47. Percutaneous fixation of the sacroiliac joint

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INTRODUCTION

The diagnosis and management of disorders of the lumbopelvic region is the source of much controversy. Pain is the main reason patients consent to surgery, yet its source is often uncertain. Imaging studies only show anatomy and do not necessarily correlate with the pain source. Injection techniques such as facet blocks, discography, and root sleeve injections may or may not be helpful. Percutaneous stabilization of suspected unstable intervertebral disc segments has been advocated. If the patient achieves pain relief, it is suggested that a spine fusion at the stabilized level will provide permanent pain relief (Jeanneret et al 1994).

The author contends that low back pain that has defied diagnosis by conventional means frequently emanates from the sacroiliac joint (SIJ), and that the pain can be relieved by SIJ stabilization. Stabilization may be achieved by physiotherapy modalities such as muscle strengthening or balancing, by belting, by tightening of the sacroiliac (SI) ligament complex via proliferant injections, or, if these fail, by SIJ fixation or fusion. Fixation can be accomplished by placing screws across the joint.

The initial aim of fixation was to see whether or not pain could be relieved in this manner, and if it could, to convert the fixation to a fusion. Clinical experience with fixation has shown that most patients thus treated had a stable course and did not require further surgery.

APPLIED ANATOMY

The SIJ is a true diarthrodial joint. The concave sacral surface is covered with thick hyaline cartilage, whereas the convex iliac surface is lined with thin fibrocartilage. The articular surfaces are ear-shaped, containing irregular ridges and depressions. This, along with strong posterior ligaments and powerful surrounding muscles, makes the joint very stable.

There is a wide range of segmental innervation, which probably accounts for the variable referred pain patterns in patients with SIJ lesions.

PERTINENT BIOMECHANICS

SIJ movement is not voluntary but is induced by motion occurring at other locations in the body (Dreyfuss et al 1995). This motion consists of rotation and translation. This movement does not occur around a single axis and is very small ($<4°$ rotation and <1.6 mm translation) (Sturesson et al 1989). Nutation refers to the backward rotation of the ilium on the sacrum, whereas counternutation is forward movement of the ilium on the sacrum.

The SIJ can withstand 20 times less axial compression and two times less axial torsion than can the lumbar spine, but the SIJs can tolerate 6 times more medially directed force (Bernard & Cassidy 1991).

The SIJ is particularly vulnerable to shear (rotation/translation). Compression of the SIJ with its ridges and depressions allows the joint to resist shear. Those structures that produce joint compression include muscles that cross the joint surface, the interosseous ligaments, and the joint capsule (Snijders et al 1995). Weight-bearing tends to force the sacrum down and rotate it forwards in relation to the ilium (nutation). The sacrotuberous and sacrospinalis ligaments resist

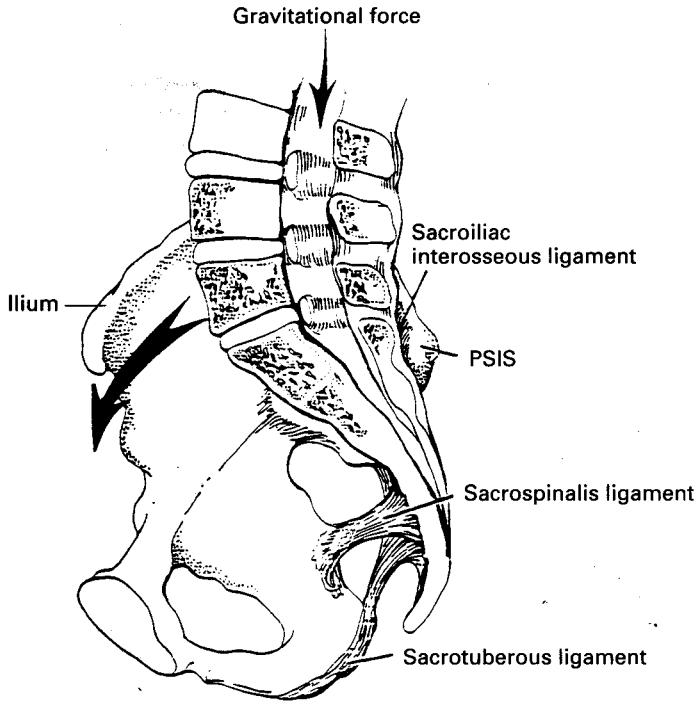

Fig. 47.1 Sagittal section through the pelvis, showing how gravity tends to force the sacrum forward (nutation) and how this is resisted by the sacrotuberous and sacrospinalis ligaments.

this movement (Fig. 47.1). In one-legged standing, the load transfer concentrates on one SIJ.

