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# Ultrasound - Guided Sacral Parahiatal Approach as a New Technique for Diagnosis and Treatment of Dysfunctional Sacroiliac Joint

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**Abstract:** ***Sacroiliac joint dysfunction is estimated to be the cause of 15 to 30% of low back pain, which can be disabling and whose origin can be degenerative, inflammatory, osteoarthritis, traumatic injury, or pregnancy. The aim of the study is to demonstrate an ultrasound - guided sacral parahiatal approach as a new technique for the diagnosis and treatment of sacroiliac joint dysfunction, as well as its efficacy in terms of post - procedure pain control. A total of 87 patients with suspected sacroiliac joint dysfunction were treated, of which 63 were female (72.4%) and 24 male (27.6%). By age range within the female sex, the following patients were attended: 16 (20 to 39 years), 30 (40 to 59 years), 13 (60 to 79 years), and 4 (80 to 99 years). Among the male sex, the following patients were treated: 6 (20 to 39 years old), 9 (40 to 59 years old), 9 (60 to 79 years old). All patients were injected with an ultrasound - guided sacral parahiatal approach under local anesthesia with a mixture of 3 mL of 0.5% bupivacaine, plus 2 mL (80 mg) of methylprednisolone acetate, plus 3 mL of sterile water for injection. Of the 87 patients in total, 9 had 50 to 74% pain relief, 32 had 75 to 89% pain relief, and 46 had 90 to 99% pain relief. The ultrasound - guided sacral parahiatal approach technique, seems to be an affordable, simple, safe, reproducible, and effective alternative for the diagnosis and treatment of sacroiliac joint dysfunction and, although promising, more studies are needed to objectively demonstrate its feasibility in the clinical field.***

**Keywords:** low back pain, sacroiliac joint, ultrasound guided injection, sacral parahiatal approach

## 1. Introduction

Lumbar pain with or without irradiation to the lower limbs continues to be a frequent reason for medical attention in the consultation of health professionals, and the dilemma of alterations of the lumbar spine, which cause pain, continues to be an important challenge for medical doctors, who face patients on a daily basis.

Of the different differential diagnoses that can be studied in a patient who presents low back pain with or without irradiation to the lower limbs, there is one that is currently underdiagnosed, due to its similarity to other lumbar spine pain syndromes. We are referring to the dysfunction of the sacroiliac joint, which is estimated to be the cause of 15 to 30% of low back pain[1], which can become disabling and where the origin can be degenerative, inflammatory, due to osteoarthritis, traumatic injury or pregnancy. An increase in the percentage in patients undergoing lumbar fusion has been described in studies.1

### Anatomy and biomechanics

The sacroiliac joint is an irregular diarthrodial joint. Therefore, it is covered with hyaline cartilage on both surfaces contained in a joint capsule. In the posterior portion it is limited mainly by a complex and thick ligament, limiting movement.1

Thawrani and collaborators report that the posterior capsule is rudimentary and is practically only ligamentous structures. This would explain that, as it is not completely surrounded by the joint capsule, the inflammatory markers that begin in the joint, extravasate towards the dorsal branches, adjacent ligaments and peripheral nerve branches, which causes pain that mimics or is accompanied by radicular pain.1

The posterior capsule is innervated by the lateral branches of the posterior roots of L5 - S4 with sensory and nociceptive fibers, which can cause pain. The anterior innervation is usually more ambiguous, with reports that it is given by L5 - S2, although it was previously believed to be by the superior gluteal and obturator nerves.2

There are multiple anatomical variants between male and female sex in the pelvis and sacroiliac joint, including the ligaments. In women, the ligaments are more lax to allow childbirth.3 The ligaments involved in the stability of the joint are: the anterior sacroiliac, the posterior sacroiliac, the sacrospinous, the sacrotuberous, the interosseous, the

iliolumbar, which consist of two bundles, the superior and the inferior, the sacral iliotransverse, the conjugated iliotransverse that are a complex formed by 4 ligaments, the first goes from the iliac tuberosity to the first conjugated tubercle, the Zaglas ligament that is attached to the second tubercle, the third and fourth extend from the posterosuperior iliac spine to the third and fourth conjugate tubercles.1

The ligaments in turn act jointly for the mobility and stability of this joint with the gluteus maximus, gluteus medius, iliopsoas, piriformis, biceps femoris, abdominal obliques, transversus abdominis and thoracolumbar fascia muscles.1

