Nerve Transfer versus Interpositional Nerve Graft Reconstruction for Posttraumatic, Isolated Axillary Nerve Injuries: A Systematic Review

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Background: The purpose of this study was to compare functional outcomes between nerve grafting and nerve transfer procedures in the setting of isolated, posttraumatic axillary nerve injuries.

Methods: A systematic review was performed using the PubMed, Scopus, and Cochrane databases to identify all cases of isolated, posttraumatic axillary nerve injuries in patients aged 18 years or older. Patients who underwent axillary nerve reconstruction were included and categorized by technique: graft or transfer. Demographics were recorded, including age, time to operation, and presence of concomitant injuries. Functional outcomes were evaluated, including British Medical Research Council strength and range of motion for shoulder abduction.

Results: Ten retrospective studies met criteria, for a total of 66 patients (20 nerve grafts and 46 nerve transfers). Median time from injury to operation was equivalent across the nerve graft and nerve transfer groups (8.0 months versus 7.0 months; $p = 0.41$). Postoperative follow-up was 24.0 months for nerve grafting versus 18.5 months for nerve transfer ($p = 0.13$). Clinically useful shoulder abduction, defined as British Medical Research Council grade M3 or greater, was obtained in 100 percent of nerve graft patients versus 87 percent of nerve transfer patients ($p = 0.09$). Grade M4 or better strength was obtained in 85 percent of nerve graft patients and 73.9 percent of nerve transfer patients ($p = 0.32$).

Conclusions: Significant differences in functional outcomes between nerve graft and transfer procedures for posttraumatic axillary nerve injuries are not apparent at this time. Prospective outcomes studies are needed to better elucidate whether functional differences do exist. (*Plast. Reconstr. Surg.* 140: 953, 2017.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

As our understanding of traumatic peripheral nerve injuries has grown, methods for reconstructing nerve defects not amenable to primary repair have evolved. Nerve grafting is considered the standard of care[1,2] and depends on neurotization from the donor to target nerve, two sites of nerve coaptation, and an adequate vascular bed in the zone of injury. Nerve transfer techniques have recently gained momentum for their ability to reduce the neurotization distance to the motor endplate target, focus microsurgery to a single nerve coaptation, and bypass the zone of injury.[3–5] Presently, there remains little consensus as to whether interpositional nerve grafting or nerve transfer procedures provide for better functional recovery.

The management of isolated axillary nerve injuries can potentially provide some insight into this reconstructive dilemma. These injuries most commonly occur from fractures and dislocations of the proximal humerus, as the axillary nerve passes through the quadrangular space to innervate the deltoid muscle. Although initiation of abduction is preserved through the supraspinatus muscle vis-à-vis the suprascapular nerve, overhead reach is significantly limited in the absence of deltoid function. Surgical intervention is typically

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recommended in cases where axillary palsy persists 4 to 6 months after the injury.

Interpositional nerve graft reconstruction of the axillary nerve has long been performed with reproducible success, with studies demonstrating 73 to 88 percent of patients regaining clinically useful strength.[6–9] An alternative method for axillary nerve reconstruction relies on nerve transfer, which was first described in 1948 by Lurje and based on the radial nerve branches to the triceps.[10] Since that time, nerve transfer methods using the long and medial head of the triceps, medial pectoral nerve, and spinal accessory nerve have been developed.[11–16] As the majority of studies on nerve transfer reconstruction of the axillary nerve have focused on patients with additional brachial plexus lesions, these studies have demonstrated varying results. Anywhere from 37 to 46 percent of patients have been reported to achieve greater than or equal to British Medical Research Council grade M4 strength.[4,17]

Few studies have directly compared outcomes between interpositional nerve grafting and nerve transfer reconstruction, largely because of the low incidence of isolated axillary nerve injuries. In this study, we sought to pool together the collective experience of the scientific community. The purpose of this systematic review is to compare functional outcomes between nerve grafting and nerve transfer procedures in the setting of posttraumatic, isolated axillary nerve injuries.

