Sacroiliac Joint Pain: Causes and Diagnosis

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Abstract:

The sacroiliac joint accounts for approximately 16% to 30% of cases of chronic mechanical low back pain. Pain originating in the sacroiliac joint is predominantly perceived in the gluteal region, although pain is often referred into the lower and upper lumbar region, groin, abdomen, and/ or lower limb(s). Because sacroiliac joint pain is difficult to distinguish from other forms of low back pain based on history, different provocative maneuvers have been advocated. Individually, they have weak predictive value, but combined batteries of tests can help ascertain a diagnosis. Radiological imaging is important to exclude "red flags" but contributes little in the diagnosis. Diagnostic blocks are the diagnostic gold standard but must be interpreted with caution, because false-positive as well as false-negative results occur frequently.

Keywords: Sacroiliac Joint, Pain, SIJ.

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Introduction:

Sacroiliac joint pain (SIJ) dysfunction is a relatively common cause of low back pain with a prevalence ranging from 10 to 27 %. Making the diagnosis of SIJ pain/dysfunction is clinically challenging. Patients often experience pain in the lower back or back of the hips. The pain is typically worse in prolonged or sustained positions and relieved when lying down. (**1**).

The International Association of Pain (IASP) has formulated criteria for the diagnosis of SIJ pain. These include pain localized in the regions of the SIJ, reproducible by stress and provocation tests of the SIJ, and relieved by selective infiltration of the SIJ with a local anesthetic (**2**).

Treatments for SIJ pain should include conservative measures such as relative rest, NSAIDs as needed and therapeutic exercises. Only after these conservative measures fail should one consider interventional treatments. Practitioners who perform interventional procedures should have a firm understanding of the joint's underlying anatomy (**3**).

The SIJ is a true diarthroidal joint, with matching articular surfaces separated by a joint space containing synovial fluid and enveloped by a fibrous capsule. Each articular surface of the joint has ridges and depressions to increase stability and reduce movement. Primary stability, however, is attributed to the adjacent ligaments surrounding the joint. These include the interosseous

ligament (primary stabilizer), anterior and posterior SI ligaments, sacrospinous ligament and iliolumbar ligament. The innervation of the SIJ is extremely complex, but primary innervation of the joint is from the S1–S3 dorsal rami and smaller contributions from the L4 and L5 dorsal rami (4).

Epidemiology

The lifetime prevalence of low back pain is 85% . In 25% of these patients, the sacroiliac joint may be the cause of the pain. The majority of SI joint pathologies affect the adult patient population. However, there is a bimodal distribution with two peaks—younger adults following sporting injury and pregnancy and older adults from degeneration. Both genders and people of all races present with sacroiliac joint dysfunction (**5, 6**).

CAUSES OF SIJ PAIN

From an anatomical perspective, pathologic changes and injuries specific to different SIJ structures can result in SIJ pain. These changes include, but are not limited to, capsular and ligamentous tension, hypo- or hypermobility, extraneous compression or shearing forces, micro- or macro-fractures, soft tissue injury, and inflammation. The mechanism of SIJ injury primarily is due to a combination of axial loading and abrupt rotation. SIJ pain may also be due to injuries sustained from falling directly on the buttocks, and collisions during sports or driving. Prior medical procedures may also play a role in SIJ pain and dysfunction (7).

Several studies have reported that prior lumbar fusion can directly increase angular motion and stresses across the patient's SIJ, and these parameters are strongly correlated to the specific lumbar levels (one or more) fused. It is well known that the surgical arthrodesis at one level causes degeneration of an adjacent segment—adjacent segment disease/disorder (**8**).

Limb length discrepancy (LLD), is another potential contributor to SIJ pain. Several authors have reported the correlation between LLD, LBP, and SIJ dysfunction. Due to the length discrepancy, the mechanical alignment of the SIJs become increasingly imbalanced, resulting in uneven load distribution across both SIJs (**9**).

Kiapour et al quantified the changes in load distribution through the SIJ as a result of LLDs of 1, 2, and 3 cm. The peak loads and stresses on both legs were higher than that of the intact or normal model, with a greater magnitude consistently occurring on the longer-leg side. Furthermore, as the length discrepancies increased from 1 to 3 cm, the stresses across the SIJ increased accordingly (**10**).