**Clinical presentation**

In a review study by Cohen, the clinical presentation of sacroiliac joint dysfunction can present in multiple ways. The possibilities are: pain in the gluteal region, occurs in 94%; 72% as low back pain, with extension to the thigh in 50%; pain below the knee occurs in 28% of patients and only 14% with inguinal pain; another 14% present pain referred to the foot. Likewise, it concludes that the patterns are multiple and do not follow a single or specific pattern. Numbness and/or clicking sensations are also possible pain patterns of sacroiliac origin.2

**Diagnosis**

Within the study for the diagnosis of this painful pathology, a battery of laboratory and image studies can be requested, such as simple x - rays of the lumbosacral spine, computed tomography scans of the lumbosacral spine, and simple and/or contrasted lumbosacral magnetic resonance imaging, which can guide us to confirm or rule out concomitant diagnoses that could cause pain, however the clinical history together with the physical examination continue to play the determining role for the diagnosis of this pain syndrome, and in this sense also the therapeutic diagnostic tests with injection of local anesthetic and anti - inflammatory drugs. Steroid inflammatory drugs are of vital importance to confirm or rule out the diagnosis.

In a study conducted by Nejati and his team, the physical tests with a sensitivity of 100% were the Gillet test and the hip anterior flexion test, both mobility tests.4 Regarding sacroiliac joint pain provocation tests, the posterior shear test was the most sensitive with 74.4%, also referred to, as the most sensitive by Schneider.5 The most specific test was the Patrick test with 66.7%. Laslett states that three or more provocative tests or having two positive tests out of four are positive predictors for performing a diagnostic and therapeutic injection.1 As there is no direct and clear clinical presentation and physical examination to determine the diagnosis of sacroiliac joint dysfunction, guided injections are the most effective method available, without being considered the gold standard. In addition to functioning as a diagnostic test, it also has a therapeutic function.1 A considerable number of studies agree that, if pain is controlled more than 75%, it is of sacroiliac origin. If pain control is 50 - 74%, the origin is multifactorial. And if it is less than 50%, the origin of the pain is not sacroiliac.1

It is for this reason that infiltration techniques guided by ultrasound, under fluoroscopy, and guided by computed tomography have been described, intra - articularly and in the vicinity of the sacroiliac joint, as well as in the posterior branches of the spinal nerves S1, S2, S3, S4 and S5, for diagnosis and treatment of this pathology.

However, different conflicts regarding infiltration techniques have been reported in recent medical literature, which we summarize below:

1) The use of techniques guided by anatomy has a high degree of failure in the infiltration objective.
2) The use of the fluoroscopy has a higher cost and confers greater radiological risk both for the patient (for example: it is not convenient to use it in pregnant patients) and for health personnel.
3) The use of computed tomography also confers a higher cost, and access to this imaging technology is limited in health centers across Mexico.
4) The use of ultrasound has conferred greater advantages in terms of cost and safety, however the techniques described for the diagnosis and treatment of sacroiliac joint dysfunction have focused on the articular structure of the sacroiliac joint and can be a challenge for the professional healthcare personnel to perform, due to the complexity of the ultrasound scan for this purpose. In addition, probably the most important pain - generating site in the sacroiliac joint is not the joint itself, but rather the neighboring structures such as ligaments and muscles.

It is for the aforementioned reasons that we have decided to objectively demonstrate a new ultrasound - guided infiltration approach for the treatment of sacroiliac joint dysfunction.

**Aim of the study**

The objective of the research study is to demonstrate an ultrasound - guided sacral parahiatal approach as a new technique for the diagnosis and treatment of sacroiliac joint dysfunction, as well as its effectiveness in terms of post - procedure pain control.

## 2. Methodology and Results

A review of the clinical records of the Pain Management Clinic - Dolomedic Alta Especialidad en Manejo Del Dolor in the city of H. Matamoros, Tamaulipas, Mexico was carried out.

Where the information was extracted, the patients treated with a presumptive diagnosis of sacroiliac joint dysfunction, presenting low back pain with or without irradiation to the lower limb and who on physical examination had 2 positive tests (Gillet, Yeoman, posterior shear, Gaenslen) and treated by injection with an ultrasound - guided sacral parahiatal approach, in a period from July 2019 to July 2023, obtaining the following information:

A total of 87 patients were treated, of which 63 were female (72.4%) and 24 were male (27.6%).

