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ORIGINAL ARTICLE

# The Success Rate of Ultrasound-Guided Sacroiliac Joint Steroid Injections in Sacroiliitis: Are We Getting Better?

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■ **Abstract**

*Background:* The sacroiliac joint is one of the most common sources of low back pain; however, it is difficult to place the needle accurately inside the joint space without image guidance. Improvement of ultrasound technology may lead to a high success rate for intra-articular drug deposition.

*Objective:* Assessment of the success rate of ultrasound-guided intra-articular sacroiliac joint injection.

*Design:* Prospective observational study.

*Methodology:* Ultrasound-guided injections were performed on 34 patients suffering from sacroiliitis. After injection of the drug solution and withdrawal of the needle, an anteroposterior fluoroscopy image was obtained and recorded for the injected joint to detect whether it was predominantly intra-articular or peri-articular. Clinical outcome using a numeric pain rating scale as well as limitation of physical functioning measured by the Oswestry Disability Index (ODI) were determined.

*Results:* Thirty-three injections (84.6%) were intra-articular, while 6 injections (15.4%) were peri-articular, as confirmed by fluoroscopy, with no statistical difference regarding clinical outcome between them. The baseline mean pain score decreased from 7.21 to 1.92 1 month after injection, and the mean ODI scores improved from 61.41% to 17.13%. Intervention was well tolerated, and 91.2% of patients were satisfied or mostly satisfied.

*Conclusion:* Ultrasonography provides a high success rate of intra-articular sacroiliac joint injection as confirmed by fluoroscopy. No significant difference in clinical outcome between intra-articular and peri-articular injection was found. ■

**Key Words:** ultrasound, sacroiliac, joint, fluoroscopy

## INTRODUCTION

Low back pain is a common cause of disability in adults. One of the most common sources of low back pain is the sacroiliac joint (SIJ). It has been reported that the SIJ accounts for 30% of the causes of low back pain.[1] The SIJ, like other joints, is susceptible to inflammation, which leads to pain and disability.[2]

Initial treatment of SIJ pain is conservative (anti-inflammatory medications and physical therapy).[3–6] Interventional procedures, such as image-guided intra-articular SIJ injections with fluoroscopy-, CT-, and MRI-guided techniques, may be performed in patients who do not respond to conservative measures.[7,8] Exact identification of the SIJ is the key for successful intervention, and due to the complexity of the SIJ, image guidance is important to place the needle accurately inside or near to the joint space.[9] Rosenberg and colleagues concluded that only 22% of SIJ injections done blindly (by identifying anatomical landmarks) were accurately placed intra-articularly.[10]

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It was demonstrated that performing SIJ injections under sonographic guidance could be a valuable alternative to other guidance modalities.[11,12] Ultrasonography has many advantages when compared to fluoroscopy techniques. Using ultrasound does not expose the patient and physician to radiation, procedures can be done outside the operating room, and the decreased cost associated with ultrasonography is of benefit in developing countries.[13]

The SIJ consists of ear-shaped auricular surfaces of the ilium and sacrum, resulting in mainly vertical and anterolateral orientations. The superior compartment is fibrous, whereas the inferior compartment is synovial; therefore, the entry of the needle must be in the lower third of the SIJ. Also, the joint space narrowing and bony spurs that occur during the disease can be challenging, making it more difficult to place the needle intra-articularly.[14]

Regarding the prior studies[15–17] that explored the feasibility of ultrasound-guided (USG) SIJ injection, there has been significant variability in the success rates of intra-articular (IA) injection. Due to the improvement of ultrasound technology and experience of technicians, we hypothesized that the success rate of IA drug deposition in USG SIJ steroid injection will be higher than that reported before in the literature.

Our initial objective was to re-assess the success rate of USG SIJ steroid deposition inside the joint capsule (confirmed by contrast spread in fluoroscopy) and to find out if there is a difference in clinical outcome between injections done strictly inside the joint and injections done peri-articularly.

