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ORIGINAL RESEARCH

Efficacy of Lateral View Needle Placement for Sacroiliac Joint Injections

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Introduction: Sacroiliac joint (SIJ) pathology is typically diagnosed and treated with fluoroscopy-guided intraarticular injections. Most practitioners use only an anteroposterior (AP) or oblique view. Although injection into the periarticular space may yield adequate pain relief, intraarticular needle placement is imperative to identify SIJ pathology and plan future management. This study highlights the importance of obtaining an additional lateral view during fluoroscopy to better evaluate SIJ disease.

Methods: A retrospective review of 38 patients who underwent fluoroscopy guided SIJ injection was conducted, for which IRB approval was granted by the MetroWest Medical Center Institutional Review Board. Patient demographics (age, sex, BMI) and pre- and post-operative numerical rating scale (NRS) scores were collected, and initial needle location was reviewed. Patients were placed into groups according to initial needle location. Statistical analysis was conducted using a Mann–Whitney *U*-test with significance defined as $p < 0.05$.

Results: The 21 females and 17 males had a mean age and BMI of 70.5 years and 27.8 kg/m^2, respectively. Thirty-one patients had initial intraarticular needle placement confirmed with lateral arthrogram, and 7 patients had initial periarticular needle placement, requiring needle readjustment in lateral confirmatory view. Both groups had similar demographic characteristics. No statistically significant differences were found between the two groups' mean NRS score improvement (p=0.108).

Conclusion: Using only the AP or oblique view during needle placement results in miss rates of nearly 20% while adding a lateral view can lower miss rates to near 0%. While pain relief may be adequate in either case, proper diagnosis and future management relies upon accurate needle placement.

Keywords: corticosteroid injections, fluoroscopy, intraarticular, periarticular

Introduction

Sacroiliac joint (SIJ) pain is becoming an increasingly recognized pathology in patients with lower back pain, with current estimates suggesting that 15–30% of lower back pain may be attributed to SIJ pathology.[1,2] The SIJ connects the sacrum to the bilateral ilium bones and is the largest axial synovial joint in the body by surface area. The SIJ is relatively inflexible due to the wide surface area of the joint, which is reinforced with irregular bony elevations and depressions that interlock the two bones in a "C" shape as well as thick, redundant ligaments exterior to the synovium.[3] The SIJ has a very narrow joint space, ranging from 0.5 to 4mm leading to approximate ranges of motion of 3 degrees in flexion and extension, 1.5 degrees in axial rotation, and 0.8 degrees in lateral bending.[4]

Sacroiliac pain may be caused by exterior shearing forces, hypo- or hyper-mobility, micro- or macro-fractures, soft tissue injury, inflammation, pregnancy causing laxity in the supporting ligaments, leg length discrepancy, and prior lumbar fusion, among others.[2,5] The proximity of the joint to the hip joint and lumbar spine often leads to a variety of presenting symptoms, which has led to SIJ pain being referred to as the great "mimicker" of different pain pathologies. The innervation

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of the SIJ is complex and, despite some conflicting information in the literature, most clinicians agree that the sensory fibers stem from the lateral branches of the posterior rami of L5-S4, which are the pain sensors of the joint.[6]

Because the differential diagnosis for SIJ pain is broad, misdiagnosis is common. The diagnosis of SIJ pain begins with a thorough history and physical examination. If a patient has a positive response to 3 or more SIJ provocative tests, the pain is likely due to pathology in the SIJ and may result in a positive diagnostic SIJ block.[7,8] The SIJ block consists of intraarticular injection of corticosteroids and local anesthetics to reduce inflammation and pain, which can be both diagnostic and therapeutic. Current standards suggest that a 75% pain improvement after two separate injections is considered a positive diagnosis of sacroiliitis.[9]

What complicates the diagnosis is that patients often report pain relief regardless of where the medicine is injected. Intraarticular steroid injections can directly treat the SIJ pathology. However, misplaced injections into the periarticular space may still yield adequate pain relief by anesthetizing nearby nerve bundles and muscle fibers.[10] SIJ pathology that is refractory to SIJ injections may be an indication for SIJ fusion, so the accuracy of the injection is imperative to adequately treat these patients. Regenerative therapies like platelet-rich plasma or bone marrow aspirate concentration would also benefit from accurate intraarticular placement. Many providers use fluoroscopy to guide their injections, with anteroposterior (AP) or oblique views comprising the majority of their imaging. In this study, we attempt to show the efficacy of confirming accurate SIJ injections by obtaining both an AP and lateral view, which can significantly increase the precision of SIJ injections and thereby improve the accuracy in diagnosis, while adding relatively little fluoroscopic time. The lateral image is quick and easy to obtain but allows the physician to view the depth of spread of contrast to ensure its placement within the joint space, rather than being periarticular.

