement yet maintain pubic symphysis stability. Great confusion and debate has resulted in numerous transverse axes of rotation being identified ranging from the symphysis pubis to the S2 sacral segment, and anywhere in between.

An analysis of the methods used in trying to determine the axis of rotation clarifies the subject to a degree. Egund (24) summarized much of the research in the 19th century plus his own findings as related to sacral nutation and counternutation in trunk flexion and extension and found the transverse axis of rotation to be located at the level of S2 at the iliac tuberosity. Kapandji (4) confirms this finding, stating that the axis of rotation is immediately posterior to the sacroiliac joint. Weisl (25) found that the sacrum did not rotate about a fixed horizontal axis and described it as an angular dynamic axis 5 to 10 cm vertically below the sacral promontory. It varied for different movements of the same individual. Don'tigny (26) says that in standing trunk flexion, sacral nutation occurs around a transverse axis near the central aspect of the sacroiliac joint while the innominate rotates around a transverse axis through the acetabulum.

During walking, there is a vertical, horizontal and oblique axis of rotation described. Greenman (23) and Gracovetsky (16) describe a vertical axis of rotation about which the pelvis and shoulder girdle counter-rotate providing the cross pattern upright gait. The horizontal axis of rotation when walking is described at the transverse axis of the symphysis pubis (23,27,28,29). In fact, Wells cites Pitskin and Pheasant who point out that if the transverse axis of rotation during walking was through the sacrum or hip joints, the pubic symphysis would rupture (30). Greenman (23) describes the pubic symphysis during walking as having an up and down oscillation in a sinusoidal curve with very little translation. It is the most stable point within the pelvic girdle during walking.

White and Panjabi (27) describe sidebend and rotation of the sacrum as coupled movements. They point out that a coupled motion will bring about a change in the axis of rotation and argue that at any one moment, therefore, there is an instantaneous axis of rotation.

Don'tigny cites McConnell and Teall who describe a position where the ilium is forward, the ischium is back-
ward and the innominate is thrown downward causing an apparent lengthening of the limb when the patient is prone (26). Greenman (28) describes a superior and inferior innominate shear mechanism that is caused by trauma and is related to an iliac rotation either forward or backward with concomitant alteration of each pubic bone at the symphysis. In a later paper (23) he describes how if sacroiliac joint surfaces are parallel or have a flattened convex-concave relationship, a superior to inferior translatory movement results. In addition, if the convex-concave relationship is reversed, the innominate rotates around a vertical axis resulting in medial or lateral rotation termed an in-flare or an out-flare dysfunction.

Mitchell et al. (31) summarized that there was a sacral respiration transverse axis through the PSIS, a standing sacral transverse axis through S2 with flexion and extension, and four walking axes. These were a transverse axis through S3, a transverse axis through the pubic symphysis and two diagonal axes. One from the upper left to the lower right and vice versa.

**MYOFUNCTION OF THE PELVIS**

The joint movement described above is the end result of leverage forces supplied by muscle action. We will use Faye’s right forward step mechanism to explain this further (19,22).

In taking the right forward step, the hip flexes mainly as a result of the action of rectus femoris. Body weight transfers to the left limb and is stabilized by the left gluteus minimus and medius. This results in the right pelvis raising to a higher level (2) (as seen in Trendelenberg test). The right ilium rotates posteriorly, while the right side of the base of sacrum rotates anteriorly and inferiorly and vice versa with the left ilium. The upper sacroiliac joint on the right side is closed by the sacrospinous muscle. The left iliopsoas contracts to counteract the right sacrospinous contraction. The action of the posterior movement of the right ilium and support by the left gluteus minimus muscle produces a lateral pelvic shift to the left. This is allowed by the mobility of the left hip joint. Stabilization is by the action of the left piriformis muscle, which closes the left side lower sacroiliac joint and induces an external rotation of the femur. With the right ilium moving posterior and inferior, the normal coupled movement is for the ilia to externally rotate while the piriformis relaxes. This induces a medial rotation in the right femur. The forward thrust in the step by the left leg is induced by gluteus maximus and hamstring contraction on the left side. The left gluteus maximus counteracts flexion of the left hip in the above right forward step action (2).

The clinical significance of the above muscle actions is that shortened, hypertonic muscles, with an inability to relax when necessary, will induce functional dyskinesia to the pelvis. Fixation in joints result, causing a shift in the axis of rotation leading to a subluxation complex. The nerve supply to some of these muscles originates in the thoracolumbar and lumbar spine Table 6.1. The clinical significance of this will be discussed later.

Two other major muscle groups, the hamstrings and the quadriceps, need to be listed in the function of the pelvis. In forward flexion, the paravertebrals support the trunk and lumbar spine for the first 30° until ligaments take over that role (32). Beyond this, the pelvis rotates around the hip joints to allow further flexion. The degree of flexion attained now depends on the ability of the hamstrings to relax and stretch. If this is limited, greater strain is placed on spinal and pelvic ligaments leading to back strain. Shortened, hypertonic hamstrings leads to a more posterior inferior position adopted by the ilium.

Shortened hypertonic quadriceps muscles may cause a more anterior superior position being adopted by the ilium and subsequent loss of lordosis of the lumbar spine and posterior superior movement of the sacral base.

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**Table 6.1.**

<table>
<thead>
<tr>
<th>Muscles</th>
<th>Nerve Supply (N), Segmental Derivations (S), Origins (O), and Insertions (I) of Some Key Pelvic Muscles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gluteus Minimus</td>
<td>N: Superior gluteal nerve S: L5-S1 O: Outer surface of the ilium I: Greater trochanter</td>
</tr>
<tr>
<td>Gluteus Medius</td>
<td>N: Superior gluteal nerve S: L5-S1 O: Outer ilium I: Oblique ridge on the lateral surface of the greater trochanter</td>
</tr>
<tr>
<td>Gluteus Maximus</td>
<td>N: Inferior gluteal nerve S: L5-S2 O: Lateral lip of the iliac crests plus the lower lateral borders of the sacrum and coccyx I: Fidiaibial band over the greater trochanter</td>
</tr>
<tr>
<td>Psoas Major</td>
<td>N: Lumbar plexus S: L1-L3 O: Transverse processes, bodies and discs of all lumbar segments I: Lesser trochanter of the femur</td>
</tr>
<tr>
<td>Iliacus</td>
<td>N: Femoral nerve S: L2-L3 O: Sacrum, iliac crest and iliac fossa I: Femur</td>
</tr>
<tr>
<td>Piriformis</td>
<td>N: Sacral plexus S: L5-S2 O: Pelvic surface of the sacrum at foramen 1-4 and margin of the greater sciatic foramen I: Greater trochanter of the femur</td>
</tr>
<tr>
<td>Rectus Femoris</td>
<td>N: Femoral nerve S: L2-L4 O: Anterior inferior iliac spine above the rim of the acetabulum I: Proximal border of the patella and the tibial tuberosity</td>
</tr>
<tr>
<td>Sacrospinus (Erector Spinae)</td>
<td>N: Dorsal rami from adjacent spinal segments S: T11-L5 O: Medial and lateral sacral crest, medial iliac crest, dorsal sacrotuberous and sacroiliac ligaments I: Spinous processes of the lumbar segments plus the 11th and 12th thoracic spinous processes</td>
</tr>
</tbody>
</table>
DEGENERATIVE JOINT DISEASE

The sacroiliac joint, being a diarthrodial joint with articular facets, hyaline cartilage, synovial lining and capsule, is subject to the pathologic changes that might occur in any joint, such as tuberculosis, and pyogenic and nonpyogenic arthritides (6,7).

Age-associated degenerative changes in the sacroiliac joint are common and appear around the fourth decade (33). Premature degenerative changes are seen after trauma or altered-weight bearing phenomena, such as scoliosis or leg length inequality. The radiographic signs are limited to the lower two-thirds of the joint (the synovial compartment). These include loss of joint space, subchondral sclerosis, and osteophytes (33). The vacuum phenomena, occasionally seen, is not diagnostic of degenerative joint disease in the sacroiliac joint (33) (Fig. 6.6).

Accessory sacroiliac articulations occur in 10 to 36% of population samples studied (34,35). They have been identified as arising from two possible sites (34). The more common superficial accessory sacroiliac joint is seen on the anteroposterior plain radiograph between the posterior superior iliac spine and the lateral crest of the sacrum opposite the second posterior sacral foramen. The deeper accessory sacroiliac joint is less common and is found between the large roughened tuberosity of the ilium and the smaller sacral tuberosity opposite the first posterior sacral foramen.

A small study by Bull (35) revealed that accessory sacroiliac joints are more prevalent in the more mobile sacroiliac joints, where there is an anterior inferior sacral base and an increased lumbar lordosis and sacral base angle. He postulates that it may be an attempt at stabilization in response to environmental stress in adulthood.

SACROILIITIS

Inflammation of the sacroiliac joint can arise from infection or by one of the inflammatory arthritides. It can be unilateral or bilateral.

The earliest sign, radiographically, is widening of the joint space and loss of the normally sharp cortical margin, due to the demineralization of the articulating bony surfaces. Narrowing of the joint space and bony ankylosis are expressions of healing and occur late in the course of inflammatory arthritis (33,35,36).

Infection is the most common cause of unilateral sacroiliitis. It occurs either by a hematogenous route or by spreading from a contiguous source (35,36). There is usually pain, tenderness, and heat in the joint area. The patient may be febrile, have an elevated erythrocyte sedimentation rate (ESR) and raised white blood cell count.

ANKYLOSING SPONDYLITIS

Ankylosing spondylitis is the most common cause for bilateral sacroiliitis. This painful condition affects pre-dominantly young men between the ages of 15 and 35 (mostly in the third decade). The onset of symptoms is confined primarily to the low back and pelvis. HLA-B27 blood antigen is present in 90% of cases.

The sacroiliac joint involvement is best seen on plain radiographs with angulated A-P views (33). Even at its earliest clinical stages, radiographic signs are present (33,35,36). Further changes can be detected 3 to 6 months...
later (33). Alterations are more prevalent in the lower two-thirds of the joint, which corresponds to the synovial portion (33,35,36).

The first stage seen on the radiographs is the initial pseudowidening of the sacroiliac joint because of the inflammatory erosion of the hyaline cartilage. This occurs predominantly on the iliac side of the joint. This is followed by reactive sclerosis and bony bridging. The final stage is seen as a narrowing of the joint space. The sclerosis gradually disappears and is replaced by a generalized osteoporosis. Ossification of the ligaments occurs, leading to ankylosis of the joint (33,35,36). The time span for the three stages takes from 7 to 23 years, with a mean of 14 years (33) (Fig. 6.7).

