



Musculoskeletal Imaging and Intervention Section Procedures

S1 Transforaminal Epidural Steroid Injection

Prior to the day of the procedure, be sure to review the patient's recent clinic notes, prior imaging, allergies and medications (particularly anticoagulants). It is also important to review the actual order, recent clinical documentation and recent imaging to confirm correct location and laterality- preferably as early as the day prior to the procedure so that the ordering MD/PA can be contacted ahead of time for clarification.

Indications

- To relieve radicular symptoms relating to irritation of the exiting S1 nerve root

Materials

- Local anesthetic: 10 ml syringe: 1% lidocaine buffered with sodium bicarbonate
- Contrast: 5 ml syringe with short extension tubing: Omnipaque 300
- Treatment mixture: 10 ml syringe: Triamcinolone (Kenalog) 40 mg/ml (always 2 ml) + 1.0% preservative-free (PF) lidocaine (2 ml for unilateral or 6 ml for bilateral)
 - If Kenalog contraindicated, alternative treatment mixture is dexamethasone 10 mg/ml 1.5 mL + 2.5 mL 1% PF lidocaine

Technique

1. After obtaining written informed consent in the consult room, bring the patient into the fluoroscopy room and perform a standard procedure timeout.
2. Position the patient prone on the table with the targeted side away from you- the main reason to do so is that the I-I will not be in your face while you work. If bilateral, consider positioning the patient so that the more symptomatic side is away from you as this site would be the first to be injected.
3. Reset all cones, collimator and magnification settings that may be in place from the previous procedure. Assess a AP image of the sacrum and lower lumbar spine to evaluate the anatomy and confirm level/laterality. (Figures 1&6) This is the best opportunity to reposition the patient prior to setting up your working views, as below.
4. Set up working views:
 - A. AP view (figure 1): Increase magnification and collimate to get an AP view centered at the midline of the sacrum at the S1 level. With rare exception, you do not need to tilt the image intensifier (I-I) cranial or caudal. Ensure that you are

able to view the S1 foramina which will be just inferior to the S1 superior articular process. Note: S1 is always smaller than S2! Save this as position 1.

- B. Trajectory view (figure 2): Reduce magnification and collimation. Rotate the tube ipsilaterally by about 15 degrees so that the targeted posterior S1 foramen is clearly demarcated. This will be inferior to the S1 pedicle/articular process - resist the temptation to go for the larger S2 foramen. This may require real-time fluoro as you rotate the tube back and forth to confirm that you are actually targeting the foramen and not superimposed bowel gas. Once optimal visualization of the target S1 foramen is achieved, use a Kelly clamp to help you mark the overlying skin with a marker. Save this as position 2.
 - C. Lateral view (figure 4): Rotate the I-I 90 degrees from your AP (position 1) view. Center the I-I at the level of the S1 foramina. Save this as position 3.
5. Prep the area with Betadine (chlorhexidine is contraindicated in spine procedures due to risk of arachnoiditis) and sterile drapes. **Draw up medications according to protocol (2 ml 1% PF lidocaine + 2 ml Kenalog 4 for unilateral S1 injection and 6 ml 1% PF lidocaine + 2 mL Kenalog 40 for bilateral S1 injections).**
 6. Set up in the trajectory view (saved position 2). Using the I-I as a trajectory guide, use the 30 gauge ½ inch needle (pink hub) to inject the buffered lidocaine solution subdermally, then switch to the 27 gauge 1 ½ inch needle for deeper application of buffered lidocaine. Use your I-I to make sure you are injecting in the same trajectory as your needle will go.
 7. Next, place the tip of the spinal needle superficial to the skin at your mark and confirm maintenance of correct positioning (this step may not be necessary with sufficient experience). Place the needle through the skin at the mark that you made, making sure to use the I-I to assist you in achieving the proper trajectory (e.g. hubogram, bull's eye- as seen in figure 3). Make your major adjustments while the tip of the needle is superficial (within the first 1-2 cm of depth). Once the appropriate trajectory is achieved, begin advancing the needle slowly under intermittent fluoroscopy. Be cognizant of the direction that the notch is facing every time you reposition/advance the needle.
 7. Based on your review of the patient's prior imaging, you should have a sense of how deep you can advance on the trajectory view before changing to the lateral view (saved position 3). Be conservative in your depth assessment. If you are unsure, then check your lateral view early on. On the lateral view, look for the lucent S1 foramen (figure 4) and gauge how far you will need to advance, and whether you need to drive the needle cranial or caudal. This may require switching between the trajectory and lateral views until you are within roughly one cm posterior from the lucent S1 foramen on the lateral view.
 8. Switch to the lateral view if you haven't already. Warn the patient that you are getting close and that they may experience reproduction of their radicular pain- if so, they should alert you at that time- this is a potential stopping point (see step 9).
 - A. Advance very slowly (1-2 mm at a time), until the needle tip is at the anterior edge of the lucent foramen (figure 4).

