Recurrent subluxation of the sacroiliac joint: diagnosis and treatment

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Abstract

A review of the clinical evidence of the sacroiliac joint as a source of pain, impairment, and disability is presented along with the concept of recurrent subluxation and discussion of the various treatment options for managing this problem emphasizing sacroiliac stabilization with screws. The surgical results for 15 patients with isolated sacroiliac joint dysfunction and an 11 patients with a combination of sacroiliac dysfunction and lumbar spine problems are presented. The surgical results indicate that sacroiliac fixation is a simple, safe, and highly effective means of managing this condition.

With the exception of spondyloarthropathy or pelvic fractures, there is little in the standard orthopaedic literature concerning sacroiliac joint dysfunction.[1] Articles have appeared in the osteopathic, manual medicine, and physical therapy journals, but these are seldom read by orthopaedic surgeons.[2-5] In the author's experience, a significant number of patients with unexplained chronic low back pain suffer from disorders of the sacroiliac joint.

This study re-introduces the concept of the sacroiliac joint as the source of pain into the orthopaedic literature. It also addresses how to recognize recurrent subluxation of the sacroiliac and its associated pain and emphasizes a method of managing this disorder through the technique of surgical stabilization (for those joints that are not controlled by conservative treatment regimens).

Pertinent Anatomy

The classification of the sacroiliac joint is controversial. Some refer to it as a synchondrosis that eventually undergoes ossification. Others believe that it should be considered a true diarthrodial or synovial joint. Embryologic studies show that the joint is never closely congruent and that the sacral and iliac development is quite distinct temporally and histologically.[6,7] The concave sacral surface is usually covered with thick hyaline cartilage whereas the convex iliac surface is lined with thin fibrocartilage (Fig. 1). Embryologically, the sacroiliac joint is fully developed by the seventh month of intrauterine life. The joint surfaces remain flat until sometime after puberty.[8] In the third and fourth decades of life there is an increase in the number and size of the elevations and depressions, which interlock and limit mobility[9] (Table 1).

Much of the integrity of the sacroiliac joint depends on the ligamentous structures. It is the thick posterior sacroiliac ligaments that give the joint its stability by keeping the incongruent sacrum and ilium opposed, thereby controlling rotation of the sacrum (Fig. 2). Injury or stretching of these ligaments contributes to sacroiliac hypermobility with subsequent subluxation.

Biomechanics

In the adult the sacrum is a wedge-shaped structure from anterior to posterior, from cranial to caudal, and it responds to the load of the vertebral axis and trunk from above as it meets the upward force of the lower extremities through the hip joint. In both sitting and standing the pelvis may rotate forward or backward, depending on the relation of the weight bearing line from above meeting the upward force from below (Fig. 3). Movement within the pelvic girdle depends on the integrated movement of the two sacroiliac joints and the symphysis pubis. A detailed explanation of the various movements is beyond the scope of this paper but is well described elsewhere.[10-14]

The amount of sacroiliac motion is so small that there has been controversy regarding the existence of movement at this joint.[3] Any movement beyond the normal range results in subluxation.

Table 1 Age Changes in the Sacroiliac Joint

Age	Joint Surface	Joint Movement
0 - 10	Flat	Glides
10 - 30	Grooves develop	Rotation
30 - 50	Marked groove osteophytes	Ankylosis
50 +	Degenerative changes	Ankylosis

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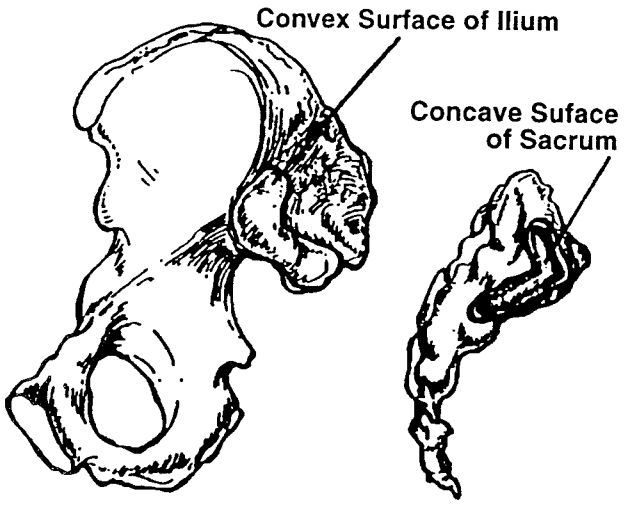

Figure 1 Joint surface of the sacroiliac joint.