Apart from injuries, prior lumbar fusion, and LLD, several other factors contribute to the gradual development of SIJ pain. These include joint infection, spondylo-arthropathies such as ankylosing spondylitis, inflammatory bowel disease, gait abnormalities, scoliosis, and excessive exercise. Regardless of the cause, the association of pain with SIJ dysfunction is rather consistent. Table 1 summarizes the causes of intra-articular and extra-articular SIJ pain (7).

Table (1): Causes of intra-articular and extra-articular SIJ pain (7).

Intra-articular Pain	Extra-articular Pain

Arthritis	Ligamentous injury
Spondyloarthropathy	Bone fractures
Malignancies	Malignancies
Trauma	Myofascial pain
Infection	Enthesopathy
	Trauma
	Pregnancy

During pregnancy, many hormonal and biomechanical changes occur, contributing to ligament laxity. One of the leading musculoskeletal changes is the increase in the mass of uterus and breasts that cause anterior displacement of the center of gravity. This effect heightens joint loads (eg, increases hip joint anterior torque by 8 times) and is aggravated by the laxity of other ligaments and other joints, which may contribute to pain and risk of injury (**11**).

Pathophysiology

The sacroiliac joints are usually considered as synovial joints but can also be classified as a diarthrosis-amphiarthrosis joint. The superior and dorsal portion of the joint is an amphiarthrosis. In this portion, fibrocartilage fills the joint space. The joint's inferior and ventral portion is a diarthrosis with hyaline cartilage covering the joint surfaces and possesses a synovial cavity. The sacroiliac joint is the largest joint in the body, with a surface area of approximately 17.5 cms. This joint is relatively immobile, and its primary function is to transfer weight to and from the lower limbs to the axial skeleton. There are three large lever arms, the trunk, and the lower limbs whose movements transmit significant force through the sacroiliac joint. The bony contours and the strong interconnecting ligaments allow only minimal motion at the joint surfaces (**7**).

Anterior innervation of the sacroiliac joint is from the ventral rami of the L5 to S2 nerve roots. The lateral branches of the dorsal rami of the S1 to S4 nerve roots innervate the posterior part. Immunohistological studies have demonstrated nociceptors throughout the joint capsule, ligaments, and subchondral bone. An injury or inflammation in any of these structures can potentially cause pain (**12**).

DIAGNOSIS

✓ **History**

Pain from the SI joint is generally localized in the gluteal region, below the L5 spinal level, where the posterior elements of the SI joint are situated (94%).Referred pain from the intra-articular part of the joint may also be perceived in the lower lumbar region (72%), groin (14%), upper lumbar region (6%), or abdomen (2%). According to one study, pain referred to the lower limb occurs in 28% of patients, with 12% reporting pain in the foot. (Figure 1). The posterior extra-articular ligaments may also result in pain that is referred into the lumbar area, lower extremity,

and into the groin. In one study, between 10% and 20% of extra-articular SI joint pain was referred to the lower extremity, with between 5% and 10% extending below the knee (**13, 14**).

Upper extra-articular SI joint pain may be more likely to extend into the groin, while middle and lower extra-articular pathology may radiate into the lower leg more than upper ligamentous pathology. Groin pain and anterior thigh pain may also occur in individuals with ventral and occasionally even dorsal SI ligamentous pathology, though epidemiological data on this are lacking. If the pain is felt in the anatomical region of the ischial tuberosity, it is less probable that the patient suffers from SI joint pain (**15**).

FIGURE 1: Typical pain referral pattern of sacroiliac joint pain (illustration: Rogier Trompert Medical Art http://www.medicalart.eu) (16).

Many investigators have emphasized that medical history is important for correct diagnosis. Several investigators have found that radiation into the groin can distinguish SI joint pain from other sources, while others reported that proximity of the area of maximal pain and/or tenderness to the posterior superior iliac spine is predictive to response to injections (**16**).