9. Stop if:

- A. The patient experiences radicular symptoms (radicular symptoms are not the goal in a TF ESI, though they may occur) severe enough to prevent you from advancing further.
- B. The tip of needle is on bone (but your trajectory remains appropriately bull's eyed), preventing you from advancing further.

10. At any of the above stopping points, remove the stylet and check your position with a small injection of contrast while watching under fluoro in the AP view (figure 5). You should see flow distally along the exiting nerve root and proximally into the epidural space- don't forget to save the image. You should not see flow into and washing out of a blood vessel - if so, you need to reposition your needle and check again with contrast. Switch to your lateral view and confirm position in an identical manner (figure 6).

11. After confirmation of appropriate epidural placement, switch to the AP view and inject your lidocaine/Kenalog mixture (4 mL for each foramen you inject) under real-time fluoroscopy to confirm appropriate dilution of contrast by the treatment solution (figure 7). Remove the needle, cleanse the skin thoroughly with isopropyl alcohol-soaked gauze (any residual betadine will cause itching), remove the drapes and place a band-aid at the puncture site.

12. Have the patient sit up on the fluoroscopy table for 1-2 minutes to ensure that they are not light-headed, dizzy or otherwise vasovagal. Warn them that they may have ipsilateral leg weakness due to the lidocaine. When the patient is ready, be sure to have an additional staff member near the patient ready to assist- then have them step off the table and start weightbearing. If they have a "dead leg," have them sit down again, bring over a wheelchair and counsel them that this will last 1-2 hours. Either way, complete routine post-procedure care which includes pain diary instructions and walking the patient out to the waiting room.

Tips:

- Position the patient prone with the target side away from you. This way the I-I will not be in your face when you are working. If you are doing bilateral S1 epidural injections, consider positioning the more symptomatic side (if there is one) away from you in case the patient has a vasovagal response during the first injection or otherwise cannot tolerate the second injection.
- Err on the side of having the patient rotated slightly away from you if not completely flat. The I-I of the C-arm will rotate toward you for the lateral images, and cannot rotate past 90 degrees.
- Be sure to invert the on-screen image so that the patient's left is on screen left to reflect prone positioning.
- When you are close to the neural foramen, the patient will appreciate if you let them know their radicular symptoms may be reproduced due to the tip of the needle being in the vicinity of their S1 nerve roots. Setting appropriate expectations, particularly during the consent process, is key. That being said, radicular tweaks are much less common for S1 than any of the levels above.
- Once in the epidural space, inject the steroid slowly and warn the patient they may get reproduction of their radicular symptoms as the steroid solution fills the S1 foramen and bathes the S1 nerve roots. Be sure to watch the patient for subtle movements that may indicate discomfort; if so, ask them directly and give them the option of taking a short

break before continuing with a slower rate of injection. Remember, your goal is to get the medication into the epidural space. It does not matter how quickly it goes in.

- After the injection is complete, tell the patient that you are removing the needle and do so slowly- this hurts less than if you remove it quickly. Your patient will appreciate that!

