

Correlating Ultrasound and MRI Epidural Space Measurements with Clinical Loss of Resistance in Cervical Steroid Injections

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INTRODUCTION

- Epidural Steroid Injections (ESI) rely on fluoroscopic guidance as the standard of care to provide knowledge of the patient's epidural space and appropriate administration of therapeutic medications.
- Precise Touhy needle placement is essential to minimize procedure risks such as intrathecal puncture or spinal cord injury and improve outcomes related to procedure time.¹ Prior studies have explored supplemental imaging for assessing skin to ligamentum flavum and posterior epidural space depth.^{2,3}

OBJECTIVE

- Determine the accuracy of ultrasound and MRI measurements for predicting cervical epidural depth during ESIs in chronic pain patients.

METHODS

- University of California, Davis IRB approval was obtained for patients >18 years y/o who are receiving cervical epidural injections at the Pain Clinic.
- We obtained transverse and parasagittal oblique ultrasound measurements in 20 prone cervical ESI patients (Figure 1). MRI measurements were obtained from preexisting images (Figure 2).
- The skin-to-posterior cervical epidural space measurements via ultrasound and supine MRI were compared to the clinical loss of resistance depth (CLORD).
- A Pearson correlation coefficient was calculated to assess for correlation between parasagittal oblique and transverse US, MRI, and CLORD cervical space measurements. (Graph 1 and Table 1). Differences in measurements were compared using two one-sided tests to assess equivalency between CLORD and the imaging modalities with an equivalence margin of 0.5cm (Table 2).

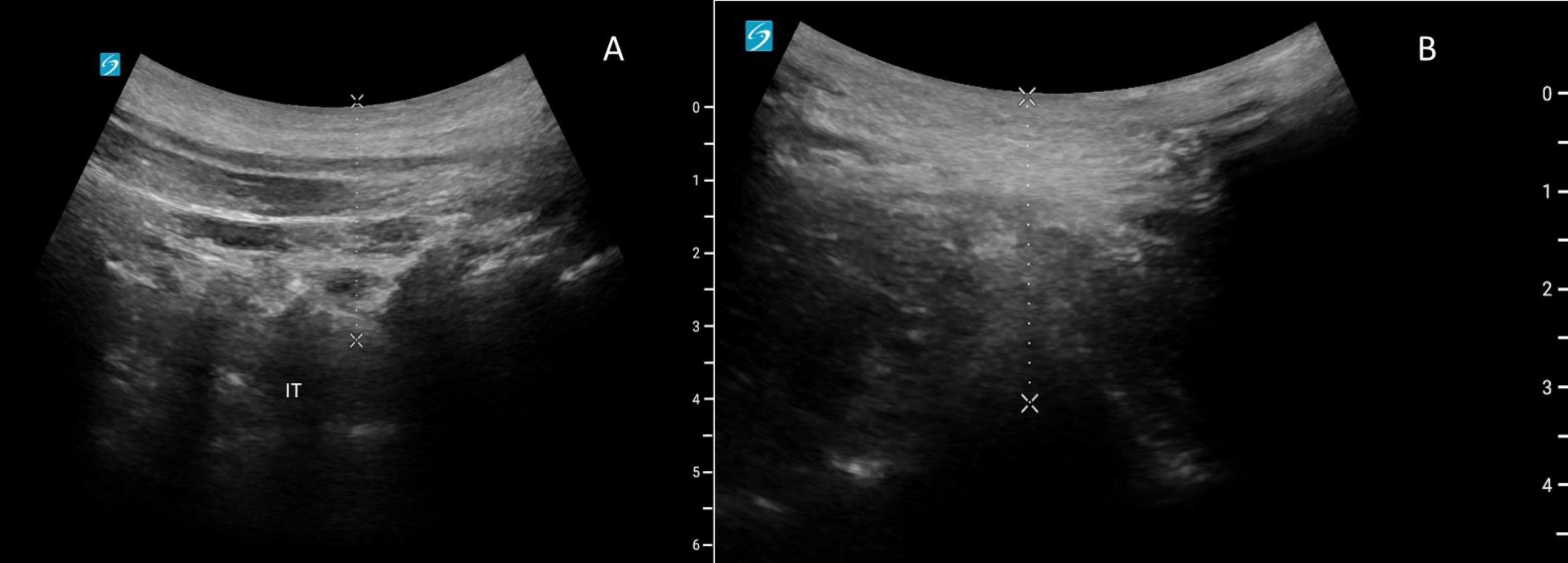


Figure 1.
A: Parasagittal view of the cervical interlaminar, epidural, and intrathecal (IT) spaces.
B: Transverse view of cervical interlaminar space. Visualization of the epidural space is more challenging in this view.