By age range within the female sex, the following were attended: 16 (20 to 39 years), 30 (40 to 59 years), 13 (60 to 79 years), 4 (80 to 99 years).

Among the male sex, the following were attended: 6 (20 to 39 years old), 9 (40 to 59 years old), 9 (60 to 79 years old). (Figure 4).

Pain relief was evaluated using a Visual Analogue Scale, starting from their initial pain, 20 days after the injection, obtaining the following information: Of the 87 patients in total, 9 had pain relief of 50 to 74%, 32 had 75 to 89% pain relief and 46 had 90 to 99% pain relief. (Figure 5).

6 patients presented as a side effect, transient paresthesia in the form of numbness in the lateral and posterior area of the leg ipsilateral to the injection.

No complications occurred in any of the patients.

**Injection technique using ultrasound - guided parahiatal approach.**
All patients included in the study underwent the pain control procedure after signed informed consent, voluntarily and in a sterile procedure room, with asepsis and antisepsis of the lumbar and sacral region, with sterile technique, in a prone position, with pad support in the lower abdomen.

Ultrasound examination is performed with a linear transducer of 6 to 13 MHz, in the sacral region, transversely until the sacral horns, the apex of the sacral hiatus and the sacrococcygeal ligament are identified, subsequently the probe is moved laterally, right or left, depending on whatever the case, parahiatal, maintaining the transverse orientation, until an image in the form of a valley or depression is identified. Subsequently, under local anesthesia with simple 1% lidocaine, the out - of - plane approach begins (it can also be performed in plane, from lateral to medial) with a quincke - type cannula, caliber 22G, 5 centimeters long (a 9 - centimeter cannula can be used, depending on the morphological biotype of the patient), until contacting the bone structure in the central part of the image in valley or depression shape, subsequently a mixture of 3 milliliters of 0.5% simple bupivacaine, plus 80 milligrams of methylprednisolone acetate (2 milliliters of volume), plus 3 milliliters of sterile injectable water (8 milliliters of total volume) is injected. The cannula is removed, a sterile dressing is placed and the procedure is terminated, keeping the patient under observation for 15 minutes until leaving the procedure room. (Figure 1).

In 5 patients (outside the study group), with prior authorization through informed consent and undergoing other spinal interventions to control pain, the ultrasound - guided sacral parahiatal approach technique was performed, under local anesthesia with 1% lidocaine, and was administered 8 milliliters of iodinated contrast solution to demonstrate the distribution of the injection using fluoroscopy. (Figure 3).

**Discussion**

The ultrasound - guided sacral parahiatal approach technique appears to be an affordable, simple, safe, reproducible and effective alternative for the diagnosis and treatment of sacroiliac joint dysfunction. Taking an anatomical account, we hypothesize that the aforementioned approach allows the injected solution to reach ligamentous, muscular, nervous and joint structures at the same time, without the need to perform multiple punctures and also having a safety framework with the guide of ultrasound.

Since the injection target with the tip of the cannula is in the vicinity of the posterior surface of the sacral bone, lateral to the sacral horn, and the muscle mass of the lumbar multifidus muscles probably serves as the roof of a space where it can pass the injected solution (performing an Erector Spinae Plane type block in the sacral region), bathing the sacrotuberous, conjugated iliotransverse, lateral sacrococcygeus, anterior sacroiliac, posterior sacroiliac, interosseous sacroiliac, sacrospinous ligaments, the posterior sacroiliac joint capsule, as well as the posterior spinal branches of S1, S2, S3, S4 and S5, in addition to the lumbar multifidus muscles and the piriformis muscle, which could also explain the relief of symptoms, not only in the lumbar area but also in the irradiation of pain to the lower limb and the area of the groin. (Figure 2).

## 3. Conclusions

Although the approach described above seems promising, more studies are needed, as well as studies using anatomical dissection in cadavers to objectively demonstrate the distribution of the injection with the ultrasound - guided sacral parahiatal approach.

If in the future the distribution of the injected solution described above in the hypothesis could be objectively demonstrated, it could give rise to a regenerative medicine approach, rather than the destruction of tissues by thermal ablation or surgical fixations in the sacroiliac joint.

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**Conflict of interest**
The authors declare no potential conflict of interests.

