

Analysis of Spinal Canal Diameter in the Placement of Thoracic Spinal Cord Stimulator (SCS) Paddle Leads

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Introduction

Neurologic deficit is a rare complication of thoracic spinal cord stimulator (SCS) paddle lead implantation. Interestingly, multiple authors believe the incidence of neurologic complications after SCS paddle lead placement is under-reported. This study looked at imaging characteristics to help predict safe paddle lead placement. This imaging study was undertaken to determine minimum canal diameter required for safe paddle lead placement.

Methods

Patients undergoing thoracic laminectomy for new SCS paddle lead placement were identified from January 2018 to July 2021. Preoperative thoracic canal diameter was measured in the sagittal plane perpendicular to the disc space from T5/6 to T11/12 (Figure 1). These thoracic levels were chosen because they span the most common levels targeted for SCS placement. Comparison of patients with and without new neurologic deficit was performed using an unpaired Student's t-test (Prism 9, GraphPad Software).

Results

Ninety-seven of 102 patients initially identified had thoracic imaging available for review. Two of 102 (2%) patients complained of transient neurologic deficit after thoracic SCS placement (Table 1). Both patients had SCS paddle lead placement at T8/9 and single-level laminectomy for placement (Table 1) and average canal diameter <11 mm (Table 2). The average canal diameter of patients with and without neurologic deficit was 9.86 mm (range 6.12-11.3 mm) and 12.04 mm (range 6.12-17.4), respectively (P < 0.001) (Table 2; Figure 2).

