

Sacroiliac Joint Pain - The Current State of Art

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SUMMARY

SIJP is still a not fully understood and underappreciated source of LBP with intra- and extra-articular causes. It can be both of mechanical and non-mechanical origin so the optimal treatment is still a matter of debate because patients suffering SIJP present significant heterogeneity, and pain referral patterns of the SIJ are extremely variable. Unfortunately, long-lasting pain syndrome, regardless of its known or unclear cause, becomes the disease itself with spinal cord sensitization and developing functional pain patterns in the form of a vicious circle, which makes it very difficult to control pain with any type of treatment.

Abbreviations: SIJ: Sacroiliac Joint; LBP: Low Back Pain; AS: Ankylosing Spondylitis; OA: Osteoarthritis

Introduction

Sacroiliac Joint (SIJ) is a paradox of nature. It contains hyaline cartilage ensuring no friction of the articular surfaces, but the interdigitating symmetrical grooves and ridges of its articular surfaces and powerful ligaments prevent it from achieving even a minimal range of motion. It is located at the confluence of opposing forces, undergoing considerable shear and distraction forces, and instead of becoming relaxed and unstable with age, like peripheral joints, it stiffens up to complete ankylosis. Being at the crossing of the muscle and fascial bands, no one muscle can regulate its function in a keyway. Being subjected to such great strains, instead of being modestly endowed with pain-conducting innervation in favor of proprioceptive innervation, it is endowed with an incomprehensible excess. All these facts cause SIJ pain (SIJP) is a phenomenon of quite complicated pathogenesis, difficult to treat when accompanies Low Back Pain (LBP).

Epidemiology

While the prevalence of LBP is estimated as high as 85%, the prevalence of SIJP is estimated at 15-30% of patients with a chronic non-radicular pattern of LBP [1]. The SIJP affects predominantly the adult patient population, it is very uncommon to find it in children,

and if so, there is always a risk of neoplastic or infection. In adults, two age peaks distribution can be observed. Younger adults' SIJP is a consequence of sports injuries or training overuse, autoimmune diseases like Ankylosing Spondylitis (AS), and pregnancy. Older adults suffer SIJP much often due to degenerative processes or as a consequence of spine surgery. There are no prevalence discrepancies between races but women are more prone to the incidences of SIJP and pelvic pain due to high mobility [2,3].

Anatomy, Biomechanics and Pathogenetic Consequences

The SIJ is a unique structure both in terms of the complicated three-dimensional structure built into the pelvic tensegrity system and its unique innervation. It is a complex of two segments with a different histological structures. The dorsally and cranially located fibrous part is a complex of very strong interosseous ligaments filling the space between sacral concavity and iliac tuberosity covered with fibrous cartilage and woven into a system of superficial ligaments (dorsal sacroiliac ligaments, iliolumbar and sacrotuberous ligaments). This part does not transfer the compressive forces from the spine to the lower limbs, but only counteracts the distraction, shear, and rotational forces acting in

three mutually perpendicular axes. Ventrally and caudally is located a proper diarthrodial joint with a typical synovial lining (and therefore prone to inflammation and hyperplasia) with not flat but rather the propeller-like shape and inter-individual variation of the auricular part of the sacrum matching almost perfectly to the joint surface of the ilium. Both C-shaped or L-shaped articular surfaces with an area of about 17 cm² are covered with hyaline cartilage and it is this part of the joint that participates in the distribution of powerful forces acting at the junction of the spine and lower limbs, transferring the tension from the ground to the axial skeleton and vice versa [4].

