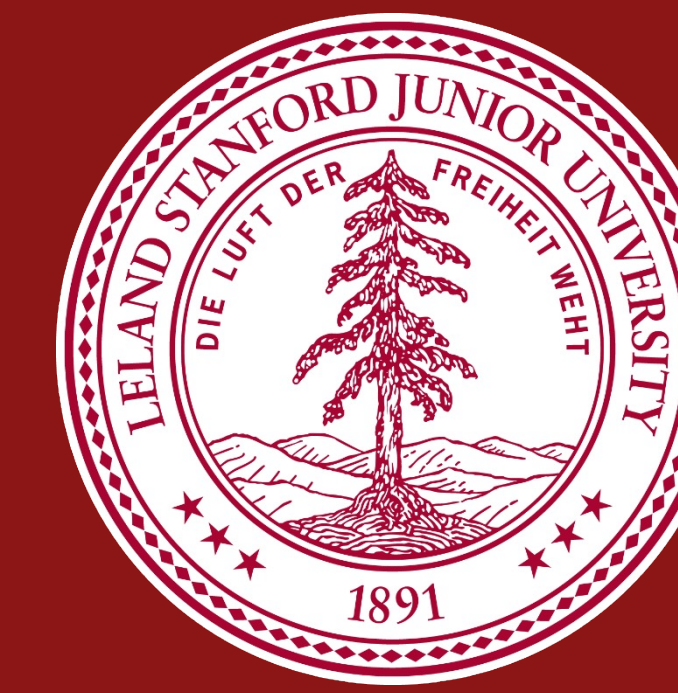




Stanford
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2D and 3D Anatomic Analysis of Thoracic Epidural Placement: A Single Center 1-Year Retrospective Review

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Introduction

- Success rates for thoracic epidural placement vary, and primary failure remains a concern.
- CT imaging of the spine is not routinely used for epidural planning.
- Anatomical factors may impact epidural catheter success and may be identified using 3D-rendered and quantitative 2D CT images when available.

Methods

- 1-year retrospective chart review was conducted for thoracic epidurals attempted at a single quaternary care academic medical center.
- Available CT images were systematically reviewed to evaluate anatomical factors associated with technically difficult placement
- This analysis was performed using standard 2D CT scans (three planes) and 3D-rendered images.
- A suggested best approach for epidural placement was also recorded, based on the most open space on imaging.

Results

- There were 11 epidural placement failures among 524 total thoracic epidurals attempted (98% success rate).
- For patient characteristics, the majority were male, with varying ages and morphometrics.
- Upper abdominal surgery was the most common indication.
- The most common anatomic findings: apposition of spinous processes (< 2 mm) (n = 8, 73%); scoliosis/rotation of the spine (n = 6, 55%); and narrow interlaminar spaces (< 3 mm) (n = 5, 45%) (Table 2).
- The 3D CT renderings facilitated identification of relatively open versus closed spaces (Images 1 and 2) in each case.
- Midline trajectory analysis frequently predicted more bony contact compared to paramedian.
- In 10 (91%) of the failed epidurals, CT analysis revealed at least one potentially viable approach at an appropriate level.

Discussion

- This study demonstrates the feasibility of spine analysis to identify optimal interspaces and anatomical contributors to epidural difficulty, with challenging or failed cases often showing indicators detectable through combined 2D and 3D evaluation.
- 3D trajectory analysis may identify interspaces where epidural placement is likely futile, supporting earlier selection of alternate levels or alternative regional analgesic techniques.