**OSTEITIS CONDENSANS IILII**

This condition should be called osteosis condensans illi because the process has been shown to be noninflammatory (10). The general consensus is that it is a direct result of a reaction to mechanical stress (10,33,35,36). Radiographically, there is bilateral, symmetrical, well defined, triangular sclerosis on the inferior portions of the iliac sides of the sacroiliac joint (35). The symptomatic patient is typically a multiparous female between 20 and 40 years of age (33). The symptoms begin during the last trimester of pregnancy and coincide with the greatest gain in weight. Sandoz (10) speculates that functional radiographs made in alternate monopodal stance shows the absence of pelvic instability. This confirms clinical examination findings of a normal Trendelenberg test (10,33). Sandoz speculates that the increased weight forces the sacrum into a +θX rotation. This is restricted by the sacrospinous and sacrotuberous ligaments and by a bony lock constituted by the forward thrust of the first sacral segment against the ilia at the linea terminalis. In the upright position, the articular cartilage and the ilium are submitted to a constant compression and, in accordance with Wolf's law of adaptation, there is a reactive condensation of the bone (10).

The bony sclerosis is located on the ilium at the level of the linea terminalis (10) and is best depicted with an anterior posterior, 30° cephalad angulated tube projection (33).

**PSORIATIC ARTHRITIS**

Between 30 and 50% of individuals with psoriatic arthritis will have sacroiliac joint changes. Bilateral asymmetrical sacroiliitis is the most common presentation (33). Radiographic changes include erosions, initial widening of the joint space, hazy joint margins and sclerosis, predominantly along the length of the iliac surface (33,35). HLA-B27 antigen is present in 75 to 90% of patients with sacroiliac involvement (33,35). Clinically, the onset of sacroiliac joint changes occurs in the fourth decade.

**REITER'S SYNDROME**

Sacroiliac involvement is common and is usually the earliest manifestation of Reiter's syndrome. Only 50% of patients will show radiographic signs, most during the later years of the course of the disease (33,35). Radiographic signs of this disease have a tendency to be bilateral and asymmetrical. They can present as unilateral in the early stages and bilaterally symmetrical in the later stages. Radiographic signs include erosions, altered joint space and sclerosis, predominantly on the iliac side of the joint. Symptoms and signs appear from 15 to 30 years of age, accompanied by the triad of sacroiliitis, uveitis and urethritis. The blood antigen HLA-B27 is present in 75 to 90% of patients (33,35).

**LEG LENGTH INEQUALITY**

A short leg can be due to congenital factors, the direct result of a slipped femoral capital epiphysis, a fracture in either the femur or tibia, or paralysis from disease such as polio. Surgical alteration from hip prostheses can cause leg length inequality as well. Sandoz (37) reports that between ⅔ and ⅔ of all humans present with a difference in leg length.

The mechanism and method of treatment of LLI will be dealt with later. The biomechanical stresses and mus-
cle imbalances caused by LLI become a complex of static forces while standing, and dynamic forces during normal gait patterns. The increased ground reaction force on the side of the long leg can cause the ipsilateral ilium to rotate posteriorly. This puts a vertical strain on the ipsilateral pubic bone, resulting in its elevation relative to the contralateral pubic bone at the symphysis. There tends to be a lumbar scoliosis convex on the short leg side. This is aggravated when the short leg moves into posterior stance during walking (10). Sciatica and unilateral hip symptoms are much more common on the side of the long leg (38).

Sandoz (10) has observed that a considerable LLI can induce a pelvic distortion. The long leg tends to rotate the innominate backwards (PI), resulting in an elevated ipsilateral pubis. This fixed posterior rotation on the ipsilateral (long leg) ilium, may favor the development of a superficial accessory sacroiliac joint.

Klein (39) observed that a compensatory mechanism, foot pronation, occurred on the side of the short leg. This resulted in genu valgus and medial collateral ligament strain and undue sacroiliac stress on the same side. Lawrence (38) reports that the short leg has overall weakness of muscle strength when compared to the long leg. Sandoz (37) cites studies that demonstrate increased activity occurring in erector spinae, gluteus maximus, anterior thigh and calf muscles on the side of the long leg, if the discrepancy is 2 cm or more.

The physical presentation of LLI, according to Sandoz (10), is that a horizontal line through the posterior superior iliac spines will show one side to be lower, whereas a line through the anterior superior iliac spines will show the situation in reverse. Altered biomechanics will lead to altered pathophysiology (10). There is considerable debate as to the significance of LLI in creating pathological states. Some authors claim 5 mm or less has a definite significance in mechanically related dysfunctions around the hips, pelvis and spine (40,41). Other investigators say less than 12.7 mm (half an inch) is not significant and has no pathologic implications (42). Giles (41) performed a study that demonstrated that a LLI of more than 9 mm induced changes in lumbar facet joint symmetry more commonly than a LLI of less than 4 mm.

Measurement of LLI can be performed via radiographic or clinical analysis. Radiographic analysis is regarded by most authors to be the most accurate. Of the clinical methods used, the most accurate assessment is to palpate the iliac crests and add lifts under the foot on the short leg side until the iliac crests are level. Of the tape measurement systems, the most accurate was the measurement from the anterior superior iliac spine to the lateral malleolus (42). The difficulty with clinical methods is in obtaining reliable, reproducible results. This can be hampered by factors such as obesity, scoliosis, and severity of back pain (38,42).

Clinical assessment of the presence of a true short leg is by Alli's test, which differentiates femoral from tibial shortness. With the patient supine and knees flexed to 90° and toes level, a disparity in knee height in the cephalad-caudal plane indicates a short tibia. Disparity in the lateral plane indicates a short femur.

Commonly seen, is the situation in which leg lengths are equal in the presence of a pronated foot. This results in a functional short leg. For ease of description, consider a right-sided congenital foot pronation. This is where the medial head of the talus has rotated internally, leading to the unlocking of the midtarsal joint (naviculo-talus joint), and a flattening of the longitudinal arch of the foot. At the same time, this induces an artificial shortening of the right leg (as the foot support collapses lower to the ground) of up to half a centimeter (43). The distal tibia follows its base (the talus) resulting in an internally rotated tibia that induces an internally rotated femur and hip joint. This adds tension to the ipsilateral iliopsoas and internal hip rotator muscles as they are stretched (43). An increased lumbosacral angle is induced, leading to hyperlordosis and a scoliosis with lumbar convexity on the ipsilateral side.

In a study of 25 patients, Smith and Markham (Personal Communication, In Shoe Systems, Bellingham, WA) found that foot pronation lead to a difference in femoral head height by up to 5 mm (average 2.2 mm) and increased the lumbosacral angle by up to 25° (average 4.1°).

GONSTEAD METHOD FOR THE PELVIS

The Gonstead technique is a system of meticulously analyzing the patient, and on the basis of all information acquired, deciding what corrective steps to take. The basic premise for this system revolves around:

i. Level Foundation
ii. Intervertebral Disc
iii. Compensation
iv. Fixation/Subluxation
v. Listing

It is the pelvis that the level foundation refers to. When level, the pelvis allows the forces of gravity to maintain the chiropractic adjustment and not work against it. In no way does this imply that the objective is for the chiropractor to straighten the spine especially if the deviation is due to malformation of the soft or hard tissue elements.

After all other tests have been performed, the radiographic line drawings and listings show the way in which the vertebra and joints have been "twisted and jammed" (fixated). This then informs the practitioner of the specific contact and direction of thrust required to reverse the positional dyskinesia and to prevent further ligamentous damage during the thrust. The adjustment restores normal function to the motion segment, thus removing neurologic dysfunction. In many instances, positional
dyskinesia as indicated by listing measurements on radiographic films is reduced. If the condition is extremely chronic, there may be no positional change on re-evaluation.

Examination

The spinal examination chapter details the comprehensive approach. The following section will deal with particular topics relevant to the pelvis. Some of the topics under each heading will have relevance to previous sections on biomechanics, pathologic states, innervation, and muscle actions. The relevance of others will be seen in the clinical presentation section.

HISTORY

A standard health history should be taken to enable a thorough differential diagnosis. While this chapter is not designed to describe systems analysis, the following are a few examples designed to outline some relevant questions regarding the pelvis. For the female, of particular relevance is the number of children. This provides the practitioner with clues as to the total amount of strain on the mother's pelvis because of parturition and from bending and lifting in the first year of each child. Previous illnesses, such as abdominal disease, that could cause viscerosomatic pain, abdominal surgery, pelvic infections, joint disorders, or diseases such as osteitis condensans ili, should be determined. Disease states such as ankylosing spondylitis, inflammatory diseases such as Reiter's, infection in blood, joints or bones, psoriasis, arthritis etc., should be queried. It is necessary to identify accidents that have caused low back pain, such as lifting strains, sporting injuries, motor vehicle accidents, sneezing or coughing fits. Fractures of the leg or pelvis can cause a shortening of the leg or hip dysfunction.

Hip prostheses can affect the function of the pelvis. The history of surgery for cancer of the bowel, kidney, prostate or uterus must be queried as these cancers can metastasize. Occupations that involve prolonged standing, bending, driving, sitting, lifting and digging can all cause postural and repetitive strain to the spine and pelvis. Age and weight can help categorize the probability of a certain condition, such as Perthe's in young teenage males, osteitis condensans ili in multiparous females, loss of muscle tone and spinal protection in overweight unfit middle aged males, and osteoporosis in post menopausal females.

A detailed description of the pathomechanics of all micro/macro traumatic episodes that the patient has experienced should be taken. This should include the site of the symptoms as well as aggravating and relieving factors. A sacroiliac subluxation is usually aggravated with prolonged standing and walking and is relieved with sitting. Disc problems in the lumbar spine will be aggravated with sitting.

POSTURAL ANALYSIS

Postural analysis is conducted to determine abnormal postural and gravitational stresses on the spine. Of particular importance in the coronal plane is the relative levels of the posterior-superior iliac spines, the iliac crests, greater trochanters, gluteal folds and anterior-superior iliac spines. These observations provide initial indications of a level foundation, possible pelvic subluxations, and anatomic LLI. The spine is examined for scoliosis, and differentiation of functional or structural scoliosis is determined with Adam's test (See Chapter 9). Foot pronation and the integrity of the longitudinal arch is investigated because this may contribute to LLI. Laterally, observation is made of the spinal curves, particularly the degree of lumbar lordosis, pelvic tilt and abdominal muscle tone is noted. Included in this examination is an analysis of gait. A shorter stride on one side may indicate a short leg or a fixation dysfunction at the sacroiliac joint. Foot pronation must also be observed for during this procedure.