## METHODOLOGY

This study was registered with clinicaltrials.gov (registration number NCT04314609). All methods and results have been reported as per STROBE (STrengthening the Reporting of OBservational studies in Epidemiology) guidelines.

After obtaining written informed consent and ethical committee approval of our institutional review board (registration number N-161-2018), 34 adult patients diagnosed with acute or chronic SIJ pain in whom conservative measures (rest, nonsteroidal anti-inflammatory drugs, and physiotherapy) had failed to control the pain after 6 weeks were enrolled in this prospective observational study from October 1, 2019, to May 1, 2020. Diagnosis of SIJ pain (acute or chronic) was established by history (moderate to severe pain, numeric pain rating scale [NRS] pain score $\geq$ 3/10) and physical examination (at least 3 positive physical examination maneuvers: distraction, thigh thrust, FABER [flexion, abduction, and external rotation] compression, and Gaenslen's test).[18] Our primary outcome was the determination of the percentage of successful IA SIJ drug injections under ultrasound guidance (as confirmed by contrast spread in fluoroscopy). Patients with coagulopathy, known allergy to local anesthetics, infection at the site of needle placement or SIJ, body mass index (BMI) more than 35 kg/m$^2$, age less than 18 years, and renal or hepatic failure were excluded from the study.

### Procedure

After applying basic monitors and inserting intravenous cannulas, patients were positioned in the prone position with a pillow under the abdomen to reduce lumbar lordosis and facilitate the procedure. Ultrasonography was used to guide needle placement in the SIJ (the hypoechoic cleft between the surface of the sacrum and the ilium) under complete asepsis.

One milligram midazolam was given for sedation. Ultrasound was performed using a Mindray scanner (Z5 ultrasound system, China) fitted with an intermediate-frequency (6 to 9 MHz) transducer, and adjusted to the frequency needed according to the penetration depth. A lower frequency (2 to 5 MHz) transducer may be used in obese patients. Ultrasound scanning and needle insertion were performed by an anesthesia and pain management specialist with more than 3 years of experience in USG injections.

The transducer was used in a sterile cover. The posterior superior iliac spine, lateral border of the sacrum, and ilium were identified in transverse orientation, then the probe was moved caudally until the superior part of the posterior SIJ was identified. The SIJ was traced caudally until the distal third of the SIJ was visualized as evident by the flat contour of the iliac crest and the presence of the second sacral foramen on the medial aspect of the sacrum, as shown in Figures 1 and 2. After local anesthetic infiltration of the skin and subcutaneous tissues using lidocaine 1%, a 21-gauge spinal needle was advanced from a medial to lateral direction using an in-plane technique. After reaching the joint, a total volume of 3 mL of injectate was injected, which consisted of 1 mL of methyl-prednisolone-acetate (Depo-Medrol®; Pfizer, Manhattan, New York City, USA), 1 mL lidocaine 2%, 1 mL Iohexol (Omnipaque 300®; GE Healthcare, Chicago, Illinois, USA).

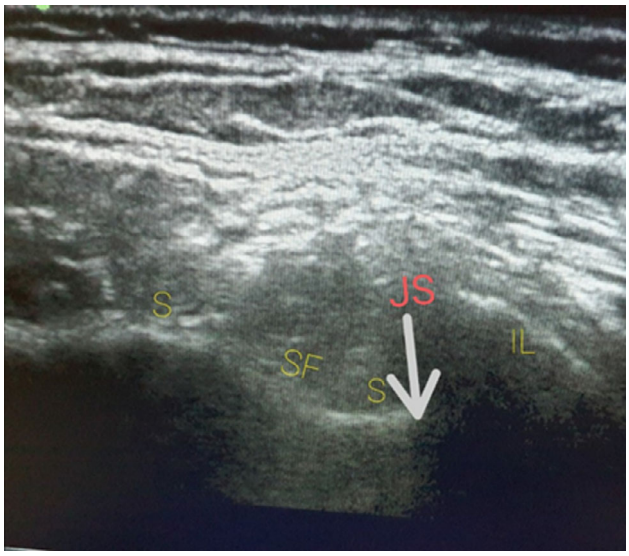


**Figure 1.** Ultrasound-guided sacroiliac joint injection. IB, iliac bone; JS, joint space; S, sacrum; SF, second sacral foramen. (Courtesy of Kasr Al-Ainy Hospital, Cairo University 2020.)

