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# Diagnosis and Treatment of the Sacroiliac Joint in Chronic Low Back Pain: An Updated Literature Review

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# Research Report

## Diagnosis and Treatment of the Sacroiliac Joint in Chronic Low Back Pain: An Updated Literature Review

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### Abstract

In the medical field, low back pain is an increasingly common complaint. Much of the time, low back pain originates in the sacroiliac (SI) joint, which is difficult for providers to diagnose and treat. Basic tools such as physical examination, in combination with special tests including the Fortin Finger Test (FFT), have helped pinpoint the source of low back pain to the SI joint. Additionally, with the help of various imaging modalities including ultrasound and fluoroscopy, interventions can localize the pain source more precisely. Low back pain originating in the SI joint has been extensively studied, resulting in the development of new treatments to include corticosteroid injections utilizing ultrasound for visualization. However, a more sustainable treatment modality employing fluoroscopically guided corticosteroid injections has shown to be cost effective, have minimal adverse reactions, produce long-term benefits, and provide opportunity for new growth in this niche of medicine.

*Key Words: Sacroiliac joint, ultrasound, Fortin Finger Test, corticosteroid, injection, back pain, fluoroscopy*

### Introduction

A popular topic in research that has emerged is understanding the role of the sacrum and its relationship to adjacent components to determine its association with low back pain. Low back pain can be single or multi-factorial and can have one or many etiologies. Etiologies may be chronic, acute, or acute exacerbations which may or may not be related to the chronic pathology. An example is a patient with chronic facet joint arthritis who strains a muscle lifting boxes.

Structurally, the sacrum serves as the cornerstone for the pelvic girdle; it has an interconnected role with neighboring body parts through joints and ligaments, but it still functions as an independent unit.[1,2] The sacrum is a diverse structure which interplays with

surrounding anatomy and has a vital role in the stability and function of the lower vertebral column and pelvic girdle.[3] It acts as a support for vertical forces directed inferiorly through the lumbar vertebral column and helps transmit those forces laterally in a horizontal plane toward the ilium of the pelvis.

Although the role of the sacrum is not fully understood, the most accepted theory is that it contributes more to passive movement than active movement. In contrast to the sacrum, other joint counterparts, such as the glenohumeral joint, largely contribute to active motion.[3] Instead, the sacrum is believed to play a central role in the stability and framework of the human body. The sacrum is the body's natural shock absorber. It does so by equally distributing forces from the spine to the pelvis and lower extremity to decrease the amount of force and tension on the vertebral column. Its lack of fusion to the pelvic girdle protects it from torsion as well as shearing forces that occur daily.[1,2]

SI joint pain is often mistakenly diagnosed as lumbar back pain. Missing or overlooking the SI joint diagnosis may contribute to untreated chronic pain and result in unnecessary and costly surgeries without relief. Given the sacrum's major role in the structural support of the lumbar spine and pelvic girdle, the pathology of the SI joint may very well be a contributing factor to low back, buttock, and lower extremity pain.[4]

The sacrum acts similarly to a keystone, in which the sacrum's wide base holds the sacrum in place between the ilia. This determines the sacroiliac (SI) joint's structure and function. With longitudinal forces, the sacrum is locked into place between the pelvis, providing stability and preventing a downward slip of the sacrum. Sacral ligaments attaching to the pelvis are critical for movement in addition to support.[3] The ligaments allow the sacrum some flexibility without compromising the structural integrity of the pelvic girdle. Each ligament plays a pivotal role in supporting the structure, whether it is the short posterior sacroiliac ligament preventing counternutation of the sacrum, or the sacrospinous and sacrotuberous ligaments preventing excessive nutation. The complex organization of the sacrum increases the difficulty of interpretation and navigation of radiographic images due to the intricate structure.[1,2]