Any disruption of the ligamentous system leads to SIJ hypermobility, with or without instability.

INCIDENCE OF SIJ DISORDERS

A study by Bernard & Kirkaldy-Willis (1987) suggested that 22.5% of patients with low back pain had SIJ dysfunction in isolation or as part of their pathology. Schwarzer et al (1995) employed diagnostic intra-articular blocks to estimate the prevalence of SIJ pain in a population of patients with chronic low back pain who had defied diagnosis by conventional means. They identified 43 patients who met their criteria, 13 of whom (30%) showed evidence of SIJ pain.

CLASSIFICATION AND ETIOLOGY

SIJ dysfunction should be divided into two categories: intra-articular and extra-articular dysfunctions. True intra-articular pathology includes fracture, infection, tumor, inflammatory spondyloarthropathies, degenerative joint disease, and metabolic conditions. Extra-articular SIJ (EXSIJ) dysfunction is a disorder of abnormal joint movement and alignment owing to disruption of the ligamentous support system. The joint itself may be chronically inflamed but, in and of itself, is structurally normal. Symptoms due to EXSIJ dysfunction are alleviated by restoring stability and alignment.

PATHOPHYSIOLOGY OF EXTRA-ARTICULAR SIJ DYSFUNCTION

The clinical significance of the small motion of the SIJ is till subject to debate. In addition, each SIJ is dependent on the other SIJ and the symphysis pubis. Any change in the characteristics of one joint in the pelvic ring will change the characteristics of the two other joints.

Stability of the SIJ is both static and dynamic. Dynamic stability is muscle dependent. Although no muscle originates from or inserts onto the SIJ,

many have fibrous expansions that blend with the SIJ ligament complex. The SIJ ligaments can therefore be affected by muscle activity. Static stability depends upon elevations and depressions on the joint surfaces that interlock and limit mobility, and the thick posterior sacroiliac (SI) ligaments that keep the incongruent sacrum and ilium opposed. In addition, the variation and complexity of the orientation of the SIJ surfaces contributes to static stability (Solonen 1957).

Trauma or hormonal changes, such as those occurring in pregnancy, will allow the SIJ ligaments to become lax and the joint to move beyond its normal range, passing beyond its normal congruity to an area of incongruity. This results in locking between the opposing surfaces of the ilium and sacrum; this locking is unlikely to be restored spontaneously. The joint is particularly vulnerable to locking when the trunk is bent forward and lateral flexion or rotation is superimposed. The joint can remain locked in a neutral or subluxed position. Subluxation can be anterior, posterior, or upwards (Aitken 1986, Fowler 1986, Greenman 1989). Ultimately, the ligamentous stretching produces a hypermobile joint subject to recurrent subluxation into a locked position (Lippitt 1995).

Traumatic causes of SIJ instability include:

- a fall on the buttock
- a dashboard injury that imparts a horizontal force to the SIJ
- a motor vehicle accident in which the affected extremity is extended and the force is transmitted upward to the SIJ, for example the foot on the brake with the knee extended at impact.

Iatrogenic etiologies include:

- instability due to weakening of the joint and ligaments from overzealous bone harvesting for graft (Coventry & Tapper 1972)
- increased force across the joint created secondarily to a spine or hip fusion (Frymoyer et al 1978).

Malposition of the SIJ leads to imbalance in the muscles, ligaments, and fascia. Muscles try to substitute for incompetent ligaments but are usually unsuccessful. The capsule becomes lax, leading to joint inflammation. The joint itself will not show degenerative changes until late in the process. Due to chronically abnormal spine, pelvis, and lower extremity mechanics, a painful disabling condition ensues. By fixing the joint in its normal position, the normal balance is restored. It should be noted that SIJ subluxation is a clinical observation that has never been proven. It also remains to be proved that altered mobility correlates with symptoms (Bernard & Cassidy 1991).