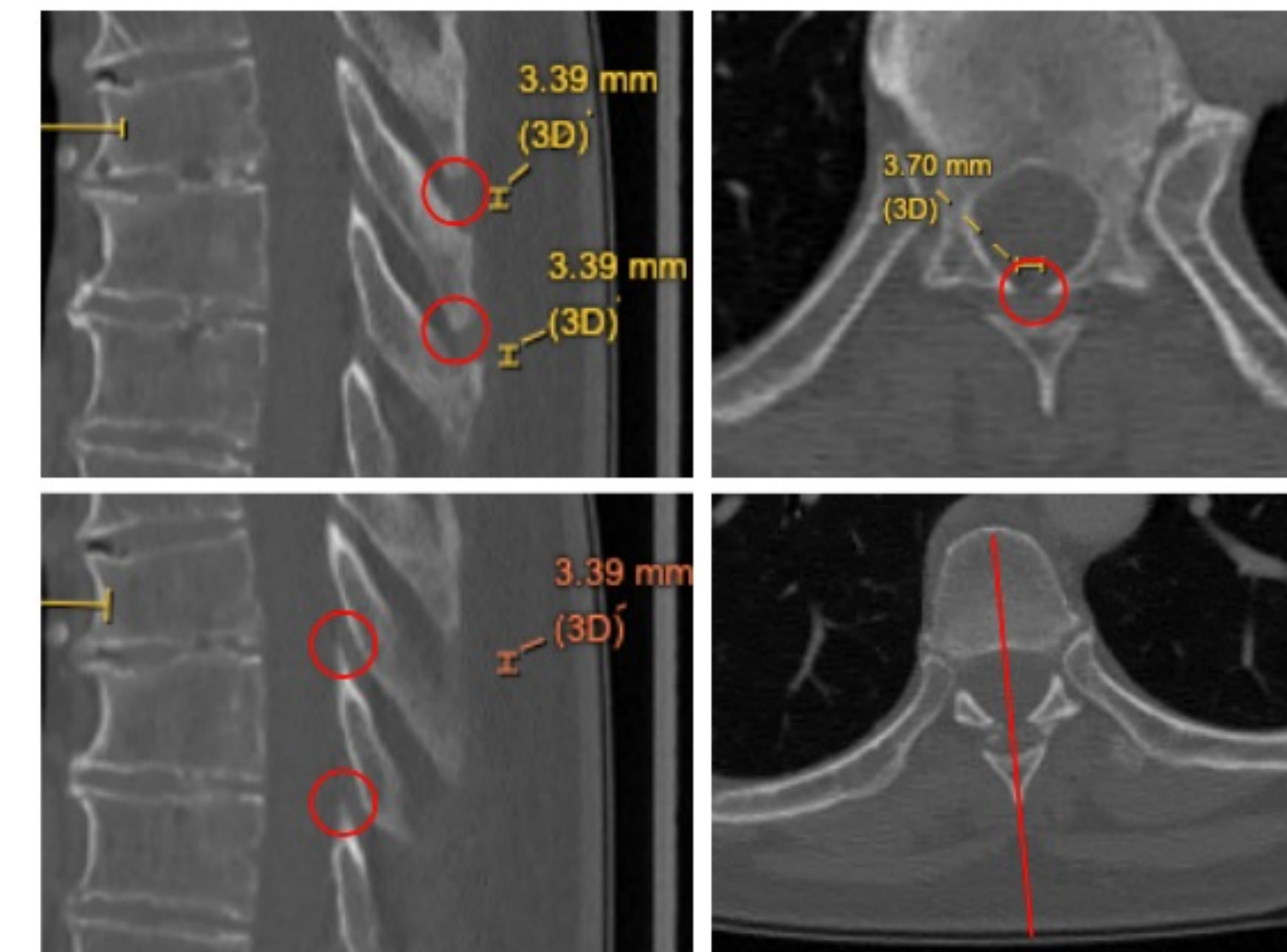


Image 1: CT scan representing closed spaces
Top left: narrow interspinous; top right: narrow inter-facet; bottom left: narrow interlaminar; bottom right: axial rotation

References



Please scan

Case #	Aborted epidural notes	Suggested best approach
1	Multiple attempts by regional fellow and attending, unsuccessful placement	L paramedian T7/8
2	Multiple attempts at 2 levels, 3 providers, midline and paramedian, unsuccessful placement	Midline T8/9
3	Multiple attempts at T7/8 and T8/9, unsuccessful, aborted	Steep paramedian T8/9
4	4 attempts with different providers, not successful	Midline T7/8
5	OR anesthesia team (no regional anesthesia involvement), aborted	Midline T8/9
6	Ultrasound counted levels, viewed interlaminar spaces but no anterior complex; multiple attempts at T6/7 and T7/8, bilateral paramedian; one attempt R paramedian T8/9	Steep paramedian/ paraspinous T7/8
7	Aborted after multiple attempts by two attendings (one OR anesthesia, one regional anesthesia)	L paramedian T10/11
8	3 attempts by 3 different providers; R paramedian T7/8, L paramedian T8/9, R paramedian T9/10	Midline T9/10
9	OR anesthesia team, multiple attempts	L paramedian T8/9
10	Attempted T7/8, significant scoliosis, engaged ligament, left loss, negative column test, unable to thread catheter	L paramedian T7/8
11	Multiple attempts, reported convincing LOR but negative column test, able to thread catheter but negative electrical stimulation test, no epidural level with local anesthetic	No clear openings

Table 1: procedure notes

Case #	Axial rotation/ scoliosis	SP apposition/ osteophytes	Steep interlaminar space	Narrow interlaminar space	Narrow inter-facet distance	Deep LOR
1	✓	✓				
2		✓		✓		
3		✓	✓			
4	✓					
5				✓	✓	
6	✓	✓	✓	✓	✓	
7	✓	✓				✓
8	✓	✓			✓	
9		✓	✓	✓		
10	✓					
11		✓		✓	✓	