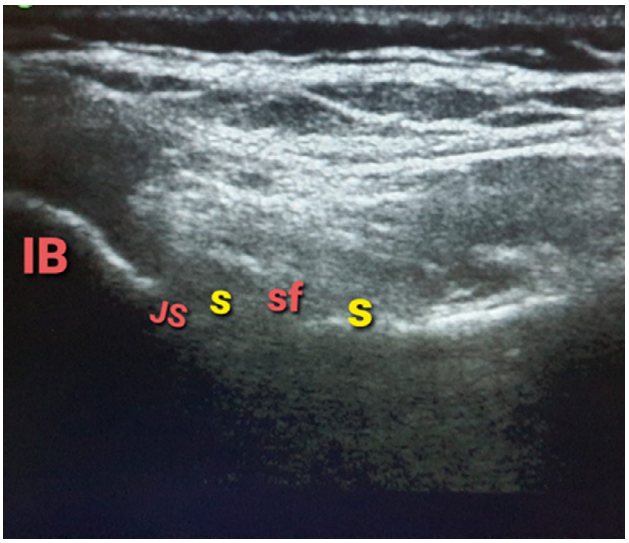


**Figure 2.** Ultrasound-guided sacroiliac joint injection. IB, iliac bone; JS, joint space; S, sacrum; sf, second sacral foramen. (Courtesy of Kasr Al-Ainy Hospital, Cairo University 2020.)

After injection of the solution and withdrawal of the needle, an anteroposterior fluoroscopy image was obtained and recorded for the injected joint to detect the spread pattern of the contrast and whether it was predominantly IA or peri-articular (PA), as shown in Figure 3 (PA injection was any injection done near the joint as evidenced by ultrasound, but on fluoroscopy no contrast is detected inside the joint). A sterile patch was applied to the puncture site and the patient was discharged to the recovery room for follow-up for 1 hour, then the patient was discharged to home. Demographic data, total number of IA and PA drug injections as evidenced by contrast spread in fluoroscopy, and patient's pain assessment using the NRS[19] measured before, 10 minutes after the procedure, and 1 week and 1 month post-procedure were obtained. Limitations of physical functioning as measured by the Oswestry Disability Index (ODI)[20] at 1 month after the procedure and procedure-related variables such as time, complications, and patient satisfaction (self-reported as not satisfied, satisfied, or mostly satisfied) were also obtained.

### Statistical Analysis

The Statistical Package of Social Science software program (SPSS), version 21 (Chicago, IL, U.S.A.) was used for all statistical comparisons. Continuous quantitative normally distributed data were expressed as means and standard deviations (SDs). Qualitative nominal data were expressed as percentages. Two-way repeated measurement analysis of variance (ANOVA) was used for comparing the change of duration of analgesia between the 2 approaches. The ANOVA analysis was followed by Tukey post hoc tests. A $P$ value of $<0.05$ was considered statistically significant.

### Sample Size

The sample size was calculated based on the incidence of the success of IA injection by ultrasonography as confirmed by contrast spread in fluoroscopy. In the reviewed literature, the incidence success of IA injection was approximately 40%.[15] Setting alpha at 0.05 and 10% as a maximum accepted error yielded that the minimum proper sample was 39 SIJs to achieve 80% statistical power. The sample size calculation was done using StatCalc software (Epi Info version 7.0.8.3 for MS Windows, 2011; Centers for Disease Control and Prevention, Washington, DC, U.S.A.).

