Comparison of Autografts vs. Allografts in the Surgical Repair of Pediatric Obstetrical Brachial Plexus Injuries

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Abstract

Obstetrical Brachial Plexus Injury (OBPI) that persists is treated surgically with nerve grafts of two main types: autografts and allografts. The object of this study is to determine the functional efficacy of acellular processed nerve allografts (Axogen) as compared to sural nerve autografts in repair of OBPI. This study is a retrospective case cohort with 50 patients total. We found that autograft and allograft to be equally efficacious with regards to functional outcomes as measured by the BRMC Motor Strength Score, Mallet score, and Toronto Score. Secondary outcomes showed a trend toward significance of shorter surgical time in the allograft group and no difference in the rate of subsequent surgeries or complications.

Introduction

(OBPI) occur during delivery with a global incidence ranging from 0.2- 4% of live births,[1] and generally, prognosis is excellent with spontaneous recovery in up to 95% of patients.[2] For patients with OBPI that do not obtain a functional recovery by 4-6 months of life, treatment is primarily surgical in nature.[3] Surgical treatment involves testing of the nerves to determine whether they remain connected distally and proximaly, removal of scar tissue/ neurolysis, and then bridging the nerve discontinuity or block with a nerve graft.[4] Nerve grafting provide a three-dimensional extracellular matrix that promotes Schwann cell migration and axon regeneration.[5] Historically, nerve graft was autograft using sural nerve. More recently, a decellularized processed cadaveric nerve allograft (Axogen) has been utilized in numerous peripheral nerve injury repairs, mostly in adults,[6] but has not been reportedly used in pediatric OBPI. The aim of this study is to determine if using nerve allografts (Axogen) will have similar functional outcomes as compared to sural nerve autografts in reconstruction of the brachial plexus after OBPI.

Mallet Classification

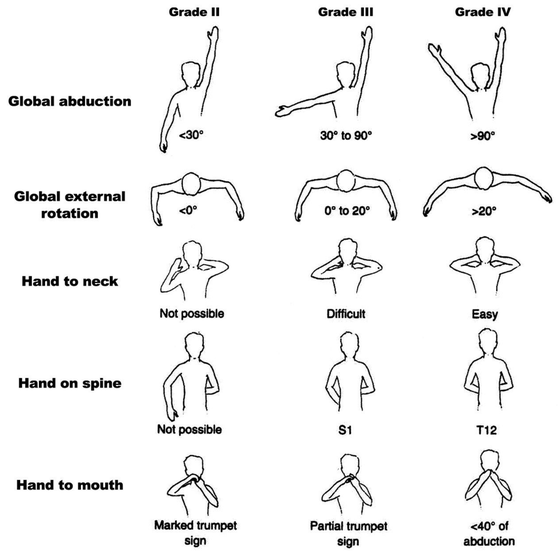

Figure 1: Representation of the modified Mallet Classification for assessing upper trunk function. Grade I is no movement. Grade V is normal function, which is symmetric to the unaffected side. Grades II, III, and IV are depicted. Scores 1-5 are assigned and correspond to the grade.[7]

Materials and Methods

This is a retrospective case cohort of patients who underwent surgical repair of an obstetrical brachial plexus injury (OBPI) using either a sural nerve autograft or a decellularized processed cadaveric nerve allograft (Axogen). There were 50 patients total, 22 in the autograft (control) and 30 in the allograft (intervention) groups. All underwent the primary neurolysis and "jump" grafting from proximal nerve root to distal divisional fascicle. The primary outcome measures were motor strength and functionality measured by the British motor strength score and Mallet score, respectively. Secondary outcomes included surgical time, rate of complications, and future surgeries. Outcomes were analyzed and are reported pre- and post-surgery. The Wilcoxon Rank Sum was used to assess the difference in mean scores between patients who underwent the autograft and allograft interventions. The Wilcoxon Signed Rank was used to compare differences between pre-surgery and follow up.

Results

There was no significant difference in the motor strength and functional outcomes between the sural nerve autografts and allografts in follow-up to the surgery. Mean follow up was 614 days (SD = 547). The BRMC Motor Strength Score improvement was statistically significant for each muscle group measured except for elbow extension and each component of the Mallet Score showed statistically significant increases in functionality. Allografts had shorter operative time (Beta (95% CI): -30.7 minutes (-62.7, 1.31)) but the same rate of future surgeries although this association only trended toward significance with a p = 0.06. Two patients had superficial infections with stitch abscesses in the autograft group at the sural nerve harvest site and no infections in the allograft group (9% vs. 0%) (p=0.17).

	Autograft N=22 Δ Mean, SD	Allograft N=30 Δ Mean, SD	P-value
BMRC Motor Score:			
Shoulder Flexion	1.17 (0.41)	1.46 (1.12)	0.83
Shoulder Abduction	1.42 (0.79)	0.58 (4.52)	0.97
Shoulder External Rotation	1.87 (1.35)	2.11 (1.49)	0.64
Elbow Flexion	1.43 (1.34)	1.40 (1.24)	0.51
Elbow Extension	-0.14 (1.23)	0.41 (1.08)	0.22
Forearm Pronation	0.50 (0.55)	0.95 (1.19)	0.55
Forearm Supination	1.45 (1.21)	1.40 (1.31)	0.89
Wrist Flexion	1.13 (1.64)	0.73 (1.16)	0.49
Wrist Extension	0.13 (1.72)	1.19 (1.46)	0.35
Digit Flexion	0.23 (1.01)	0.67 (1.20)	0.50
Digit Extension	0.40 (0.69)	1.04 (1.25)	0.17
Mallet Score:			
Arm at Rest	0.71 (0.72)	0.78 (0.95)	0.79
Global Abduction	1.07 (1.11)	1.25 (0.75)	0.66
Global External Rotation	1.00 (0.78)	0.78 (0.75)	0.37
Head and Neck	1.07 (1.03)	0.93 (1.29)	0.56
Head and Spine	1.00 (0.84)	1.00 (0.87)	0.94
Head to Mouth	1.31 (0.94)	1.11 (1.18)	0.54
Supination	0.71 (0.82)	1.11 (0.99)	0.23

Table 1: Each component we measured had an average improvement, as shown by the positive numbers, except for elbow extension. However the scores showed no statistically significant difference, meaning that neither the autograft or allograft was superior.

Discussion and Conclusions

Our study found that the utilization of autograft and allograft for the treatment of OBPI during the primary surgery to repair the brachial plexus were found to be equally efficacious with regards to functional outcomes as measured by the BRMC Motor Strength Score and Mallet score. Importantly, all of the children who underwent surgical intervention utilizing these grafting materials were found to improve and most were able to gain functionality (i.e.) ability to get their hand to mouth to feed themselves, Mallet III. The surgical time was shorter in the utilization of allograft although this only showed a trend toward significance. Our analysis showed no difference in the rate of subsequent surgeries or complications.

The limitations of our study included the small sample size, non-randomized patient population, and raters of function were non-blinded.

These data suggest that the use of nerve grafts that utilize allografts for "jump" grafting are the preferable method for OBPI repair as they have comparable motor and functional outcomes to autograft but are less invasive since they require only one surgical site, potentially decreased surgical time, and potentially decreased risk of complications.

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