PHYSICAL EXAMINATION

A thorough orthopedic and neurologic examination is required, including vital signs. Of particular relevance is the differential diagnosis of disc herniation, nerve root inflammation, and myofascial trigger point pain referral patterns. In addition, relative shortening and weakness of the iliopsoas, quadriceps, and hamstring muscles should be investigated.

STATIC PALPATION

Attention should be directed to locate areas of tenderness, edema (e.g. PI has edema in the posterior superior area of the sacroiliac joint, AS in the posterior inferior area of the sacroiliac joint and Ex in the entire posterior area of the joint), heat, and hypertonic muscle changes. This provides vital clues as to the histopathologic, myopathologic and biochemical components of the subluxation complex.

MOTION PALPATION

The pelvis is a closed kinematic system. To locate and isolate joint fixation dysfunction and compensatory hypermobility, the motion of the sacroiliac joints, pubic symphysis, and lumbosacral joints require examination. It is clinically accepted by many authors (19,20,21,32,44, 45,46) that the motion of sacroiliac joints can be palpated and observed. As such, fixations can be located based on both the aberrant patterns of motion and the juxtaposition of two opposing bones at the joint surface. There are
thirteen methods for motion palpating sacroiliac joints currently described.

**Sitting Sacroiliac Motion Palpation of Axial Rotation.** To palpate the left sacroiliac joint, the practitioner stands on the left side of the seated patient, facing them obliquely. The left hand is placed on the patient's right shoulder. The tip of the right middle finger is placed on the patient's left posterior superior iliac spine, while the tip of the index finger rests on the immediately adjacent sacrum. The practitioner actively rotates the patient's slightly flexed trunk to the left. This movement will create motion at the sacroiliac joint and the fingers will separate. The practitioner moves to the right side to palpate the right sacroiliac joint.

**Prone Sacral Push.** The practitioner applies firm vertical, downward pressure to the sacrum of the prone patient. The patient's feet should be extending comfortably over the end of the pelvic bench. With normal sacroiliac motion, the feet will externally rotate when the pressure is applied. They return to neutral when the pressure is released. If there is a sacroiliac fixation, the foot on the fixed side will either move sideways or lift slightly.

**Sitting Side Bend.** The practitioner is positioned behind the seated patient and places each thumb on each of the patient's posterior superior iliac spines. The patient is asked to actively sidebend while maintaining both buttocks firmly in contact with the surface of the couch. During this action both thumbs should remain level. If one segment is fixed, the thumb over the PSIS on the fixed side will ride up.

**Standing Side Bend.** Contact as in Sitting Side Bend Test and the patient is asked to actively side bend, keeping both feet firmly in contact with the ground. The normal motion is for the posterior superior iliac spines to glide naturally but remain level. If one joint is fixed, the segment on the fixed side will ride up with contralateral side bend.

**Standing Knee Bend PSIS Contact.** The contact is the same as in standing side bend. The patient flexes the knee and elevates it as high as possible, in a smooth action achieving maximal active hip flexion. With normal motion, the posterior superior iliac spine on the side of hip flexion moves inferiorward while the contralateral side remains higher. The degree of inferiorward excursion should be compared bilaterally.

**Standing Knee Bend PSIS-Sacrum Contact**

A. **Flexion Component of the Upper Sacroiliac Joint:** The practitioner is located behind the standing patient. To test the right sacroiliac joint, the right thumb is placed on the right posterior superior iliac spine of the patient. The left thumb is placed on the second sacral tubercle. The patient flexes the right knee and elevates it as high as possible in a smooth action achieving maximal active hip flexion. In normal movement, both thumbs approximate as the ilium moves posteriorly and inferiorly and the sacrum moves anteriorly and inferiorly. If the joint is fixed, both thumbs move as one unit and fail to approximate. This theoretically tests the upper sacroiliac joint flexion component.

B. **Extension Component of the Upper Sacroiliac Joint:** Contact as in (a). The patient flexes the left knee and elevates it as high as possible in a smooth action, achieving maximal active hip flexion. In normal movement, both thumbs separate as the ilium moves anteriorly and superiorly and the sacrum moves posteriorly and superiorly. If the joint is fixed, both thumbs move as one unit and fail to approximate. This tests the upper sacroiliac joint extension component.

C. **Flexion Component of the Lower Sacroiliac Joint:** The practitioner's left thumb contacts the sacral apex, while the right thumb contacts the inferior aspect of the sacroiliac joint on the ischium. For the right joint, the patient flexes the right knee as in (a). When movement is normal, the practitioner's right thumb moves laterally. When the joint is fixed, the practitioner's right thumb moves slightly upward as the patient elevates the right knee.

D. **Extension Component of the Lower Sacroiliac Joint:** The contact is the same as in (c). The patient elevates the left knee. When movement is normal, the prac-
titioner's right thumb moves upward. If the joint is fix-
ated, no movement is discernible.

INSTRUMENTATION

The subject of the use of the bilateral temperature differential instruments such as the Nervoscope for measuring temperature asymmetries of the spinal column has been dealt with earlier in Chapter 4. Although criteria have been set down for conducting and interpreting readings over the spinal column, the interpretation for the pelvis remains poorly defined. The Nervoscope can register for a sacroiliac subluxation. This occurs more reliably when the subluxation is in the acute, inflammatory state. Chronic fixations may or may not register a temperature differential. To obtain a reading it helps to “tilt” the Nervoscope from side to side (i.e., ± 90° movement).

A PEST subluxation will tend to give a temperature differential at the upper sacroiliac joint, presumably because this is the area of inflammation (44).

An ASIN subluxation will tend to give a temperature differential at the lower sacroiliac joint, presumably because this is the area of inflammation.

A base posterior sacrum will usually cause a temperature differential at the lumbosacral junction. For an acute condition, a significant change in the instrument reading after the adjustment can take at least 6 hours.

As presented in the section on innervation of the sacroiliac joint, the segmental innervation extends from L1 to S4. Additionally, the innervation of the anterior and posterior aspects of the amphiarthrodial and diarthrodial portions of the joint at the same level differs. Further work needs to be done in this area to lay down firm criteria for conducting and interpreting the use of the Nervoscope on the pelvis. Therefore, at this stage, observation and palpatory assessments are the preferred examinations, supported with plain film radiography (44,46).

Clinical Presentations and Management

The sacroiliac joint can present with a diversity of symp-
toms and signs that require very careful analysis. Researchers have found that pain in the sacroiliac joint was associated with either marked increases or decreases in mobility of the joint (47). Sacroiliac joint fixation was found in 28.1% of school age children 6 to 17 years of age. In the same study, low back pain was present in 23.5%. This gave a significant association between sacroiliac hypomobility and a history of low back pain (48).

Sacroiliac pain may be characterized by low back pain plus pain and localized tenderness over the joint, extend-
ing to the buttock, groin, genitalia, trochanteric region, mainly posterior, but also medial and anterior. It may also cause thigh pain, pain that extends to the heel, and lateral border of the foot (3,7,20,21,32,45,48,49). It is commonly referred and the extent of the referral is regarded as an indication of the severity of the nerve root inflammation (49). In a literature review by Otter, the peripheral nociceptive system is classified into interstitial and perivascular nociceptive receptors (3). The systems are activated by sufficiently severe degrees of mechanical tissue distortion or marked chemical alteration of the tissue fluid. Thus, he describes mechanical changes as giving rise to pressing, stabbing, bursting or vise-like sensations and chemical alterations as scalding or burning sensations.

If we can generalize about the complex pelvic area in relation to the sacroiliac joint then, typically, the patient has hurt the sacroiliac joint with a lifting and twisting action. This results in a grabbing sensation in the back which worsens to the point of the patient experiencing difficulty rising from the bed the next morning. There is unilateral pain and no neurologic signs. Difficulty is experienced rising from a prolonged sitting position and can be aggravated by walking. Stabbing pain is experienced with certain movements, particularly ipsilateral side bending when standing.

Management of an inflamed sacroiliac subluxation requires that ice be applied after the adjustment for 10 to 15 minutes every hour, as is practicable, for at least 24 hours. After the adjustment, the patient should go for a 5- to 10-minute walk. This is of utmost importance in the pelvis, because walking will help mobilize the pelvic joints. To get straight into a car, either to drive or be driven home, is contraindicated. Under no circumstances is heat applied to an acute inflammatory low back condition.

The chronic degenerative condition will usually undergo a more gradual improvement. Because of chronic ligamentous contracture, it may not be possible to obtain an audible set initially. These patients need a number of adjustments to restore normal joint function.

The Pelvic Bench

The patient lies on their side, on the third of the table nearest to the doctor, who is standing at the side of the pelvic bench (Fig. 6.8) (50). The patient's down side leg is pushed to a straight position so that the foot extends over the end of the bench corner (for ease of rolling). The head is on its side, facing the side the doctor is standing on, with the neck in a neutral position. The patient's shoulders are positioned in a vertical plane with the downside shoulder being drawn slightly caudally. The patient's hands are approximated in a comfortable position near the trunk. The high side leg is flexed at the hip and knee so that the foot is hooked behind the knee of the low side leg.

The doctor stands facing the patient approximately at the level of their pelvis. Skin on skin contact is made so that the joint is palpated with the doctor's cephalad hand and slack tissue pulled in the direction of the intended adjustment. The pisiform or finger of the caudal hand is then applied to the joint being adjusted. The patient's
high side knee is straddled and moved cephalad until the joint is felt to move back into the psoas contact hand. The knee is then brought back to reduce the tension in the sacroiliac joint.

The cephalad hand cups the anterior inferior aspect of the acromioclavicular portion of the shoulder joint and applies a slight pressure in a cephalad direction. The doctor maintains shoulder and psoas contact and steps back slightly from the bench. The patient is rolled to the side towards the doctor who then places the anterior thigh of the caudad leg gently along the side of the patient’s thigh. The cephalad leg is positioned approximately level with the patient’s lower rib cage while the same foot is pointing toward the shoulder contact.

The end result is that the doctor’s caudad leg should be straight. It should be making ground contact with the ball of the foot, inducing a straight back and comfortable preadjustment stance, resulting in no spinal strain to the doctor and the patient.

The adjustment is executed by lowering the caudad elbow to enable the forearm to point in the direction of the thrust. The push move adjustment is executed by dropping to set the joint followed with a holding for two seconds. There should be no recoil or rebound. No thrust should be applied to the patient’s shoulder. In essence, the doctor will roll the patient over, get him or her to relax, then thrust and hold.

The Knee Chest Table

The patient kneels and rests both head and upper anterior chest on the head rest section while holding onto the side hand grips. Both knees are separated sufficiently to be as wide as both hip joints. Both femurs should be sloping 5–10° caudad from the vertical. The ankles have the same separation distance as the knees. The shoulders should be the same height as the hip and pelvic joints (See Chapter 7).

