

Ultrasound Guidance for Intra-articular Sacroiliac Joint Injections

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Myth: Ultrasound guidance is equivalent in accuracy to fluoroscopic guidance for intra-articular sacroiliac joint (SIJ) injections.

Fact: For intra-articular SIJ access, evidence suggests that accuracy with ultrasound guidance is inferior to fluoroscopic guidance. For diagnostic injections, this increases the risk of both false negative and false positive responses. The impact this has on the clinical effectiveness of injections of corticosteroid into the SIJ is less clear.

Potential advantages of ultrasound guidance for SIJ injection include the ability to visualize soft-tissue structures, the ability to perform the procedure at bedside, and a lack of exposure to ionizing radiation. Current guidelines consider the use of fluoroscopy with real-time contrast administration as the preferred method of image guidance (1). Fluoroscopy allows for multiplanar imaging to assess the final needle tip position in medial-lateral, cephalo-caudal, and anterior-posterior (AP) dimensions, which cannot be achieved with ultrasound. Fluoroscopy with the use of contrast also allows for visualization of an arthrogram, which is not possible with ultrasound. Fluoroscopy with real-time observation of contrast administration allows visualization of intra-vascular uptake, as opposed to ultrasound, which allows direct visualization of vascular structures but without the ability to reliably confirm intra-vascular needle tip position(2). The Centers for Medicare and Medicaid Services still considers use of ultrasound for SIJ injections an emerging technology (3). That said, there may be times fluoroscopy is contra-indicated and ultrasound the only option, such as with a pregnant patient.

Accuracy of Needle Placement

From a technical standpoint, the question is whether the accuracy of final needle position and injectate placement is equivalent with ultrasound guidance and fluoroscopic guidance. The clinical implications are two-fold. The first pertains to accuracy of diagnosis, in which confirmation of exclusively intra-articular (IA) spread of injectate is vital to minimize false negative and false positive responses. The second pertains to the therapeutic effect of medications, such as steroid deposition injected into the SIJ.

Using fluoroscopy as the reference standard, Jee *et al.* found that 87% (48/55) of ultrasound-guided injections were IA. This was found to be significantly less accurate when compared with initial use of fluoroscopy, which resulted in 98% accuracy (2). Soneji *et al.* performed 20 SIJ injections with ultrasound guidance and 20 SIJ injections with fluoroscopic guidance (4). The small sample size limited the statistical power, with 50% IA

placement in the ultrasound group compared with 65% in the fluoroscopy group, not reaching statistical significance. More recently, De Luigi *et al.* reported that IA needle placement with ultrasound-guidance was achieved in 96% (48/50) of patients, again using a fluoroscopic arthrogram as the reference standard, with one showing concomitant vascular uptake (5). Notably, while this study describes an arthrogram as the reference standard, the provided images only show a single fluoroscopic AP image without visible contrast medium.

Using computed tomography as the reference standard, which allows for three-dimensional characterization of the final needle position, ultrasound guidance using either an "upper" or "lower" joint approach resulted in IA needle placement 80% (16/20) of the time in a cadaveric study. There was no fluoroscopic comparator in this study (6).

There are two studies using cadaveric dissection to evaluate final position of latex injectate as the reference standard when evaluating accuracy of ultrasound guidance for SIJ injection. Perry *et al.* reported that 88% (15/17) of ultrasound-guided injections reached the joint as determined by subsequent dissection (7). This study is limited by use of 5 mL of injectate, which is greater than the approximate 2mL volume of the SIJ (8). Moreover, of the 15 injections deemed IA, eight were concomitantly extra-articular (7). Of these eight, extra-articular spread was recognized during the ultrasound-guided procedure in five cases, while in the other three, this was only evident upon dissection. As such, this study found that 41% (7/17) of SIJ injections with ultrasound guidance resulted in exclusively IA injectate spread; in 18% (3/17), ultrasound mischaracterized the injection as exclusively IA when, in fact, it was not. Most recently, Stelzer *et al.* performed 20 SIJ injections with ultrasound guidance and 20 injections with fluoroscopic guidance in cadaver specimens. In the ultrasound group, exclusively IA injection was confirmed on dissection only 5% (1/20) (95% CI: 0%-12.5%) of the time (9). In the fluoroscopy group, exclusive IA injection was confirmed 50% (10/20) (95% CI: 34.2%-74.2%) of the time, which was significantly more frequent than the ultrasound guidance group (9).

Two studies compared clinical outcomes of steroid injections into the SIJ using either ultrasound or fluoroscopic guidance (2,4). In the study by Jee *et al.*, no difference was observed in group mean numeric pain scores or Oswestry Disability Index (ODI) scores at two or 12 weeks (2). Soneji *et al.* similarly reported no significant intergroup differences at three months, using mean analysis of numeric pain scores and ODI scores (4). It may be that therapeutic effect of the injection is not dependent on IA needle placement, as peri-articular steroid injections have also been described as equally or more effective than IA injections of steroid (10). Alternatively, in the Soneji study, there was a statistically significant within group improvement in ODI score within the fluoroscopy group that was not observed in the ultrasound group.

Other differences between ultrasound and fluoroscopy use have even less available data. Soneji *et al.* found that ultrasound-guided procedures were associated with a significantly greater procedure time compared to fluoroscopy (4). However, procedure time is likely dependent on many confounding variables, and no other studies report such data. Similarly, while there is a theoretical benefit that ultrasound does not expose the patient to ionizing radiation, available data show that the radiation dose from a fluoroscopically-guided SIJ injection is low (average 18mGy) (11,12).

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