Table 2 Pelvic Dysfunction

1. Hypermobility
2. Hypomobility
3. Postional faults (joint is fixed in a subluxed postion)
   - I. Inominate or iliosacral positional faults
     - a. Hemipelvic upslip (superior shear)
     - b. Hemipelvic downslip (inferior shear)
     - c. Inominate rotation, anterior
     - d. Inominate rotation, posterior
     - e. Displacement of the inominate in relation to the sacrum outward (outflare)
     - f. Displacement of the inominate in relation to the sacrum inward (inflare)
   - II. Symphysis pubis positional faults
     - a. Upslip
     - b. Downslip
   - III. Sacral torsions

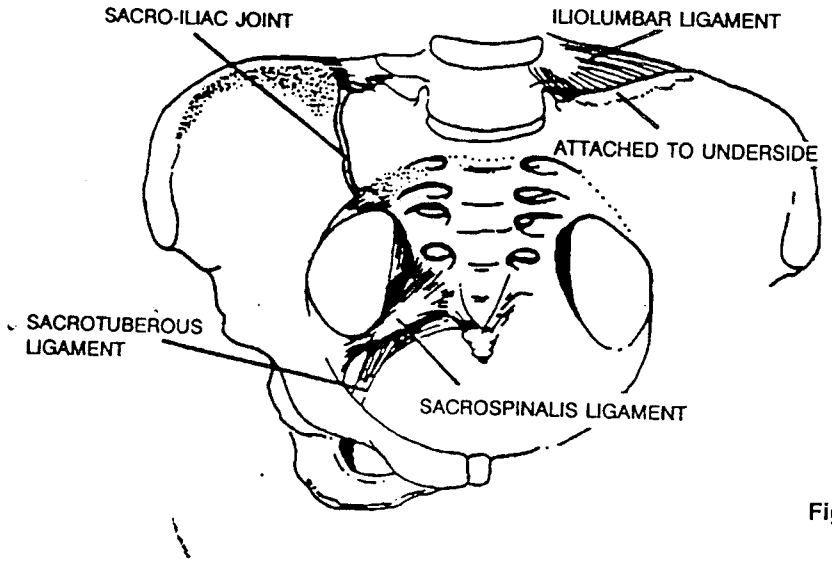

Figure 2 Sacroiliac ligaments.

Classification of Pelvic Dysfunctions

Table 2 outlines the various pelvic dysfunctions. Sacral and pubic dysfunctions are treated manually. It is the innominate or iliosacral dysfunctions that constantly recur (recurrent subluxation) that may require stabilization. Detailed descriptions of the various dysfunctions and their manner of treatment can be found throughout the literature.[3-5,10-13]

The Concept of Recurrent Subluxation

Repetitive trauma or hormonal change such as those occurring in pregnancy allow the sacroiliac joint to become lax and move beyond its normal range. The joint thus passes beyond its normal congruity into an area of incongruity. Locking, occurring between the opposing surfaces of the ilium and the sacrum, is the result. This locking is unlikely to be restored spontaneously unless there is a traumatic event such as a fall. The joint is particularly vulnerable to locking when the trunk is bent forward and lateral flexion or rotation is superimposed. Ultimately the ligamentous stretching produces a hypermobile joint subject to recurrent subluxation into a locked position.