PI Ilium

The ilium portion of the innominate articulates with the sacrum. A posterior inferior ilium is one that has rotated about the center of axis and juxtapositioned itself in a posterior and inferior position relative to the sacrum. In fact, it has rotated counter clockwise around the X axis (−bX) and posterior on the Z axis (−Z). It is relatively fixated in this position.

AP FILM ANALYSIS

The vertical height of the innominate from the iliac crest to the ischial tuberosity increases (Fig. 6.9). This also occurs on the lateral film. The size of the obturator foramen increases, in vertical and diagonal length. The PI ilium causes the femoral head to appear lower. This creates a functional shortening of the leg length.

LATERAL FILM ANALYSIS

There may be an increased lumbar lordosis on the lateral film or an increased sacral base angle.

CLINICAL FINDINGS

For a PI ilium, the posterior superior aspect separates and becomes edematous (Fig. 6.10). The posterior superior aspect can be statically palpated for edema and tenderness. A PI ilium induces a relative anterior inferior shift of the ipsilateral sacral base.

An increased lumbar lordosis may result from a PI ilium subluxation. The gluteal fold is lower on the side of the PI ilium. The leg length check will likely reveal a short leg on the PI side, unless an anatomical discrepancy is present.

Name of technique: Gonstead

Name of technique procedure: Side posture PI ilium push adjustment (Fig. 6.11).

Indications: PI subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The PI ilium is on the high side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench.
Figure 6.9. A, Normal AP pelvis. B, Right PE ilium with increased vertical height of the innominate and increased diagonal and vertical length of the obturator foramen. C, Plain film of left PE ilium.

Figure 6.10. A PE ilium showing the palpable edematous and tender area of the sacroiliac joint.

Contact Point: Skin on skin contact is made so that the doctor’s cephalad hand takes up slack tissue in a cephalad direction over the high side PSIS. The pisiform of the caudad hand is applied to the posterior inferior border of the high side PSIS. The patient’s high side knee is straddled and moved cephalad until the PSIS is felt to move back into the pisiform contact hand. The knee is then brought back slightly until the tension in the joint is felt to release.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: The doctor lowers the caudad elbow to the level of the contact point to allow the direction of thrust to be posterior to anterior (+Z) and inferior to superior (+θX) in the direction of the plane of movement of the sacroiliac joint.

Name of technique: Gonstead

Name of technique procedure: Hi-lo prone PE ilium push adjustment.

Indications: PE subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie prone.

Patient position: The patient lies prone, with both arms resting over the side of the table.
Figure 6.11. A, Correct set up for a side posture right PI ilium push adjustment. B, Left PI set-up on an anatomic model. C, Lytic metastasis of the proximal femoral shaft—an contraindication for side postures adjustments. This patient died one month after the radiograph was taken. D, Bilateral hip prostheses. A contraindication for side posture adjustments.

Doctor’s position: The doctor stands on the opposite side of the patient’s PI ilium at the level of the patient’s thigh and as close to the table as possible with the outside foot placed directly in front of the inside foot.

Contact point: The contralateral PI ilium is skin to skin contacted with the heel of the doctor’s inside hand just inferior to the PSIS.

Supporting hand: The doctor’s outside hand stabilizes the near side AS ilium at the ischial spine with the heel of the hand.

Pattern of thrust: The adjustment is made by applying pressure to take up tissue slack and thrusting with a straight arm in a posterior to anterior direction (+Z) and inferior to superior (+βX) in the plane of movement of the joint. The joint is set and held for 2 seconds. No rebound is made. No thrust is made with the stabilizing hand.

Name of technique: Gonstead

Name of technique procedure: Knee chest PI ilium push adjustment.

Indications: PI subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to kneel or extend the lumbar spine.

Patient position: The patient assumes the basic position.
Doctor's position: The doctor stands behind the patient and straddles their ankles.

Contact point: The heel of one hand contacts inferior to the PSIS of the PI ilium.

Supporting hand: The AS ilium is stabilized by contacting the ischial spine with the heel of the hand.

Pattern of thrust: The adjustment is made by applying pressure to take up tissue slack and thrusting in a posterior to anterior (+Z) and inferior to superior (+θX) direction in the plane of movement of the joint. The joint is set and held for 2 seconds. There is no rebound. No thrust is made with the stabilizing hand. Care should be taken that the patient’s pelvis is balanced centrally over the knees before the adjustment.

**PIEx Ilium**

In rotating counterclockwise to assume a posterior inferior (PI) position (−Z, −θX), the ilium may flare away from the sacrum in a −θY rotation on the left or a +θY on the right, and is thus listed as having moved externally (Ex).

**AP FILM ANALYSIS**

The vertical height of the innominate from the iliac crest to the ischial tuberosity increases (Fig. 6.12). The size of the obturator increases. The PI increases the diagonal measurement. The Ex increases the width. The femoral head is lower. The PI lowers the femoral head. The Ex also lowers the femoral head.

**LATERAL FILM ANALYSIS**

There may be an increased lumbar lordosis on the lateral film. The PI increases the lumbar lordosis. The Ex may also increase it.

**CLINICAL FINDINGS**

The PI opens the joint space at the posterior superior and anterior inferior margins. The Ex opens the posterior joint space. The combined result is an increased opening of the posterior superior joint space creating a palpable, tender and edematous region.

Name of technique: Gonstead

Name of technique procedure: Side posture PIEx ilium push adjustment (Fig. 6.13).
Figure 6.14. Side posture PIEx pull adjustment.

Indications: PIEx subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient adopts the side posture position on the pelvic bench. The PIEx ilium is on the high side.

Doctor's position: The doctor adopts the side posture position for the pelvic bench.

Contact point: The pisiform of the caudal hand is applied to the inferior and lateral border of the PSIS. The patient’s high side knee is straddled and moved cephalad until the PSIS is felt move back into the pisiform of the contact hand. The knee is then brought back slightly until the tension in the joint is felt to release.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: The doctor lowers the caudal elbow to a level that is higher than the contact point, ensuring that the direction of thrust is posterior to anterior (+Z), inferior to superior (+θX), and lateral to medial (−θY on right, +θY on left). The contact hand is torqued clockwise to induce −θY movement if the patient is right side up, and anticlockwise to induce +θY motion if the patient is left side up.

Name of technique: Gonstead

Name of technique procedure: Side posture PIEx pull adjustment (Fig. 6.14).

Indications: PIEx subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position for the pelvic bench with the PIEx ilium on the down side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench with some slight modification for the contact point.

Contact point: The doctor’s cephalad hand lifts the patient’s pelvis to enable the caudal hand to slide under the ilium so that the fingers extend around to the ASIS. The pelvis is released by the cephalad hand and allowed to rest totally on the doctor’s caudal contact hand. The contact hand is drawn supero-medial to take up tissue slack and bring the pisiform inferior and lateral to the PSIS. At this point the fingers of the contact hand are inferior to the PSIS. If the Ex is a greater component, the fingers are moved to a more lateral position. If the PI is a greater component, the fingers are moved to a more inferior position.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench. The patient’s pelvis is stabilized by the doctor resting the caudal knee against the posterior thigh of the patient’s flexed high side leg.

Pattern of thrust: The thrust is posterior to anterior (+Z) in an inferior to superior (+θX) and lateral to medial (+θY on left −θY on right) direction via the pisiform contact. No thrust is given by the doctor’s knee.

Name of technique: Gonstead

Name of technique procedure: Hi-lo prone PIEx ilium push adjustment.
Indications: PIEx subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the prone position.

Patient position: The patient lies prone, with both arms resting over the side of the table.

Doctor's position: The doctor stands on the PIEx side of the prone patient, at the level of their thigh. The doctor's outside foot is placed in front of the inside foot.

Contact point: The outside hand makes a pisiform contact inferior and lateral to the PSIS and takes up tissue slack in an inferior to superior and lateral to medial direction.

Supporting hand: The doctor's inside hand stabilizes the far side ilium by contacting the ischial spine with the heel of the hand.

Pattern of thrust: Posterior to anterior (+Z), inferior to superior (+θX), and lateral to medial (+θY on left, −θY on right) direction. There is no torque.

Name of technique: Gonstead

Name of technique procedure: Knee chest PIEx ilium push adjustment.

Indications: PIEx subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to kneel and extend the lumbar spine.

Patient Position: The patient assumes the basic position on the knee chest table.

Doctor's position: The doctor stands behind and to the PIEx side of the patient and straddles their ankles.

Contact point: Pisiform contact is made inferior and lateral to the PSIS of the PIEx ilium.

Supporting hand: The opposite ilium is stabilized by contacting the ischial spine.

Pattern of thrust: Posterior to anterior (+Z), inferior to superior (+θX), and lateral to medial (+θY on left, −θY on right) direction.

PIIn Ilium

In rotating counterclockwise to assume a posterior inferior (PI) position (−Z, −θX), the ilium may move toward the sacrum in a +θY direction on the left or a −θY on the right and is thus listed as having also moved internally (In).

AP FILM ANALYSIS

The vertical height of the innominate from the iliac crest to the ischial tuberosity increases (Fig. 6.15). The size and shape of the obturator changes. The PI increases the diagonal measurement. The In decreases the width. The femoral head height can change. The PI lowers the femoral head height. The In raises the femoral head height. The combined result either lowers or raises the femoral head height depending on which one predominates, if no other factors are involved.

LATERAL FILM ANALYSIS

The lumbar lordosis can change. The PI increases the lumbar lordosis. The In decreases the lumbar lordosis.

Figure 6.15. A, Left PIIn ilium with increased vertical height of the innominate and deviated symphysis pubis. B, Plain film of a left PIIn ilium.
The combined result depends on whether the PI or In predominates.

**CLINICAL FINDINGS**

The PI opens the joint space at the posterior superior margins. The In opens the anterior and closes the posterior joint space. Palpable edema and tenderness may not be present.

Name of technique: Gonstead

Name of technique procedure: Side posture PIIn ilium push adjustment (Fig. 6.16).

Indications: PIIn subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The PIIn ilium is on the high side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Contact point: Skin on skin contact is made so that the cephalad hand of the doctor takes up the slack tissue in a cephalad direction. The pisiform of the caudal hand is applied to the inferomedial border of the PSIS. The patient’s high side knee is straddled and moved cephalad until the PSIS is felt to move back into the pisiform contact hand. The knee is then brought back slightly, until the tension in the joint is felt release. The doctor lowers the level of the caudal elbow to a level lower than the contact point, ensuring that the direction of thrust is posterior to anterior and medial to lateral. The lateral direction being accentuated more if the In component is greater. The contact hand is torqued anticlockwise for the right side and clockwise for the left side.

