Does Disc Distraction After Cervical Total Disc Arthroplasty Impact Range of Motion and Patient Reported Outcomes?

Authors: Vincent P. Federico, MD; Athan G. Zavras, BS; Alexander Butler, MD; Mohammed A. Munim, BS; Michael T. Nolte, MD; Wylie Lopez, MD; Gregory D. Lopez, MD; Howard S. An, MD; Matthew W. Colman, MD; Frank M. Phillips, MD

Rush University Medical Center, Division of Orthopaedic Spine Surgery

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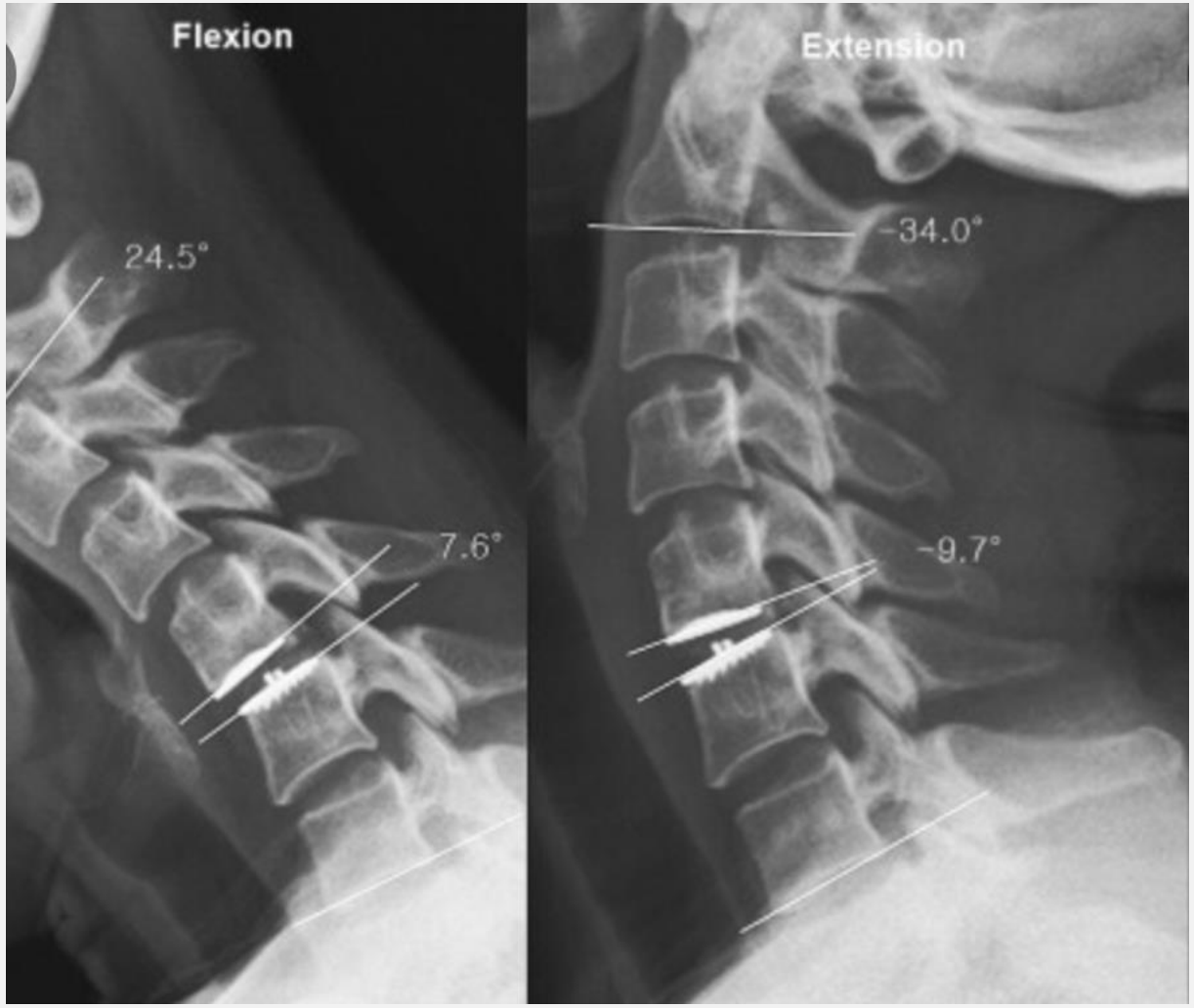
INTRODUCTION

- TDA has shown to be equivalent or even superior to anterior cervical discectomy and fusion (ACDF) with regards to:
  - Patient reported outcomes (PROs)
  - Device-related serious adverse events
  - Subsequent surgery at the index and adjacent levels
- More recently, studies have suggested that over-distraction can lead to reduced ROM and clinical outcomes.
- Additionally, disc heights at both index and adjacent levels have been found to be less than the smallest available implant height.