Etiology of Pelvic Joint Dysfunction

Causes of pelvic dysfunction include the following:

1. Muscle imbalance
2. Dashboard injury in which a horizontal force to the knee rotates and locks the ilium in a forward position
3. A fall on one buttock (ischial tuberosity)
4. Sexual intercourse
5. Skiing or golfing (one leg standing)
6. Pre- and postpartum laxity of the ligaments of the symphysis pubis and sacroiliac joints

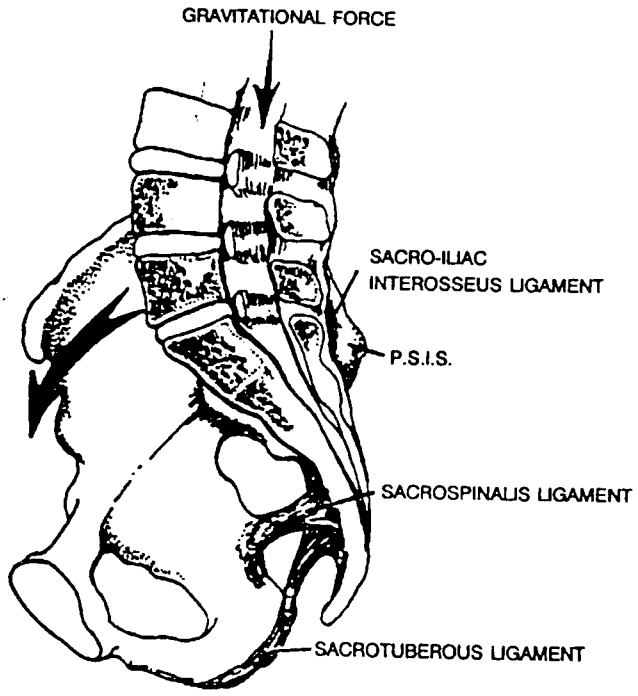

Figure 3 Sagittal section of the pelvis.

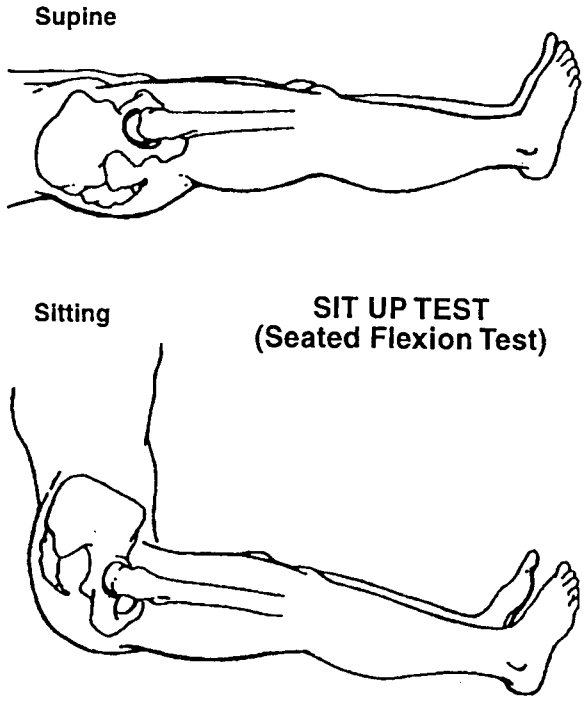

Figure 4 Sit up test (seated flexion test).

7. Overzealous kick against a missed target
8. Iatrogenic:
   a. Weakening of the joint and ligaments when harvesting an iliac bone graft[15,16]
   b. Increased force across the joint created secondary to a spine or hip fusion

Symptoms (Subjective)

1. Unilateral pain referred to the posterior thigh, iliac fossa, and buttock on the affected side
2. Pain aggravated by walking, particularly during stance phase, and worse with recumbency
3. A feeling of being unbalanced
4. A sensation of the hip "popping in and out"

Signs (Objective)

One Legged Stork Test

The *One Legged Stork Test* is used to determine which side is subluxed and/or locked. With the patient standing and the examiner behind, one can test upper pole movements as follows. One thumb is placed on the posterior superior iliac spine to be examined and the other thumb on the sacrum at S2. As the patient flexes his hip to 90 degrees on the side to be tested, the examiner's thumb on the posterior superior iliac spine should normally drop and move laterally. If it moves upward, the joint is locked and/or subluxed. Once the affected side is determined, an assessment is made for the position of subluxation by examining for asymmetry. The standing patient is viewed from the front, side, and back. Landmarks are observed including the anterior superior iliac spine and posterior superior iliac spine, the symphysis pubis, the ischial tuberosities, and the inferior lateral angle of the sacrum. The notch below the posterior superior iliac spine causes a cutaneous dimple that is observable and palpable on thin individuals. Placing the thumbs in each dimple allows visualization and alignment of the posterior superior iliac spine. Note however that a joint can be locked without being subluxed.

