Percutaneous Sacroiliac Joint Fixation in Sacroiliac Instability

The First Case Report Using a Fully CT-Guided Technique

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Key words: sacroiliac joint, fusion, instability, CT

Summary

The prevalence of sacroiliac Joint (SIJ) disease as a cause of LBP is considered to range from 21% to 25%. Nevertheless, SIJ instability is frequently underestimated. Although conventional surgery has been used for several years in an attempt to stabilize the SIJ, a new percutaneous system has been proposed for articular fusion. Recently a new “one-step” fixation procedure has been proposed. We describe the case of a patient with painful SIJ instability treated with a fully CT-guided technique in simple analogue sedation.

Introduction

The sacroiliac joint (SIJ) is the largest, strongest and best protected joint in human body, as a complex system of ligaments (anterior sacroiliac, interosseus, sacrospinous and sacrotuberosus) and muscles (gluteus maximus, piriformis and biceps femoris) concurs to stabilize the joint¹. Nevertheless, several conditions can generate SIJ instability. In women, SIJ ligaments are weaker than in men, to be prepared for the necessary sacral mobility for delivery. Consequently, post-partum SIJ instability can occur², even in the absence of degenerative arthritic disease. Moreover, posterior interbody fixation (PIF) –generally performed in case of lumbar instability - significantly increases sacroiliac stress, and 75% of patients suffer from SIJ instability and pain in five years after PIF treatment^{3,4}.

SIJ innervation is complex, as the posterior surface of the joint receives collaterals from L3 to S4 dorsal rami^{5,6}, while the anterior articulation is supplied by L2 to S2 nerves^{7,8}. Consequently, SIJ instability generates pain referred not necessarily at the local area of inflammation only, the pain frequently being irradiated to the lower limbs, overlying other common causes of radicular pain. Biomechanical studies demonstrated the average mechanical threshold to activate the SIJ nociceptor is approximately 70g, definitely superior when compared to the facet joint (6g) and inferior to the lower lumbar discs (241g). Consequently the pain sensitivity of the SIJ is definitely higher than disc sensitivity⁹⁻¹¹. Although several authors claim SIJ instability is the cause of 5 to 25% of all low back pain (LBP)^{12,13}, the diagnosis of the disease is frequently underestimated and no consequent treatment is proposed.

Conventional open surgery with sacroiliac fixation (SF) has been performed for a long time with good results in terms of pain control¹⁴. Recently, however, new “one-step” fixation procedures have been tried. We describe the case of a patient with painful SIJ instability treated with a fully CT-guided SF technique in simple analogue sedation.

Case Report

A 52-year-old woman with a seven-year history of LBP and left sciatica came to our observation, the pain being controlled by chronic

opioid drug administration only. Because of a previous MR diagnosis of L4/L5 protrusion, PIF from L3 to S1 had been proposed in another institution one year before, but the patient had refused. A new MR study of the lumbar spine confirmed a typical "black disc" at L4/L5 level with mild median protrusion and disc space reduction, while a 2D spiral CT study did not depict any significant abnormality in the lumbar and pelvic area. Electromyography was referred as normal, and she had no significant results after L4/L5 facet joint infiltration performed at another hospital.

Under clinical examination, mild lumbosacral pain was exacerbated performing Faber, compression, distraction and Gaenslen's test, suspecting the patient had sacroiliac joint instability. To confirm the syndrome, under CT control a 20G spinal needle was introduced into the sacroiliac joint bilaterally, and 3 cc of Lidocaine were injected. As the patient's pain completely disappeared in five minutes, a diagnosis of sacroiliac instability was assumed, and SF was proposed to the patient, to block the painful joints.

Using a CT-guided technique and analogue sedation, and simultaneous X-scopic control with a C-arm placed on the CT table, the patient lying prone, a lateral approach was adopted to perform the SF technique using a novel SIJ fusion device (I-Fuse®, SI-Bone, San Jose, CA, USA). After local anaesthesia (Lidocaine, 10 cc) injected with a 20G spinal needle, a 17G guidewire was introduced, advancing through the superior third of the left SIJ, penetrating the left sacral wing for 15 mm approximately (Figure 1A). After that, coaxial soft tissue dilators, drill sleeve and pin sleeve together were introduced until bony contact was achieved (Figure 1B). The pin sleeve was removed, and a manual driller was introduced over the guidewire to prepare a bone cavity through the iliac bone and sacral wing, maintaining at least 15 mm safe distance from the first sacral foramina. Drilling was always performed under fluoroscopic guidance on AP view. We removed the drill sleeve, and tapped a broach across the joint, to enlarge the bony hole. The broach was 1.5 mm smaller than the selected implant, to obtain excellent interference fit. Using real time 2D measurement of the left SIJ CT images, a 45 mm I-Fuse implant was placed over the pin, finally introduced into the preformed sacroiliac hole (Figure 1C). We checked the correct position of the implant with CT scan. The procedure was repeated at the level of the SIJ