Due to the tiny and very individually variable depressions on the side of the sacrum, matching the ridges on the side of the iliac bone, the lower part of the SIJ joint does not provide shape stabilization and only thanks to very strong ligaments and the force closure system similar to the central brick at the top of the arch arcade, it can maintain integrity. The forces that SIJ must counteract are evidenced by the load on the limb when jumping onto one leg, measured at the hip joint reaching a mean peak loading of 5.5-8.4 × body weight [5]. Each pelvic asymmetry, or a change in the gait pattern as a result of peripheral joints diseases or injuries, or even a 1 cm leg length discrepancy, increases the forces acting on the SIJ up to five times [6]. The SIJ has a very limited range of motion and it is not the same in all six degrees of freedom (rotation and translation on transversal, sagittal and vertical axis). The largest component of the movement is related to the rotation of the sacrum on the transverse axis (nutation and counter-nutation) - it is still debatable where exactly this axis is situated (S2, S1, and S2 boundary?) and according to old textbooks and posters hanging in physiotherapists' offices, it amounts allegedly to ca. 2 degrees. However, a recent radiostereometric analysis of movement study performed *in vivo* by Kibsgård et al. showed that in both the standing- and hanging-leg SIJ, a total of 0.5-degree rotation was measured [7].

Even less mobility was shown by *in-vitro* tests because under the loading of 100% bodyweight the rotation of SIJ consisted of 0.16 degrees and an inferior translation of the sacrum relative to the ilium - 0.32 mm, which may question the ability of palpation diagnosis for SIJ mobility disorders [8]. Excessive nutation of the sacrum is inhibited by the sacrotuberous and sacrospinous ligament system and the muscular tension of hamstrings, counter-nutation of the sacral bone is limited by the shape of the L5S1 joint and the stability of the pelvic ring, which always requires the three-plane movement of the iliac bones accompanying the rotation of the sacrum (inflare - posterior rotation - sacral nutation and outflare - anterior rotation - sacral counter-nutation). In a broader aspect - the muscle ring surrounding the abdominal cavity (especially m. transversus abdominis), diaphragm, and mm. of the pelvic floor

generate adequate intra-abdominal pressure and activate m. multifidus, which is an additional stabilization mechanism of the SIJ, according to the core stabilization theory where "core," is referred to as the lumbopelvic-hip complex with muscular boundaries that produces a corset-like stabilization effect on the trunk and spine [9,10].

The SIJ has a segmental innervation from L2-S4 nerves, predominantly by the S1 and S2 nerves, with the posterior part more supplied by the lateral branches of the L4-S3 dorsal rami, and the anterior joint innervated by L2-S2. This rich innervation explains why the spectrum of pain referral patterns is so abundant (buttock, trochanteric region, groin, popliteal area, and even heel) and why the SIJ is a wide-open window for spinal cord sensitization [11]. The main question that matters and was not fully elucidated is: how strong is a link between the mobility disorder and SIJP? On the one hand, the common SIJP in pregnancy is a well-documented cause of the hormone-related relaxation of the ligaments, on the other hand, inborne generalized ligamentous laxity does not have to be the cause of SIJP. Another paradox is that manual therapy practitioners often claim that the pain comes from hypomobility, surgeons oppositely tend to stiffen the joint claiming that the joint's micromovements irritate nociceptors by ongoing congestion and inflammation of the joint, however, even ankylotic SIJs are also a source of pain. The extensive and at the time very fashionable theory of core stabilization also blamed the inefficient muscle cylinder for initiating pain in LBP and SIJP.

Given the above considerations, the pathogenesis of SIJ pain can be considered in three aspects:

- **Mechano-Dependent:** Hypomobility (dysfunctions, degenerative changes), hypermobility (constitutional and periodic ligamentous laxity dependent on the hormonal balance), high and low energy injuries (stress fracture), asymmetric overloads and gait disturbances (pathologies of the peripheral joints of the lower joint and disturbances in the axis)
- **Immune-Dependent:** Autoimmune (systemic inflammatory and reactive arthritis), infectious (extremely rare), and metabolic (gout and pseudo-hypersensitivity)
- **Functional:** Pain projected from internal organs (reproductive organ, urinary tract), spinal sensitization, or upper pain centers of an unexplained cause (psychosomatic, visceral-visceral reflex).