Low back pain is a common complaint with the SI joint accounting for approximately fifteen percent of cases.[5,6] The SI joint is a tri-planar shock absorber and is the largest axial joint in the body. The joint is composed of synovium, ligaments, fascia, muscles, and spinal nerves that form a plexus. Although the sacrum is considered a synovial joint, barely 25% of its surface is composed of synovium. The joint is surrounded by a fibrous capsule, with the anterior portion being composed of thin ligaments and the posterior portion constructed by interosseous ligaments. Thoracodorsal fascia helps strengthen the joint posteriorly where reinforcement of the SI joint is the most prominent. The joint is stabilized by a number of muscles including the gluteus maximus, gluteus medius, erector spinae, latissimus dorsi, biceps femoris, psoas, piriformis, abdominal musculature. These muscles are all innervated by T12-S4, whereas the joint itself is innervated by L5-S2 ventral rami, nerves of the sacral plexus, and lateral branches from S1-4 dorsal rami. Free nerve endings are located in the SI joint capsule and surrounding ligaments, which are responsible for conveying pain and

temperature sensation.[3,6] The synovium, ligaments, fascia, muscles, and neural innervation can all become dysfunctional acutely or chronically and lead to a pathological state.

The intricate structure of the SI joint makes imaging difficult and also complicates the clinical presentation and diagnosis of the SI joint as the source of pain. The diagnosis is further complicated by the possibilities of multifactorial and multiple etiologies leading to the patient's back pain. The SI joint may be the only etiology, or it may be one of many etiologies. Additional causes of low back pain may include muscle sprain or spasm, ligamentous injury, zygapophyseal dysfunction as seen in arthritis or spondyloarthropathies, and radicular pain due to irritation of nerves or disc herniation.[5,7,8] The causes may be especially difficult to differentiate between when more than one are present.

Compounding the difficulty of SI joint diagnosis are the use, specificity, and sensitivity of special tests performed during the physical examination. A myriad of special tests exists to aid in the diagnose of the SI joint as one of the etiologies.[4] Each test has a different sensitivity and specificity. Researchers have investigated sensitivity and specificity for many of the tests and have found different results and conclusions. The Fortin Finger Test is one of the oldest tests, but it has good sensitivity and specificity. This test consists of the localization of pain with one finger to an area inferomedial and within 1cm of the Posterior Superior Iliac Spine (PSIS), in which the patient pointed to the same area at least two times.[9,10] Other popular tests include the FABER, thigh-thrust, distraction test, and Gillet. Each of which will be discussed in depth.

Treating the SI joint can be approached with multiple different options, once the SI joint is diagnosed as an underlying cause of the patient's back pain. One of the most common and successful treatments is corticosteroid injections containing lidocaine.[10-13] The steroid with local anesthetic has a significant benefit due to its ability to diagnose and treat the SI joint. The injection is considered diagnostic if the patient's pain is decreased within a few minutes due to the local anesthetic. The corticosteroid will take affect over the next few weeks, but affects often only last a few months and have to be repeated. The diagnosis as well as the therapeutic approach is a controversial topic with varying degrees of research and opinions. Physicians may come to a diagnosis by clinical presentation, physical examination, special tests, ultrasound, bone scintigraphy, CT, MRI, or a combination of the modalities. Providers may also choose to perform the injection blindly, under ultrasound guidance, or under fluoroscopic guidance, each of which have their own relative benefits and disadvantages. If corticosteroid injections fail, other treatments include radiofrequency ablation and cooled radiofrequency ablation.[14-16] Surgical intervention is the last option for refractory cases.

## Low Back Pain

Low back pain can be defined as pain originating from the area of the lumbar vertebrae or the sacrum. As previously mentioned, the lumbar spine and sacrum are intimately related in both structure and function, demonstrating how pain in one area may predispose an individual to pain in another. Degeneration of interspinous ligaments may decrease structural support for the pelvic girdle and contribute to low back pain. Without support,

the sacrum becomes hypermobile, leading to further damage or strain. Studies have hypothesized other sources of pain may be due to excessive or inappropriate stimulation of nerves in the area of the SI joint, particularly from L4-S2. This concept was demonstrated through contrast media injection into the SI joint which resulted in somatic low back pain, indicating the SI joint may be a prime source of the pain.[5,7,8]

Multiple causes of SI joint pathology exist including age, disease processes, and some are of idiopathic etiology. Increasing age results in destruction of the synovium lining the sacrum and ilium. The combination of age and disease processes may lead to an unstable or hypo-mobile joint leading to injury.[3,5] Idiopathic etiology is the most common cause of pathology among the SI joint. Some of the intra-articular sources of pathology include osteoarthritis and infection, while extra-articular sources include enthesis, ligamentous sprain, and fractures. Intra and extra-articular inflammation may be facilitated by metabolic, traumatic, or arthritic causes.