PATIENTS AND METHODS

Literature Review

The study protocol followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines.[18] Search criteria, inclusion and exclusion criteria, and analytic methods were specified in advance. In July of 2015, two independent researchers queried the PubMed, Scopus, and Cochrane databases using four distinct search terms. The following search terms were used in various combinations for the review: "axillary nerve," "trauma," "traumatic," "injury," "deltoid," "paralysis," "palsy," "repair," "intervention," "grafting," "graft," "transfer," "nerve," "brachial plexus," "trauma," "injury," and "isolated axillary nerve injury." Inclusion criteria were studies in the English language, published between 1940 and 2015, and dealing with axillary nerve injuries treated by nerve graft or transfer. Exclusion criteria were (1) nontraumatic axillary nerve injuries, (2) axillary nerve injuries with additional brachial plexopathy, (3) patients younger than 18 years, (4) patients who were operated on over 12 months from their injury, (5) patients who had follow-up less than 12 months after their operation, and (6) studies without any functional data for active shoulder abduction.

Two authors independently screened the articles based on review of title and abstract. Duplicates were next eliminated, and a full-text review of the remaining articles was performed. The references of the remaining articles were scanned for additional relevant articles. When there was disagreement about the inclusion of a study or data point, a consensus decision was determined with the assistance of the senior author (M.S.).[19]

The final articles included in the study were then reviewed for both general study data and the presence of individual data points. General data points included type of study, number of grafts and transfers, and general cohort characteristics (i.e., age, sex, concomitant injuries to the shoulder complex, time from injury to operation, description of reconstruction, active range of motion, British Medical Research Council grade (Table 1) for shoulder abduction both preoperatively and postoperatively, and follow-up time).

To evaluate study quality and reporting bias, the Methodological Index for Non-Randomized Studies criteria were applied.[20] Each study was evaluated with a score of 0, 1, or 2 points for each of the applicable Methodological Index for Non-Randomized Studies criteria items. The scores were added and reported in percentages (of a possible 16 points for noncomparative studies and 24 for comparative studies) to allow for a review of individual study quality. One hundred percent indicates a perfectly conducted study and 0 percent indicates the worst possible study design.

Data Analysis

Individual data points were categorized based on type of surgical intervention (nerve graft versus transfer) and reviewed. Comparisons were made between age (younger than 40 or 40 years of age

Table 1. British Medical Research Council Motor Grading Scale

Grade of Motor Recovery	Clinical Examination Results
M0	No contraction
M1	Visible contraction without movement
M2	Active motion with gravity eliminated
M3	Active motion sufficient to offset gravity
M4	Active motion against some resistance
M5	Muscle contracts normally against full resistance

or older),[7] time to intervention (<6 months or ≥6 months),[21] and functional outcome. Additional analyses were performed to look at differences in percentage of patients achieving grade M3 or better (clinically significant) and grade M4 or greater strength for shoulder abduction between the two groups.

Continuous and ordinal data were evaluated by the Shapiro-Wilk test for normal distributions. Where normality was not satisfied, data were presented as medians with interquartile ranges for the 25th to 75th percentile and comparisons were performed with the Mann-Whitney *U* test. Where normality was demonstrated, data were reported as means with standard deviation and comparisons were performed with the *t* test. Categorical data were presented as a percentage with 95 percent confidence interval, where appropriate, and analyzed using the 2 × 2 Fisher's exact test. A value of $p < 0.05$ was considered significant.

RESULTS

The review of the PubMed, Scopus, and Cochrane databases using the above-mentioned search terms initially yielded 2428 results. These were then filtered down to 10 articles that met inclusion and exclusion criteria (Fig. 1).[6,12,13,22–28] General study characteristics are listed in Tables 2 and 3. The methodologic quality of included studies ranged from 25 to 75 percent, with a mean Methodological Index for Non-Randomized Studies criteria score of 41.7 percent for nerve graft articles and 63.3 percent for nerve transfer articles ($p = 0.30$).

Twenty patients underwent nerve graft and 46 patients underwent nerve transfer. Detailed analysis of injury characteristics and postoperative functional outcomes for nerve graft versus nerve transfer reconstruction of isolated axillary nerve palsy can be found in Table 4. There were no significant differences in general characteristics, including age, concomitant shoulder injuries, time to surgery, and follow-up time.