Other Objective Signs

Localized tenderness over pelvic landmarks suggests a dysfunction. One can also look for tenderness over *Baer's point.*[17] This is a point just to the side and below the umbilicus one third of the way between the umbilicus and the anterior superior iliac spine. Tenderness in this area is highly suggestive of a sacroiliac dysfunction.

Other physical signs that should make one suspect sacroiliac dysfunction include the presence of greater trochanteric bursitis, meralgia paresthetica, and/or piriformis spasm.

Other Tests

Van Durson Standing Flexion Test[18]

To perform the Van Durson Standing Flexion Test the patient should be standing and the examiner's thumbs pressed firmly below the posterior superior iliac spine in the sacral dimples. The patient then flexes his trunk without bending the knees. Upward excursion of the posterior superior iliac

spine is greater on the locked side because during trunk flexion the ilium is caught on the flexing sacrum.

Supine to Sitting Test[19]

When performing the Supine to Sitting Test the medial malleoli are palpated with the patient supine. The patient then sits up with the knees extended. A positive test consists of the affected leg being longer when supine but shorter when sitting, implicating anterior innominate rotation on the affected side. The opposite observation (i.e., shorter to longer when sitting) indicates posterior innominate rotation (Fig. 4).

Piedallu or Locking Sign[20] *(Seated Flexion Test)*

The Piedallu or Locking Sign, sometimes referred to as the Seated Flexion Test, is performed with the patient seated on a hard surface and the examiner positioned behind. The examiner's thumbs are placed on the posterior superior iliac spine as the patient bends forward. If the thumb on the affected side moves higher than on the opposite side, the innominate is locked onto the sacrum and thus will rock forward with it, whereas on the mobile, unaffected side, the posterior superior iliac spine will also move superiorly but much less so (Fig. 5).

Imaging

Many other tests have been described in the literature, but none of these studies is reliable and none has been proven useful in the diagnosis of subluxation of the sacroiliac joint.[18] The results of plain film radiography, computed tomography, magnetic resonance imaging, as well as bone scans are also unreliable. Fluoroscopically controlled sacroiliac joint injections (provocative-analgesic radiology) can aid in the diagnosis. In this study, pain is provoked and then relief is attempted by administering local anesthesia into the joint (it is best to block the joint inferiorly to avoid numbing the nerve roots, which can happen with a superior sacroiliac approach).

Differential Diagnosis

Table 3 lists the conditions that need to be considered in the differential diagnosis of sacroiliac dysfunction. It is important to realize that a sacroiliac disorder is a diagnosis of exclusion. Herniated nucleus pulposus with radiculopathy is usually easy to diagnose. Facet arthropathy, spinal stenosis, and the presence of a trapped nerve root are somewhat more difficult. The signs and symptoms of facet arthropathy have been previously described.[21] Facet arthropathy often mimics a sacroiliac problem — both localize the pain in the hip and buttock. Facet problems, however, are often referred into the groin