METHODS

Radiographic Outcomes

- Middle disc space height was measured on preoperative and 6 weeks postoperative lateral radiographs to quantify the magnitude of disc space distraction
- Patients were grouped into <2mm distraction and >2mm distraction groups

Radiographic Measurements

- Operative segment lordosis
- Segmental range of motion (ROM) on flexion/extension
- Global Cervical (C2-C7) ROM on flexion/extension

Patient Reported Outcomes (PROs)

- Neck Disability Index (NDI)
- Visual Analog Scale (VAS) Neck and Arm
- Veterans RAND 12-Item Health Survey (VR-12)
- Short Form 12-Item Health Survey (SF-12)

Statistical Analysis

- Independent samples *t*-test was used to compare outcomes between groups
- Multivariate linear regression to adjust for baseline differences

RESULTS

- 44 patients who received cervical TDA at 50 operative levels were included for analysis
- Distraction <2mm was seen at 24 levels, while distraction >2mm was observed at 26 levels
- No baseline differences except for younger age (42.00 ± 7.29 vs 46.70 ± 7.52, p = 0.042)
- No differences in TDA device used

	All Patients/Levels	< 2 mm Distraction	> 2 mm Distraction	p-value
Age (years)	44.45 ± 7.70	42.00 ± 7.29	46.70 ± 7.52	0.042
BMI	27.73 ± 4.89	26.56 ± 2.78	28.69 ± 6.00	0.175
Sex				0.365
Female	22/44 (50%)	12/21 (57.14%)	10/23 (43.48%)	
Male	22/44 (50%)	9/21 (42.86%)	13/23 (56.52%)	
Number of Levels				0.448
1-Level	38/44 (86.36%)	19/21 (90.48%)	19/23 (82.61%)	
2-Levels	6/44 (13.64%)	2/21 (9.52%)	4/23 (17.39%)	
Operative Level				0.499
C4-C5	2/44 (4.55%)	0/21 (0%)	2/23 (8.70%)	
C5-C6	20/44 (44.45%)	10/21 (47.62%)	10/23 (43.48%)	
C6-C7	16/44 (36.36%)	9/21 (42.86%)	7/23 (30.43%)	
C4-C6	1/44 (2.27%)	0/21 (0%)	1/23 (4.35%)	
C5-C7	5/44 (11.36%)	2/21 (9.52%)	3/23 (13.04%)	
Device				0.136
Mobi-C	29/50 (58%)	11/24 (45.83%)	18/26 (69.23%)	
M6	15/50 (30%)	11/24 (45.83%)	4/26 (15.38%)	
PCM	3/50 (7.69%)	1/24 (4.17%)	2/26 (7.69%)	
ProDisc-C	3/50 (7.69%)	1/24 (4.17%)	2/26 (7.69%)	
Follow Up (months)	33.12 ± 20.74	36.25 ± 21.56	30.27 ± 20.00	0.345

Bold p-value denotes statistical significance; BMI, Body Mass Index

RESULTS

- No preoperative differences except for less segmental lordosis (1.05 ± 3.79° vs 4.40 ± 4.12°, p = 0.004) among patients with <2mm distraction
- At 6 weeks postop and final follow up, <2mm distraction had significantly greater C2-C7 ROM
- <2mm distraction resulted in significantly greater improvement in ROM from preop to final follow up

