

Order of Surgical Intervention in Double-Crush Syndrome

Melissa R Holloway, Clarke Cady-McCrea, Cindy Xindi Wang, Thomas J Carroll, Danielle Wilbur, Robert W Molinari

INTRODUCTION: Double-crush syndrome involves concurrent nerve compression at two points, typically in the cervical spine and peripherally in the upper extremity, such as the ulnar nerve at the elbow or the median nerve at the wrist. Surgical management of this condition, including which decompression to perform first, remains controversial. We aim to explore the effect of surgical technique, timing, and relative order on outcomes in patients with combined cervical and peripheral upper extremity nerve compression.

METHODS: This retrospective study included adult patients treated at a Level 1 trauma center between 2015 and 2022. All patients underwent primary cervical decompression and fusion (posterior spinal fusion or anterior cervical discectomy and fusion) and either carpal tunnel release, cubital tunnel release, or both, with open and endoscopic procedures included. Collected data included patient demographics, electrodiagnostic findings, surgical dates, and postoperative PROMIS scores (Physical Function [PF], Pain Interference [PI], and Depression [D]) collected over a minimum 6-month follow-up. We compared outcomes based on whether cervical decompression or peripheral nerve decompression was performed first. Multivariable logistic regression assessed the impact of surgical order and other factors on achieving the minimal clinically important difference (MCID) in PROMIS scores. This retrospective study included adult patients treated at a Level 1 trauma center between 2015 and 2022. All patients underwent primary cervical decompression and fusion (posterior spinal fusion or anterior cervical discectomy and fusion) and either carpal tunnel release, cubital tunnel release, or both, with open and endoscopic procedures included. Collected data included patient demographics, electrodiagnostic findings, surgical dates, and postoperative PROMIS scores (Physical Function [PF], Pain Interference [PI], and Depression [D]) collected over a minimum 6-month follow-up. We compared outcomes based on whether cervical decompression or peripheral nerve decompression was performed first. Multivariable logistic regression assessed the impact of surgical order and other factors on achieving the minimal clinically important difference (MCID) in PROMIS scores.

RESULTS: Patients who underwent cervical spine decompression first showed significantly better outcomes in PROMIS PF and D categories at multiple postoperative time points, including 1 month (PF, p=0.03; D, p=0.02), 6 months (PF, p=0.02; D, p<0.01), and 1 year (PF, p<0.01; D, p<0.01). Regression analysis revealed that primary cervical decompression was significantly associated with greater odds of achieving MCID in both PF (OR 2.5, p=0.03) and D (OR 2.3, p=0.05). Undergoing both carpal and cubital tunnel release, as opposed to only one, was also associated with improved outcomes (OR 3.1, p=0.03). No significant differences were found between groups for pain interference (PI) scores.

DISCUSSION AND CONCLUSION: Performing cervical spine decompression prior to peripheral nerve decompression was associated with superior functional and emotional recovery in patients with double-crush syndromes. These findings suggest that cervical pathology may have a greater impact on overall patient outcomes and should be prioritized in surgical planning. Future research should further investigate optimal management strategies for patients with multiple nerve compressions to guide surgical decision-making.

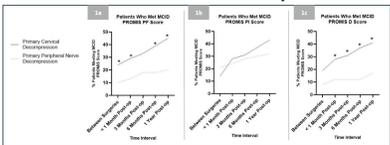


Table 1: Demographic characteristics and operative data, primary cervical spinal decompression versus primary peripheral nerve decompression.

Treatment	Cervical Decompression First (n=51)	Peripheral Nerve Decompression First (n=52)	p value
Sex			0.9999
Male	31	32	
Female	20	20	
Age (years)	58.5 (11.9)	61.1 (12.2)	0.2222
BMI	30.6 (6.7)	31.3 (7.0)	0.4731
Charlson Comorbidity Index (CCI)	2.8 (2.1)	2.8 (1.8)	0.6740
Cervical Spine Surgery	33	35	0.9999
Approach			
Anterior	30	31	
Posterior	3	4	
Peripheral Nerve Decompression Performed			0.6992
Carpal Tunnel Release	7	5	
Cubital Tunnel Release	12	10	
Both	43	44	0.8304
Carpal Tunnel Release Approach			
Open	13	15	
Endoscopic	43	44	
Cubital Tunnel Decompression			0.4513
Yes	7	3	
No	12	12	
Time Between Spine and Peripheral Nerve Surgery (days)	640.0 (500.9)	640.9 (546.5)	0.9921
Time Between Peripheral Nerve Surgery (days)	106.4 (190.0)	17.5 (55.3)	0.1701

Table 2: Multivariable Regression Met PROMIS MCID at Final Follow-up

Covariate	Met MCID PROMIS PF	Met MCID PROMIS PI	Met MCID PROMIS D			
	OR (95% CI)	P Value	OR (95% CI)	P Value	OR (95% CI)	P Value
Age	1.01 (0.96-1.06)	0.80	1.02 (0.97-1.08)	0.39	0.98 (0.93-1.03)	0.50
Charlson Comorbidity Index (CCI)	1.04 (0.77-1.40)	0.80	0.87 (0.64-1.18)	0.39	1.15 (0.86-1.54)	0.35
Gender						
Male	1.53 (0.65-3.61)	0.33	1.90 (0.85-4.30)	0.12	0.74 (0.31-1.77)	0.50
Female	0.98 (0.92-1.05)	0.56	1.01 (0.95-1.07)	0.24	1.01 (0.94-1.07)	0.86
BMI	1.00 (0.99-1.00)	0.54	1.00 (0.99-1.00)	0.55	0.99 (0.99-1.00)	0.42
Time Between Surgeries						
Surgical Order (First)						
Peripheral Nerve Decompression	2.50 (1.08-5.81)	0.03	1.52 (0.69-3.33)	0.30	2.32 (1.00-5.47)	0.05
Cervical Spine Surgery						
Peripheral Nerve Decompression Performed						
Carpal Tunnel Release	1.74 (0.44-6.81)	0.43	1.50 (0.39-5.77)	0.55	2.32 (0.63-8.60)	0.21
Cubital Tunnel Release	3.10 (1.09-8.83)	0.034	2.03 (0.73-5.67)	0.17	1.62 (0.55-4.79)	0.39
Both						
Cervical Spine Surgery Approach						
Anterior	0.73 (0.31-1.74)	0.48	0.97 (0.43-2.19)	0.94	0.94 (0.39-2.23)	0.88
Posterior						

MCID: Minimal Clinically Important Difference; PF: Physical Function; PI: Pain Interference; D: Depression
 Adjusted for all other reference values. Bolded text denotes p < 0.05