Results

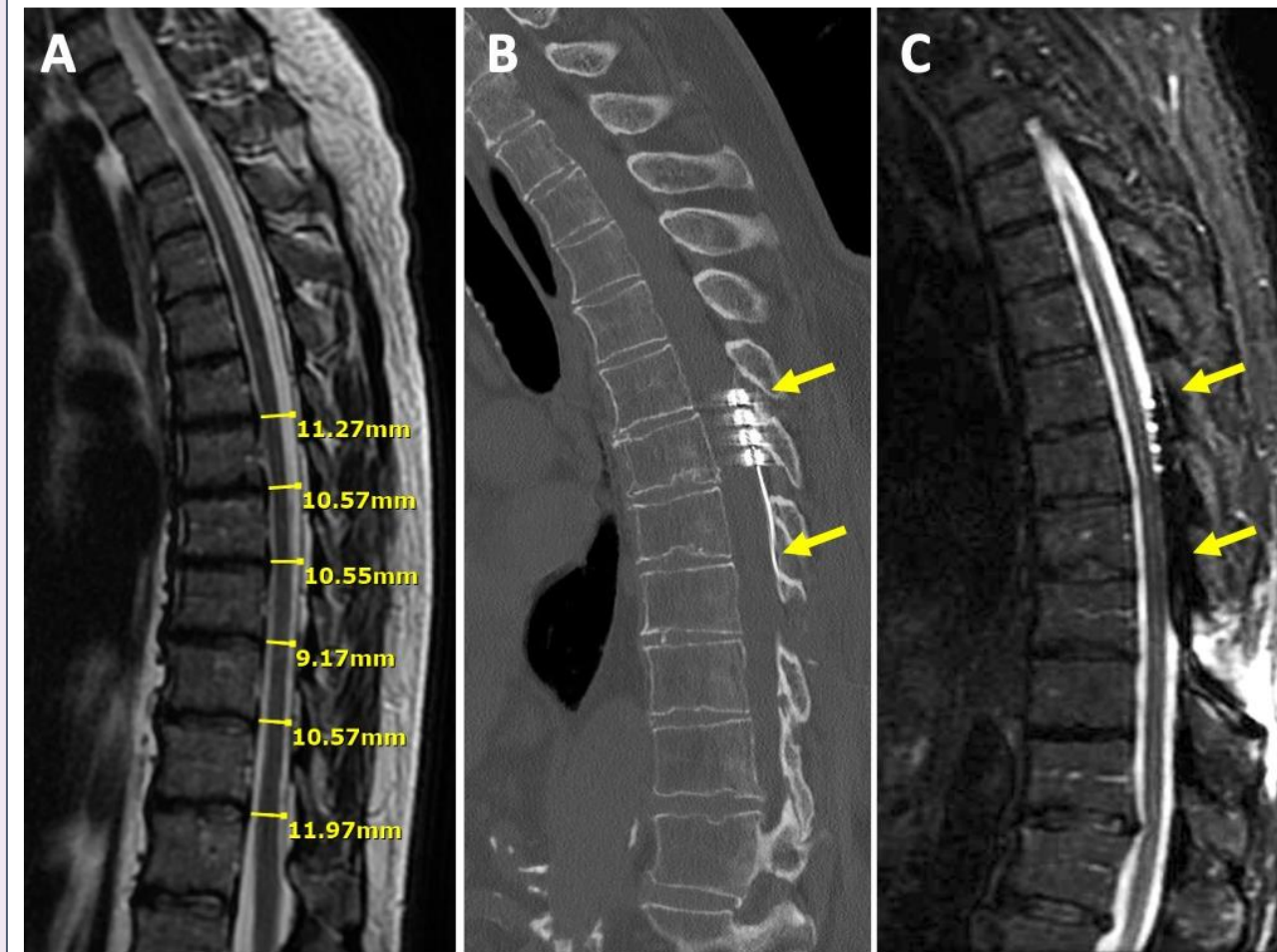


Figure 1. A. Sagittal T2WI MRI demonstrating measurement of thoracic canal diameter. Anteroposterior canal diameter is measured perpendicular to the disc space at T5/6, T6/7, T7/8, T8/9, T9/10, and T11/12 from dorsal aspect of disc to dorsal dura. These thoracic levels span the most common levels targeted for spinal cord stimulator placement. B and C. Sagittal thoracic CT (B) and MRI (C) depicting implanted SCS paddle lead (yellow arrows) measuring 46 mm long x 11 mm wide x 2 mm thick.

Results

Table 1. Demographics of 102 patients undergoing thoracic laminectomy for new spinal cord stimulator paddle lead placement from January 2019 to July 2021

Variable	Total (%)	Neurologic deficit	
		Yes	No
No. patients	102	2 (2%)	100 (98%)
Female	48 (47%)	1 (1%)	47 (46%)
Male	54 (53%)	1 (1%)	53 (52%)
BMI			
< 30	37 (36%)		37 (36%)
30 - 40	49 (48%)	2 (2%)	47 (46%)
> 40	16 (16%)		16 (16%)
Level SCS paddle lead			
T7/8	10 (10%)		10 (10%)
T8/9	81 (79%)	2 (2%)	79 (77%)
T9/10	7 (7%)		7 (7%)
Other	4 (4%)		4 (4%)
Surgical technique			
Standard laminectomy	88 (86%)	2 (2%)	86 (84%)
Aggressive laminectomy	14 (14%)		14 (14%)

Table 2: Imaging* characteristics of 97 of 102 patients undergoing thoracic laminectomy for new spinal cord stimulator paddle lead placement from January 2019 to July 2021

Variable	Total (%)	Neurologic deficit	
		Yes	No
No. patients	97	2	95
Average canal diameter†			
< 10 mm	10 (10%)	1 (1%)	9 (9%)
10 - 11 mm	23 (24%)	1 (1%)	9 (9%)
11 - 12 mm	21 (22%)		21 (22%)
> 12 mm	43 (44%)		43 (44%)
Spinal cord position at implant level			
Ventral	17 (18%)	1 (1%)	16 (17%)
Central	73 (75%)	1 (1%)	72 (74%)
Dorsal	5 (5%)		5 (5%)
N/A (CT only)	2 (2%)		2 (2%)

*Thoracic imaging included 89 magnetic resonance imaging, 6 computed tomography (CT) myelograms, and 2 CT without contrast. Five patients did not undergo thoracic imaging prior to SCS.

†Average canal diameter was calculated by averaging the diameters of T5/6, T6/7, T7/8, T8/9, T9/10, and T10/11, which are the most common levels targeted for SCS placement.

Results

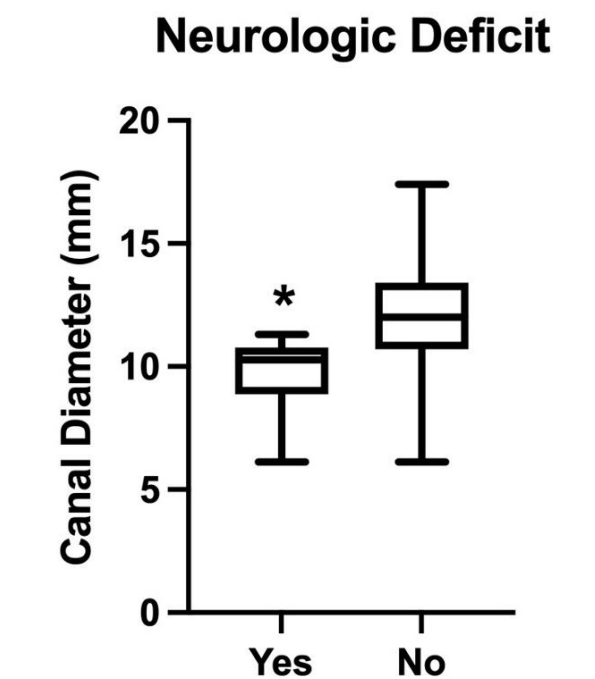


Figure 2. Box plot graph of 97 imaged patients with (Yes) and without (No) neurologic deficit after thoracic laminectomy for spinal cord stimulator paddle lead placement. Mean canal diameter with (Yes) and without (No) neurologic deficit was 9.86 mm vs. 12.04 mm (P < 0.001, t-test), respectively.

Discussion

Postoperative neurologic deficit is a rare complication after thoracic laminectomy for SCS paddle lead placement. The authors recommend ensuring a thoracic canal diameter of at least 11 mm to accommodate a SCS paddle lead measuring 2 mm thick (Figure 1 and 2). If canal diameter is <11 mm, aggressive undercutting of the lamina or a second laminectomy should be considered.

Conclusion

For safe placement of thoracic SCS paddle leads, consider aggressive undercutting of lamina or second laminectomy for canal diameters less than 11 mm.



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