Clinical Picture

The complicated and very extensive innervation of the SI joint and the multidirectional forces acting on the joint make the

symptomatology of pain generated from the SI joint very rich. It includes both well-located pain in the projection of the SI joint itself (finger test) as well as referred pain to the buttock, groin, trochanteric area, popliteal fossa, and thigh but rarely exceeding the knee line, which distinguishes it from true radicular pain. It should be differentiated from lumbar facet syndrome, tendinopathies, or hip Osteoarthritis (OA).

Diagnosis

Clinical examination is an indispensable part of making a diagnosis, unfortunately, in the case of SIJP, numerous proposed provocation tests using a mechanical stimulus centered on the joint through shear, distraction, or compression forces have limited reliability and do not show any correlation with imaging tests [12]. These, in turn, do not always effectively show an ongoing inflammatory process even in Ankylosing Spondylitis (AS), which resulted in the formation of the term non-radiographic axial spondyloarthritis (nrAxSpA) was coined for patients who have a clinical picture of Ankylosing Spondylitis (AS) but do not exhibit radiographic sacroiliitis. More than that, even negative MRI or HLA B27 does not exclude the diagnosis in patients with a high clinical suspicion for nrAxSpA although imaging enabling precise visualization of the SIJ in cross-sections and 3D processing with the support of contrast are very useful in the event of structural changes such as injuries, infections, stress fractures, neoplastic or infectious process. Unfortunately, in the case of functional chronic pain syndromes imaging techniques are not relevant [13].

Treatment

Non-interventional treatment - includes manual therapy aimed at improving the mobility of the joint and exercise programs aimed at regaining muscle balance following the theory of pelvic tensegrity, pharmacotherapy - starting from anti-inflammatory and analgesic drugs to adjuvants from the group of antidepressants and anticonvulsants, orthoses (stabilizing belts, especially during pregnancy), insoles to compensate for the limb length discrepancy, and instruction in prophylaxis and work ergonomics. In the case of chronic pain syndromes on a functional or psychogenic basis, behavioral therapy plays a huge role. Interventional treatment - includes injection procedures, mini-invasive treatments, and surgery. Temporary elimination of SIJP by switching-off pain generators through a targeted diagnostic block of the dorsal branches of the L5-S3 spinal nerves is usually the introduction to cryoanalgesia or thermoablation, which are widely used in chronic pain syndromes unresponsive to conservative treatment. In the case of over 50% pain reduction after the diagnostic block (single or double block), this procedure is fully justified and allows for at least 6-month improvement in approximately 60% of patients. Currently, in addition to conventional unipolar RF, several modified techniques targeting the lateral branches of the primary dorsal rami have been

proposed by different manufacturers, including cooled RF ablation, Simplicity III RF ablation, and bipolar RF ablation [14,15].

For true synovial inflammation of the SIJ, steroid injections or blood-derived regenerative injections (autologous conditioned serum, PRP) are justified, and when the ligamentous instability is considered, prolotherapy is suggested, which in this case promises a longer period of improvement [16,17]. Borowsky et al. confirmed evidence supporting the existence of extra-articular sources for SIJP by comparing two groups of patients where pure intraarticular or combined with periarticular injections were given. They found a much greater success rate in the second group using a local anesthetic and steroid, intra-articular injection alone, the rate of positive response at 3 months was 12.50% versus 31.25% for the combined injection which seems to underpin the prolotherapy premises [18]. For recalcitrant, non-responding cases with strong suspicions of joint instability a surgical treatment option emerges. It is possible to perform percutaneous SIJ arthrodesis, using a minimally invasive technique of distraction by interference screw which turned out to be a less disruptive way compared to the conventional open technique. Nevertheless, there is no convincing evidence of its superiority over injection and mini-invasive techniques with relatively high complication rates [19,20].

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