DIAGNOSIS

The diagnosis of extra-articular SIJ dysfunction is based on a pattern of findings, none of which in and of itself is precise. *One cannot rely on imaging studies.*

Pain is always noted over the posterior superior iliac spine (PSIS), but there is no specific pain referral pattern. Schwarzer et al (1995) compared the pain patterns of patients with SIJ pain confirmed with diagnostic intra-articular blocks with those with non-SIJ pain. They found that the only clinically distinguishing characteristic was the presence of groin pain in those patients with chronic low back pain of SIJ origin. Radiation of pain below the knee was as common in patients with SIJ pain as in those without. Hackett et al (1991) injected hypertonic saline into various ligaments and mapped out the referred pain pattern. SIJ ligament-referred pain follows a distribution similar to that found by Schwarzer. Of special note is the absence of pain referral into the popliteal fossa in patients with attenuated posterior SIJ ligaments.

The physical examination can lead one to suspect SIJ dysfunction, but it does not *per se* allow one to make the diagnosis. Screening tests for SIJ dysfunction are well described elsewhere (Aitken 1986, Fowler 1986, Greenman 1989). These include static palpation of bony landmarks, looking for asymmetry, a one-legged stork (Gillet's) test, a seated flexion (Piedallu) test (Fig. 47.2), and a supine-to-seated test looking for leg length changes ('yo-yo sign') (Fig. 47.3).

It has been shown that these tests are neither reliable nor specific (Dreyfuss et al 1994, Van Deursen et al 1990) and, although positive tests in an individual should raise the index of suspicion

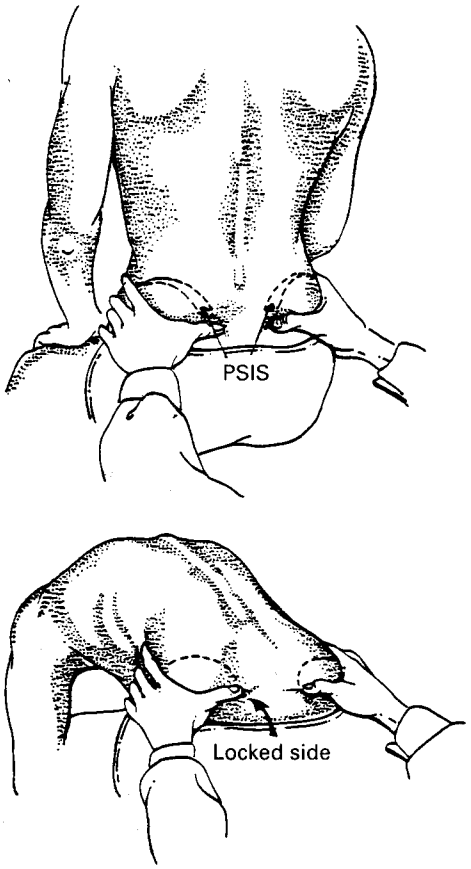

Fig. 47.2 Seated flexion test (Piedallu or lock sign). As one bends forward, the sacrum is locked versus the ilium and is thus brought upward, whereas the free or unlocked side stays down.

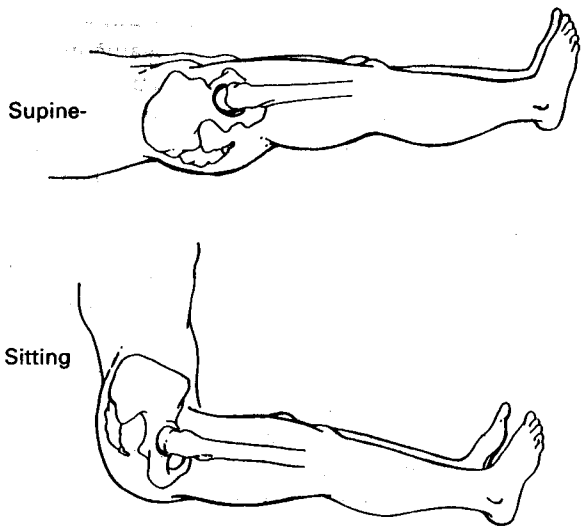

Fig. 47.3 Sit-up test (seated flexion test). As one sits up, leg lengths change ('yo-yo sign').