Materials and Methods

Data Collection

Data from 38 patients who underwent fluoroscopy guided SIJ injection was retrospectively reviewed, for which IRB approval was granted by the MetroWest Medical Center Institutional Review Board. Preoperatively collected patient data included demographics (age, sex, BMI), patient reported outcome scores from the numerical rating scale (NRS), and initial needle location. Post-operative NRS scores were collected at 1–2-week follow-up for each patient.

Patient Assessment

Patients were assessed for positive clinical history and a physical examination positive for three or more SIJ provocative maneuvers. After failing more conservative measures first (eg, nonsteroidal anti-inflammatory drugs, physical therapy, alternate modalities, etc.), patients elected for SIJ steroid injections on the affected side. Patients who had previous SIJ surgery were excluded from receiving SIJ injections and were thus unable to participate in the study. All patients were assessed pre-operatively and post-operatively using the NRS patient reported outcome measure. The NRS is a 10-point scale used to assess pain where patients self-report symptoms on a continuous 10 cm scale indicating “no pain” at the 0 cm line and “worst pain” on the 10 cm line. Patient pain is interpreted as the point selected on the scale.[11]

Procedure

Our procedure was performed under standard protocols and conditions according to current International Spine Intervention Society (ISIS) guidelines, with the addition of a lateral view to confirm placement in the SIJ. All procedures were done by the same physician and team at the same location and with the same equipment, mitigating any potential confounding variables. Patients were placed in the prone position on the operative table. The superficial SIJ region was first numbed with local anesthetic. Using fluoroscopy, the C-arm was initially placed in the AP view to visualize the affected SIJ, and further adjustments to a contralateral oblique view were made to view the inferior portions of the confluence of the anterior and posterior portions of the SIJ. A 22-gauge, 3.5-inch spinal needle was then advanced toward the inferomedial aspect of the SIJ in question. Once the needle was presumed to be in the intraarticular space via tactile sensation, 0.3–0.5 mL of contrast was injected, and this arthrogram was stored. The C-arm was then rotated to a lateral

view to confirm accurate placement within the joint. Finally, the combination of anti-inflammatory steroids and local anesthetics were injected into the joint space, and the needle was removed.

Statistical Analysis

Patients were placed in groups according to initial needle location after needle placement using the AP view. The lateral view was subsequently used to confirm needle placement. Patients with initial needle placement in the intraarticular space, as confirmed by lateral view, were included in the intraarticular (IA) group. Patient with initial needle placement in the periarticular space, as seen on lateral view, required needle readjustment to get into the intraarticular space but were included in the periarticular (PA) group. All statistical analyses were performed using Microsoft Excel Version 16.58 (Microsoft Corp., Redmond, WA, USA). Mann–Whitney *U*-tests determined differences between groups with significance denoted as $p < 0.05$.

Results

The total cohort had a mean age of 70.5 years (standard deviation, 13.2; range, 31–89), a mean BMI of 27.8 kg/m^2 (standard deviation, 4.4; range, 19.5–37.9), and consisted of 21 (55.3%) females. Thirty-one patients (81.6%) were found to have initial intraarticular needle placement using the AP view, which was confirmed on lateral view (Figure 1). The remaining 7 patients (18.4%) required needle readjustment after the lateral view revealed initial periarticular needle placement. Ultimately, 100% of patients in the study had intraarticular needle placement and accurate spread of medication into the joint space. Out of this cohort, 97.4% reported post-operative improvement in NRS score.

The IA group consisted of 17 (54.8%) females and 14 (45.2%) males with a mean age of 70.4 (standard deviation, 13.8; range, 31–86) and a mean BMI of 27.8 kg/m^2 (standard deviation, 4.4; range, 21.5–36.9). The PA group consisted of 4 (57.1%) females and 3 (42.9%) males with a mean age of 71.1 (standard deviation, 9.2; range, 63–89) and a mean BMI of 28.0 kg/m^2 (standard deviation, 5.2; range, 23.8–37.9). There were no significant differences in age (p=0.13) or BMI (p=0.21) between the 2 groups. Preoperative NRS scores were comparable between groups (p=0.10). Patients in the intraarticular group demonstrated a mean NRS score improvement of 5.03 ± 0.39 (SEM), while patients in the periarticular group demonstrated a mean NRS score improvement of 4.50 ± 1.65. No statistically significant differences were found between the two groups (p=0.108). Demographics and NRS scores, pre- and post-operatively, are demonstrated in Table 1.

