



Functional outcome of nerve transfers for traumatic global brachial plexus avulsion

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ABSTRACT

Background: The treatment of global brachial plexus avulsion is a demanding field of hand and upper extremity surgery. The recent development of functional and quality-of-life (QOL) assessment tools has improved quantifying these functional outcomes after surgery.

Objective: We sought to combine Medical Research Council (MRC) grading with the Disability of the Arm, Shoulder, and Hand (DASH) questionnaires and Numerical Rating Scale (NRS) for pain to evaluate the functional outcome of patients who suffered complete brachial plexus avulsion before and after nerve transfers.

Methods: The author carried out a retrospective review of 37 patients with global avulsion of the brachial plexus between 2000 and 2007. All of them underwent nerve transfers in Hua Shan Hospital in Shanghai. They were followed up for over 3 years for physical examination and responding to the questionnaires of DASH, NRS, as well as the satisfaction with the surgery.

Results: The mean time to surgery was less than 6 months and the mean follow-up period was 4.59 years (range: 3–9 years). The effective motor recovery rate was 54%, 86%, 46% and 43%, respectively, in supraspinatus, biceps, triceps and finger flexor. Patients who underwent nerve transfers scored consistently better on the DASH score and NRS score than those before surgery. There was also a significant correlation between the change in NRS scores and patient satisfaction.

Conclusion: This study validated the effect of nerve transfers for global brachial plexus avulsions from objective MRC grading combining with patients' self-assessments. Neurolysis after neurotisations correlated positively with functional outcomes.

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Adult traumatic brachial plexus injuries can have devastating effects on the upper extremity function.¹ Apart from motor and sensory loss, pain could aggravate and functional limitations would increase after brachial plexus injuries.^{2–5} The prevalence of brachial plexus injuries in the multiple trauma population is about 1.2%.⁶ Surgical management consists of nerve repair and nerve grafting for extraforaminal nerve root or trunk injury, and of neurotisation or nerve transfer for nerve roots avulsion.⁷ Nerve transfer employs redirection of an intact motor nerve from one muscle to the distal undamaged portion of a nerve from another, effectively bypassing the injured segment of nerve.¹ Nowadays, patients who have surgery for brachial plexus injuries are focussed on the recovery of motor and sensory.^{8–11} However, the success of

microsurgical reconstruction should incorporate the patients' self-assessments of their functional recovery.¹²

The present study was to evaluate the functional outcome of patients who suffered global brachial plexus avulsion before and after nerve transfers by Medical Research Council (MRC) grading, the Disability of the Arm, Shoulder, and Hand (DASH) questionnaires and Numerical Rating Scale (NRS) for pain. Patients were also sent an additional question regarding their satisfaction with the surgery.¹²

Patients and methods

A retrospective review of 37 patients with global avulsion of the brachial plexus was carried out (Table 1). The inclusion criteria included global brachial plexus root avulsion, a minimum postoperative interval of over 3 years, treated by nerve transfers from 2000 to 2007 at the Department of Hand Surgery in Hua Shan Hospital in Shanghai.

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Table 1
Patient demographics.