Functional outcomes were then compared across the two groups (Table 4). Preoperative British Medical Research Council data were available for 17 of 19 nerve graft patients (89.5 percent) and 16 of 47 of nerve transfer patients (34.0 percent). All patients in both groups had clinically poor strength (grade M2 or less, or electromyography showing complete denervation). Postoperatively, clinically useful strength for shoulder abduction, defined as grade M3 or greater, was obtained in 100 percent of graft patients (95 percent CI, 88.3 to 100 percent) versus 87 percent of transfer patients (95 percent CI, 77.3 to 96.7 percent) ($p = 0.09$). Grade M4 or better strength was obtained in approximately 85 percent of nerve graft patients (95 percent CI, 69.4 to 100 percent)

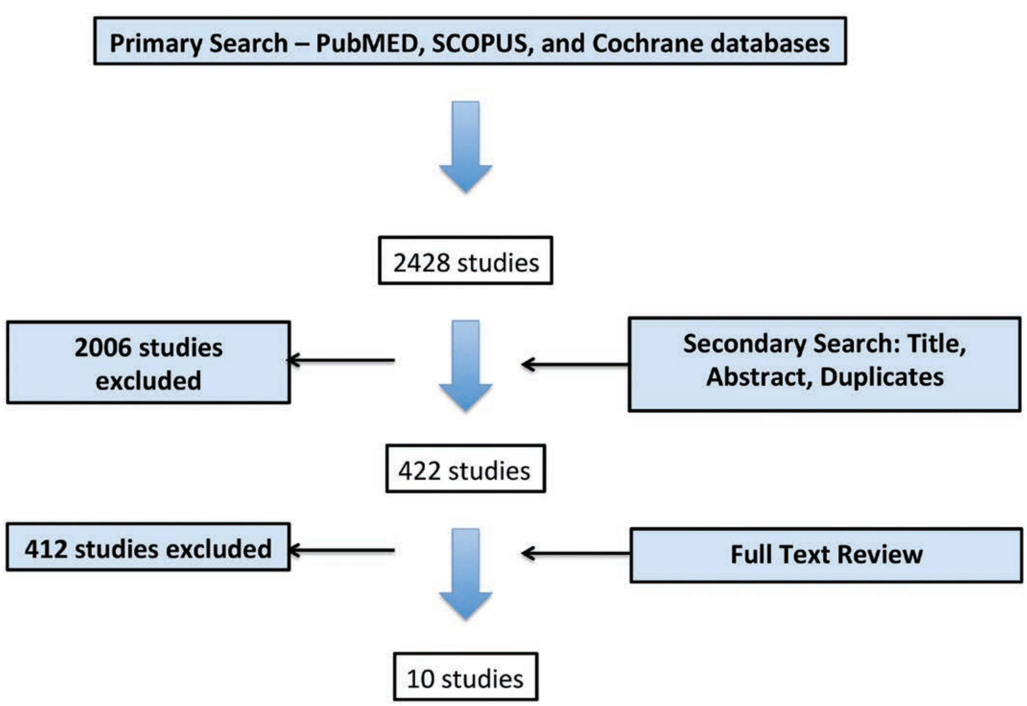

Fig. 1. Attrition diagram for systematic review. *LOS*, length of stay.

Table 2. Summary of Nerve Grafting*

Reference	Study Design	No.	Age (median/mean) (yr)	Time from Injury (median/mean) (mo)	Graft Source	Postoperative Shoulder Abduction Strength M3 or Greater (%)	Postoperative Shoulder Abduction Strength M4 or Greater (%)	Postoperative Shoulder Abduction AROM (median/mean) (degrees)	Follow-Up Time (median/mean) (mo)	MINORS Criteria Score (%)
Petrucci et al., 1982[6]	Retrospective, case series	8	NA	5.5 (IQR, 4.3–7.5)	2–3 grafts, 3–8 cm, sural nerve	8/8 (100%)	7/8 (88%)	NA	12 (uniform)	4 (25)
Friedman et al., 1990[22]	Retrospective, case series	2	Range, 18–52	Range, 5–6	1. Two 6-cm sural nerve grafts; 2. Two 5-cm sural nerve grafts, 5 cm	8/8 (100%)	2/2 (100%)	Range, 90–120)	Range, 13–14	6 (37.5)
Moor et al., 2010[23]	Retrospective, case series	10	41 (IQR, 25–46)	11 (IQR, 8–12)	Mean no. of sural nerve grafts, 3.9 (range, 3–6); mean length, 8.8 cm (range, 6–11.5 cm)	8/8 (100%)	8/10 (80%)	NA	24 (uniform)	10 (62.5)