Pattern of thrust: Posterior to anterior (+Z), inferior to superior (+θX), and medial to lateral (+θY on right, −θY on left).

Name of technique: Gonstead

Name of technique procedure: Side posture PIIn ilium pull move adjustment.

Indications: PIIn subluxations.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The PIIn ilium is on the high side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench, but stands more cephalad and slightly further away from the pelvic bench.

Contact point: The inferior medial border of the PSIS is contacted by the fingertips of the caudal (contact) hand.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench. The patient’s high side knee is moved cephalad until the PSIS is felt to move back into the finger tip contact and then brought back sufficiently to release the tension in the joint.

Pattern of thrust: The thrust is a pull move by the contact fingers in a posterior to anterior (+Z), inferior to superior (+θX), and medial to lateral (+θY on right, −θY on left) direction.
Name of technique: Gonstead

Name of technique procedure: Hi-lo prone PIln ilium push adjustment.

Indications: PIln subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie prone.

Patient position: The patient lies prone, with both arms resting over the side of the table.

Doctor’s position: The doctor stands on the contralateral side of the PIln ilium at the level of their thigh. The doctor’s outside foot is placed in front of the inside foot.

Contact point: The inside hand makes a pisiform contact inferior and medial to the PSIS and takes up tissue slack in an inferior to superior and medial to lateral direction.

Supporting hand: The doctor’s outside hand stabilizes the near side ilium at the ischial spine.

Pattern of thrust: The thrust is given in a posterior to anterior (+Z), inferior to superior (+θX), and medial to lateral (+θY on right, −θY on left) direction. There is no torque.

Name of technique: Gonstead

Name of technique procedure: Knee chest PIln ilium push adjustment.

Indications: PIln subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to kneel and extend the lumbar spine.

Patient position: The patient assumes the basic position on the knee chest table.

Doctor’s position: The doctor stands behind the patient and toward the contralateral side of the PIln ilium while straddling their ankles.

Contact point: The inside hand makes a pisiform contact inferior and medial to the PSIS of the PIln ilium and takes up tissue slack in an inferior to superior and medial to lateral direction.

Supporting hand: The near side ilium is stabilized by contacting the ischial spine with the outside hand.

Pattern of thrust: The thrust is given in a posterior to anterior (+Z), inferior to superior (+θX), and medial to lateral (+θY on right, −θY on left) direction. There is no torque.

AS Ilium

An anterior superior ilium is one that has juxtapositioned itself in an anterior and superior direction relative to the ipsilateral sacral surface (+θX, +Z).

AP FILM ANALYSIS

The vertical height of the innominate from the iliac crest to the ischial tuberosity decreases (Fig. 6.17). The size of the obturator foramen decreases in vertical and diagonal length. The AS ilium causes the femoral head to be raised. This creates a functional lengthening of the leg.

LATERAL FILM ANALYSIS

There may be a decreased lumbar lordosis or decreased sacral base angle.

CLINICAL FINDINGS

For an AS ilium, the posterior inferior aspect of the sacro-iliac joint separates and becomes edematous and painful (Fig. 6.18). The AS ilium induces a relative posterior

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Figure 6.17. Left AS ilium with decreased vertical height of the innominate and a decreased obturator foramen vertical and diagonal measurement. For the plain film line drawing of an AS ilium refer to Fig. 6.9C, right ilium.

Figure 6.18. An AS ilium showing the palpable edematous and tender area of the sacroiliac joint.
superior shift of the ipsilateral sacral base. The gluteal fold is higher on the side of the AS ilium.

Name of technique: Gonstead

Name of technique procedure: Side posture AS ilium push adjustment (Fig. 6.19).

Indications: AS subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The AS ilium is on the high side.

Doctor's position: The doctor adopts the side posture position for the pelvic bench.

Contact point: The contact point is medial to the rim of the acetabulum over the ischial spine. The ischial tuberosity is not contacted as this would create too much leverage for the maneuver, heightening the possibility of injury. Skin on skin contact is made so that the cephalad hand of the chiropractor takes up slack tissue toward the shaft of the femur. The pisiform of the caudal hand is applied to the contact point. The patient's high side knee is moved cephalad until tissue pull is felt under the contact hand. The knee is brought back slightly to release the tension.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: The patient is rolled toward the doctor. The contact arm is slightly bent at the elbow. The adjustment is made by thrusting in the direction indicated by the shaft of the femur and generally toward but inferior to the doctor's symphysis pubis, creating a $-\theta$X motion.

Name of technique: Gonstead

Name of technique procedure: Hi-lo prone AS ilium push adjustment.

Indications: AS subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie prone.

Patient position: The patient lies prone, with both arms resting over the side of the table.

Doctor's position: The doctor stands on the side of the patient's AS ilium at the level of the patient's thigh and as close to the table as possible with the outside foot placed directly in front of the inside foot.

Contact point: The heel of the doctor's outside hand contacts the ipsilateral ilium over the ischial spine.

Supporting hand: The doctor's inside hand stabilizes the far side PSIS.

Pattern of thrust: The adjustment is made by applying pressure to take up tissue slack. The thrust is made with a straight arm in a posterior to anterior direction and slightly inferiorward, to create a $-\theta$X movement.

Name of technique: Gonstead

Name of technique procedure: Knee chest AS ilium push adjustment.
Indications: AS ilium.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to kneel or extend the lumbar spine.

Patient position: The patient assumes the basic position.

Doctor's position: The doctor stands behind the patient and straddles their ankles.

Contact point: The heel of the adjusting hand contacts the ischial spine of the AS ilium.

Supporting hand: The PI ilium is stabilized by contacting the PSIS with the heel of the hand.

Pattern of thrust: The adjustment is made by applying pressure to take up tissue slack. The thrust is made with a straight arm in a posterior to anterior direction, indicated by the shaft of the femur on the AS ilium side, to create a $-\theta X$ movement. Care must be taken not to thrust with the stabilizing hand.

**ASIn Ilium**

In rotating clockwise around the X axis to assume an anterior superior position (AS), the ilium may move toward the sacrum in a $+\theta Y$ direction on the left or a $-\theta Y$ on the right and is thus listed as having also moved internally (In).

**AP Film Analysis**

The vertical height of the innominate from the iliac crest to the ischial tuberosity decreases (Fig. 6.20). The size and shape of the obturator foramen decreases. The AS decreases the diagonal measurement. The In decreases the width. The femoral head height is raised. The AS raises the femoral head height. The In raises the femoral head height. This occurs, assuming no other factors are involved that affect leg length inequality.

**Lateral Film Analysis**

The lumbar lordosis decreases. The AS decreases the lumbar lordosis. The In also decreases the lumbar lordosis.

**Clinical Findings**

The AS opens the sacroiliac joint at the posterior inferior aspect. The In opens the anterior joint space. The combined result is an increased opening in the anterior superior sacroiliac joint space. Palpable edema and tenderness may not be present. There may be groin pain associated with damage to the anterior ligamentous elements of the sacroiliac joint.

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Name of technique: Gonstead

Name of technique procedure: Side posture ASIn ilium push move adjustment (Fig. 6.21).

Indications: ASIn subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

**Figure 6.20.** A, Left ASIn ilium with decreased vertical height of the innominate and decreased diagonal measurement and width of the obturator foramen. B, Plain film of a left ASIn ilium.
Figure 6.21. Side posture right ASIn ilium push move.

Patient position: The patient lies in the side posture position on the pelvic bench. The ASIn ilium is on the high side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench.

Contact point: The contact point is medial to the rim of the acetabulum, over the ischial spine.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench. Skin on skin contact is made, so that the cephalad hand of the doctor takes up slack tissue towards the shaft of the femur. The pisiform of the caudal hand is applied to the contact point. The patient’s high side knee is moved cephalad until tissue pull is felt under the contact hand. The knee is brought back slightly to release tension. The patient is rolled, the contact arm bent further at the elbow depending on the degree of In.

Pattern of thrust: The adjustment is made by thrusting in the direction indicated by the shaft of the femur, generally toward the doctor’s symphysis pubis. The direction is superior to inferior, creating a $-\theta X$ movement, and medial to lateral for the In component. A torque action is included with the thrust; clockwise for the left ilium ($-\theta Y$) and anticlockwise for the right ilium ($+\theta Y$).

Name of technique: Gonstead

Name of technique procedure: Hi-lo prone ASIn ilium push adjustment (Fig. 6.22).

Indications: ASIn subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie prone.

Patient position: The patient lies prone, with both arms resting over the side of the table.

Figure 6.22. Prone right ASIn ilium adjustment.

Doctor’s position: The doctor stands on the contralateral side of the ASIn ilium at the level of the patient’s thigh and as close to the table as possible with the outside foot placed directly in front of the inside foot.

Contact point: The contralateral ASIn ilium is contacted skin to skin with the heel of the doctor’s inside hand over the ischial spine, taking up tissue slack in a superior to inferior and medial to lateral direction.

Supporting hand: The doctor’s outside hand stabilizes the near side PSIS.

Set up: The doctor achieves the correct line of correction by positioning the contact arm’s shoulder vertically over the S2–3 sacral tubercles.

Pattern of thrust: The thrust is with a straight arm in a posterior to anterior, slightly superior to inferior ($-\theta X$), and medial to lateral ($-\theta Y$ on the left and $+\theta Y$ on the right) direction.
Name of technique: Gonstead

Name of technique procedure: Knee chest ASI ilium push adjustment.

Indications: ASI subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to kneel and extend the lumbar spine.

Patient position: The patient assumes the basic position on the knee chest table.

Doctor's position: The doctor stands behind the patient and toward the contralateral side of the ASI ilium while straddling the patient's ankles.

Contact point: The heel of the adjusting hand contacts the ischial spine of the ASI ilium.

Supporting hand: The near side ilium is stabilized by contacting the ischial spine with the outside hand.

Pattern of thrust: The adjustment is made by applying pressure to take up tissue slack and thrusting with a straight arm in a posterior to anterior direction and slightly superior to inferior (−θX) direction down the shaft of the femur and in a slightly medial to lateral (−θY on the left, +θY on the right) direction, depending on the degree of in present.

ASEX Ilium

In rotating +θX around the X axis to assume an anterior superior position (AS), the ilium may move away from the sacrum in a −θY direction on the left or +θY on the right and is thus listed as having moved externally (Ex).