Write-up credit: Stephen Tang, MD and Vaz Zavaletta, MD, PhD

Appendix: Figures

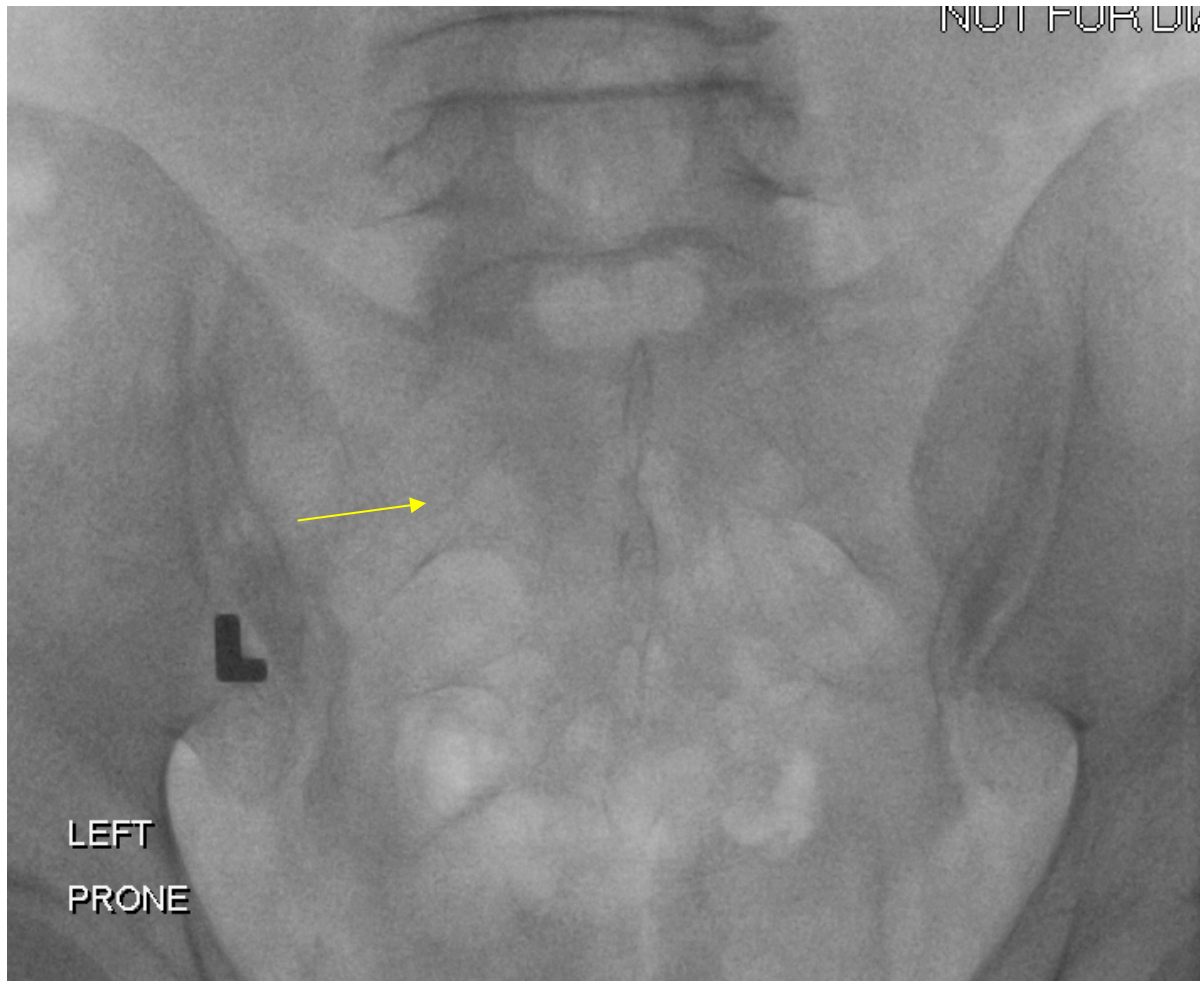


Figure 1: True AP view of the pelvis and lumbar spine. Make sure to position the patient as flat as possible on the table to reduce the amount of I-I obliquity required to bring the spinous processes midline and equidistant from both pedicles. Recall that no craniocaudal tilt should be needed to set up this view. (yellow arrow: left S1 foramen. Note the more conspicuous S2 foramen just below it)

