Factors Associated with Postoperative Kyphosis and Loss of Range of Motion after Cervical Disc Replacement

Abel De Varona Cocero[1], Stephane Owusu-Sarpong[2], Fares Ani, Camryn Patz Myers[3], Constance Maglaras, Tina Raman[2], Themistocles Stavros Protopsaltis[4]
[1]NYU Langone Health Orthopedic Surgery, [2]NYU Langone Orthopedic Hospital, [3]NYU Langone Health, [4]NYU Hosptial For Joint Disorders

INTRODUCTION:

Cervical disc replacement (CDR) is an effective option for the treatment of herniated cervical discs with radiculopathy or myelopathy. One of the main benefits of CDR is that it maintains physiological range of motion (ROM) and lordosis while achieving decompression. However, there are cases where patients experience loss in segmental ROM or have segmental kyphosis postoperatively. This study analyzes the radiographic outcomes of these patients and evaluates the risks associated with postoperative kyphosis and loss of range of motion after CDR.

METHODS:

Patients undergoing CDR were included. The cohort was separated into poor x-ray outcomes cases (PXR) and successful x-ray outcomes cases (SXR). The PXR group was defined as patients who had a loss in segmental ROM (≥11° decrease in Δ Segmental ROM) after the CDR and/or had postoperative segmental kyphosis at the operative level. Radiographic outcome measures: pre-and postoperative segmental and regional sagittal alignment in neutral and flexion/extension, cSVA, disc height, implant distance to the center of the disc, and implant distance to the posterior endplate. Independent T-test analysis and $\chi 2$ test were used to analyze differences in radiographic surgical outcomes, with significance set at $p<0.05$.

RESULTS:

In total, 151 (PXR=47; SXR=104) patients met the cohort criteria. Pre-and postoperative segmental lateral cobb angles were more kyphotic in the PXR group (3.5 vs. -1.4, p<0.001; 2.6 vs. -5.6, p<0.001). There was a larger Δ in segmental lateral cobb angle in the SXR group (-4.2 vs. -0.9, p<0.001). The PXR group had a larger degree of flexion and a significantly smaller degree of extension at the segment (11.3 vs. 6.5, p<0.001; -2.2 vs. -6.1, p=0.049). There was a significant loss in segmental ROM in the PXR group (-5.7 vs. 1.5, p<0.001). Pre-and postoperative C2-C7 lateral cobb angles were more kyphotic in the PXR group (-1.2 vs. -9.4, p<0.001; -2.9 vs. -13.9, p<0.001). Pre- and postoperative cSVA were larger in the PXR group (29.6 vs. 25.3, p=0.047; 30.10 vs. 22.8, p=0.004). There were no significant differences in postoperative complications between the two groups.

DISCUSSION AND CONCLUSION:

Following CDR, patients who developed postoperative kyphosis or decreased range of motion were more likely to have less segmental and regional C2-7 lordosis and a larger preoperative and postoperative cSVA. Surgeons indicating CDR and counseling patients on the options for anterior cervical discectomy should consider these preoperative parameters. Further studies with long-term follow including clinical outcomes are warranted.

Implant Distance to the Center of the Disc (mm)			
CDR Level	Poor X-Ray Outcomes (N=47)	Successful CDR (N=104)	p-value
C3-C4 (N=3)	0.07±0.12	1.00±0.56	0.024
C4-C5 (N=5)	0.98±0.61	0.83±0.65	0.63
C5-C6 (N=28)	0.87±0.68	0.82±0.74	0.748
C6-C7 (N=26)	0.78±0.93	1.02±0.81	0.268
Implant Distance to the Posterior Endplate (mm)			
CDR Level	Poor X-Ray Outcomes (N=47)	Successful CDR (N=104)	p-value
C3-C4 (N=3)	1.45±0.41	2.41±0.55	0.028
C4-C5 (N=5)	1.59±0.64	2.39±1.16	0.153
C5-C6 (N=28)	2.33±1.30	2.00±0.89	0.22
C6-C7 (N=26)	1.57±0.95	1.99±1.10	0.119

Cervical Disc Replacements			Poor X-Ray Outcomes (N = 47)	Successful CDR (N = 104)	p-value
Radiographic Analysis	Segmental Lordosis	Preop Segmental Lateral Cobb Angle at OP Levels* (deg)	3.5 ± 4.9	-1.4 ± 5.1	<0.001
		Postop Segmental Lateral Cobb Angle at OP Levels* (deg)	2.6 ± 4.1	-5.6 ± 5.7	<0.001
		Δ Segmental Lateral Cobb Angle at OP Levels (deg)	-0.9 ± 4.4	-4.18 ± 0.554	<0.001
		Preop Segmental Range of Motion at OP Levels (deg)	13.5 ± 14.8	12.67 ± 8.45	0.675
		Postop Segmental Range of Motion at OP Levels (deg)	9.9 ± 11.1	13.5 ± 7.8	0.061
		Δ Segmental Range of Motion at OP Levels (deg)	-5.7 ± 11.6	1.5 ± 7.4	<0.001
	C2-C7 Lordosis	Preop C2-C7 Lateral Cobb Angle* (deg)	-1.2 ± 13.3	-9.5 ± 11.8	<0.001
		Postop C2-C7 Lateral Cobb Angle* (deg)	-2.9 ± 10.9	-13.9 ± 10.1	<0.001
		Δ C2-C7 Lateral Cobb Angle (deg)	-1.7 ± 10.7	-4.4 ± 9.7	0.125
		Preop C2-C7 Range of Motion (deg)	47.8 ± 17.7	42.1 ± 19.1	0.083
		Postop C2-C7 Range of Motion (deg)	38.5 ± 24.6	40.4 ± 17.9	0.613
		Δ C2-C7 Range of Motion (deg)	-10.4 ± 26.6	-1.6 ± 21.7	0.068
	cSVA	Preop cSVA (mm)	29.6 ± 12.2	25.3 ± 12.4	0.047
		Postop cSVA (mm)	30.1 ± 16.8	22.8 ± 12.8	0.004
		Δ cSVA (mm)	0.4 ± 13.5	-2.5 ± 10.3	0.196
	Disc Height	Preop Disc Height (mm)	4.9 ± 1.1	5.3 ± 1.2	0.046
		Postop Disc Height (mm)	6.0 ± 1.6	6.1 ± 1.4	0.942
		Δ Disc Height (mm)	1.1 ± 1.6	0.8 ± 1.3	0.106

* (+) Lateral Cobb Angles indicate Kyphosis, (-) Lateral Cobb Angles indicate Lordosis

Subanalysis PreOp Segmental Kyphosis: Outcomes	PreOp Segmental Kyphosis (N=59)	Non-Kyphotic (N=94)	p-value
Loss in ROM (≥ 11° decrease in the Δ of Segmental ROM) (% of patients)	18 (30.5%)	19 (20.2%)	0.106
Disc Height Collapse (% of patients)	14 (23.7%)	28 (29.8%)	0.265
Postop Segmental Kyphosis (% of patients)	34 (57.6%)	16 (17.0%)	<0.001
Postop C2-C7 Kyphosis (% of patients)	18 (30.5%)	5 (5.3%)	<0.001
Poor X-Ray Outcomes CDR (% of patients)	30 (50.8%)	17 (18.1%)	<0.001