Yih and Sarno, (17) found positive correlations between SI joint pain and worsening of symptoms when rising from a sitting position, when symptoms are unilateral (particularly in younger individuals with traumatic, extra-articular SI joint pain), and with three or more positive pain provocation tests. Yet, other investigators have found no aggravating or relieving factors to be helpful in identifying a painful SI joint.

✓ **Physical examination**

Although solitary pain provocation maneuvers have no pathognomonic value in identifying a painful SI joint, two individual pain provocation tests- the compression and thigh thrust test- may be helpful in diagnosing SI joint pain. Patients with a positive thigh thrust test or compression test may be more likely to suffer from intra-articular SI joint pain (sensitivity 0.907 (0.78–0.97), specificity 0.662 (0.53–0.77), diagnostic odds ratio 18.461 (5.82–58.53)). Due to the size and the immobility of the SI interface, large forces are needed to stress the joint, which can be a source of false negatives. In addition, if forces are applied incorrectly, pain can be provoked in neighboring structures, resulting in false-positive tests. Both the sensitivity and specificity of the clinical examination increases as a direct function of the number of positive tests (**18**).

This was confirmed by a meta-analysis which showed that 3 or more positive stress tests have discriminative power for diagnosing SI joint pain. However, three recent studies call into question the diagnostic value of individual or a battery of provocative tests. In a systematic review involving five studies and 422 patients, Saueressig et al. found that a battery of positive provocative SI joint maneuvers had only a 35% certainty of identifying the SI joint as the primary pain generator, but that a negative cluster of tests is associated with a non-painful joint in 92% of cases (**19**).

There is scant research on the association of historical and physical exam findings to predict response to extra-articular injections, with one study finding an association between a positive block and the patient identifying the most painful point as being within 2 cm of the posterior superior iliac spine. More research needs to be done on tests to identify extra-articular pathology and distinguish between pathology involving different aspects of the SI joint complex (**16**).

There are several clinical tests described in the literature: palpation tests to assess mobility and alignment, and provocation tests to reproduce a patient's typical pain. (**18**).

1. Fortin's finger test: The patient localizes the pain with one finger, in the area immediately inferomedial to the posterior iliac spine (within 1 cm), and consistently points to the same area (Fig. 2) (**20**).

Fig 2: Fortin finger test. The patient points to the area of pain with one finger. The test is positive if the site of pain is within 1 cm of the posterior superior iliac spine. Usually, the pain is inferomedial to the posterior superior iliac spine on the affected side (21).

2. A combination of five provocation tests for SI joint pain with a threshold of three or more positive tests, including the compression, thigh thrust, distraction, Gaenslen's, and Patrick's tests. Each of these purports to reproduce a patient's typical pain.

1. **Compression test (Approximation test):** The patient lies on his/her side with the affected side up; the patient's hips and knees are flexed approximately 45° and 90°, respectively. The examiner stands behind the patient and places both hands on the front side of the iliac crest and then exerts downward pressure (Fig. 3) (22).

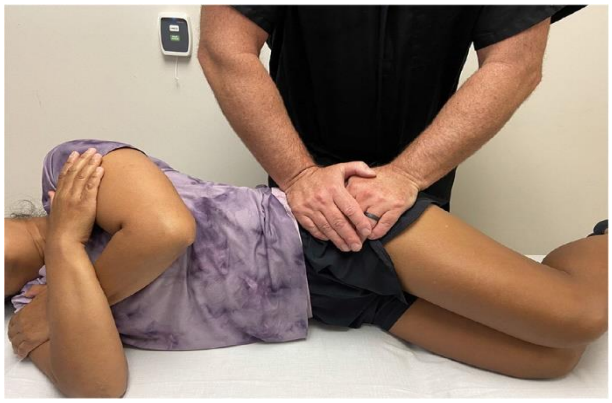

Fig 3: Compression test. A posteriorly directed force is applied to the iliac crest, thereby compressing the sacroiliac joint. The test is positive if pain is reproduced on the affected side (21).

2. **Thigh thrust test (POSH-Posterior Shear test, Femoral Shear test):** The patient lies supine with the unaffected leg extended. The examiner stands next to the affected side, then bends the leg at the hip to an angle of approximately 90° with slight adduction while applying

light pressure to the bent knee, causing anterior-to-posterior shear in the affected SI joint (Fig. 4) (16).