AROM, active range of motion; MINORS, Methodological Index for Non-Randomized Studies; IQR, interquartile range; NA, not available.
*General results of the systematic review based on nerve graft articles are presented here. For articles where the entire cohort did not follow complete inclusion and exclusion criteria, individual data points were extracted (as available) and calculations performed to obtain descriptive statistics.

Table 3. Summary of Nerve Transfers*

Reference	Study Design	No. of Transfers	Age (median/mean) (yr)	Time from Injury (median/mean) (mo)	Transfer Donor	Postoperative Shoulder Abduction Strength M3 or Greater (%)	Postoperative Shoulder Abduction Strength M4 or Greater (%)	Postoperative Shoulder Abduction AROM (median/mean) degrees)	Follow-Up Time (median/mean) (mo)	MINORS Criteria Score (%)
Bertelli et al., 2007[24]	Retrospective, case series	3	22 (range, 19–27)	9 (range, 8–10)	Radial nerve (long head) to triceps transfer	3/3 (100)	3/3 (100)	NA	18 (uniform)	6 (37.5)
Ray et al., 2012[13]	Retrospective, case series	1	25	9	Medial pectoral nerve to axillary transfer	1/1 (100)	1/1 (100)	NA	20	8 (50)
Lee et al., 2012[25]	Retrospective, case series	18	39 (IQR, 21.8–46.3)	7 (IQR, 6–9)	Radial nerve (typically long head) to triceps transfer	14/18 (78)	10/18 (56)	125 (IQR, 85–160)	20 (IQR, 13.75–24)	8 (50)
Bertelli and Ghizoni, 2014[12]	Prospective, case series	7	39 (IQR, 25–42)	6 (IQR, 4–8)	Radial nerve (medial head/anconeus) transfer	7/7 (100)	7/7 (100)	175 (IQR, 165–175)	36 (IQR, 24–36)	12 (75)
Miyamoto et al., 2014[26]	Retrospective, case series	4	49.5 (IQR, 24.8–56.3)	5.8 (IQR, 3.3–7.1)	Radial nerve (long head) to triceps transfer	4/4 (100)	4/4 (100)	135 (IQR, 100–147.5)	16.5 (IQR, 9.5–25)	6 (37.5)
Wolfe et al., 2014[27]	Prospective, cohort	3	38 (range, 26–73)	Range, 5–11	Radial nerve (10 from long head, 1 from lateral, 3 from medial) to triceps transfer	3/3 (100)	2/3 (67)	160 (range, 90–180)	10 (range, 9–10)	12 (75)
Wheelock et al., 2015[28]	Retrospective, case series	10	30.5 (IQR 19.8–63.3)	7 (IQR, 6–8)	Radial nerve (7 from medial head, 2 from long, 1 from lateral) to triceps transfer	8/10 (80)	7/10 (70)	NA	13 (IQR, 12–16.3)	9 (56.3)

AROM, active range of motion; MINORS, Methodological Index for Non-Randomized Studies; NA, not available; IQR, interquartile range.
*General results of the systematic review based on nerve transfer articles are presented here. For articles where the entire cohort did not follow complete inclusion and exclusion criteria, individual data points were extracted (as available) and calculations performed to obtain descriptive statistics.

and 73.9 percent of nerve transfer patients (95 percent CI, 61.2 to 86.6 percent) ($p = 0.32$).