Table 2: CT scan findings

The presence of a check mark indicates a specific anatomic finding is present for that case
Steep IL space: > 45 degrees; narrow IL space: < 3 mm; narrow inter-facet: < 4-5 mm; narrow SP: < 2 mm; deep LOR: > 7 cm

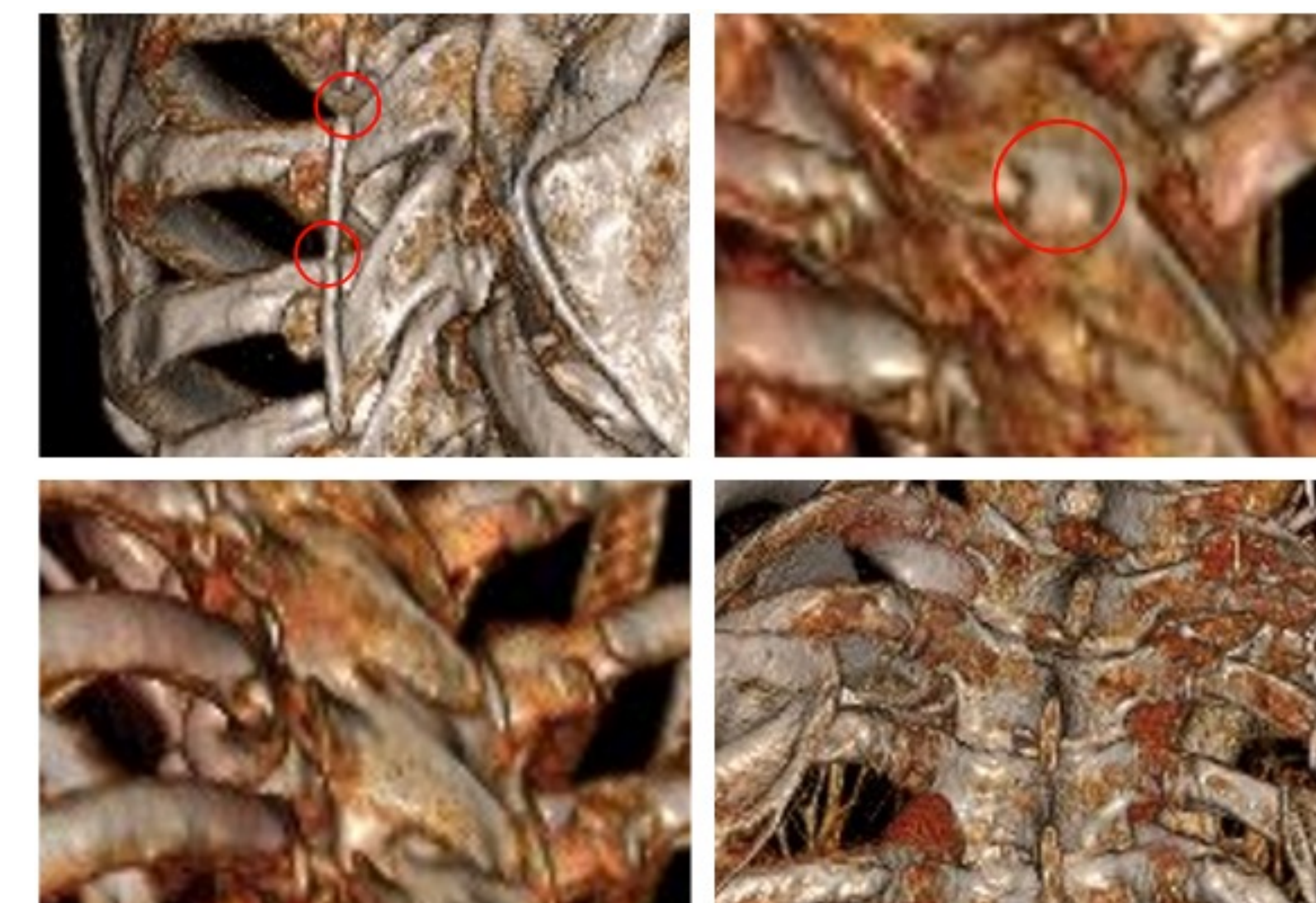


Image 2: 3D modeling of open/closed spaces
Top left: narrow interspinous; top right: osteophyte in lamina; bottom left: narrow and steep interlaminar space; bottom right: spine rotation