Fig 4: Thigh thrust test. The sacrum is fixated against the table with the caudal hand, and a force is applied through the axis of the femur with the cephalad hand, producing a shear force. The test is positive if pain is reproduced on the side being tested (21).

3. **Distraction test (Gapping test):** The examiner stands on the affected side of the patient who is in the supine position with their arms crossed and hands on the spinae iliaca anterior superior (SIAS). The examiner applies pressure in the dorso-lateral direction (Fig. 5) (14).

Fig 5: Distraction (gapping) test. A posteriorly directed force is applied to the anterior superior iliac spine thereby distracting the sacroiliac joints. The test is positive if pain is reproduced on the affected side (21).

4. **Patrick's sign (FABER-Flexion Abduction External Rotation test):** The patient lies in the supine position with the examiner standing on the affected side. The leg of the affected side is bent at the hip and knee, with the foot positioned under the opposite knee. The examiner fixes the contralateral SIAS to prevent movement in the lower back. Downward pressure is then applied to the knee of the affected side (Fig. 6) (1).

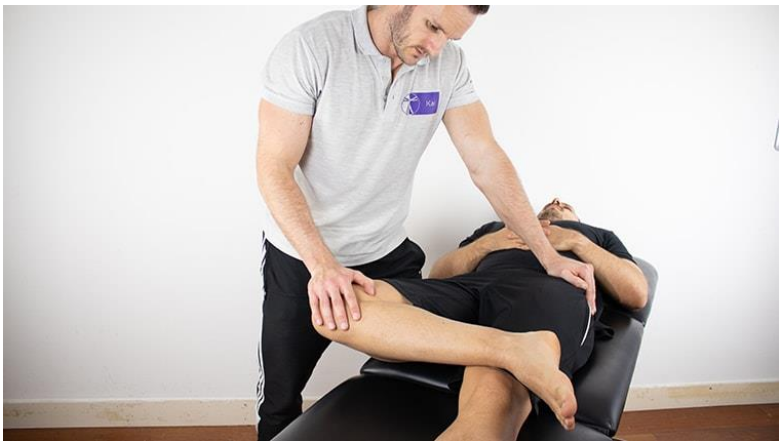

Fig 6: Patrick's sign. The patient is in supine lying position and the examiner is standing on the affected side. The patient is asked to flex the ipsilateral knee with the medial side of the heel against the other knee. While the examiner fixates the contralateral anterior superior iliac spine (ASIS), the patient lowers the ipsilateral knee towards the treatment table as far as possible, while the plantar side of the foot remains in contact with the other knee. At last, the examiner applies overpressure at the ipsilateral knee of 15kg for 5 second (23).

5. **Gaenslen's test (Pelvic torsion test):** The patient lies in a supine position with the affected side on the edge of the examination table. The unaffected leg is bent at both the hip and knee, and maximally flexed until the knee is pushed against the abdomen. The leg on the affected side is brought into hyperextension whereby light pressure is applied to the knee (Fig. 7) (24).

Fig 7: Gaenslen test. The pelvis is loaded by a superior or posterior force applied to the cephalad knee and a posteriorly directed force applied to the caudal knee. The test is positive if pain is reproduced. In this example, the right side is being tested (21).

3. **The Gillet test**, also known as the Stork test, is one of the tests used in the assessment of SI and hip joint mobility and alignment. The patient stands upright in a comfortable posture, with both feet flat on the floor. The examiner stands behind the patient to observe their back and pelvis. Pelvic Movement Assessment: Instruct the patient to lift one leg while flexing the knee

toward their chest, as if they were marching in place. They can choose either leg for the initial assessment. While the patient lifts their leg, palpate, and closely observe the position of the iliac crest on the side of the lifted leg (the ASIS—Anterior Superior Iliac Spine). During normal hip flexion, the ASIS on the side of the lifted leg should rise slightly or move upward symmetrically compared to the stationary ASIS on the opposite side. If, during the leg lift, the ASIS on the side of the lifted leg does not move upward or moves downward compared to the opposite side, it may indicate a lack of mobility or dysfunction in the SI joint on that side. This can suggest SI joint pathology or immobility. After assessing one leg, repeat the test on the other leg to compare mobility and symmetry (Fig. 8) (**25**).