## RESULTS

Forty patients were screened for eligibility. Five patients were excluded from the study for not meeting our inclusion criteria, and 1 patient was excluded from the final analysis for missing follow-up, leaving 34 patients available for final analysis, of whom 29 had

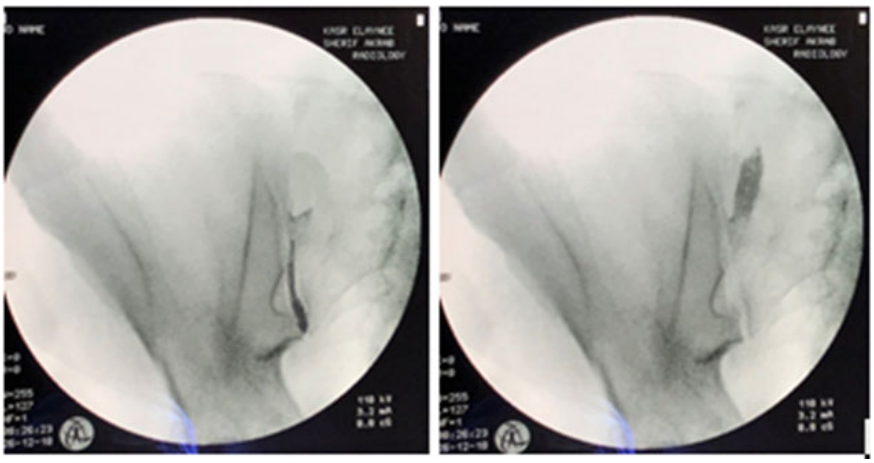

**Figure 3.** A, Intra-articular sacroiliac joint (SIJ) injection. B, Peri-articular SIJ injection. (Courtesy of Kasr Al-Ainy Hospital, Cairo University 2019.)

unilateral sacroiliitis, 5 had bilateral sacroiliitis; accordingly, 39 SIJs were injected (Figure 4). Twenty patients (58.8%) were female, while 14 patients (41.2%) were male; the mean age was 40.5 ± 8.45 years, and the mean BMI was 25.5 ± 3.5 kg/m$^2$. In the 34 patients, 39 SIJ injections were performed, among which fluoroscopy revealed that 33 were exactly positioned into the SIJ space (84.6%), whereas the other 6 (15.4%) missed the SIJ space as demonstrated by PA localization of iohexol (Omnipaque 300®; Table 1). The mean time of the procedure (time from application of the ultrasound probe to completion of injection and withdrawal of the needle) was 4.90 ± 1.18 minutes. The time of the procedure was longer in the first patient (6 minutes) than in the last patient (3 minutes). As shown in Figure 5, there was a statistically significant decrease in the mean pain score just after intervention and for 1 month thereafter. IA and PA injections revealed no significant difference in clinical outcome as there was no significant difference in the pain scores 10 minutes, 1 week, and 1 month after the intervention, as shown in Table 2. The intervention was well tolerated in all patients and most of the patients were satisfied (Table 3). No major side effects were observed. Two patients complained about temporary numbness and lower limb weakness (grade 3) lasting for 2 hours. Concerning the ODI, scores significantly improved after SIJ injections were performed, showing statistically significant results ($P < 0.05$). Thirty-one patients (91.2%) had minimal disability (ODI < 20%), while 3 patients (8.8%) had moderate to severe disability (ODI 20% to 60%) 1 month after injection (Table 4).