Preoperative active range of motion for shoulder abduction was not reported for nerve graft patients and was available for only 10 of 46 of nerve transfer patients (21.7 percent). Average preoperative active range of motion for shoulder abduction was 109.0 ± 76.8 degrees for nerve transfer patients. Postoperative active range of motion was reported for one of 19 nerve graft patients (5.3 percent) and 32 of 46 nerve transfer patients (69.6 percent). Postoperative active range of motion for shoulder abduction was 120 degrees for the nerve graft patient and a mean of 132.7 ± 44.4 degrees for nerve transfer patients.

The relationships between the age of the patient or time to operation and strength of shoulder abduction were next explored (Table 5). At age younger than 40 years, 100 percent of graft patients (95 percent CI, 67.0 to 100 percent) versus 92.3 percent of transfer patients (95 percent CI, 81.8 to 100 percent) demonstrated grade M3 or greater strength ($p = 0.47$), and 66.7 percent of graft patients (95 percent CI, 29.0 to 100 percent) versus 84.0 percent of transfer patients (95 percent CI, 69.6 to 98.4 percent) demonstrated grade M4 or better strength ($p = 0.34$). At age 40 years or older, 100 percent of graft patients (95 percent CI, 67.0 to 100 percent) versus 77.8 percent of transfer patients (95 percent CI, 58.6 to 97.0 percent) demonstrated grade M3 or greater strength ($p = 0.21$), and 100 percent of graft patients (95 percent CI, 67.0 to 100 percent) versus 61.1 percent of transfer patients (95 percent CI, 38.6 to 83.6 percent) demonstrated grade M4 or better strength ($p = 0.07$).

For patients who had less than 6 months elapse from injury to surgery, 100 percent of graft patients (95 percent CI, 62.1 to 100 percent) versus 100 percent of transfer patients (95 percent CI, 78.3 to 100 percent) demonstrated grade M3 or better recovery, whereas 100 percent of graft patients (95 percent CI, 62.1 to 100 percent) versus 100 percent of transfer patients (95 percent CI,

Table 4. Comparisons between Individual Nerve Graft and Nerve Transfer Data Points*

	Nerve Graft (%)	Nerve Transfer (%)	p
Age, yr ($n = 55$)			
Median	39.5	38	
Range	24.0–46.8	22.0–46.5	0.94
No.	12	43	
Concomitant shoulder injury ($n = 40$)			
No.	10/12 (83.3)	28/28 (100)	0.08
Time to operation, mo ($n = 66$)			
Median	8.0	7.0	
Range	5.8–11.0	6.0–8.8	
No.	20	46	0.41
Length of follow-up, mo ($n = 58$)			
Median	24.0	18.5	
Range	24.0–24.0	13.0–24.0	
No.	12	46	0.13
Postoperative BMRC grade ≥3	20/20 (100)	40/46 (87)	0.09
Postoperative BMRC grade ≥4	17/20 (85)	34/46 (73.9)	0.32

BMRC, British Medical Research Council.
*Individual data points were extracted from qualifying studies, and analyzed to identify differences between nerve grafting.

Table 5. Outcome Comparisons Based on Age and Time to Intervention*

	Shoulder Abduction BMRC Grade ≥3			Shoulder Abduction BMRC Grade ≥4		
	Nerve Graft (%)	Nerve Transfer (%)	p	Nerve Graft (%)	Nerve Transfer (%)	p
Age						
<40 yr	6/6 (100)	23/25 (92.3)	0.47	4/6 (66.7)	21/25 (84.0)	0.34
≥40 yr	6/6 (100)	14/18 (77.8)	0.21	6/6 (100)	11/18 (61.1)	0.07
Time to intervention						
<6 mo	5/5 (100)	10/10 (100)	†	5/5 (100)	10/10 (100)	1.00
≥6 mo	15/15 (100)	30/36 (83.3)	0.09	12/15 (80.0)	24/36 (66.7)	0.34

BMRC, British Medical Research Council.
*Data were stratified based on age (<40 yr or ≥40 yr) and time to intervention (<6 mo or ≥6 mo) to identify incidence rates of obtaining British Medical Research Council grade 3 or 4 strength for shoulder abduction.