Fig 8: Gillet test (25).

✓ **Additional tests**

Medical imaging is indicated only to rule out *red flags* for potentially serious conditions (**26**).

The choice of imaging depends on the patient's clinical presentation. In various studies, the use of radiography, computed tomography, single photon emission computed tomography (SPECT), bone scans, and other nuclear imaging techniques have been used to identify specific disorders of the SI joint. As a sole diagnostic tool, computed tomography (CT) is not helpful in diagnosing SI joint pain because of the high prevalence of degenerative changes among asymptomatic individuals. This prevalence increases with age, whereby >85% of asymptomatic patients over the age of 60 have radiological evidence of SI joint degeneration. Degenerative changes on the sacral surface generally lag years behind the occurrence on the iliac side, with the correlation between clinical symptoms and imaging being poor. Similar to CT scans, SI joint abnormalities are commonly observed on magnetic resonance imaging (MRI) of asymptomatic individuals and include bone marrow edema, erosions, and sclerosis, with erosions being more specific in patients with low back pain (**27**).

According to the Assessment of Spondyloarthritis International Society (ASAS), MRI is the most adequate imaging modality to detect sacroiliitis, but care must be taken to distinguish between inflammatory SI joint pathology and non-inflammatory changes which may resemble sacroiliitis. (Table 2) (**16**).

Table (2): Differential diagnosis for spondyloarthropathy and the major findings in MRI (**16**).

Conditions that resemble sacroiliac joint pain	**MRI findings in SI joints**

Anatomical variations involving the cartilaginous or ligamentous part of the joint, including an accessory SI joint, transitional vertebrae, hemisacralization	Small vessels located in transitional cartilaginous-ligamentous portions which may simulate bone marrow edema (BMO).
Osteoarthritis/degenerative changes of the SI joints and lower lumbar spine	Young (sports-active) individuals: (BMO) in the SI joints, minor erosions, osteophytes, and sclerosis. Elderly with SI joint osteoarthritis: BMO (often in the antero-superior part of the SIJs), minor erosions.
Osteitis condensans ilii (OCI)	Triangular-shaped, well-circumscribed, subchondral sclerosis (anteriorly located, iliac side > sacral) without gross erosions or SI joint narrowing. BMO surrounding sclerosis. If there is BMO surrounding fat metaplasia, this suggests SpA may coexist with OCI.
Infectious sacroiliitis	Anatomic boundaries are not respected (involvement can be unilateral or bilateral), usually with large erosions, joint effusion, and more extensive BMO; soft tissue involvement, often with abscess(es).
Tumors/pseudotumors	Usually a straightforward imaging diagnosis
Diffuse idiopathic skeletal hyperostosis	Evident, coarse bony/ossified bridges over the anterior and posterior SI joint articular margins and entheseal bridging. Intra-articular ankylosis.
Hyperparathyroidism	Subchondral resorption with irregularity, gross erosions, and pseudo-widening of the SI joints (more pronounced on the iliac side).
Synovitis, acne, pustulosis, hyperostosis, osteitis syndrome, and chronic recurrent multifocal osteomyelitis	Osteitis/BMO (on either side of the SI joints) precedes erosive changes, sclerosis, and hyperostosis in the SI joints (more marked on the iliac side). Unilateral or bilateral asymmetric involvement of the SI joints mainly involving the iliac side, with extensive osteosclerosis.

Gout	Tophi may form in SI joints (juxta-articular, intra-articular and subchondral).
Paget's disease	Must have other Pagetic changes in the pelvis. Fusion of the SI joints is occasionally observed in Paget's disease with coexisting sacroiliitis.
Sarcoidosis	May mimic SpA in radiographs. In the presence of known clinical sarcoidosis, the diagnosis of bone sarcoidosis should be considered if there is concomitant involvement of the SI joints.

Abbreviations: BMO, bone marrow edema; OCI, Osteitis condensans ilii; SpA, spondyloarthropathy.