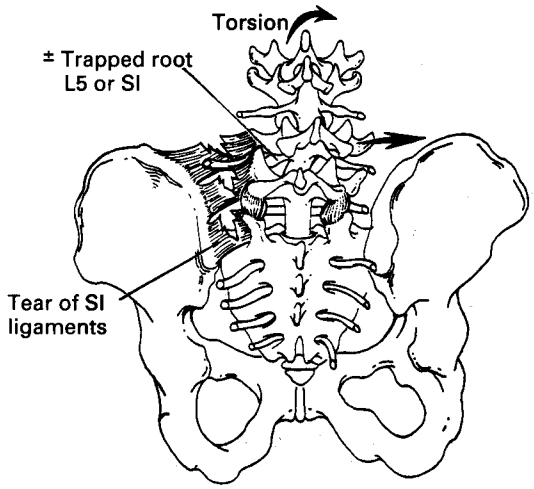

Fig. 47.4 Severe torsion produces ligament and facet capsule disruption, producing torsional instability with resultant nerve root entrapment.

as to the presence of extra-articular SIJ dysfunction, they are not diagnostic.

Symptomatic EXSIJ dysfunction cannot be diagnosed with laboratory or imaging studies. Bone scanning is best to identify occult or stress fractures, infection, or inflammatory disorders (Goldberg et al 1978). The diagnosis of EXSIJ dysfunction must be confirmed by a fluoroscopically controlled SIJ block (Dreyfuss et al 1995, Fortin & Tolchin 1993, Schwarzer et al 1995. However, this technique is probably not effective in anesthetizing a superficial ligament such as the long dorsal SI ligament (see also Chapter 3).

ASSOCIATED CONDITIONS

EXSIJ dysfunction can exist as an isolated disorder or in conjunction with other conditions. The most frequent combined lesion is a torsion injury in which the SI ligaments are torn in conjunction with tearing or stretching of facet capsule, a facet fracture, or tearing of the annulus, with or without disc herniation. Significant ligamentous and facet disruption can lead to a fixed deformity producing nerve root entrapment (Fig. 47.4).

Clinical observation has shown that disruption at L4–5 is more commonly associated with

SIJ dysfunction than are other intervertebral segments.

Piriformis syndrome, greater tronchanteric bursitis, and meralgia paresthetica can be found in conjunction with SIJ dysfunction.

DIFFERENTIAL DIAGNOSIS

Many spine conditions cause pain referral patterns to the SIJ (Table 47.1). These include facet syndrome, herniated disc, lateral spinal stenosis, hip disease, and thoracolumbar facet dysfunction (Maigne syndrome). Imaging studies are helpful in the diagnosis of herniated nucleus pulposus and hip disease, whereas fluoroscopically controlled blocks help to differentiate facet disorders or root entrapment from SIJ dysfunction. It should be noted that these conditions can exist in conjunction with each other.

TREATMENT

The goal of treatment of EXSIJ dysfunction is primarily to restore normal lumbopelvic mechanics. This includes the use of medication or intra-articular steroids for acute or chronic inflammation, manual techniques to reduce SIJ subluxation, muscle strengthening and rebalancing techniques for the muscles involved in SIJ mechanics, and belting or proliferant injections (prolotherapy) to stablilize the joint. Manual methods are well described in the literature (Aitken 1986, Fowler 1986, Greenman 1989). Likewise prolotherapy is covered elsewhere (Hackett et al 1991, Klein et al 1993, Ongley et al 1987, Reeves 1995) (see also Chapter 40). Should these modalities fail, surgical stabilization is indicated.