**Author contributions**
All authors contirbuted equally to the data research, discussion, writing, and revising of the manuscript.

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## Annexes

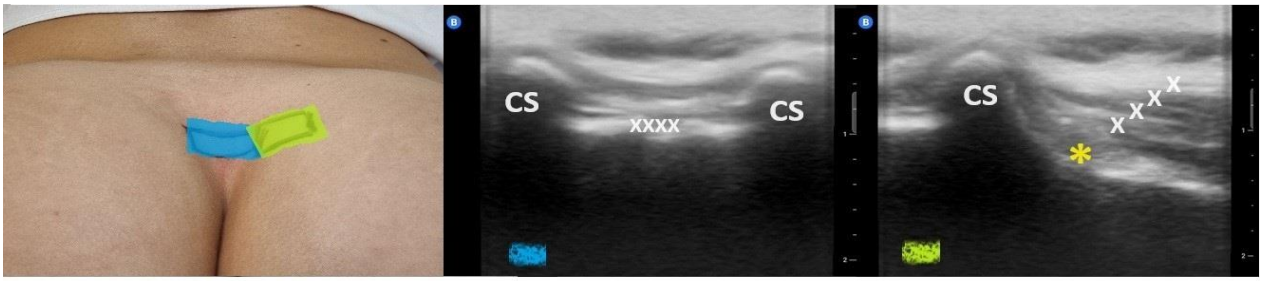


Figure 1. Transversal exploration of the sacral region. The blue zone marks the first exploration spot. The sacral cornua (CS) and the sacral canal (xxxx) are identified. The green zone marks the lateral position of the transducer. The lateral sacral cornua and the injection target (yellow asterisk) are identified, the approach can be performed in and out of plane (white x marks the needle trajectory).