78.3 to 100 percent) demonstrated grade M4 or better recovery. For patients who had 6 months or greater time from injury to surgery, 100 percent of graft patients (95 percent CI, 84.8 to 100 percent) versus 83.3 percent of transfer patients (95 percent CI, 71.1 to 95.5 percent) demonstrated grade M3 or greater strength ($p = 0.09$), whereas 80 percent of graft patients (95 percent CI, 59.8 to 100 percent) versus 66.7 percent of transfer patients (95 percent CI, 51.3 to 82.1 percent) demonstrated grade M4 or better strength ($p = 0.34$).

DISCUSSION

Previous studies have examined nerve transfer versus interpositional nerve graft reconstruction of the brachial plexus and have yielded mixed results. In a systematic review of nerve transfers for restoration of shoulder abduction, Yang et al. found that 79 percent of patients achieved grade M3 or better and 46 percent achieved grade M4 or better muscle strength. This is in contrast to grafting, which resulted in 50 percent achieving grade M3 or higher and 0 percent achieving grade M4 or better.[17] A more recent study by Baltzer et al. directly compared interpositional nerve grafting versus long head of the triceps motor nerve–to–anterior division of the axillary nerve transfer, concluding that nerve grafting secured higher functional recovery at 1 year postoperatively. Unfortunately, that study could not be included in this current systematic review, as there were no individualized patient data.[29]

Such findings are in disagreement with the current systematic review, which demonstrated no significant functional differences between nerve transfer versus interpositional nerve graft reconstruction for isolated, posttraumatic axillary nerve injuries. The discrepancy may be resolved by the location of nerve injury that is under study. More proximal nerve injuries, such as at the brachial plexus trunk/division/cord level, may pose additional challenges to nerve grafting. Under these circumstances, nerve grafts have to span long distances and rely on cervical root input that is being shared across multiple targets. This is in contrast to nerve transfers, with a nerve coaptation site much closer to the muscular target and a 1:1 donor-to-target ratio.

For more distal nerve injuries, such as at the terminal branch level (i.e., axillary nerve), the advantages of nerve transfers over interpositional grafting are not apparent. The distance for neurotization across the graft and terminal nerve may not be appreciably longer than that for the nerve transfer with a coaptation site just beyond the branch take-off from the cord level. Furthermore, interpositional nerve grafting at this level involves one donor nerve for one target muscle and avoids issues related to axonal sharing as for more proximal injuries. Given this understanding, a similar timeline and strength for muscular recovery would not be unexpected for interpositional grafting versus nerve transfer procedures at the terminal branch level.

The literature provides conflicting viewpoints on the relationship between time to surgery and functional outcome in this patient population. Bonnard et al. reported that patients who underwent interpositional nerve grafting of the axillary nerve greater than 5.3 months from the time of injury experienced a higher reconstructive failure rate (grade M2 or less recovery).[7] In contrast, Moor and colleagues reported that interpositional nerve grafting at greater than 6 months from injury could yield satisfactory outcomes, as 100 percent of patients achieved grade M3 or better and 82 percent of patients demonstrated grade M4 or greater muscle strength.[23]

The findings of this systematic review support the conclusions of Moor and colleagues and extend the window of reconstructive surgery beyond 6 months after injury for both nerve graft and nerve transfer procedures. Although patients undergoing nerve transfers during the later timeframe did demonstrate a decline in the percentage achieving grade M4 function, this group still performed statistically as well as patients undergoing interpositional nerve grafting during the same, later timeframe. This may be explained by the relatively short distance and time for neurotization in both techniques. Interpositional nerve grafts generally range from 6.0 to 11.5 cm long (this notably does not include the distance from distal site of coaptation to the deltoid muscle), whereas the distance from axillary nerve coaptation to the deltoid muscle target for nerve transfer procedures typically fall within a similar, albeit shorter distance (2.6 to 6.2 cm).[23] Factoring in a latency period of 30 days and neurotization at 1 mm/day, neuromuscular signaling should first be reestablished around 4 months postoperatively. Ample time should still be available for muscle reinnervation, as irreversible motor end plate loss has generally been accepted to occur at 12 to 18 months after injury.