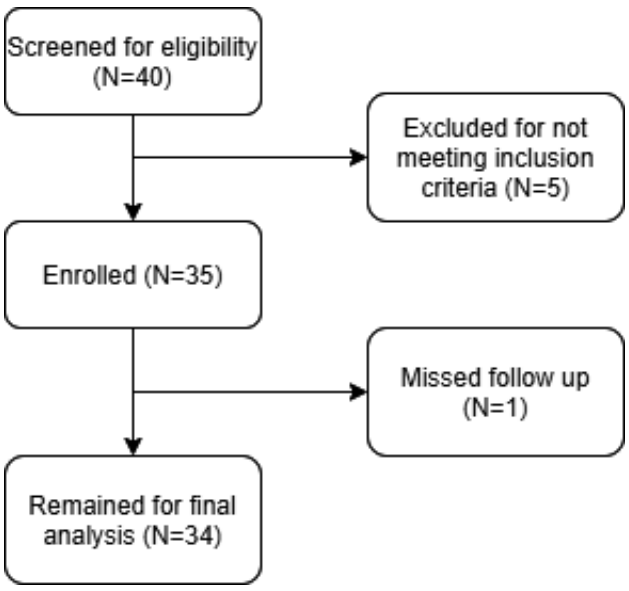


**Figure 4.** Flow chart showing subject inclusion and exclusion.

## DISCUSSION

In this study, we found that USG SIJ injection was a reasonable alternative to fluoroscopically guided injections. Several studies[9,15–17] investigated the feasibility of USG SIJ injection that demonstrated significant variability in success rates of IA injection. Our main goal was to re-assess the success rate of USG SIJ steroid injection in depositing the drug inside the joint capsule (confirmed by contrast spread in fluoroscopy), since we hypothesized that the success rate would be higher than recorded before due to the improvement of ultrasound

**Table 1. Success Rate of Intra-articular Sacroiliac Joint Injection**

| Injection | *n* (%) |
|---|---|
| Intra-articular | 33 (84.6) |
| Peri-articular | 6 (15.4) |
| Total | 39 (100) |

Data are presented as frequency (%).

**Table 2. *P* Values of Pain Score Over Time Between Intra-articular and Peri-articular Groups**

| | IA | PA | *P* Value |
|---|---|---|---|
| Pain score after 10 minutes | 1.45 ± 0.971 | 2.33 ± 1.751 | 0.381 |
| Pain score after 1 week | 1.75 ± 0.902 | 2 ± 1.549 | 0.862 |
| Pain score after 1 month | 1.90 ± 1.011 | 2 ± 1.549 | 0.679 |

IA, intra-articular; PA, peri-articular.
Data are presented as mean ± standard deviation. $P < 0.05$ denotes statistical significance.

**Table 3. Patient Satisfaction**

| Patient Satisfaction | Number of Patients (%) |
|---|---|
| Not satisfied | 3 (8.8) |
| Satisfied | 26 (76.4) |
| Most satisfied | 5 (14.8) |

Data are presented as frequency (%).

technology and experience of performers. Our study demonstrated that 84.6% of USG injections were IA, while 15.4% missed the SIJ space, as confirmed by fluoroscopy. Our results were higher than that reported by Pekkafahli et al., who demonstrated that 76.3% of SIJ injections guided with ultrasonography were IA when controlled by fluoroscopy. One major drawback of this study is that it did not evaluate the clinical outcome of the injections.[12] Our reported percentage was close to what was reported by Jee et al.,[17] who demonstrated that 87.3% of 55 USG SIJ injections were IA, as confirmed by fluoroscopy. In this research, we tried to assess the patient improvement following USG injections and the difference in clinical outcome between IA and PA injections. In accordance with previous studies, we found an overall significant improvement after USG SIJ injection and no clinical difference between IA and PA injections. Klauser et al. and Hartung et al. reported significant pain relief after the procedure at 3 months and 28 days, respectively, in nearly all patients.[9,15]

In addition, Hartung et al. found no significant differences observed in the clinical outcome between the intra-articularly injected group and the peri-articularly injected group. Jee et al.[17] reported the same results, since analysis of mean NRS scores after intervention revealed a significant reduction from 6.5 to 2.58 after 12 weeks.