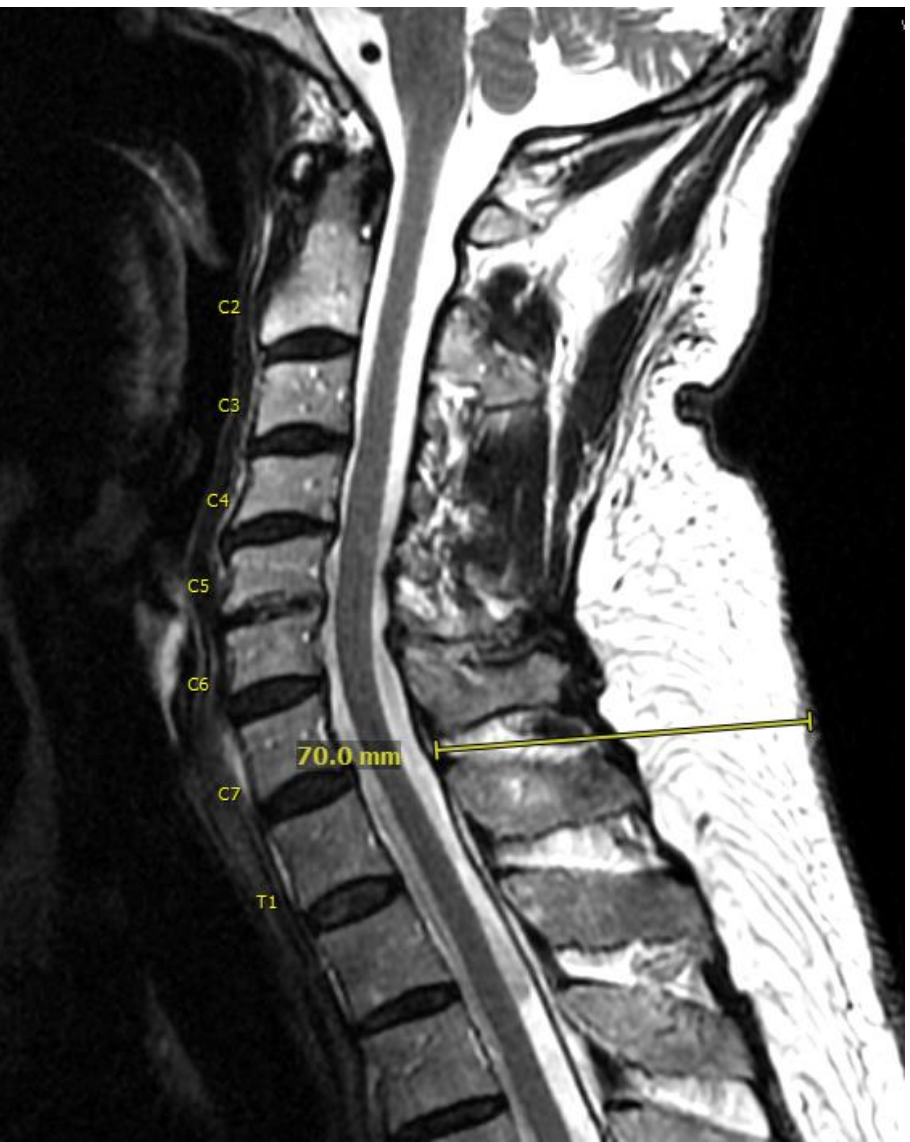


Figure 2.
Measurement of C7-T1 ligamentum flavum depth on MRI. Line extends from the skin surface to anterior border of ligamentum flavum.

MRI and Ultrasound Measurements Are Not Equivalent to Clinical Loss of Resistance Depth During Cervical Epidural Steroid Injections