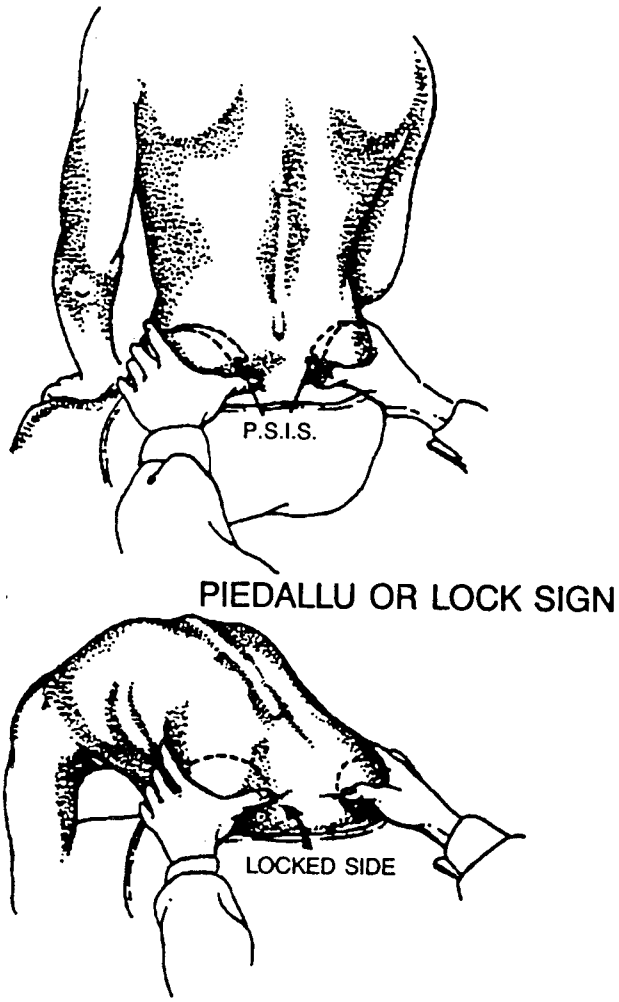

Figure 5 Piedallu or lock sign.

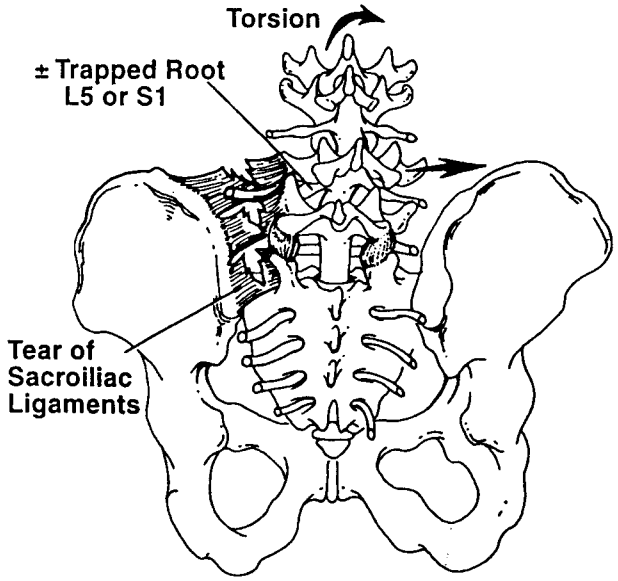

Figure 6 Torsion injury producing trapped root and tearing of the sacroiliac ligament.

Table 3 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 progresses	Positive response to facet block
Sacroiliac dysfunction	Negative	Aggrevated by walking Worse with recumbancy	Positive response to sacroiliac block
Spinal stenosis	+/-	Aggravated by walking (claudication)	Positive response to epidural block
Trapped nerve root	+/-	Better with rest Worse with activity May be helped with corset	+/- positive nerve study Positive root sleeve injection
Spinal instability	+/-	Worse with ambulation	+/- flexion extension lateral radiographs Positive discogram
Hip disorder	Positive	Worse with ambulation	Radiographs

and are associated with morning stiffness that gets progressively *better* as the day progresses. With a sacroiliac disorder, however, the patient is not particularly stiff in the morning and the problem gets progressively *worse* with continued standing and increased movement. Fluoroscopically controlled blocks of the sacroiliac joint and/or facet joints are helpful in differentiating between the two conditions.

The diagnosis of a trapped nerve root secondary to a fixed torsion injury is much more difficult. Macnab discussed the concept of the trapped nerve root and how to diagnose it using root sleeve injections.[22] Farfan described the mechanism of trapped nerve root injury secondary to torsion injury.[23,24] He introduced the concept of "creep." After a joint has been injured in torsion, prolonged standing will return the joint to the deformity due to the weakening of the ligaments. Thus, these patients often feel fine in the morning, but with prolonged standing they experience increasing leg pain. Farfan ignored the sacroiliac involvement in this torsion injury. There is a considerable amount of overlap between the two conditions, and the two conditions are often associated (Fig. 6).

Treatment (Table 4)

The treatment of the subluxed joint is manual. Just as one would reduce a shoulder subluxation or dislocation manually, there are methods of reducing a subluxed sacroiliac joint.[3,5,10-13] Since a chronically subluxed sacroiliac joint often becomes inflamed, the use of non-steroidal anti-inflammatories or intra-articular steroid injections may help alleviate some elements of the symptomatology.