Criteria for stabilization include the following:

1. Pain must be disabling.
2. Pain must be localized to the SIJ and not relieved by conservative modalities.
3. Pain should be relieved on a transient basis by a fluoroscopically controlled SIJ block.
4. Other causes of lumbopelvic pain such as herniated nucleus pulposus, facet arthropathy, trapped nerve root, spinal stenosis, hip disorders, etc. should be ruled out.
5. Associated conditions must be treated before, in conjunction with, or after treating the SIJ dysfunction.

TECHNIQUE OF SI STABILIZATION

There are several articles describing SIJ fusion (Campbell 1927, Smith-Peterson & Rogers 1926, Waisbrod et al 1987). For EXSIJ dysfunctions, the placement of cannulated screws across a reduced (properly positioned) SIJ is usually adequate. Titanium screws are recommended since they are computerized tomography and magnetic resonance imaging compatible.

SIJ stabilization for traumatic injuries is well described in the orthopedic literature. Matta and Saucedo (1989) suggest that the patient be placed prone on a radiolucent table to allow the use of an image intensifier during surgery. The aim of

Table 47.1 Differential diagnosis

	Imaging study	Pattern	Work-up
Herniated nucleus pulposus	Positive	Better with rest, worse with activity	± Nerve study
Facet arthropathy	Negative	Very stiff in the morning, better as the day goes on	Positive response to facet block
SI dysfunction	Negative	Aggravated by walking, worse with recumbency	Positive response to SI block
Spinal stenosis	±	Aggravated by walking (claudication)	Positive response to epidural block
Trapped nerve root	±	Better with rest, worse with activity; may be helped by a corset	± Positive nerve study, positive root sleeve injection
Spinal instability	±	Worse with ambulation	± Flex/extend lateral X-rays, positive discogram
Hip disorder	Positive	Worse with ambulation	X-ray

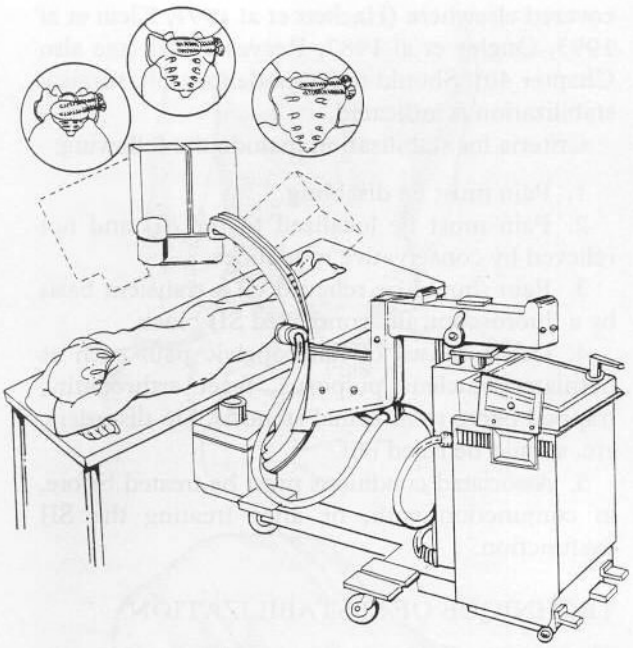

Fig. 47.5 Positioning of the patient and use of the image intensifier for SIJ fixation.

the operation is to insert cannulated screws from the ilium into the sacrum, monitoring proper placement with an image intensifier (Fig. 47.5). A posterior skin incision is made over the iliac crest. Underlying muscles are stripped from their attachments, exposing the outer iliac table. A point midway between the iliac crest and the sciatic notch, approximately 1.5 mm anterior to the crista glutea, is identified, and a K-wire placed under direct image intensification across the ilium into the sacrum. Anteroposterior (AP) views at 90°, 40° cephalad, and 40° caudad must be obtained to assess proper K-wire placement. If proper placement is achieved, a cannulated screw of appropriate length is then inserted over the K-wire. A second and, if room permits, a third screw are then inserted in a similar manner (Fig. 47.6).

The author has found that the procedure can also be carried out percutaneously. When this is done, it is essential that a lateral view be obtained to ensure that the screws are placed in the sacrum (Fig. 47.7). An external rotation AP view allows one to visualize the joint and outer table to determine that the screws are across the joint and placed all the way to bone.