AP FILM ANALYSIS

The vertical height of the innominate from the iliac crest to the ischial tuberosity decreases (Fig. 6.23). The size and shape of the obturator foramen change. The AS decreases the diagonal measurement. The Ex increases the width. The femoral head height changes. The AS raises the femoral head height. The Ex lowers the femoral head height. The combined result either raises or lowers the femoral head height depending on which one predominates, if no other factors are involved.

LATERAL FILM ANALYSIS

The lumbar lordosis can change. The AS decreases the lumbar lordosis. The Ex increases the lumbar lordosis. The combined result depends on whether the As or Ex predominates.

Figure 6.23. Plain film of right ASEX ilium.

CLINICAL FINDINGS

The AS opens the sacroiliac joint at the posterior inferior aspect. The Ex opens the posterior joint space. The combined result is an increased opening in the posterior inferior sacroiliac joint space, creating a palpably tender, inflamed and edematous region.

Name of technique: Gonstead

Name of technique procedure: Side posture ASEX ilium push adjustment.

Indications: ASEX subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The ASEX ilium is on the high side.

Doctor's position: The doctor adopts the side posture position for the pelvic bench.

Contact point: Skin on skin contact is made so that the cephalad hand of the doctor takes up slack tissue in an inferior direction towards the posterior shaft of the femur. The pisiform of the caudal hand is applied to the contact point, which is medial to the rim of the acetabulum, over the ischial spine.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.
Set up: The patient’s high side knee is moved cephalad until tissue pull is felt under the contact hand. The knee is brought back slightly to release the tension. The patient is rolled slightly with the contact elbow being relatively higher than the contact point depending on the degree of Ex.

Pattern of thrust: The adjustment is made with a thrust in a posterior to anterior and superior to inferior \((-\theta X)\) direction, down the shaft of the femur, and slightly lateral to medial \((+\theta Y)\) on the left, \(-\theta Y\) on the right\) with a slight torque. The contact hand is torqued anticlockwise for the left side and clockwise for the right side up.

Name of technique: Gonstead

Name of technique procedure: Side posture ASE\textsubscript{Ex} ilium pull move adjustment (Fig. 6.24).

Indications: ASE\textsubscript{Ex} subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The ASE\textsubscript{Ex} ilium is on the down side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench, but stands more cephalad and slightly further away from the pelvic bench.

Contact point: The doctor’s cephalad hand lifts the patient’s pelvis to enable the caudal hand to slide under the ilium so that the fingers extend around and under the ASIS. The pelvis is released by the cephalad hand and allowed to rest totally on the doctor’s caudal (contact) hand. The contact hand is drawn infero-medial to take up tissue slack and bring the pisiform just medial to the rim of the acetabulum and lateral to the ischial spine.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench. The patient’s pelvis is stabilized by the doctor resting the caudal knee against the posterior thigh of the patient’s flexed high side leg.

Pattern of thrust: The thrust is posterior to anterior and superior to inferior \((-\theta X)\), plus lateral to medial \((+\theta Y)\) on the left, \(-\theta Y\) on the right\) direction. The thrust is achieved by rapidly straightening the flexed wrist of the contact hand while the doctor’s caudal knee stabilizes the patient’s pelvis with a positive contact against the posterior thigh of the patient. No thrust is given by the doctor’s knee.

Name of technique: Gonstead

Name of technique procedure: Hi-lo prone ASE\textsubscript{Ex} ilium push adjustment.

Indications: ASE\textsubscript{Ex} subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the prone position.

Patient position: The patient lies prone, with both arms resting over the side of the table.

Doctor’s position: The doctor stands on the side of the ASE\textsubscript{Ex} ilium at the level of the patient’s thigh and as close to the table as possible with the outside foot placed directly in front of the inside foot.

Contact point: The ipsilateral ASE\textsubscript{Ex} ilium is contacted skin to skin with the heel of the doctor’s outside hand lateral to the ischial spine.

Supporting hand: The doctor’s inside hand stabilizes the far side PSIS.

Pattern of thrust: The adjustment is made by applying pressure to take up tissue slack and thrusting with a straight arm in a posterior to anterior, superior to inferior \((-\theta X)\) and lateral to medial \((+\theta Y)\) on the left, \(-\theta Y\) on the right\) direction. This is achieved by
the doctor positioning the contact arm's shoulder vertically and laterally to the ipsilateral ilium's PSIS.

Name of technique: Gonstead

Name of technique procedure: Knee chest ASEK ilium push adjustment.

Indications: ASEK subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to kneel and extend the lumbar spine.

Patient position: The patient assumes the basic position for the knee chest table.

Doctor's position: The doctor stands behind and to the ASEK side of the patient and straddles the ankles.

Contact point: Skin on skin contact is made by the heel of the adjusting hand over the lateral edge of the ischial spine, medial to the rim of the acetabulum, of the ASEK ilium.

Supporting hand: The opposite ilium is stabilized by contacting the PSIS.

Pattern of thrust: The adjustment is made by applying pressure to take up tissue slack. The thrust is made with a straight arm in a posterior to anterior direction down the shaft of the femur, creating a $-\theta X$ movement, and lateral to medial ($+\theta Y$ on the left, $-\theta Y$ on the right), direction. The greater the Ex component, the greater the degree of lateral to medial thrust.

In and Ex

The ilium can torque lateral to medial (a $+\theta Y$ rotation on the left, $-\theta Y$ on the right) to assume an In position, i.e., internally toward the sacrum. It can also torque medial to lateral ( a $-\theta Y$ rotation on the left, $+\theta Y$ on the right) to assume an Ex position, i.e., externally away from the sacrum. Because they are joined at the symphysis pubis, if one side is In, the other side is Ex. Only one of the ilia is actually in a fixated and subluxated condition. The other is the compensation.

AP FILM ANALYSIS

The vertical height of the innominate from the iliac crest to the ischial tuberosity remains unchanged for both the In and Ex (Fig. 6.25). The size and shape of the obturator foramen changes. The In has a more narrow width. The

Figure 6.25. A, Transverse view of a normal pelvis. B, Left Ex and right In ilium. C, Plain film of left Ex and right In ilium.
Ex has a wider width. The femoral head height changes. The In tends to raise the femoral head height. The Ex tends to lower it.

**LATERAL FILM ANALYSIS**

The lumbar lordosis may change. The In tends to decrease the lumbar lordosis and the Ex increases it.

**CLINICAL FINDINGS**

The In opens the joint at the anterior aspect creating an edematous area. The Ex opens the joint at the posterior aspect, creating a palpable, tender, edematous area. In the supine patient the In ilium will tend to cause the ipsilateral foot to flare away from the median line, while the Ex ilium will tend to cause the ipsilateral foot to converge toward the median line. This may also be visible in the standing position.

**Name of technique: Gonstead**

**Name of technique procedure: Side posture In ilium push move adjustment** (Fig. 6.26).

**Indications:** In subluxation.

**Contraindications:** All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

**Patient position:** The patient lies in the side posture position on the pelvic bench. The In ilium is on the high side.

**Doctor's position:** The doctor adopts the side posture position for the pelvic bench.

**Contact point:** Skin on skin contact is made so that the cephalad hand of the doctor takes up slack tissue in a medial to lateral direction near the center of the sacroiliac joint. The pisiform of the caudal (contact) hand is applied just medially to the PSIS.

**Supporting hand:** The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

**Pattern of thrust:** The elbow is lowered to enable the thrust to be made in a medial to lateral (−θY on the left, +θY on the right) direction.

**Name of technique:** Gonstead

**Name of technique procedure:** Side posture In ilium pull adjustment.

**Indications:** In subluxation.

**Contraindications:** All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

**Patient position:** The patient lies in the side posture position on the pelvic bench. The In ilium is on the high side.

**Doctor's position:** The doctor adopts the side posture position for the pelvic bench, standing slightly further away from the pelvic bench.

**Contact point:** The finger tips of the caudal hand are applied medially to the center of the sacroiliac joint.

**Supporting hand:** The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

**Pattern of thrust:** The doctor remains more upright and thrusts by pulling the ilium in a medial to lateral direction.
Contact point: The doctor’s cephalad hand lifts the patient’s pelvis to enable the caudad hand to slide under the ilium so that the fingers extend around the ASIS. The pelvis is released by the cephalad hand and allowed to rest totally on the doctor’s caudad (contact) hand. The contact hand is drawn medially to take up tissue slack and bring the pisiform to the lateral border of the PSIS.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: The patient’s pelvis is stabilized by the doctor resting their caudal knee against the posterior thigh of the patient’s flexed high side leg. The thrust is lateral to medial (+Y on the left, −Y on the right) via the pisiform contact. This is achieved by extending the flexed wrist of the contact hand. It is stabilized by a gentle but positive contact by the doctor’s knee against the posterior thigh of the patient. No thrust is given by the doctor’s knee.

In-Ex Ilium

It is possible to have both left and right ilia fixated and subluxated. This occurs when there is no AS or PI component and no lumbar axial rotation. When this occurs, both listings are recorded, the left listing first, followed by a hyphen before the right listing.

Name of technique: Gonstead

Name of technique procedure: Side posture In-Ex ilium pull adjustment (Fig. 6.28).

Indications: In-Ex subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The In ilium is on the high side, the Ex is on the down side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench with some slight modification for the contact point.

Figure 6.27. Side posture right Ex ilium pull move adjustment setup on an anatomic model.

Figure 6.28. A, Side posture In-Ex ilium pull adjustment on an anatomic model. B, Side posture adjustment for an In-Ex listing.
Contact point: The doctor's cephalad hand lifts the patient's pelvis to enable the caudal hand to slide under the ilium so that the fingers extend around to the ASIS. The pelvis is released by the cephalad hand and allowed to rest totally on the doctor's caudal contact hand. The contact hand is drawn superomedial to take up tissue slack and bring the pisiform caudal and lateral to the PSIS. Along with the pisiform contact, the doctor's forearm contacts the caudal and medial border of the PSIS of the In ilium on the high side.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: The thrust is directed through the sacroiliac joints by the pisiform and forearm, to achieve a simultaneous bilateral correction of the Ex and In ilia.

**SACRUM**

The sacrum articulates at three joints (the left and right sacroiliac joints and the lumbosacral junction). As a result, the sacrum is regarded as moving in rotation about the X axis and the Y axis. As reviewed earlier in this chapter, the sacroiliac joint is made up of an upper amphiarthrodial section and a lower diarthrodial (synovial) section. The female sacroiliac joints are built for mobility, whereas the male joints are built for strength and contain articular ridges. The joints are asymmetrical in individuals and changes in the joint occurs in response to imposed stress with age. The sacral segments articulate before fusing at approximately 10 years of age. It is logical to assume therefore that the sacrum can have more complex fixation subluxation complexes within each sacroiliac joint.