Whereas most sacroiliac conditions can be treated with simple manual techniques or the use of anti-inflammatory medication, recurrent subluxation calls for some type of stabilization to prevent further recurrence. Various belts have been devised that may or may not be of benefit. Since the ligaments are the primary stabilizers of the sacroiliac joint, tightening of these ligaments can alleviate the problem, and the use of proliferative injections into the joint and ligaments is often very successful in that regard.[4,21,25]

Sacroiliac Stabilization

There are numerous articles describing the treatment of sacroiliac joint disorders with fusion techniques.[26-29] The author feels that except in the most grossly unstable sacroiliac joints, fusion should not be considered for sacroiliac hypermobility or recurrent sacroiliac subluxation. Rather, a relatively simple technique of fixation exists which consists of the placement of cannulated screws from the ilium into the sacrum.

Criteria for sacroiliac stabilization:

1. Absolute:
   a. Pain must be intractable and disabling
   b. Documentation of recurrent subluxation of the joint not controlled with conservative treatment
   c. Exclusion of other causes such as herniated nucleus pulposus, facet arthropathy, trapped nerve root, spinal stenosis or hip disorders
2. Relative criteria:
   a. An increase or decrease of pain with fluoroscopically controlled sacroiliac blocks

Note that the operation may be done in females of child bearing potential if they are willing to undergo a Cesarean

Table 4

Pathology	Treatment
1. Inflammation	Nonsteroidal anti-inflamatories or intra-articular steroid injections
2. Sacroiliac subluxation	Mobilization
3. Sacroiliac hypermobility	Sacroiliac belt Proliferative injections Screw fixation

section. The operation itself is simple. The indication and diagnosis are difficult. The sacroiliac joint should be reduced prior to stabilization.

Technique of Sacroiliac Stabilization

The technique has been previously described by J.M. Matta (Fig. 7).[6,22] The patient is placed prone on a radiolucent table to allow the use of an image intensifier during surgery. The aim of the operation is to insert cannulated screws from the ilium into the sacrum. Monitoring proper placement with image intensifier avoids injury to the sacral nerve roots. The patient is positioned so that an anteroposterior view can be taken in a 40 degree cephalad, neutral, and 40 degree caudad position.

A posterior skin incision is made parallel and slightly medial to the posterior superior iliac spine extending cephalad and parallel to the iliac crest. In a subperiosteal manner the glutei are stripped from their attachment exposing the outer table of the ilium. The posterior superior iliac spine and the crista glutaei are identified, and at a point approximately midway between the iliac crest and the sciatic notch approximately 15 mm anterior to the crista glutaei, a K-wire is placed under direct image intensification across the ilium into the sacrum. Three views are noted to ensure proper placement, and if proper placement is noted, a cannulated screw is inserted over the K-wire. A second screw should be placed in a similar manner. It is not necessary to fuse the joint. Once surgeon feels comfortable with screw placement, the procedure can be done percutaneously.

Postoperative immobilization is not necessary, and the patient may increase activity to tolerance, but vigorous activity should be avoided for at least two months. Occasionally the patient will complain of some localized discomfort and the area over the ligaments and operative site will remain tender for several weeks. Sclerosing these ligaments as a supplemental step can be beneficial. Problems of muscle imbalance and spasm are frequent and can be successfully addressed with proper physical therapy.

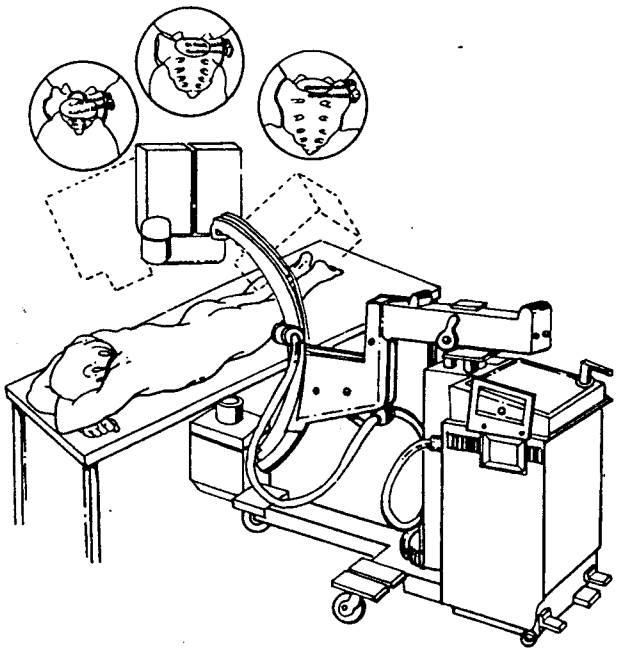

Figure 7 Positioning of the patient and use of the image intensifier for sacroiliac fixation.