No postoperative immobilization is required. The patient increases his or her activity to tolerance. Problems with muscle imbalance and spasm are frequent and must be addressed with physical therapy modalities. Associated conditions such as

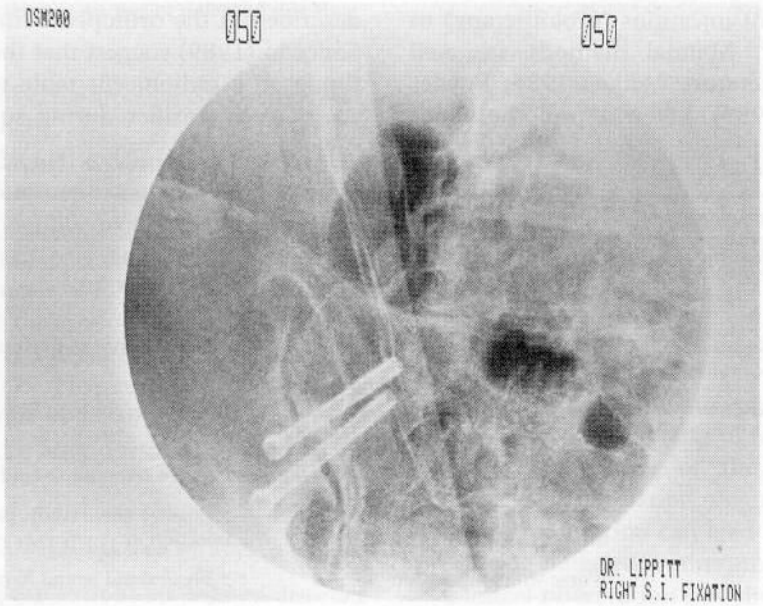

Fig. 47.6 AP X-ray showing proper screw placement.

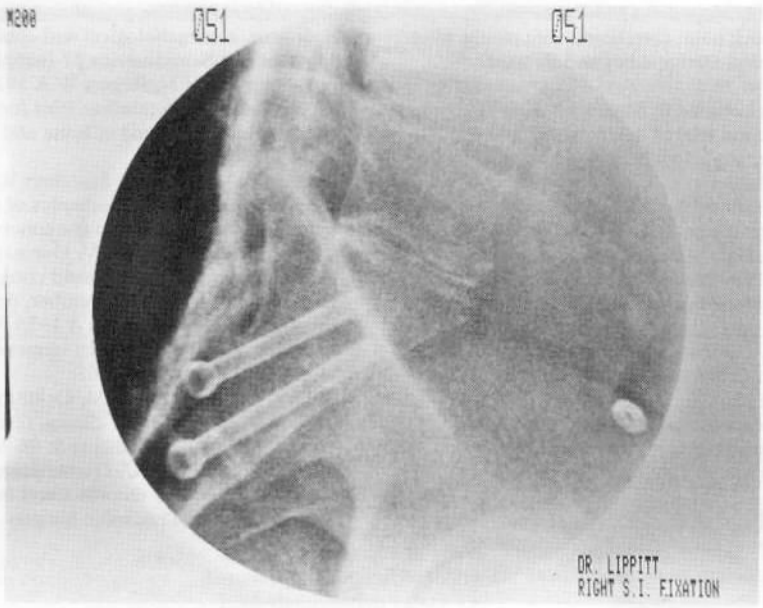

Fig. 47.7 Lateral view showing proper screw placement.

herniated discs, trapped nerve roots, facet arthropathy, segmental instability, piriformis syndrome, and/or meralgia paresthetica *must also be treated* for a successful outcome.

To date, no screw has broken or backed out, and follow-up X-rays have failed to show evidence of fusion despite continued clinical improvement.

The procedure has been performed in women of childbearing potential who are willing to undergo caesarean section if necessary. To date, none of those patients has become pregnant.

CONCLUSIONS

1. SIJ fixation is a relatively simple, safe, and effective treatment in those patients suffering from EXSIJ dysfunction unresponsive to conservative modalities.
2. It is not necessary to fuse the joint.

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