Pregnancy and delivery both contribute to SI pathology due to laxity of ligaments induced by estrogen and relaxin.[3,5] These hormones lead to hypermobility of the SI joint and can cause ligamentous sprain.[8,17] Hyperlaxity of ligamentous structures may lead to a maintained dysfunctional state. This state can be maintained for months by chronically contracted muscles in the surrounding area. Estrogen also increases clotting factor production by the liver during pregnancy, leading to a hypercoagulable state that may result in venous thrombosis and referred pain. However, this etiology is less common.

Previous studies have discovered the SI joint has high vascularity and hyper-metabolic activity which predisposes the joint to degeneration and inflammation. Of some of the purported causes of sacroiliac joint-induced low back pain, trauma has been one of the major areas of investigation. As such, sacroiliac joint dysfunction should be suspected in an individual who may have symptoms of low back pain after a traumatic injury or fall, including but not limited to prat-fall or motor vehicle accidents.[8]

## Physical Examination and Special Tests

An important component aiding in the determination of the SI joint as a contributor to the low back pain is the physical examination. On physical exam, patients may exhibit a positive seated flexion test indicating sacral somatic dysfunction, a positive FABER (flexion, abduction, and external rotation) test which elicits ipsilateral iliosacral joint pain, and sacrotuberous ligament tenderness on palpation.[4] Additionally, tenderness may be induced when the pubic symphysis or piriformis muscles are palpated. At least three positive tests indicate a high sensitivity and moderate specificity for sacroiliac joint dysfunction and pain.[18] To aid in diagnosing the SI joint as one of the causes of low back pain, physicians utilize multiple special tests all with varying degrees of sensitivity and specificity. However, the data supporting these tests is weak. Previous studies investigated many of these tests and found them to have low sensitivity, specificity, reliability, and validity. The studies which investigated these tests were limited or incomplete and may not be an accurate source of determining which tests to use.[19,20]

A handful of studies have been performed to narrow down the more useful, practical, reliable, and valid tests for diagnosing SI joint pain. Wurff *et al.* compared 11 studies and found only one study to have an acceptable methodological score. This was the Thigh Thrust test on pregnant women. Wurff *et al.* concluded the majority of the studies did not have sensitivity, specificity, or proper methodology.[20] Cattley *et al.* concurred there is a large number of special tests for the SI joint, but most studies did not investigate the test's validity or reliability. The following tests were found to be reliable: Gaenslens, Thigh Thrust test, Finger Point test (Fortin's Finger test, Point of Maximal Tenderness), and SI Joint Pain Mapping.[19] The only test found be valid was the Thigh Thrust test.[19] Cid *et al.* determined the indicators with the highest degree of predictability, using a modified Delphi survey, included approximation, gapping, FABER, pelvic torsion, axial torsion, Fortin Finger, and Gillet.[21] Laslett *et al.* studied the validity of these special tests in diagnosing the SI joint. They found the highest predictive value was accomplished by utilizing multiple tests. Requiring 3 out of 6 tests to be positive or at least 2 out of 4 tests to be positive increases diagnostic validity. Laslett *et al.* concludes the Thigh Thrust test is the most sensitive and the distraction test is the most specific.[22]

In identifying origins of pain in low back pain, true low back pain is more often described by a patient with the palm of the hand identifying the site of the pain. Conversely, one finger is more often used to point to within 2cm of the posterior superior iliac spine (PSIS) when the SI joint is the source of low back pain.[9]