Results

Tables 5 and 6 outline in some detail various results achieved in patients with a follow-up of over two years. The criteria for success included:

1. Absence of further subluxation
2. Resolution of pain
3. Ability to return to previous employment
4. Improvement in activities of daily living including ambulation, sitting, and sports

All patients were evaluated by unbiased, independent professionals who worked with the patients before and after surgery. Results must be divided into two categories:

1. Those patients with isolated sacroiliac dysfunction
2. Those patients with sacroiliac dysfunction associated with a lumbar spine condition

Results will be reported on only those patients who have been followed for greater than one year postoperatively. This includes a total of 26 patients (22 female, 4 male) with an age range of from 21 and 61 years (mean age of 30 years). Symptoms lasted between 5 to 60 months with an average of 20 months.

Isolated Sacroiliac

Fifteen patients had isolated sacroiliac dysfunction. The mechanism of injury included a direct blow in seven patients, a torsion injury in four, chiropractic manipulation in one, a forward flexion injury in one, a motor vehicle accident injury in one, and in one patient the mechanism of

Table 5 Sacroiliac Fixation with Greater Than Two Years Follow-Up – Isolated Sacroiliac

Patient	Date of Surgery	Etiology	Symptoms	Duration	Work Up	Sacroiliac Block	Results
T.S. 31year old Female	2/87	Direct blow, right buttock	Right hip and buttock pain	1 yr	(-) Bone Scan (-) CT Scan (-) Nerve Study	(+) X 4	Significant pain relief Went to nursing school
B.C. 34 year old Male	11/89 Bilateral	Manipulation	Bilateral hip and buttock pain Can't sit	1 yr	Pain Clinic Antidepressants	No	Complete relief Can sit
D.W. 35 year old Female	1/90 Bilateral	Fall on buttocks	Bilateral hip and buttock pain	5 yr	Extensive PT Gross instability clinically	No	Minimal relief Reflex dystrophy
S.L. 30 year old Female	4/90	Torsion	Right hip and buttock pain	19 mo	Clinical	No	Excellent
D.R. 33 year old Female	8/90	Direct blow, right buttock	Right hip and buttock pain	5 mo	(-) MRI Clinical evidence of instability	No	Complete relief Return to work

injury was unknown. All 15 patients with isolated sacroiliac dysfunction were females. The duration of this groups' symptoms ranged from 5 months to 48 months. Twelve patients had right sided dysfunction, two had left sided, and one patient had bilateral dysfunction. Two patients required contralateral side fixation after the symptoms became apparent following fixation of one side. In seven of the 15 the procedure was performed with the insertion of a single screw. Two of these required a second screw insertion approximately one to two years later when the pelvis began rotating around the single screw. Since then, all fixations have been performed using two screws. Eleven of the 15 patients can be classified as having had an excellent result: complete resolution of pain, no further need for pain medication, and the ability to resume all pre-symptom activities including their return to work. One patient who had a bilateral fixation, each side with a single screw, had an excellent result for approximately three years and then the pelvis began rotating around the screws necessitating the addition of a second screw to each side. Following this surgical revision the patient's result could be classified as excellent. The remaining three patients can be classified as having had equivocal results. No patient was made worse as a result of the surgery.