Patient no.	Age (injury)/sex	Delay to OR (months)	Follow-up (years)	Other nerve injury	Operation	Neurolysis	DASH (pre/postoperative)	NRS (pre/postoperative)
1	29/M	<6	8	Spinal accessory nerve (complete)	Pr–Mc,C7–Mcf, Ic–Td,Ax	No	77.5/79.2	10/5
2	29/M	<6	3	None	Sa–Ss, Pr–UT, C7–LT, Ic–Td,Tr	No	44.2/27.5	6/3
3	38/M	<6	4	Phrenic nerve (partial)	Sa–Ss,C7–Mc.Md, Ic–Td,Tr	No	60/46.7	5/4
4	25/M	<6	4	None	Sa–Ss,Pr–UT,C7–Ra, Ic–Td	No	29.2/29.2	8/4
5	13/M	<6	5	Spinal accessory nerve (partial) Phrenic nerve (complete)	C7–Tr.Md,Ic–Mc	No	44/14.7	9/2
6	34/M	<6	4	Spinal accessory nerve (partial) Phrenic nerve (complete)	Sa–Ss,C7–Ra.Md, Ic–Td,Mc	Median nerve		5/5
7	19/M	<6	4	None	Sa–Ss,C7–Ra, Ic–Td,Tr	No	75.8/60.8	8/7
8	19/M	<6	4	None	Sa–Ss,Pr–Raf, C7–Md.Mc,Ic–Ax.Tr.Td	No	13.3/7.5	0/5
9	16/M	<6	9	Spinal accessory nerve (partial) Phrenic nerve (complete)	Lt–Ss,C7–Md, Ic–Ax.Mc	No	70/16.7	1/7
10	37/M	>6	6	None	Sa–Ss,Pr–Mc, C7–Ra.Ax,Ic–Td,Md	No	15/10	0/0
11	30/M	<6	5	Spinal accessory nerve (partial) Phrenic nerve (complete)	Sa–Ss,C7–Md, Ic–Td,Mc	No		8/5
12	15/M	<6	3	None	Sa–Ss,Pr–Mc, C7–Ra,Ic–Td,Md	Median nerve Radial nerve	78.3/73.3	0/0
13	38/M	<6	3	Phrenic nerve (complete)	Sa–Ss,C7–Mc.Md, Ic–Td,Tr	No	65/69.2	0/0
14	25/M	<6	5	Phrenic nerve (partial)	Sa–Ss,Pr–UT, C7–Md	Median nerve	68.8/51.7	8/6
15	20/M	<6	5	None	Sa–Mcf–Ax,Pr–Mc, C7–Md,Ic–Td,Tr	Median nerve	28.3/17.5	0/0
16	32/M	<6	3	Phrenic nerve (complete)	Sa–Ss,C7–Md, Ic–Td,Mc	No		8/6
17	20/M	<6	8	None	Sa–Ss,Pr–Mc, C7–Md.Ra,Ic–Td	No	20/18.8	7/3
18	19/M	<6	3	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr	Median nerve	86.7/23.3	10/0
19	25/M	<6	7	None	Sa–Ss,Pr–UT, C7–Md, Ic–Td,Tr	No		8/2
20	24/M	<6	5	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr	No		0/1
21	18/M	<6	4	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr		40.8/20.8	7/2
22	27/M	<6	4	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr	Median nerve	52.5/30.6	2/5
23	16/M	<6	3	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr	Median nerve Radial nerve	60.8/17.2	7/3
24	27/M	<6	4	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr	No		1/2
25	21/M	<6	5	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr	No	50/44.8	0/5
26	28/M	<6	3	None	Sa–Ss,Pr–UT, C7–Md,Ic–Td,Tr	Median nerve	45.9/37.9	9/3
27	38/M	<6	9	None	Sa–Ss,Pr–Mc, C7–Md,Ic–Td	No	77.5/73.3	7/7
28	21/M	<6	4	Phrenic nerve (complete)	Sa–Ss,C7–Md.Tr, Ic–Td.Mc	No	51.9/40.7	6/3
29	17/M	<6	4	None	Pr–Mc, Sa–Ss C7–Md,Ic–Td,Tr	No	23.3/52.5	1/1
30	17/M	<6	4	None	Pr–Mc, Sa–Ss C7–Md,Ic–Td,Tr	No	63.3/21.7	0/2
31	21/M	<6	4	None	Pr–Mc, Sa–Ss C7–Md,Ic–Td,Tr	No	56.7/41.7	7/4
32	20/M	<6	4	Spinal accessory nerve (complete) Phrenic nerve (complete)	C7–Md, Mc, Ss Ic–Td,Tr	No	18.3/15.8	0/1
33	24/M	<6	4	None	Pr–Mc, Sa–Ss C7–Md,Ic–Td,Tr	No	20.8/16.7	2/2
34	59/M	<6	4	None	Pr–Mc, Sa–Ss C7–Md,Ic–Td,Tr	No	35.8/47.5	2/2

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