	All Levels	< 2 mm Distraction	> 2 mm Distraction	p-value
Preoperative				
Segmental Lordosis	2.79 ± 4.27	1.05 ± 3.79	4.40 ± 4.12	0.004
Segmental ROM	6.28 ± 3.81	6.70 ± 4.76	5.87 ± 2.61	0.519
C2-C7 ROM	40.41 ± 18.56	40.96 ± 24.04	39.85 ± 11.41	0.860
6 Weeks Postop				
Segmental Lordosis	5.55 ± 6.68	3.85 ± 6.77	7.12 ± 6.33	0.517
Segmental ROM	8.55 ± 3.88	8.05 ± 4.15	10.26 ± 2.39	0.404
C2-C7 ROM	47.97 ± 14.79	51.18 ± 14.51	38.32 ± 12.10	0.022
Final Postop				
Segmental Lordosis	6.30 ± 6.59	5.00 ± 6.68	7.50 ± 6.40	0.894
Segmental ROM	8.54 ± 4.47	9.21 ± 5.50	7.92 ± 3.25	0.915
C2-C7 ROM	45.25 ± 15.80	54.28 ± 13.75	36.23 ± 12.31	0.004
Delta (Δ)				
Segmental Angle	3.50 ± 6.83	3.08 ± 7.18	3.86 ± 6.64	0.538
Segmental ROM	2.20 ± 5.54	2.39 ± 6.00	2.03 ± 5.26	0.277
C2-C7 ROM	2.20 ± 21.02	11.36 ± 21.19	-6.96 ± 16.86	0.009

Bold p-value denotes statistical significance; ROM, Range of Motion

RESULTS

- No differences in baseline PROMs between groups
- Significant improvement was noted for both groups in all PROMs ($p<0.05$), except for SF12 MCS and VR12 MCS
- After controlling for baseline differences, distraction <2mm resulted in better SF12 PCS, VR12, VAS Arm, and VAS Neck, as well as in greater improvement in VAS Neck and NDI

	All Levels	< 2 mm Distraction	> 2 mm Distraction	p-value
Preoperative				
SF12 PCS	35.43 ± 9.45	33.58 ± 8.46	37.14 ± 10.14	0.641
SF12 MCS	51.76 ± 9.10	52.23 ± 7.36	51.33 ± 10.59	0.478
VR12 PCS	37.59 ± 10.44	35.88 ± 9.79	39.17 ± 10.95	0.890
VR12 MCS	54.15 ± 8.79	54.34 ± 7.24	53.97 ± 10.15	0.400
VAS Arm	5.23 ± 2.80	5.76 ± 2.73	4.77 ± 2.84	0.476
VAS Neck	5.25 ± 2.52	5.80 ± 2.45	4.76 ± 2.53	0.163
NDI	36.09 ± 15.83	41.81 ± 14.10	31.08 ± 15.84	0.381
Final Postop				
SF12 PCS	45.47 ± 10.45	47.30 ± 9.03	43.55 ± 11.65	0.038
SF12 MCS	55.11 ± 6.98	55.30 ± 6.57	54.91 ± 7.53	0.618
VR12 PCS	47.99 ± 9.37	49.78 ± 7.57	46.12 ± 10.80	0.026
VR12 MCS	59.12 ± 7.09	59.65 ± 6.41	58.57 ± 7.84	0.257
VAS Arm	1.55 ± 2.35	0.68 ± 1.21	2.38 ± 2.85	0.017
VAS Neck	2.28 ± 2.59	1.18 ± 1.79	3.34 ± 2.83	0.008
NDI	14.99 ± 14.75	10.77 ± 11.55	19.22 ± 16.55	0.058
Delta (Δ)				
SF12 PCS	9.88 ± 11.91	13.37 ± 9.70	6.23 ± 13.09	0.071
SF12 MCS	2.95 ± 8.18	2.86 ± 8.71	3.05 ± 7.80	0.829
VR12 PCS	9.98 ± 11.57	13.29 ± 9.93	6.52 ± 12.35	0.118
VR12 MCS	4.80 ± 8.47	5.36 ± 9.39	4.22 ± 7.57	0.769
VAS Arm	-3.63 ± 3.85	-4.98 ± 3.22	-2.39 ± 4.03	0.063
VAS Neck	-2.89 ± 3.64	-4.59 ± 2.75	-1.33 ± 3.70	0.005
NDI	-20.36 ± 20.86	-30.46 ± 15.08	-10.71 ± 21.32	0.050

Bold p-value denotes statistical significance; SF12, Short Form 12-Item Health Survey; VR12 Veteran RAND 12-Item Health Survey; PCS, Physical Component Score; MCS, Mental Component Score; VAS, Visual Analog Scale; NDI, Neck Disability Index

CONCLUSION

Patients with <2mm disc height difference had increased C2-C7 ROM at both 6 weeks and final follow-up but not segmental ROM.

Patients with <2mm disc height difference had significantly greater improvement in VAS neck and NDI after controlling for baseline differences.

Limiting differences in disc space height to <2mm may result in more harmonious kinematics between all cervical levels, allowing for improved global ROM and neck pain.

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THANK YOU!

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