Combination Lesions

Eleven patients had combination lesions. Two patients in this group had undergone previous spine fusions that resulted in sacroiliac instability iatrogenically created as a result of bone graft harvesting. Both of these patients gained complete relief of their prior, severe right hip and buttock pain. One patient had isolated left hip and buttock pain 20 years postpartum with clinical evidence of sacroiliac instability and chronic radiculopathy and MRI evidence of disc herniations at L5 and S1 on the side of the radiculopathy and on the side of the sacroiliac dysfunction. The radiculopathy responded to epidural steroid injections and the severe hip and buttock pain to sacroiliac fixation with no further problems. One patient who, prior to surgery, had no evidence of lumbar disc pathology underwent sacroiliac fixation with very questionable relief and, subsequently, a herniated disc was demonstrated on follow-up imaging studies. One female patient had evidence on imaging studies of a herniated disc as well as evidence of sacroiliac instability. A discectomy eliminated the patient's radicular pain but did not change her hip and buttock pain; however, pain was completely relieved with subsequent sacroiliac fixation. Of the seven remaining combination lesions, two had excellent results with sacroiliac fixation. The remaining five had minimal pain relief despite clinical evidence of an unstable sacroiliac joint. Unfortunately, these five were not tested with fluoroscopically controlled sacroiliac blocks prior to surgery.

Based on these results it is reasonable to conclude that a certain percentage of people who have sacroiliac instability clinically do not necessarily have pain emanating from that instability. Therefore, prior to sacroiliac fixation, especially in patients with a combination of other lesions, fluoroscopically controlled sacroiliac blocks should be carried out and surgery should not be performed unless good

Table 6 Sacroiliac Fixation with Greater Than Two Years Follow-Up – Sacroiliac and Lumbar Spine

Patient	Date of Surgery	Etiology	Symptoms	Duration	Work Up and Associated Back Condition	Sacroiliac Block	Results
P.T. 44 year old Female	6/88	Iatrogenic (bone graft)	Right hip and buttock pain	4 yr	Prior disectomy and fusion	No	Fair
CC. 34 year old Male	11/88	Iatrogenic (bone graft)	Right hip and buttock pain	6 mo	Prior disectomy and fusion; (+) block	(+) X 4	Complete relief Right hip and buttock pain
S.A. 45 year old Female	5/90	MVA	Right hip and buttock pain	5 yr	Associated herniated disc, L5-S1 right; (+) block	(+)	Prior discectomy: relief back & radicular pain Right hip and buttock pain: complete relief after fixation
P.H. 48 year old Female	8/90 12/90	MVA	Bilateral hip and buttock pain	3 yr	Left L5 decompression prior to first sacroiliac fixation; (+) block	(+)	Partial pain relief Not working
J.C. 31 year old Male	9/90	Direct blow	Right hip and buttock pain	5.5 yr	Prior spine surgery did not help pain Clinical evidence of sacroiliac instability Decompression and spine fusion for spondylolisthesis	No	No pain relief
J.M. 48 year old Female	12/90	Direct blow	Right hip and buttock pain	3.5 yr	Clinical evidence of sacroiliacinstability Four prior back surgeries	(+) X 2	Complete pain relief Back to work
R.D. 43 year old Female	2/91	MVA	Right hip and buttock pain	14 yr	Prior discectomy Clinical Instability	No	No change in pain
S.W. 41 year old Female	4/91	Torsion	Right hip and buttock pain	8 mo	Degenerative disc L2-3, on MRI	(+)	Partial relief of symptoms Not back to work

symptomatic relief of their pain as a result of the blocks can be demonstrated.

Complications

No postoperative infections were encountered in this series of patients. One patient had a transient sciatica and severe headaches, which resolved over a time. One patient had an immediate postoperative syncopal episode that was transient and resolved with no further problems. One patient had reflex sympathetic dystrophy that was felt to have existed prior to the procedure; she had a long-standing grossly unstable sacroiliac problem that did not respond to sacroiliac fixation. Two patients have had problems with postoperative muscle spasms, one of the piriformis muscle and one of the adductor muscle, both of which resolved with physical therapy. To date, no screws have backed out and none have broken.

Conclusions

1. The sacroiliac joint can be the source of much pain, disability, and impairment that often goes unrecognized.
2. Stabilization for recurrent subluxation is a safe, simple, and an effective means of managing the problem.
3. For patients with isolated sacroiliac subluxation the results achieved with this technique of stabilization have been excellent.

4. For patients with a combination of other lesions sacroiliac fixation should be considered only if significant pain relief with a fluoroscopically controlled sacroiliac block can be demonstrated preoperatively.

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