Discussion

Using palpated anatomic landmarks, miss rates of SIJ injections are reportedly between 78% and 100%, even when done by experienced clinicians.[12] As a result, various imaging modalities have been incorporated to improve the accuracy of the procedure and ensure the medication is entering the intraarticular space. Fluoroscopy is the most commonly utilized

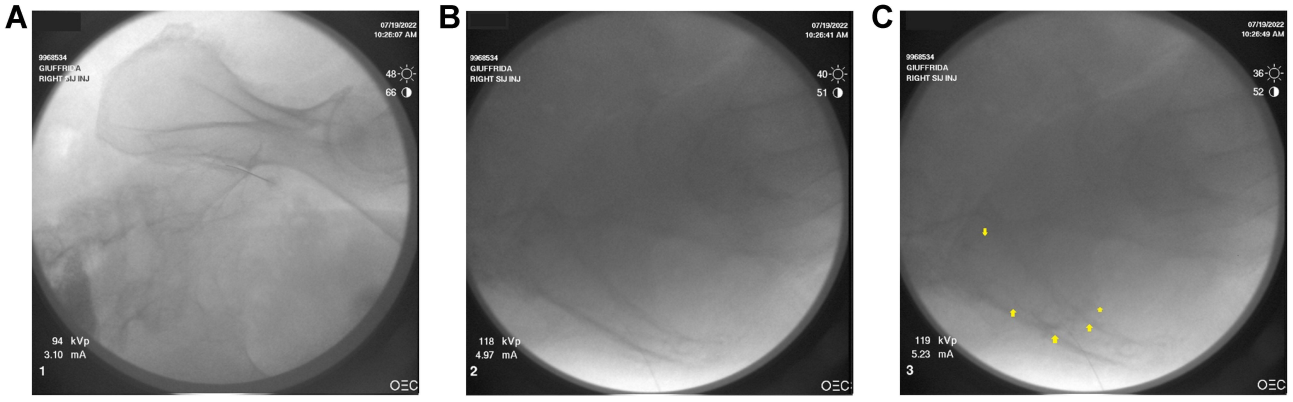

Figure 1 (**A**). Anteroposterior view prior to sacroiliac joint intraarticular injection. (**B**). Lateral view prior to sacroiliac joint intraarticular injection. (**C**). Lateral view post sacroiliac joint intraarticular injection.

Table 1 Patient Demographics and NRS Scores

Variable	Intraarticular Group (n=31)	Periarticular Group (n=7)	*p*-value
Age	70.39 (SD=13.8)	73.83 (SD=9.2)	0.127
BMI (kg/m)	27.81 (SD=4.4)	28.17 (SD=5.2)	0.209
Sex			
Male	14	3	
Female	17	4	
NRS (preop)	7.74 (SD=1.5)	7 (SD=1.9)	0.099
NRS (postop)	2.71 (SD=2.2)	2.5 (SD=2.1)	0.108

Abbreviations: NRS, numerical rating scale; SD, standard deviation.

imaging modality, as it allows for contrast injections and real-time feedback to confirm intraarticular placement of injectate and visualize the medicine's spread from the joint to the surrounding structures.[12] However, ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI) have all been described in the literature.[12,13] Reported miss rates for fluoroscopy are between 4% and 20%.[12] Similarly, miss rates for CT are approximately 24% and the excess radiation exposure makes CT a less favorable modality.[12] In contrast, the success of ultrasound is highly variable, with studies reporting miss rates anywhere between 4% and 62.5%.[12] Additionally, although bedside ultrasound may make SIJ injections more accessible, the high rates of intravascular injection make ultrasound a less favorable modality.[12] While use of MRI may result in miss rates as low as 13%, the lengthy imaging procedure makes this modality less available.[13]

The standard fluoroscopic technique is an AP or oblique view to ensure adequate placement of the injection into the intraarticular space. Although incorporating an additional lateral fluoroscopic view for SIJ steroid injection is anecdotally practiced by some providers, there has been little published research supporting the necessity and efficacy of this approach. In one of the only existing studies that reports using an additional lateral view, Kasliwal et al utilized AP and lateral fluoroscopy during SIJ injections and reported satisfactory needle placement within the SIJ in 93% of cases.[14] Another study by Lee et al proposes the use of an alternative far-contralateral oblique approach for sacroiliac joint injection with lateral fluoroscopic imaging to confirm injection location.[15] Their study concluded that their proposed technique can be utilized to determine candidacy for SIJ fusion. Our study builds on these two studies by demonstrating the efficacy of an additional lateral view during SIJ injection. In congruence with Kasliwal et al's high satisfactory needle placement rate, we demonstrated intraarticular placement rates of 100% when using both an AP and lateral view. Additionally, our study further emphasizes Lee et al's conclusion of the diagnostic efficacy of an additional lateral view in determining proper diagnosis and future management of patient's with SIJ pathology.