**P-R, P-L, PI-R, PI-L**

The sacrum may undergo a clockwise rotation about the Y axis and is listed as having moved posterior on the left, P-L, (+\(\theta Y\)). An anticlockwise rotation is listed as posterior on the right, P-R (−\(\theta Y\)). The sacrum may undergo a clockwise rotation about the Z axis and is listed as having moved inferior on the right (+\(\theta Z\)). An anticlockwise rotation is listed as inferior on the left (−\(\theta Z\)) (Fig. 6.29).

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**Figure 6.29**  
A, Posterior left sacrum (P-L). B, PI-R sacrum. C, Malformed sacrum. D, Plain film of a P-R sacrum. E, Posttreatment radiograph of patient depicted in D. This radiograph was performed 6 hours after the original.
AP FILM ANALYSIS

Because the posterior surface of the sacrum is convex, the distance from the second sacral tubercle to the left lateral border of the sacrum on the AP radiographic film is greater for a P-L listing than the distance to the right lateral sacral border.

In the majority of cases, sacral inferiority is due to malformation of the sacral plateau. This is best confirmed by drawing a series of connecting horizontal lines through like points (Fig. 6.29C). The lumbar spine will rotate with the sacrum.

CLINICAL FINDINGS

Motion palpation reveals a restriction in motion in the sacroiliac joint on the side of sacral posteriority. The joint becomes edematous and tender on palpation along the posterior aspect (Fig. 6.30–6.33).


Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The subluxation is on the high side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench.

Contact point: The doctor’s caudad hand makes a skin on skin contact via the pisiform on the sacral alar, as lateral as possible, yet medial to the posterior superior iliac spine so as to avoid contact with it. The contact hand’s fingers should point downward to the floor (i.e., they should be resting across the sacrum and contralateral PSIS). A thenar contact can also be made.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: The doctor leans over the patient to lower the elbow to the level of the plane of the sacroiliac joint. The adjustment is made by thrusting through the plane of the sacroiliac joint posterior to anterior, $-\theta Y$ for a P-L and $+\theta Y$ for PR. If there
Figure 6.31. A, AP radiograph of a PI-L sacrum. B, Right lateral bending demonstrates normal rotation of the lumbar spine and sacrum. C, Effect of PI-L sacral rotation on the lumbar spine and sacrum during left side bending. Note the decreased $-\theta Z$ and $-\theta Y$ on the side of sacral posteriority when in left side bend.

is an inferiority of the sacrum, a torque is applied through the pisiform during the thrust. The torque is clockwise for a PI-L, $(+\theta Z)$, and anticlockwise for a PI-R, $(-\theta Z)$.

Name of technique: Gonstead

Name of technique procedure: Side posture sacral push adjustment, subluxation side down (Fig. 6.35).


Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench. The subluxation is on the down side.

Doctor’s position: The doctor adopts the side posture position for the pelvic bench.

Contact point: The doctor’s caudal hand makes skin on skin contact via the pisiform on the sacral ala as lateral as possible, yet medial to the PSIS so as to avoid contact with it. The contact hand fingers should point cephalad, with the index finger resting near the lumbar spine.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: The doctor leans over the patient to align the forearm to the level of the plane of the sacroiliac joint. The adjustment is made by thrusting through the plane of the sacroiliac joint posterior to anterior ($-\theta Y$ for P-L and $+\theta Y$ for P-R). If there is an inferiority of the sacrum, a torque is applied through the pisiform during the thrust. The torque is clockwise for a PI-L, $(+\theta Z)$, and anticlockwise for a PI-R, $(-\theta Z)$.

Name of technique: Gonstead

Name of technique procedure: Hi-lo prone sacrum push adjustment.


Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie prone.
Patient position: The patient lies prone, with both arms resting over the side of the table.

Doctor's position: The doctor stands facing the patient on the contralateral side of the posterior sacral subluxation at the level of the middle of the sacroiliac joint.

Contact position: Skin on skin contact is made with the caudad hand on the lateral border of the sacrum, immediately medial to the PSIS.

Supporting hand: Stabilization occurs by gripping the contact hand wrist with the cephalad hand. The caudad arm is locked at

**Figure 6.32.** A, AP radiograph (1-3-85) of an 82-year-old female before a fall. B, Post trauma radiograph of 1-5-85. Notice the sacral and ilium positional dyskinesias. C, Post treatment radiograph of 4-8-85 after correction of the rotated sacrum. D, Normal positioning of a phantom. E, Intentional malposition of a phantom in axial rotation. Notice the induced rotation of the pelvis, lumbar spine and thorax. Compare to the radiograph in B in which pelvic positional dyskinesia has little effect on the rotational coefficients of the lumbar spine.
the elbow and the forearm aligned with the plane of the sacroiliac joint.

Pattern of thrust: The patient exhales, tissue slack is removed with increasing downward pressure. The adjustment is made by thrusting posterior to anterior and slightly laterally through the plane of the sacroiliac joint, (−θY for P-L, and +θY for P-R). If there is an inferiority of the sacrum, a torque is applied through the pisiform during the thrust. The torque is clockwise for a PI-L, (+θZ), and anticlockwise for a PI-R, (−θZ).

Management

The choice of adjusting subluxated side up versus side down depends on clinical results with that individual patient. There are no strict guidelines. Sometimes obese patients are easier to adjust with the subluxated side down because it locks the ilium and enables easier movement of the sacrum. In some instances, the patient may experience increased discomfort one way, hence the choice for the alternative approach. Hip and knee problems resulting in pain or limitation in movement may dictate a certain approach.

The preferred approach is with the patient in side posture on the pelvic bench. If the patient is too obese to adjust, the second choice is the knee chest table. The reason that the knee chest table is not the preferred approach is that the sacroiliac joints are weight bearing and hence are not completely relaxed (Personal Communication, Dr. Alex Cox).

Clinical observations of a sacroiliac syndrome alone make it difficult to determine if the patient is suffering from an ilium or a sacral subluxation. Clinical observations suggest that the patient will respond more favorably if the outlined protocol is followed (50). An analysis of the AP plain film radiograph will determine which short lever arm to contact for the adjustment.

A posteriorly rotated sacrum is generally regarded as clinically significant if the difference between the left and right measurements is 7 mm or greater.

The decision as to whether to adjust the sacrum or the ilium depends on the following three rules:

1. If there is no ilium listing, the sacrum is adjusted.
2. If the ilium on the side of sacral posteriority has a listing of AS, In, or any compound listing in which AS or In are the dominant factors, the sacrum is adjusted to the ilium. This should correct the sacral rotation and the AS and In ilium components simultaneously.
3. If the ilium on the side of sacral posteriority has a listing of PI, Ex, or any compound listing in which PI or Ex are the

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Figure 6.33. A, Pretrauma lateral radiograph of the patient in Figure 6.32A. B, Post trauma radiograph of patient in Figure 6.32A. Notice loss of the normal lumbar lordosis. C, Posttreatment lateral radiograph of patient in Figure 6.32A.
dominant factors, the ilium is adjusted to the sacrum. If the sacrum were adjusted to the ilium it would increase the PI and exacerbate the already inflamed joint capsule.

4. With an AS or In ilium listing, the sacrum needs to be adjusted if the ipsilateral leg is shorter (supine leg check) and no anatomic deficiency is present. This is recorded as an S-ASln. The ilium needs to be adjusted if the ipsilateral leg is longer.

5. If there is an AS, In, or ASln, and no pain is palpable, set the ilium to the sacrum. If an AS, In, or ASln is present and there is palpable pain and edema, set the sacrum to the ilium.

Posterior (−Z) movement of S2 relative to S1. In the child, this displacement may be associated with enuresis. If left uncorrected, this condition is seen in adults as a thickened rudimentary posterior open wedge disc. The second sacral segment may appear in a posterior position (−Z) relative to S1. The following is a brief summary of the work of Dr. Max Joseph. It details some of the more salient points required to recognize this condition (Unpublished data, Dr. Max Joseph, Mornington, Vic., Australia).

Segmental Sacral Subluxations

Sacral segments fuse in children at approximately 10 years of age. Before this, they have a degree of articulation with a disc space separating each segment. A condition often seen in children is a posterior open wedge shaped disc between S1 and S2. This is often accompanied by a

AP FILM ANALYSIS

Repeated observations of the S2 congenital asymmetry has revealed a high frequency of other abnormalities occurring; spina bifida S1 or L5, transitional L5 or S1, failure of the iliac crest line to pass through the L4–5 disc space, asymmetrical sacroiliac joint shapes.
Figure 6.36. A, Plain film lateral view showing posteriorly open wedge between S1 and S2 in a child. B, S2 subluxation of a young adult. C, S4 subluxation of a child. D, Posttreatment radiograph of patient depicted in C.

LATERAL FILM ANALYSIS

There may be a posterior L5, S1-S2 rudimentary disc with or without "gibbus type" contour, or a posterior open wedge rudimentary disc between S1 and S2 (Fig. 6.36).

CLINICAL FINDINGS

There is usually no temperature differential present. The patient may complain of chronic unilateral or bilateral hip pain (with associated hip pathology). In general, the patient can have any symptoms associated with the lumbar or sacral plexuses. There is usually tenderness present at the tubercle of the involved segment.

Indications: S2 subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie in the side posture position, previous hip replacement surgery.

Patient position: The patient lies in the side posture position on the pelvic bench.

Doctor's position: The doctor adopts the side posture position for the pelvic bench.

Contact point: Skin on skin contact is made by the pisiform of the caudad hand on the inferior border of the second sacral tubercle.

Supporting hand: The doctor supports the anterior shoulder as described in the side posture position for the pelvic bench.

Pattern of thrust: Posterior to anterior (+Z) and inferior to superior (+vX).
Name of technique: Gonstead

Name of technique procedure: Prone S2 sacral adjustment.

Indications: S2 subluxation.

Contraindications: All other listings, hypermobility, instability, lytic metastasis in the region, inability to lie prone, abdominal aortic aneurysm, severe osteoporosis.

Patient position: Prone on the hi-lo table.

Doctor's position: At the level of the sacrum, standing facing the hi-lo.

Contact point: Skin on skin contact with the pisiform of the cephalad hand on the inferior border of the second sacral tubercle. The fingers pointing caudad and resting on the buttocks.

Supporting hand: The caudal hand clasps the wrist of the contact hand.

Pattern of thrust: Posterior to anterior (+Z) and inferior to superior (+θX). If the patient is very obese or otherwise cannot be adjusted with the preceding maneuvers, a table with a drop mechanism may be used.