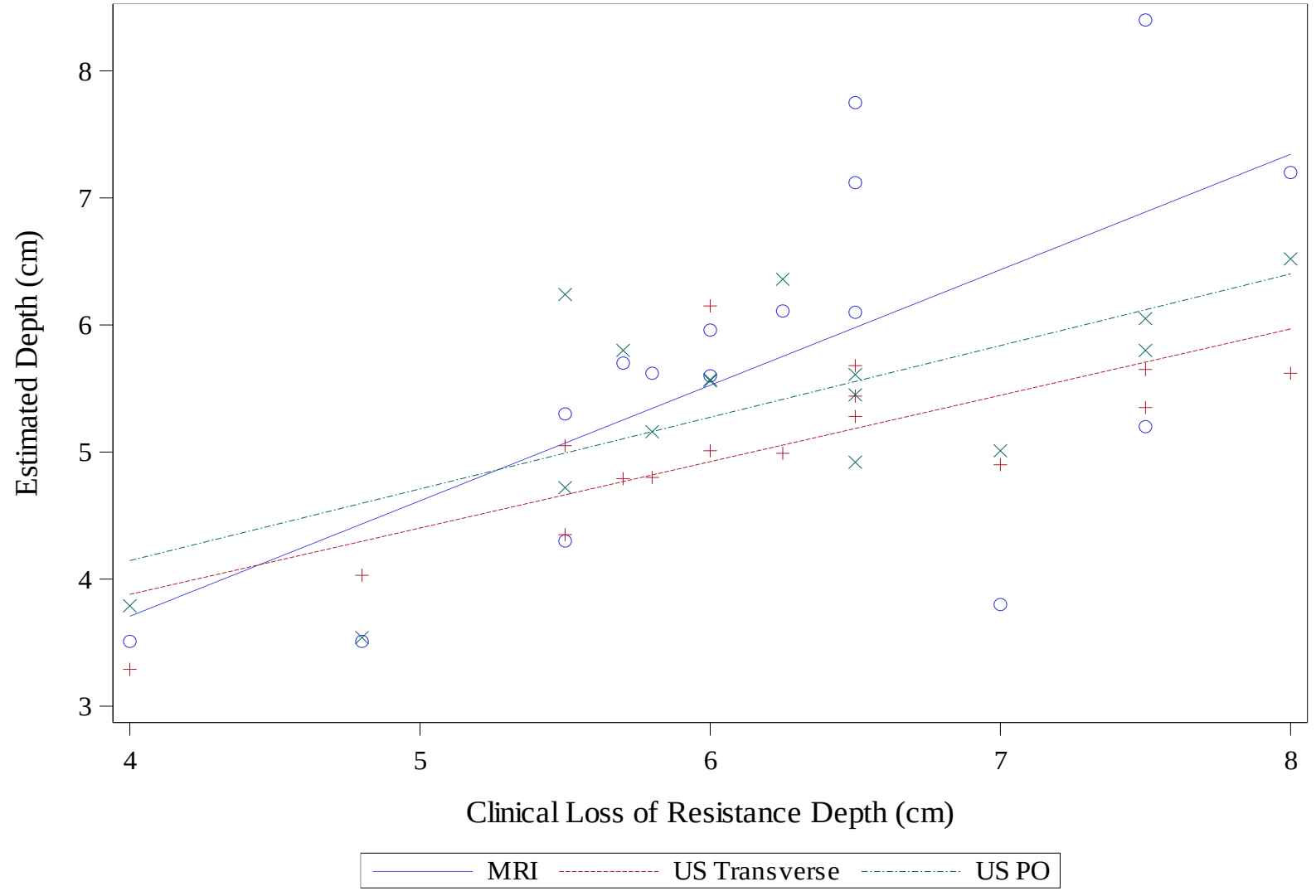


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RESULTS

Graph 1: Correlation between Ultrasound and CLORD



- We found strong correlation between MRI and ultrasound measurements and CLORD. The Pearson correlation coefficient for transverse ultrasound and CLORD was the highest at 0.76 (P<.001), compared to 0.68 (p=.003) and 0.64 (p=.007) for parasagittal oblique ultrasound view and MRI, respectively.
- Age, BMI, and gender did not have a significant effect on measurements of ultrasound and CLORD.

Table 2: Tests for equivalency between clinical loss of resistance and radiological measurements, with 0.50 cm equivalence margin

Difference Measurement	Mean	Lower Bound		90% CL Mean			Upper Bound	Assessment
Parasagittal Oblique - CLORD	-0.8094	-0.5	>	-1.1422	-0.4766	<	0.5	Not equivalent
Transverse - CLORD	-1.1669	-0.5	>	-1.4589	-0.8749	<	0.5	Not equivalent
MRI - CLORD	-0.4919	-0.5	>	-0.9827	-0.00105	<	0.5	Not equivalent

- MRI was not equivalent and underestimated CLORD, with mean difference of -0.49 cm (95% CI -0.39, -0.11). Transverse and parasagittal oblique measurements were also not equivalent and under-estimated CLORD with mean difference of -1.1669 cm (95% CI -1.4589, -0.8749) and -0.8094 (95% CI -1.214, -0.4766), respectively.

DISCUSSION

- Preliminary data from this study suggest that ultrasound and MRI measurements in the cervical spine may not be useful to estimate clinical LOR during ESI.
- Compared to the lumbar spine, the cervical spine has anatomical complexity presents challenges for ultrasound visualization and accurate measurements. Its smaller size and robust spinous process may create shadowing on the ultrasound imaging.
- Patient body habitus (morbidly obese), misidentification of the levels, operator error, excessive tissue compression, prior surgery, and/or significant degenerative changes in the spine may impede the ability to use ultrasound and obtain accurate measurements.
- Despite the lack of full agreement of either imaging modality, the underestimation to CLORD is worth mentioning. The tendency to underestimate rather than overestimate may provide an initial but safe estimate for depth of needle placement.

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