In addition to improved injection placement accuracy, Kasliwal et al reported pain relief of 50% or more with appropriate needle placement and 50% or less with inappropriate needle placement. In contrast, Khalil et al found that patients with periarticular injections were found to have significantly reduced pain scores when evaluated using numerical rating scale (NRS) and verbal rating scale (VRS), as compared to intraarticular injections.[16] Another study by Murakami et al further echoed these findings, showing a 96% improvement with periarticular injection and a 62% improvement with intraarticular injection when assessed using the "restriction of activities of daily life" scoring system.[17] Alternatively, Nacey et al's comparison of the effects of intraarticular and periarticular injections found no significant differences in pain relief between the two.[18] Our findings were most similar to Nacey et al revealing no significant differences in pain between patients with an initial intraarticular injection and an initial periarticular injection. However, this is likely because after lateral view revealed initial periarticular needle placement, our needle injection site was corrected to the intraarticular space.

The literature is inconclusive regarding the superiority of one injection site (eg, intraarticular versus periarticular) over the other for SIJ pain but converges on the idea that any SIJ injection results in reduced pain from baseline. Our investigation follows this trend, demonstrating that 97.4% of patients obtained pain relief post-operatively, as defined by

post-operative improvement in NRS score, though notably all of our injections ended up intraarticular. Despite potential differences in pain reduction, considering the context of the appreciated pain relief can provide diagnostic insight of the underlying SIJ pathology expressed. Adequate pain relief after periarticular injection may indicate that pathology exists outside of the SIJ and that radiofrequency ablation or lateral branch block may be a better treatment option. However, failure of NRS score to improve after accurate SIJ injection may indicate more severe SIJ disease, such as advanced joint degeneration, severe arthritis, or the presence of osteophytes, rendering standard therapies ineffective and potentially requiring SIJ fusion. Alternatively, the absence of SIJ pathology may also yield unchanging NRS score after intraarticular injection, prompting further diagnostic workup. Centers for Medicare and Medicaid Services (CMS) guidelines for medical necessity suggest that, in patients with properly diagnosed SIJ pathology, patient must achieve 75% or more relief for the duration of the anesthetic after accurate SIJ injection in order to justify an SIJ fusion. As a result, accurate needle placement is crucial to better guide patient management.

Our study supports existing literature, which suggests that adequate pain relief can be achieved regardless of whether needle placement is intraarticular or periarticular. However, intraarticular needle placement is necessary to properly determine the best course of treatment for each patient. SIJ pathology can only be assessed if the injection is intraarticular. By identifying issues within the SIJ, physicians can better assess the need for further intervention, such as SIJ fusion or lateral branch ablation, or avoid such invasive procedures if they are not indicated. However, this relies on adequate diagnosis via accurate SIJ injections.

In addition to studying pain relief, our study also sought to identify what patient factors may have contributed to the initial periarticular needle placement. A majority of procedures were done by an experienced interventional physiatrist using the same radiographic equipment and procedural team. Patients with prior lumbosacral fusion were excluded from the study to avoid any obscuration of fluoroscopic imaging. One possible alternative explanation as to why intraarticular needle placement was inaccurate in some patients, is the presence of more severe SIJ disease such as advanced joint degeneration, severe arthritis, or the presence of osteophytes, which can alter the anatomy, making needle placement more challenging. However, further studies with advanced imaging to correlate would be required to make this a definitive claim. Alternatively, the variability in SIJ technique and injection location may be due to the dynamism within the phenotype of the SIJ, which may vary from one side to the other in a single patient.

Some limitations of this study include the sample size of the patients included in the study. It would benefit the power of the study and therefore strength of the hypothesis to increase the number of patients included. It would also likely prove to be beneficial to include patients from different interventional specialists with different levels of expertise over a longer period of time. The inclusion criteria of this study were non-surgical patients who have undergone an SIJ steroid injection on either side. This patient population makes it easier to build on our initial results and include more subjects in the future. Further studies may focus on longer timeframes and compare the duration of pain improvement and frequency of SIJ fusion in patients who had SIJ injections via AP and lateral imaging versus those who were diagnosed and treated for sacroiliitis without lateral imaging confirmation.

Conclusion

SIJ pain is becoming increasingly recognized as a common cause of lower back pain. The differential diagnosis of SIJ pathology is broad, and misdiagnosis is common. SIJ injections can be both diagnostic and therapeutic. However, needle placement must be accurate to ensure correct diagnosis and management. Adding a lateral fluoroscopy view to the standard AP view will improve injection accuracy rates, leading to improved diagnostic accuracy and subsequent patient management.

Ethics

IRB approval was granted by the MetroWest Medical Center Institutional Review Board, the overseeing IRB for the Cantor Spine Center at The Paley Orthopedic & Spine Institute investigative site. Informed consent was obtained from the study participants and guidelines outline in the Declaration of Helsinki were followed.

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