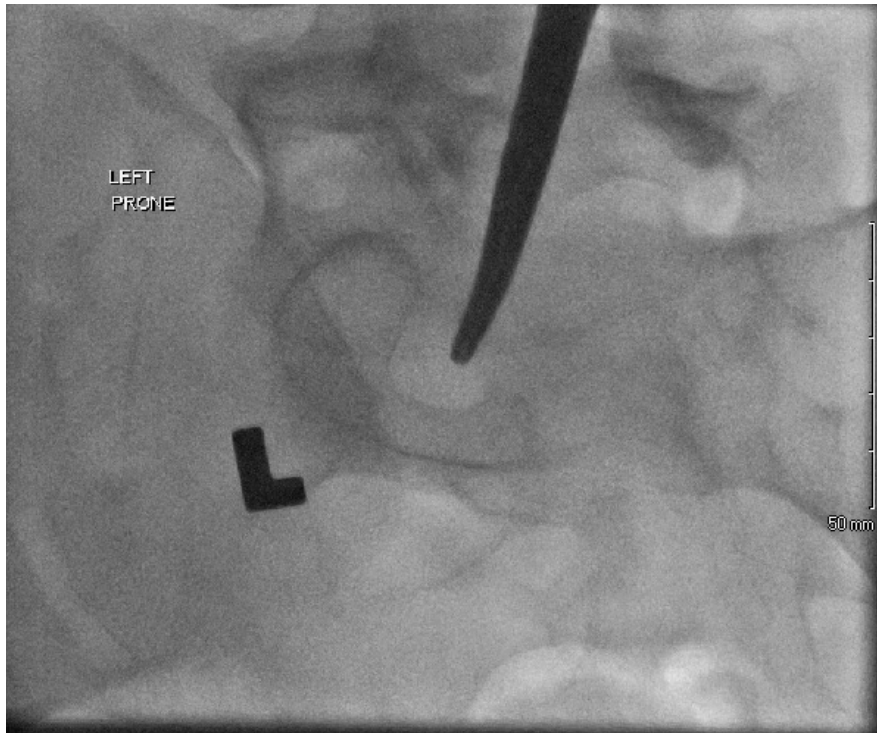


Figure 2: Trajectory view setup at 15 degrees of obliquity. Target the posterior left S1 foramen.