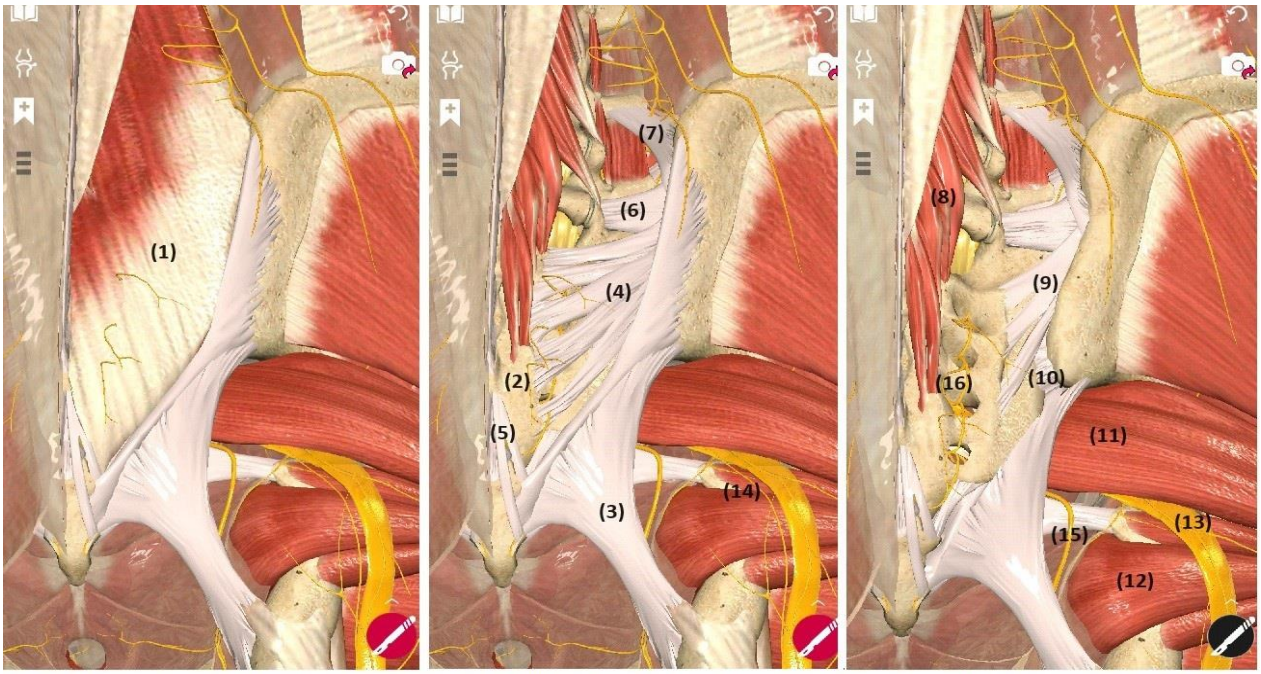


Figure 2. Anatomical planes of the lumbosacral region. Musculus multifidus lumborum (1), sacrum bone (2), sacrotuberous ligament (3), iliotransverse conjugate bundles (4), superficial posterior sacrococcygeal ligament (5), sacral iliotransverse ligament (6), ligamentum iliolumbale (7), musculi multifidi (8), posterior sacroiliac ligament (9), interosseous sacroiliac ligament (10), piriformis muscle (11), internal obturator muscle (12), sciatic nerve (13), posterior cutaneous femoral nerve (14), pudendal nerve (15), posterior branches of sacral nerves (16).

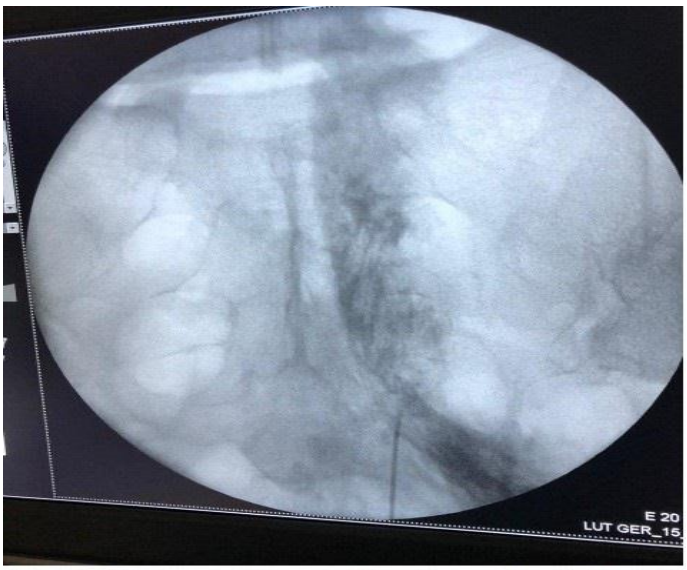


Figure 3. Fluoroscopic image of the ultrasound guided sacral parahiatal approach, showing the dispersion of the contrast solution.

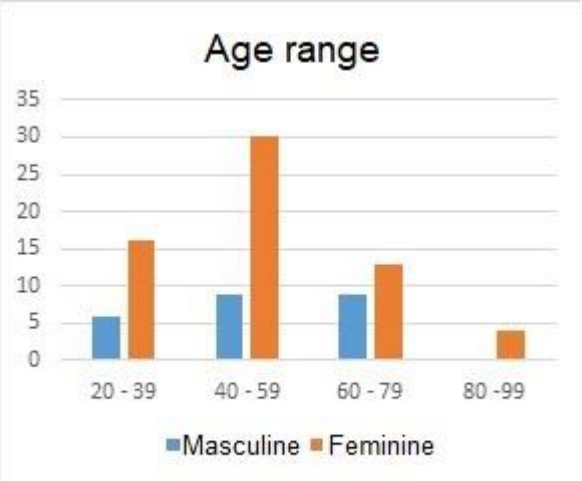


**Figure 4. Age range chart**

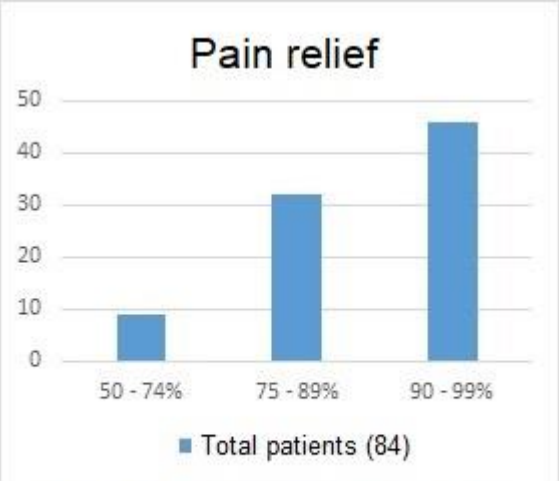


**Figure 5. Pain relief percentage chart.**