One of the tests found to be accurate in diagnosing the SI joint was described by Fortin and Falco and is referred to as the Fortin Finger Test.[10] A patient will be asked to point to their pain using one finger. The test is deemed positive if the patient points within 1cm inferiomedially to the PSIS joint on two occasions. When Fortin and Falco studied this test, they found it to correlate 100% with the SI joint when utilizing provocation joint injection tests. Provocation joint injection tests consist of inserting the needle to be used for the injection and using it as a probe to find the patient's pain intra-articularly.[10]

Murakami *et al.* investigated the Fortin Finger test and concluded the test to be useful in implicating the SI joint as the source of pain. This study included 46 patients and utilized the Fortin Finger test or "one-finger test" to determine its accuracy. 72% of the patients who indicated their source of pain to be within 2cm of the PSIS showed improvement with a periarticular SI joint block containing 2% lidocaine. The site of pain was confirmed with fluoroscopy prior to initiating the SI joint block.[9]

Another proposed diagnostic test for sacroiliac joint pain is the PSIS distraction test. With this test, Werner *et al*.[23] determined bilateral medial-to-lateral distraction of the PSIS from the sacrum generates pain similar to that of the patient's symptoms. The test is highly sensitive and specific for sacroiliac joint pain contributing to low back pain. While the PSIS distraction test may be a valuable tool, testing in the study by Werner *et al*.[23] was conducted on individuals with sacroiliac joint arthropathy following an infiltrative procedure. This procedure may have led to the high sensitivity results discovered in the test. Therefore, sacroiliac joint corticosteroid injections eliciting pain remain the gold standard for diagnosis of sacroiliac joint pain.[11,12,23]

It is important to note repetitive tests performed in succession or manipulation of the joint can alter the test results. This is in part due to the complex anatomy and abundance of soft tissue surrounding the joint. Preceding tests have the potential to engage surrounding tissues, altering the biomechanical response to the test.[19]

An additional valuable tool for diagnostic work-up is imaging such as ultrasound, CT, MRI, and scintigraphy. CT may be useful in detecting structural change or degeneration, however, cost may limit use. Bone scintigraphy may be beneficial in determining if sacroiliac joint pain is due to a mechanical cause.[8]

At this time, our recommendation is to perform a minimum of three special tests. There are currently no guidelines or published criteria on diagnosing the SI joint. Researchers, however, have found the best results with the Fortin Finger test, FABER, PSIS distraction, and the Thigh Thrust test. The current research investigating the special tests have not shown reliable or valid study design and require more investigation before official recommendations, guidelines, and criteria may be written.

## Intervention and Treatment

First line treatments for SI joint pain are supportive and non-invasive in nature. This includes non-steroidal anti-inflammatory drugs, rest, ice, physical therapy, and osteopathic manipulative therapy. If pain does not resolve or does not improve, more invasive treatment modalities are pursued. These could include corticosteroid joint injections, radiofrequency denervation, and surgical fusion as a last resort.[13] Unfortunately, these possible treatments provide little evidence to suggest they are effective long-term or devoid of serious complications.[13,24]

Cohen *et al*. investigated radiofrequency denervation on patients with chronic low back pain to determine if it was a feasible long-term treatment. Two study groups were created including a placebo group receiving a local anesthetic followed by a placebo denervation and second group which received radiofrequency denervation in the area of L4-L5 and S1-S3 followed by an anesthetic. Cohen's method also employed fluoroscope-assisted sacroiliac joint injections and an anterior-posterior view on radiographic imaging to ensure proper placement of the injection.[14]

During follow-up appointments and evaluations, the patients who received the therapeutic radiofrequency denervation reported at least fifty percent pain relief and a more positive perception of their treatment results than the placebo group. While some individuals of the placebo group reported no change in pain level, a few individuals did state their pain levels decreased, but the pain relief did not last as long as the therapeutic group. Of the therapeutic group, the duration of pain relief varied between five and twelve months. One possible explanation for these results is the radiofrequency denervation was administered to a parental branch of the L4 nerve rather than individually targeting each dorsal rami branch.[15] Differences in regards to duration of pain relief was attributed to the variability in the rate of nerve regeneration amongst individuals. The use of radiofrequency denervation

is supported by Cohen's study as seen by the results exhibiting favorable outcomes for patients receiving therapeutic injections.[14]