medium and lower part, introducing other 40 mm and 35 mm implants respectively (Figure 1D). The final result was evaluated on CT control study with 2D recon images (Figure 1E,F). Finally, the guidewire and dilator were removed and the skin was sutured. Post-op CT control was performed immediately after the procedure and 60 days later as a follow-up control. Only mild analogue sedation (Fentanyl 1 to 3 gamma/kg/h / Remifentanyl 0.2 to 0.3 gamma/kg/h) was performed during the procedure, the total working time being 2h.

The patient was discharged the day after, with recommendations to walk using crutches for three weeks to reduce load stress on the SIJ.

Results

At clinical control performed after three weeks, the patient referred the LBP to be almost completely resolved. She was able to walk painlessly without crutches. Faber, compression, distraction and Gaenslen's test were repeated, and no pain was referred during physical manoeuvres. CT study demonstrated evident SF, with no significant scar and/or granulosomatous tissue at the level of the implants. A mild bone reaction was appreciated, and it increased at the four-month late CT follow-up control, the patient remaining painless.

Discussion

The prevalence of SIJ disease as a cause of LBP is considered to range from 21% to 25%^{15,16}. Nevertheless, SIJ instability is frequently underestimated when a patient with LBP undergoes physical and radiological examination. Although many physical manoeuvres exist to confirm SIJ instability, and MRI studies can increase the suspicion of instability, only a properly performed diagnostic block of the SIJ using Lidocaine intra-articular injection is considered the most reliable test¹⁷ when a CT-guided technique is adopted to perform infiltration^{18,19}. LBP relief after SIJ block certifies the SIJ to be the pain generator responsible for the patient's clinical symptoms. Although conventional surgery has been used for several years in an attempt to stabilize the SIJ, a new percutaneous system has recently been proposed to obtain articular fusion after functional tests performed on cats and sheep SIJ²⁰, consisting in the evalu-

ation of anatomic variation on pre-op C-arm radioscopy, introduction of three Steinman pins along the direction desired, and implantation of triangular-shaped titanium implants using a coaxial cannulated system²¹.

Several surgical techniques have long been adopted to obtain sacroiliac arthrodesis. Anterior fusion includes sharp dissection of the gluteal fascia and external oblique muscles, removing the superior capsule and the cartilage of the SIJ, introducing bone cancellous screws and bone graft in pre-drilled holes through the joint²². The posterior intra-iliac approach, and lateral open SI joint fusion approach (Smith-Petersen Technique) has also been proposed. According to several studies, a single unilateral fusion is sufficient to stabilize the SIJ²². Moreover, thanks to the porous nature of the implants (titanium plasma coating) and the specific design, no other procedures (i.e. bone tamp or iliac crest bone harvesting) are required.

Minimal invasive surgical fusion with a lateral approach and C-arm fluoroscopy has recently been used with good results. Nevertheless, according to the great anatomical variability of SIJ morphology, the risk of treatment failure related to incorrect introduction of implants exists. CT-guided techniques in minimal invasive spinal treatment are increasingly used in the daily practice, reducing the complication rate²³. We generally adopt this technique to perform common augmentation procedures (vertebroplasty, kyphoplasty, vesselplasty), as

well as interspinous spacer introduction, transpedicular or trans-facet stabilization with screws.

Using the same approach (i.e. the patient in prone position on the CT table, in analogue sedation), a “one-step” SIJ fusion procedure was performed without any complication or difficulty. CT-guided monitoring was fundamental for accurate planning of the joint area to stabilize, the implant size to choose, and the evaluation of any local side-effects (i.e. haemorrhage). While the triangular shape of the implant avoids rotation, assuring a more stable fusion, an equidistant position of the implants covering the area of the superior third of the SIJ is fundamental to obtain valid stabilization. The SIJ, sacral wings and iliac bone have great shape variability. CT real-time 2D recon images of the SIJ surface area allow the physician to choose the best place to introduce implants, avoiding accidental extra-osseous placement and choosing an implant as long as possible, as the stabilization power of the implants increases proportionally to the length: the mean SIJ area in the adult human body is 1600 mm², while the total coverage area offered by three titanium implants is approximately 1000 mm², 1400 mm² and 1800 mm² when a 35 mm, 45 mm or 55 mm implant is selected²⁴.

In conclusion, CT-guided SIJ fusion using titanium implants seems to be an easy-to-perform safe procedure when SIJ instability has to be treated.

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