✓ ***Diagnostic blocks***

According to the 3rd IASP criterion, SI joint pain should be completely relieved by selective infiltration of local anesthetics into the symptomatic SI joint, whereby a local anesthetic is injected in the joint cavity. Yet, this approach fails to consider both concomitant pain generators and failure to achieve spread throughout the entire SI joint complex. Several authors used a single diagnostic block in clinical studies. Others have used confirmatory (double) diagnostic blocks on two separate occasions, ideally using local anesthetics of different durations of action, though the sensitivity of the "comparative local anesthetic" paradigm has been reported to be low in other contexts (**28**).

In six studies, corticosteroids were used in combination with local anesthetics. Although the volume of local anesthetic used for infiltration has varied between 1 mL and 4 mL, the capacity of the intra-articular portion of the SI joint typically does not exceed 2.7 mL; hence, volumes too low can result in false-negative blocks while excessive volumes can lead to rupture of the joint capsule or extravasation outside of the joint and false-positives. In individuals in whom posterior extra-articular pathology is suspected (eg, young individuals with unilateral pain after trauma and prominent tenderness in the absence of significant radiographic findings), either extra-articular injections or lateral branch blocks may be employed, with the latter also being used as a prognostic tool before sacral lateral branch RFA (**29**).

The use of fluoroscopy or other imaging to guide needle placement during SI joint blocks is strongly recommended. In studies evaluating the ability of blind injections to spread inside the joint, the accuracy has varied between 8% and 22%. CT-guided injections can be useful when the SI joint cannot be accessed using fluoroscopy (**30**).

✓ **Differential diagnosis**

Spondyloarthropathy or axial spondyloarthritis is an inflammatory disease of the spine. It usually presents as chronic low back pain before the age of 45 years, with involvement of other joints and inflammation observed on imaging studies. Possible accompanying symptoms include uveitis,

psoriasis, and inflammatory bowel disease. Patients frequently carry the gene for human leukocyte antigen (HLA)-B27, and those with active inflammatory disease often have evidence of elevated acute phase reactants, including erythrocyte sedimentation rate and C-reactive protein (CRP) (**31**).

Hip pain is usually secondary to arthritis of the joint. Patients usually present with pain in groin area but also frequently have pain in the buttock and lateral hip which can extend below the knee. Activity makes the pain worse, and it may interfere with sleep. Plain radiography is indicated (**32**).

Endometriosis is a common cause of pelvic, abdominal, and low back pain caused by the implantation of normal uterine endometrial mucosa in abnormal locations including the bowel, diaphragm, and pleural cavity. The pain in endometriosis can be associated with other symptoms such as dysmenorrhea, dyspareunia, and dysuria (**33**).

Myofascial pain. is a relatively common source of chronic pain caused by the presence of trigger points, spasm or increased myoelectric tone, or even atrophy within muscles. In addition to pain, it is associated with restricted active movement in the affected area (**34**).

Piriformis syndrome is associated with pain in the buttock, hip, and lower limb. Sciatic-like symptoms may accompany piriformis syndrome and can be caused by irritation of the sciatic nerve if the nerve passes through the muscle or adjacent to the piriformis or neighboring (eg, gemelli, obturator internis) muscle(s) anteriorly. Entrapment of the sciatic nerve may develop following excessive muscle strain, spasm or trauma to the buttocks in patients with anatomical variations in which the sciatic nerve passes through or next to the piriformis muscle (20%). Pathology involving the adjacent musculature of the lateral rotator group (superior and inferior gemelli, obturator internus) can also mimic SI joint pain (**35**).

Cluneal nerve entrapment syndrome is a medical condition characterized by the compression or irritation of the superior, middle and/or inferior cluneal nerves. In all three categories of nerve involvement, individuals typically experience pain in the lower back or buttocks, along with dysesthesia or paresthesia. Symptoms are typically exacerbated by lumbar movements or shifts in posture, with numbness or radiating pain provoked when pressure is applied over the relevant trigger point(s). Symptomatic relief achieved through nerve blocks is considered a diagnostic hallmark (**36**).

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