Klauser et al.[9] reported that the time taken to carry out the first injection was longer than the time taken for the last injection, as we established in our results. Furthermore, Pekkafahli et al. reported that the successful IA injection rate was 60% in the first 30 injections, and it gradually improved to reach 93.5% in the last 30 injections. They linked the rise in the success rate of IA injections to the increasing experience of performers.

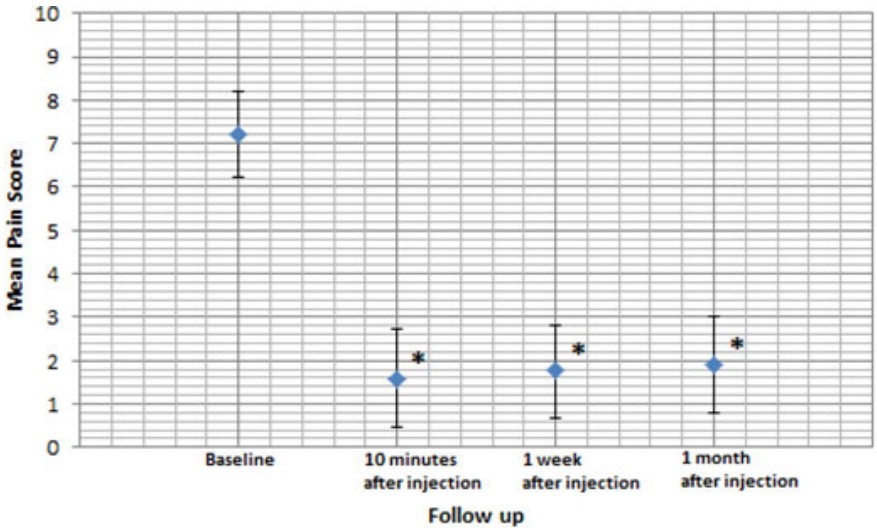


**Figure 5.** Mean pain score over time among all cases. I denotes standard deviation. *Statistically significant at $P < 0.05$, comparison before and after the injection.

**Table 4. Oswestry Disability Index (ODI) Scores (Baseline and 1 Month After Injection)**

| | 1 month | | |
|---|---|---|---|
| | Baseline | After Injection | *P* Value |
| ODI | 61.41% ± 14.96 | 17.13% ± 7.41 | <0.05 |
| Pain score | 7.21 ± 0.978 | 1.92 ± 1.08 | <0.05 |

Data are presented as mean ± standard deviation.

In reference to functional outcome, ODI scores were used to assess the limitation of physical functioning. Lower scores indicated less disability than higher scores.[20] A minimum clinically important difference (MCID) should be found in ODI score to be clinically reliable in patients with low back pain. MCID is defined as the smallest change in a treatment outcome that an individual patient would identify as important (at least 10% to 12%).[21] Our study showed a statistically significant reduction in baseline ODI scores to those measured 1 month after the procedure. Also, we found a large change in ODI score (more than 50%), suggesting that USG injections were associated with overall clinical improvement in physical function as measured by ODI.[21] Jee et al.[17] demonstrated a similar pattern as in our study; however, they had a lower baseline ODI, which may have contributed to significantly improved results postoperatively.

### Limitations

In this study, we followed the patients for a short period (1 month) given the fact that our primary objective was to assess the accuracy of needle placement inside the SIJ. Future studies could focus on longer term outcomes up to 6 months after the intervention. Also, we performed the study on patients with a BMI < 35 kg/m$^2$. The application of ultrasound in patients with a higher BMI is technically challenging and may have contributed to the high success rates in this study. Thus, additional studies are needed to evaluate the role of ultrasound in SIJ injection of this population.

## CONCLUSION

USG SIJ injection is a reasonable alternative to fluoroscopically guided injections, since high success rates were observed in this study. There was no clinically significant difference between IA and PA SIJ injection.

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## CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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