In a similar study, Ho *et al*. assessed the efficacy of cooled radiofrequency denervation administered to the area of L4-L5 and S1-S3 and the areas lateral to the posterior sacral foramina to treat low back pain due to sacroiliac joint dysfunction. The effectiveness of this study was evaluated two years' status-post procedure and patient's indicated significant decreases in pain levels. However, because there were no comparison control groups, cooled radiofrequency denervation cannot be ruled as a superior method to other conventional therapies.[16]

Surgical intervention is another therapeutic method that is being assessed for treatment of sacroiliac joint-induced low back pain. Spiker *et al.'s* systematic review compared and contrasted surgical intervention against injection treatment to evaluate which modality leads to better outcomes. Some of the surgical interventions included vertebral fusion with bolt attachment and sacroiliac joint debridement. While both surgical intervention and injection treatment resulted in decreased pain levels and favorable results in regards to sacroiliac joint pain, surgical intervention resulted in a higher percentage of infection and post-operative complications. Fusion also led to problems with hardware and intraoperative complications including fracture. Based on the information evaluated in this case study, the authors determine the most advantageous therapeutic approach is joint injections, reserving surgical procedures for extremely severe cases unresponsive to other treatment modalities.[12]

**Ultrasound-Guided Corticosteroid Injections**

As corticosteroid injections gain popularity and favor, clinicians have adapted several different approaches for conducting the procedure. Patients may be given an intraarticular corticosteroid injection through the use of palpation, ultrasound guidance, or fluoroscopy. The use of intraarticular corticosteroid injections has advantages and disadvantages. Several studies have indicated satisfactory results whereas other studies demonstrated no improvement in their patient's pain levels.[24,25] These contradictory findings may be due to improper injection technique or poor placement of the needle upon insertion. However, there are still conflicting views regarding the effectiveness of ultrasound guided injections to treat low back pain due to the complexity of the anatomical structures surrounding the SI joint as well as the advanced level of skill required to properly place the needle.[8]

One way to administer a sacroiliac joint corticosteroid injection is in an outpatient office setting. Giving the injection based purely on palpation of the sacroiliac landmarks provides the lowest success rate, between twelve and twenty-two percent.[26,27] Often, the injections are not administered in the correct location or lead to infiltration of a nearby ligament due to the complex structure of the sacrum.[8,28-30]

The use of ultrasound guided injections has helped increase the rate of successful SI joint injections because it provides a method of visualizing the path of the needle to a precise

location.[31,32] It has become a popular method for treating musculoskeletal dysfunction, but is still gaining popularity for use in sacroiliac joint injections.

Ultrasound imaging minimizes the amount of radiation exposure in comparison to fluoroscopy, CT or MRI. As a result, it is an effective treatment imaging modality in pregnant patients. Additionally, ultrasound can be used to administer corticosteroid injections in a clinic setting due to its ease of use and portability. It is also more comfortable and cost-affordable for patients because it eliminates the need for sedation and operating room costs.[33] While imaging the sacrum with ultrasound, physicians can interpret real-time images and adjust needle alignment while directly visualizing the joint.[32-34]

One disadvantage which presents itself through the use of ultrasound guidance is the extensive training and skill level required to accurately perform the procedure. Injecting the SI joint can be incredibly difficult, and physicians with years of experience in ultrasound imaging may struggle with precise placement of the needle.[29,30] Injection errors may occur more often due to the complex nature of the joint and high skill level required. This may subsequently result in intravascular injection which can further precipitate the intensity of pain.[13]