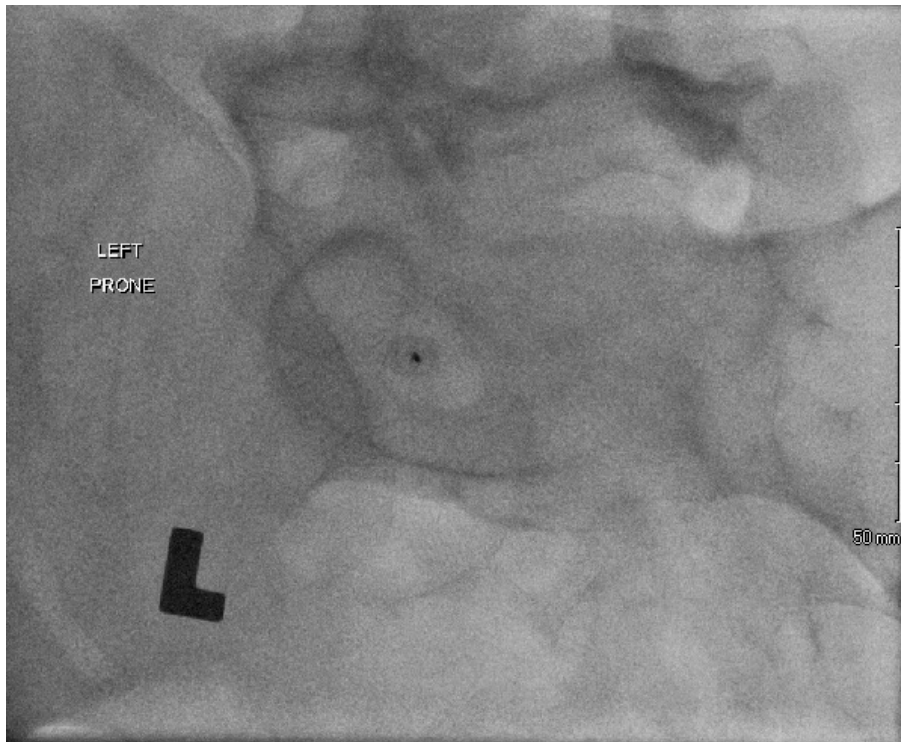


Figure 3: Bull's eye/hubogram in the trajectory view. This is what you want to see in the early stages of needle advancement.

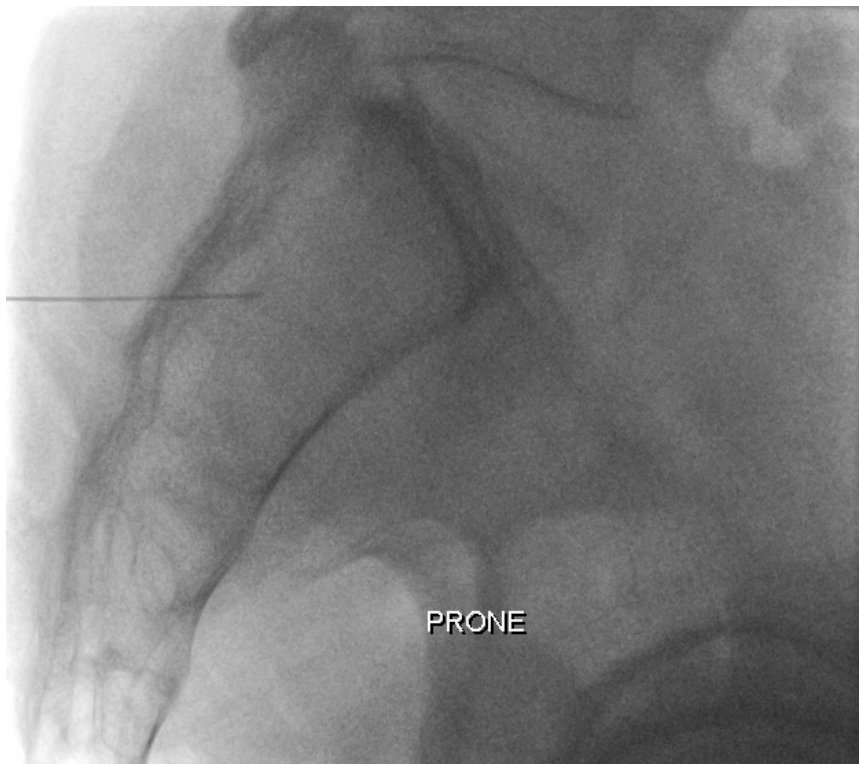


Figure 4: Lateral view of the sacrum. If you have any I-I obliquity on your AP view, make sure to account for that to ensure a true lateral view. Look for the lucent S1 foramen- in this case, the needle tip is in the anterior aspect of the S1 foramen- which is a stopping point.