There also remain conflicting viewpoints on the relationship between surgical age and functional outcome in patients treated for axillary nerve injuries. Bonnard and colleagues noted that the proportion of patients achieving grade M4 or greater strength decreased significantly from 83 percent for age 20 years or younger to 63 percent for age 35 years or older following interpositional nerve grafting for axillary nerve palsy.[7] In contrast, Moor and colleagues reported that the success rate of interpositional nerve grafting did not worsen with increasing patient age.[23] The findings of this systematic review concur with the conclusions of Moor and colleagues, maintaining a broad age range for reconstructive surgery. They are also in agreement with the additional analysis performed by Bonnard et al., which found that the success rate (grade M3 or greater) in patients older than 40 years remained satisfactory (61 percent) and was not significantly worse than that in the younger group (77 percent).

The findings of this systematic review must be interpreted in the context of several limitations. Functional analysis of shoulder abduction presents many challenges. First, one needs to isolate the specific contribution of the axillary-innervated deltoid muscle from that of the suprascapular-innervated supraspinatus muscle. One method for isolating the function of the deltoid is to assess abduction in internal rotation, which few groups actually perform. Second, functional analysis is complicated by the fact that the suprascapular nerve has a profound effect on shoulder function. Normal shoulder range of motion is possible with a paralyzed deltoid and compensation by other rotator cuff muscles. This makes it difficult to determine how much postoperative recovery is actually attributable to deltoid reinnervation. Third, abnormal shoulder range of motion can be observed with strong deltoid function if seen in conjunction with shoulder/rotator cuff abnormality.[25] Concomitant injuries to the shoulder complex were noted in a majority of the patients reported in studies. Other authors have also reported that 41 percent of patients with isolated injuries also had rotator cuff repairs.[7] These injuries may significantly affect shoulder range of motion and abduction strength, and also interfere with postoperative rehabilitation. Finally, the use of the British Medical Research Council scale as a quantification of strength after intervention is somewhat subjective and introduces a degree of interrater variability.

A number of additional factors also affect the interpretation of these results. Although this was an extensive systematic review, the study is low-powered, as the total number of patients within the combined cohorts was only 66. The heterogeneity of study design and poor quality, as represented by the low Methodological Index for Non-Randomized Studies criteria scores for the included articles, also limited this review. These studies were performed using different diagnostic methods, operative techniques, postoperative protocols, and outcome evaluations. For instance, the majority of studies did not include preoperative active range of motion, and approximately 60 percent of the studies did not report preoperative British Medical Research Council grade for shoulder abduction. Similarly, studies tended to report either active range of motion or British Medical Research Council grade but not both, explaining the discrepancy between preoperative British Medical Research Council grade and active range of motion, as they were typically derived from separate patient cohorts. Furthermore, postoperative active range-of-motion data were also infrequently reported and, as a result, proved not to be valuable in the setting of this systematic review. Overall, the nerve graft patients had British Medical Research Council grades reported more consistently (both preoperatively and postoperatively), whereas the nerve transfer patients had active range of motion reported more. The difference is more likely attributable to a difference in practice patterns rather than to a difference in characteristics of the patients. Surgical technique can also differ significantly among different reports. For example, some individuals tend to perform nerve transfers to the entire axillary nerve rather than just the anterior or posterior division, and there is also variability in the choice of donor nerves (e.g., branch to the medial head of the triceps, branch to the long head of the triceps).[25,30] Nerve graft length is also a potential confounding variable, as longer nerve grafts tend to have poor functional recovery; however, this cannot be directly compared to data presented, as the reported nerve graft length tends to not take into account the distance from the distal coaptation site to the muscle target. Finally, the discrepancy in length of follow-up may have confounded our outcomes, as nerve transfers were followed for shorter periods on average. With nerve transfers, the first signs of recovery generally occur more than 5 months after surgery, but full recovery can take up to 26 months.[25,26] Nerve graft recovery, in contrast, will vary based on the defect size.

CONCLUSIONS

This systematic review failed to delineate a clear difference in outcomes between nerve grafts and transfers for treating isolated traumatic injuries to the axillary nerve. Although both interventions have theoretical benefits and shortcomings, surgeons should continue to perform the procedure with which they are the most adept.

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