Although ultrasound guided sacroiliac joint injections may be difficult to conduct, Pekkafahli states low initial success rates may be ameliorated as physicians perform more injections and perfect their radiographic skills.[35] Over time, modifying the type of probe used, position of the probe, and ability to identify landmarks and structures helps improve success rates for ultrasound guided injections. In recent studies, authors have indicated the use of a curvilinear transducer to be the most successful, as well as injections administered to the lower one third of the sacroiliac joint to be adequately effective in diagnosing and treating sacroiliac joint pain.[29,30,32,35-38] However, one notable study has indicated patients who had injections that extended to the superior pole of the sacroiliac joint exhibited lower pain levels at two weeks post-injection. This may provide an area for further exploration regarding the placement of injections.[39]

**Fluoroscopy-Guided Injections**

Fluoroscopy-guided injections have also expanded in popularity, particularly in the diagnosis and treatment of sacroiliac joint pathology contributing to low back pain. While ultrasound and fluoroscopy have both produced successful results, fluoroscopy has a slightly higher success rate of about 98% compared to ultrasound which is 87.3%.[34] Through the use of fluoroscopy, clinicians have reported infrequent accidental injections of surrounding structures and more accurate needle placement.[8] Even though correct placement of the injection has been emphasized in several studies, one study has revealed that even if the injection is not in the precise location of the sacroiliac joint, periarticular injections are thought to be effective in the treatment of sacroiliac joint pain.[31]

Some major advantages to using fluoroscopy are increased localization and control of the injection. Once contrast media is injected, the joint can be imaged using a plain film in

anterior-posterior view to determine if there are any tears in the sacral lining or visible structural dysfunction.[8] Additionally, the contrast media flow can be visualized to aid in determining the underlying pathology. Through the use of fluoroscopy-guided injections, the flow patterns of the contrast media may help predict clinical outcomes for patients experiencing chronic low back pain due to sacroiliac joint dysfunction.[28,38-40]

Disadvantages surrounding fluoroscopy include inconvenience, cost, and exposure to contrast media. Arranging the procedure can take extensive time and resources. The procedure can be costly for the patient, especially if it does not produce long-term results, and radiation exposure can have long-term consequences for the patient's health, rendering it a questionable treatment for chronic low back pain.[34]

## Conclusion

SI joint dysfunction is not an uncommon underlying cause of low back pain.[5,6] It is often complicated by the intricate anatomy of the joint such as the synovium, ligaments, fascia, muscles, and spinal nerves.[1-3] Low back pain may simultaneously have more than one contributing etiology. Some of the other causes include muscle sprain or spasm, ligamentous injury, zygapophyseal dysfunction as seen in arthritis or spondyloarthropathies, and radicular pain.[5]

CT, MRI, bone scintigraphy, and ultrasound may all be used to aid in the diagnosis, but ultrasound is the most easily accessible and practical with the fewest adverse effects. Less invasive special manual diagnostic-tests are preferred over expensive imaging. In regards to special tests, the best recommendations are to utilize a minimum of three of the following tests: Fortin Finger test[9,10,19,21], FABER[21], PSIS distraction[22,23], and the Thigh Thrust test[19,22]. More research is needed on special tests before any definitive conclusions can be made.

Treatment geared toward the SI joint includes supportive care, physiotherapy, corticosteroid injections with local anesthetic, and radiofrequency ablation. Corticosteroid injections are more common and have a good safety profile for the amount of relief provided.[11,12,23] Although radiofrequency ablation may provide better long-term relief, it contains more risk, cost, and time to perform.[14-16] Surgical intervention is reserved for severe cases refractory to the previous treatment modalities due to its elevated risk. Surgical intervention has higher rates of infection and complications than any of the other treatments discussed.

As ultrasound-guided and fluoroscopic sacroiliac joint injections present themselves as front-runners for diagnosis and treatment of sacroiliac joint-induced low back pain, the benefits and downsides to both are weighed and compared. While ultrasound provides ease and affordability for patients, fluoroscopic boasts a slightly higher success rate.[32] Through further research, perfecting techniques surrounding ultrasound-guided injections to enhance accuracy and precision in placement of the needle and injection may lead to ultrasound-guided injections becoming the method of choice for diagnosing and treating the sacroiliac joint low back pain.

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