Improved Range of Motion and Pain Relief Following Radial-to-Axillary Nerve Transfer Across Injury Mechanisms

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INTRODUCTION:

Axillary nerve injury can cause debilitating loss of shoulder function, severely impacting patients' daily activities. One option to restore lost function is to surgically transfer a branch of the radial nerve to the axillary nerve. However, outcomes following this nerve transfer are not well documented. This study examined the functional and patient-reported outcomes after radial to axillary nerve transfer across a range of injury mechanisms.

METHODS:

The electronic medical record (EMR) at a tertiary academic center was queried from EMR inception (February, 2013) through February 6th, 2025. Demographic data, preoperative evaluations, functional outcomes, and patient reported outcomes were recorded. Patients with at least one month of postoperative follow-up were included to minimize confounding by postoperative pain. Wilcoxon signed-rank tests were used to analyze paired nonparametric continuous data with statistical significance set at $\alpha = 0.05$.

RESULTS:

Thirty-nine patients (8 females, mean age 53.5 ± 15.2 years) met inclusion criteria (Table 1). The most common injury mechanisms were trauma (16, 41.0%), iatrogenic causes (10, 25.6%), and cervical spine surgery (5, 12.8%). Most patients (28, 71.8%) presented with both motor and sensory symptoms. The mean time between injury and surgery was 9.1 ± 3.5 months, and the average duration of follow-up of 20.9 ± 10.1 months.

Compared to preoperative values, patients experienced significant improvements in shoulder flexion (60.4° ± 54.0 vs 106.8° ± 46.3, $p = 0.002$), abduction (46.7° ± 41.2 vs 108.1 ± 48.0, $p = 0.001$), and pain (3.4 ± 2.9 vs 2.0 ± 2.9, $p = 0.002$) (Table 2). No significant changes were observed in external rotation, Patient-Reported Outcomes Measurement Information System (PROMIS) Physical Function, PROMIS Upper Extremity, PROMIS Pain, or PROMIS Depression. Single Assessment Numeric Evaluation (SANE) scores could not be analyzed due to a lack of paired data.

Muscle strength, measured by Medical Research Council (MRC) scores, improved in 8/10 patients (80%) for deltoid, 4/5 (80%) patients for abduction strength, 1/3 patients (33.3%) for forward flexion, 4/7 patients (57.1%) for external rotation, and 0/4 patients for internal rotation (Table 3). No patients showed decreased strength when compared to preoperatively. At final follow-up, MRC scores ≥ 4 were seen in 6/13 patients (46.2%) for deltoid strength, 3/8 (37.5%) in abduction, 4/6 (66.7%) in forward flexion, 4/8 (50%) in external rotation, and 3/6 (50%) in internal rotation, indicating full recovery.

DISCUSSION AND CONCLUSION:

Axillary nerve injury in this cohort most commonly occurred following trauma, iatrogenic causes, or cervical spine surgery. Radial to axillary nerve surgery resulted in significant improvements in forward shoulder flexion, abduction, and pain at final follow-up. While MRC strength scores improved in most shoulder movements, full recovery (MRC ≥ 4) varied by movement and was achieved in 38-67% of patients. Importantly, no cases of postoperative strength loss were observed. Further research is needed to standardize the timeline between recognition of axillary nerve injury, evaluation, and progression to surgical intervention, as the wide variability in timing observed in our cohort could have clinical implications on outcomes.

Table 1. Patient Demographics

Age at Procedure	53.5 ± 15.2 (17 - 73)
Sex	8 Female, 31 Male
Race	
Caucasian/White	26 (66.7%)
Black	9 (23.1%)
Not Reported/Declined	3 (7.7%)
Other	1 (2.6%)
Laterality	19 Left, 20 Right
Smoking Status	
Never	21 (53.9%)
Former	12 (30.8%)
Current	6 (15.4%)
Mechanism of Injury	
Trauma	16 (41.0%)
Iatrogenic	10 (25.6%)
Cervical Spine Surgery	5 (12.8%)
Shoulder Dislocation	4 (10.3%)
Parsonage Turner Syndrome	3 (7.7%)
Tumor	1 (2.6%)
Comorbidities	
Depression	9
Type 2 Diabetes	7
Spine Surgery	4
Asthma	3
Substance Abuse	3
Cancer	3
Rheumatoid Arthritis	2
Kidney Disease	2
Thyroid Disease	2
Liver Disease	2
Fibromyalgia	1
NSTEMI	1
Heart Failure	1
Coronary Artery Disease	1
Deficits at Presentation	
Motor Only	11 (28.2%)
Motor & Sensory	28 (71.8%)
Time from Injury to Surgery	9.1 ± 3.5 (3.6 - 19.4) months
Follow-Up Duration	20.9 ± 10.1 (7.6 - 53.1) months

Legend. NSTEMI = Non-ST Elevation Myocardial Infarction

Table 2. Range of Motion and Patient Reported Outcomes

	Preoperative	Final Follow-Up	p
Flexion (°)	60.4 ± 54.0 (0 - 180)	106.8 ± 46.3 (40 - 180)	**0.002**
Abduction (°)	46.7 ± 41.2 (0 - 150)	108.1 ± 48.0 (42.5 - 180)	**0.001**
External Rotation (°)	30.4 ± 19.4 (0 - 60)	71.3 ± 19.8 (40 - 90)	0.125
PROMIS - PF	41.7 ± 6.3 (33 - 52)	41.2 ± 11.6 (27 - 76)	0.67
PROMIS - UE	33.0 ± 6.3 (26 - 43)	32.2 ± 7.2 (20 - 44)	0.5
PROMIS - Pain	59.1 ± 10.5 (39 - 74)	57.7 ± 8.8 (39 - 70)	0.153
PROMIS - Depression	51.3 ± 11.2 (34 - 64)	49.5 ± 9.9 (34 - 69)	1
VAS Pain	3.4 ± 2.9 (0 - 9)	2.0 ± 2.9 (0 - 8)	**0.002**
SANE	31 ± 22.5 (0 - 50	47.3 ± 26.2 (0 - 95)	*NA*

Legend. PROMIS = Patient-Reported Outcomes Measurement Information System; SANE = Single Assessment Numeric Evaluation; VAS = Visual Analogue Scale

Table 3. Strength Testing

	Deltoid	Abduction	Forward Flexion	External Rotation	Internal Rotation
Preoperative	0 [0 - 1]	1 [0 - 3]	1 [0 - 3]	3 [0 - 4]	3 [0 -5]
Final Follow-Up	2+ [1 - 4+]	3+ [2+ - 4]	4+ [2+ - 5]	3 [0 - 5]	3 [0 - 5]
Improved	8	4	1	4	0
Unchanged	2	1	2	3	4
Incomplete Data	29	34	36	32	35
Patients with MRC ≥ 4	6 (6/13, 46.2%)	3 (3/8, 37.5%)	4 (4/6, 66.7%)	4 (4/8, 50%)	3 (3/6, 50%)

Legend. Results presented as Median [Q1 - Q3]. MRC = Medical Research Council for Muscle Strength