COCXYX

The coccyx sits at the apex of the sacrum and can undergo a \(-θX\) rotation and is listed as anterior (A). This may be combined with either a \(-θZ\), or \(+θZ\) rotation and is listed as an anterior right (AR) or anterior left (AL) lateral deviation (Fig. 6.37).

CLINICAL FINDINGS

The coccyx subluxation usually presents following trauma. This generally involves falling onto the buttocks creating the anterior and/or lateral deviation. There will usually be edema and severe tenderness to palpation. Localized pain is experienced when sitting, rising from sitting, and on defecation.

Name of technique: Gonstead

Name of technique procedure: Hi-lo prone coccyx pull/thrust adjustment (Fig. 6.38).

Indications: A, AR, and AL coccyx.

Contraindications: All other listings.

Patient position: The patient lies prone, with both arms resting over the side of the table. The pelvic support is raised to elevate the coccyx.

Doctor position: The doctor stands facing the patient at the level of mid-thigh on the side of lateral deviation. If no lateral deviation is present, either side is suitable.

Contact Point: The cephalad thumb of the doctor contacts the coccyx approximately two to three centimeters inferior to the sacrococcygeal junction. Thin cotton cloth separates the skin on skin contact.

Supporting hand: The caudal hand makes a pisiform contact distal to the contact thumb's metacarpophalangeal joint and grips the contact hand for improved stabilization.

Pattern of thrust: Tissue slack is removed by the stabilization hand applying slight pressure in a posterior to anterior and inferior to superior direction. The adjustment is made by applying a thrust in an inferior to superior, \((+θX)\) direction.

SHORT LEG SYNDROME

The Gonstead system pays particular attention to the level foundation concept as a basic premise for spinal column integrity. When completing line drawings on an AP plain radiograph of the lumbar-pelvis, it is frequently noted that the femoral head line is not horizontal. In other words there is an obvious difference in femoral head heights. This denotes a leg length inequality, (LLI) or short leg.

This LLI may be due to pelvic subluxations or foot pronation and is referred to as either a functional short leg, or a physiologic short leg. When the LLI is due to an
Figure 6.38. A, Contact point for the prone coccyx pull-thrust adjustment. B, Pattern of thrust for the anterior coccyx.

Figure 6.39. AP plain film demonstrating pelvic listings, discrepancy in femoral head height measurements and the actual difference after applying the 5:2 rule.

actual difference in leg length, it is referred to as either a true short leg, or an anatomic short leg.

Distinguishing the cause of LLI is paramount in determining the correct management of the patient. This is particularly important in deciding on the prescription of a heel lift or other orthotic insert.

Functional Leg Length Inequality From Pelvic Subluxation

A posterior-inferior (PI) and an external (Ex) ilium causes the acetabulum to move in an anterior and superior direction. For heel contact to be maintained on the ground, the acetabulum is lowered and hence appears on the AP film as a lowered femoral head.

An anterior-superior (AS) and an internal (In) listed ilium causes the acetabulum to move in a posterior and inferior direction. Heel contact forces the acetabulum to raise and hence appears on the AP film as a raised femoral head line (Fig. 6.39).

Plaugher and Hendricks have demonstrated a high level of inter- and intraexaminer reliability for line drawings of the pelvis using the Gonstead method (46).

After many years of extensive investigation, using pre- and postadjustment radiography at the Gonstead clinic, the 5:2 (i.e., 1.0:0.4) rule was formulated (Personal Communication, Dr. Alex Cox). The effect of ilium correction on the ipsilateral femoral head height projection on the AP film is as follows:

1. For every 5 mm of PI, or Ex correction, the femoral head height will be raised 2 mm.
2. For every 5 mm of AS, or In correction, the femoral head height will be lowered 2 mm.
Example:
A PI will result in the ipsilateral femoral head being 2 mm lower on the AP film.
A PI \( _{0} \) Ex will result in the ipsilateral femoral head being 6 mm lower on the AP film.
An AS will result in the ipsilateral femoral head being 2 mm higher on the AP film.
A PI \( _{0} \) IN will result in the ipsilateral femoral head being 2 mm lower on the AP film.
An AS \( _{0} \) IN will result in the ipsilateral femoral head being 2 mm higher on the AP film.

CLINICAL FINDINGS

The subluxated ilium results in ipsilateral symptoms such as buttock, hip, leg and groin pain. This type of LLI is managed by adjusting the subluxated ilium. The short leg side ilium is either PI or Ex. The psoas, piriformis and gluteals are generally tender on the short leg side.

Functional Leg Length Inequality From Foot Pronation

A pronated foot is recognized by a flattened longitudinal arch. This occurs when the subtalar joint pronates, because of the talus rotating medially. When this occurs the entire lower limb internally rotates. This results in an ipsilateral iliopsoas muscle stretch and subsequent increased sacral base angle. It also results in a functional shortening of that limb and a lowered femoral head height on the AP film.

Brown, Markham and Smith (In Shoe Systems, Bellingham, WA., Personal Communication) in a study of 25 patients using Gontstead line drawings on A-P films demonstrated that by correcting foot pronation, femoral head height increased on average, 2.2 mm (maximum 5 mm).

CLINICAL FINDINGS

Foot pronation results in ipsilateral internal hip rotator muscle tenderness and ipsilateral sacroiliac tenderness. A further test was described by Brown (Personal Communication) to distinguish LLI caused by foot pronation or anatomic short leg. With the patient standing, the ASIs are palpated bilaterally, noting which is higher. The PSIs are then palpated noting which is lower. For a pronated foot, the lower PSIS will be on the same side as the higher ASIS. Without moving the patient, externally rotate the lower limb so as to place the subtalar joint in the neutral position. It will be noted that the ASISs and PSISs will approximate a more level position. If a true anatomic LLI is present, both the ASIS and PSIS will be high (or low) on the same side.

MANAGEMENT

If the foot pronation is prominent when observing the patient’s gait and standing posture, and in addition to this the patient’s condition remains unstable after adjustments, orthotics should be prescribed.

The orthotic should be molded with the patient's foot aligned to bring the talus to the neutral position. With the subtalar joint in a neutral position, the mid-tarsal joint is further stabilized. Precision vacuum-molded orthotics are available for chiropractors, or the patient can be referred to a podiatrist.

Anatomic Leg Length Inequality

After applying the 5:2 rule and ruling out any other predisposing factors to LLI, an anatomic true short leg is often observed. This difference can be quantified. An example would be a difference in femoral head height of 10 mm with a PI \( _{0} \) Ex on the short leg side. After applying the 5:2 rule, the PIEx subluxation correction would still leave an LLI of 8 mm.

CLINICAL FINDINGS

Although there are exceptions to the rule, in a series of 50 cases with true short leg the author has observed that the majority of patients complained of pain on the contralateral side. They experienced pain on the long leg side in the buttock, and sacroiliac joint. Also observed was ipsilateral long leg psoas contraction, with tenderness, plus gluteal and piriformis tenderness. The sacrum drops inferiorly on the short leg side.

MANAGEMENT

Once a true short leg has been established, the doctor must first establish if it is significant and if so, whether a heel lift or orthotic is required. The patient's subluxation(s) must first be treated (Fig. 6.40). If the subluxation proves to be unstable and matches a history of recurring episodes, then a heel lift may well be indicated. If the patient responds to adjustments and remains stable in spite of a large LLI, then this patient does not require a heel lift.

Author opinions about the amount of LLI tolerated vary. As a general guide, 5 mm LLI or greater is significant if the subluxation is unstable after correction.

A heel lift raises the ipsilateral head height and induces an ipsilateral side bend in the lumbar spine. The coupled movement is for vertebral body rotation to the opposite side. Therefore a heel lift should only be prescribed if L5 vertebral body rotation is to the short leg side and the lumber spine convexity is on the short leg side.

The foundation for the spine is the sacrum, not the femoral heads. If the sacral groove line is level, then a heel lift for a true short leg is contraindicated. A malformed sacrum, inducing an unlevel sacral groove line, may well need a heel lift to create a level foundation.

In some situations, age and the degree of chronicity
and even degenerative changes in the spine may prevent adaptation to a heel lift. These changes must be investigated in the lumbosacral region as well as the thoraco-lumbar region before prescribing.

In adults, the ability for the spine to adapt and the amount of heel lift required, determines whether to fit the full amount all at once or increase the amount of lift gradually over several weeks or months. Heel lifts are never prescribed while the patient is in an acute inflamed condition.

After the application of a heel lift, the patient will need periodic treatment to ensure that full spine functional adaptation occurs. Some of the greatest changes occur at the thoraco-lumbar junction and the upper cervical region.

Once a heel lift has been successfully prescribed, patients use them for the rest of their lives.

REFERENCES


Knowledge gained from studying the spinal column in sections is inherently weak. The spine exists and functions as one integrated whole, one area of the spine often being affected by other more distant regions. Similarly, the spinal column and pelvis are supported and acted on by the lower and upper extremities, thus influencing them in diverse and complex interactions.

The lumbar spine is unique for a variety of reasons. Because each region of the spine supports the weight of the body in increasing amounts as one moves caudal, the lumbar column is especially susceptible to extreme axial loads and external bending torques or moments. This may be the reason there is an increase in lumbar spinal dysfunction among truck drivers and hard laborers (1,2). The lumbar spine is a point of transfer of forces from the strong bony pelvis to the flexible axial motion segments.

As with the more caudal structures of the body, dysfunction in the lumbar spine will have direct mechanical reactions in the joints above, a continuation of the foundation principle discussed in Chapter 6. This is the reason a pronated foot can influence pelvic list and the posture of the torso, or an increase in the lumbar lordosis with hyperextension of the upper lumbar motion segments, may reduce the cervical lordotic curve (Fig. 7.1).

This chapter covers the dysfunction and management of disorders afflicting the vertebral joints of L1 to S1. The mechanical lesion is emphasized, although some attention is given to organic and visceral conditions that may impact on the decision making processes of the astute clinician. A few aspects of the clinical anatomy and biomechanics of the lumbar spine are presented here. This subject, however, is covered in more detail in Chapter 2, which the reader is encouraged to review before proceeding. The pathomechanics of the lower spine and its relationship to the vertebral subluxation complex is covered. The chiropractic management of mechanical disorders of the low back is thoroughly discussed.

**CLINICAL ANATOMY AND BIOMECHANICS**

**Central Joint**

The central joint is composed of two vertebral bodies, their associated end-plate structures and their common intervertebral disc, which is composed of the annulus fibrosis and the nucleus pulposus.

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**Figure 7.1.** Lateral full spine radiograph (two exposures) illustrating how reduction of the cervical lordosis can occur in compensation for abnormalities (e.g., hyperextension of the upper lumbar spine) in the lower spine.