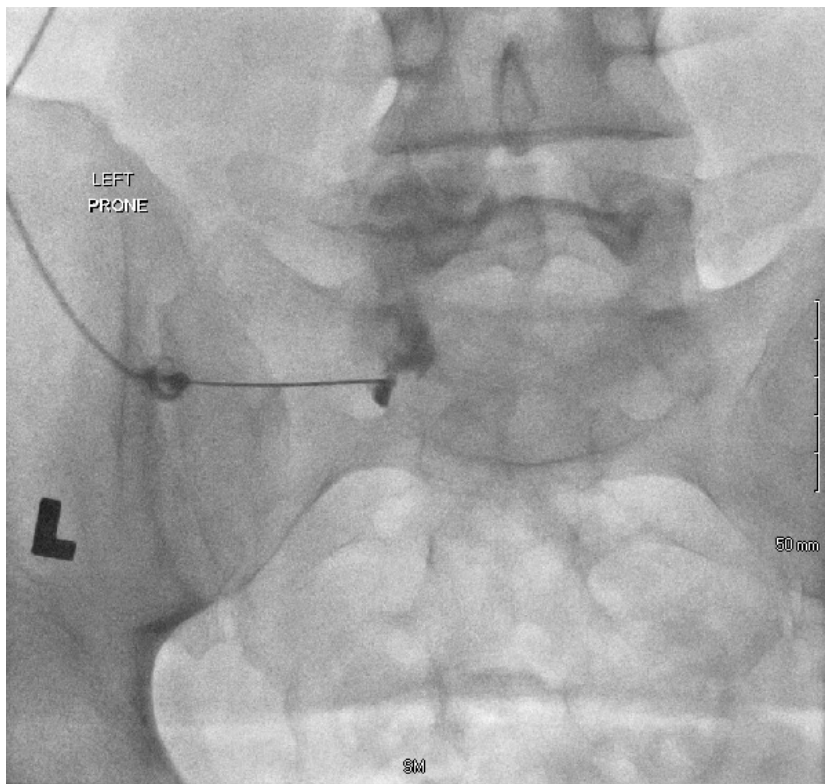


Figure 5: Appropriate injection of contrast into the left S1 epidural space.



Figure 6: Injection of contrast in the lateral view, confirming appropriate position of the needle tip in the epidural space.

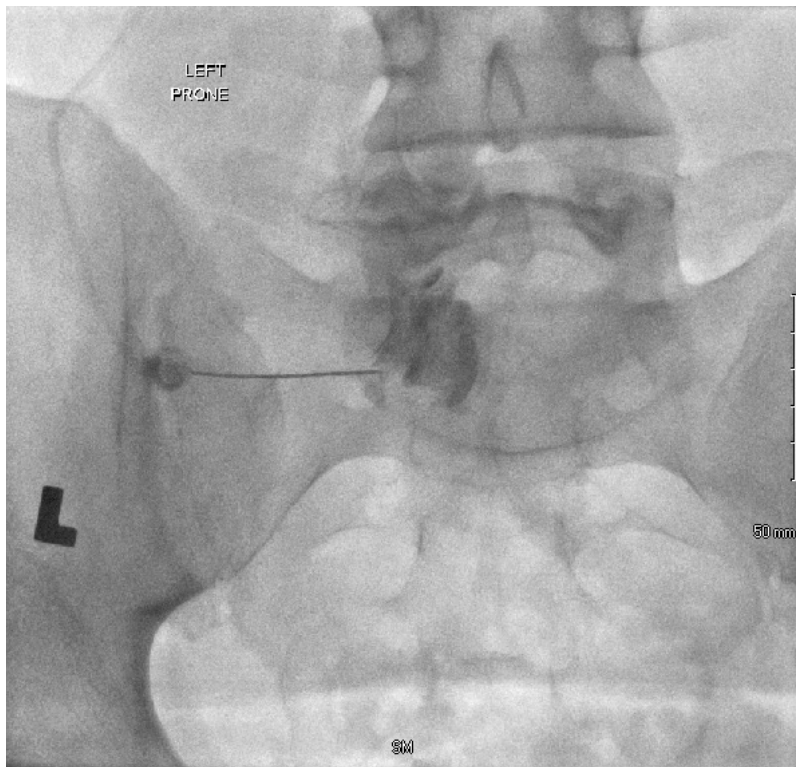


Figure 7: Appropriate displacement and dilution of contrast with injection of the treatment mixture.