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Our experience with triceps nerve reconstruction in patients with brachial plexus injury

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Summary Although elbow extension is facilitated by gravity, triceps muscle provides elbow joint stability; in patients with brachial plexus injuries stable elbow is necessary for obtaining useful hand function. This study presents the senior author's experience with triceps nerve reconstruction and the functional results in patients with brachial plexus injuries. Outcomes were analyzed in relation to denervation time, severity score, length of the interposition nerve graft and donor nerves used.

One hundred and sixty two patients with brachial plexus injury had triceps nerve neurotization and elbow extension recovery between 1978 and 2006. The mean patient's age was 25.45 ± 9.90 years and the mean denervation time was 16.90 ± 26.95 months. Two hundred and thirty two motor donors were used in 156 patients; 6 patients underwent neurolysis; 86 intercostal nerves were transferred in 41 patients. Interposition nerve grafts were used in 130 patients.

Results were good or excellent in 31.65% of patients. The age of patients and the severity of the brachial plexus lesion are among the factors that significantly influenced functional results. Intraplexus motor donors are always preferable achieving better functional outcomes than extraplexus donors. Intercostal nerves and the posterior division of contralateral C7 proved preferred donors for elbow extension restoration in multiple avulsions.

Although it is difficult to restore strong elbow extension, triceps nerve reconstruction is suggested in brachial plexus management, since it provides elbow stability. Satisfactory elbow extension strength was restored in young patients with high severity score.

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Introduction

Brachial plexus injuries lead to devastating paralysis and the patients face severe functional loss. Young motorcycle drivers suffer the most.[1] The victim's life has drastic socioeconomic impact. The advances in Reconstructive Microsurgery and the application of novel modalities have improved the prognosis and outcomes of the paralyzed upper extremity.[2–6] Yet, the patients have to know that the reconstruction of these injuries involves multiple stages, there is a prolonged postoperative period and the most successful treatment yields a useful and functional upper limb but never normal.[6,7]

Priorities in upper limb reanimation are elbow flexion and shoulder function. Due to the fact that elbow extension is facilitated by gravity, in brachial plexopathies, it is commonly viewed of lesser importance to neurotize the triceps nerve; sometimes, the triceps muscle is sacrificed to substitute for biceps function.[8–10] Nevertheless, reports indicate that for elbow stability in patients with brachial plexus palsy, strong triceps is necessary otherwise patients even if they regain hand function, are not able to use it in an appropriate way in daily activities without the assistance of the contralateral hand.[11–13] Additionally, the senior author views elbow extension as crucial to the overall upper limb function and triceps reconstruction is attempted in most cases.

The triceps muscle, with its lateral, medial and long heads, and anconeous muscle are the elbow extensors.[14–16] All are innervated by the triceps nerve, branch of the radial nerve, which carries fibers from the sixth, seventh, and eighth cervical roots.[17,18] In global paralysis there is total lack of elbow extension, while in upper plexus palsy with C7 involvement (C5–C6–C7) minimal triceps function may be preserved.[17]

The intent of this retrospective study is to present the authors' experience with triceps nerve reconstruction in a post-traumatic plexopathy population. Functional outcomes were analyzed in terms of multiple variables such as timing of surgery (denervation time), severity of injury (severity score), age of patient, type of reconstruction (intraplexus versus extraplexus motor donors), length of interposition nerve grafts and their influence at the received results were recorded.

Patients and methods

The charts of 162 patients, with brachial plexus palsy who underwent triceps nerve reconstruction from 1978 to 2007, were reviewed. The mean patient's age was 24.93 ± 8.61 years. High velocity motor vehicle accidents were the main cause of brachial plexus injuries. A total of 125 patients (77.16%) were involved in motorcycle and car accidents (Table 1). The mean speed, at which the accidents occurred, was 52.65 ± 22.6 mph. Most patients had multiple trauma. The elapsed time from injury to reconstruction (denervation time) was 16.90 ± 26.95 months (range from 1 to 170 months) and 92 patients (56.79%) were operated in the first 8 months since the injury. Patients' demographic data are shown in Table 2.

In 1984 the senior author introduced the severity score; it is a scale to grade intraoperatively the brachial plexus lesions, at the level of individual roots, (avulsion = 0, avulsion/rupture = 1, rupture = 2, rupture/traction = 3, traction = 4, normal = 5).[7] The normal plexus has a severity score of 25. The severity score in global avulsion plexopathy is 0; the lower the severity score, the worse the injury.[7] In the current series the mean severity score is 5.76 ± 5.56 which depicts severe plexus lesions; there were 114 patients (70.37%) with severity score less than 10. A

Table 1 Type of accident for 162 post-traumatic brachial plexus patients.

Type of accident	No. of patients (%)
Motorcycle accident	87 (53.70%)
Motor vehicle accident	38 (23.45%)
Pedestrian	5 (3.08%)
Sports-related	6 (3.70%)
Gunshot wound	8 (4.93%)
Others	18 (11.11%)
Total	162

Others: fall, work related injury, tumors.

Table 2 Demographic data of 162 patients with triceps nerve reconstruction.

Data	Number of patients (%)
Gender	Female: 18 (11.11%)
	Male: 144 (88.88%)
Age	Mean: 25.45 ± 9.90 years
	0–15 years: 21 (12.96%)
	15–30: 109 (67.28%)
	>30: 32 (19.75%)
Side	Left: 90 (55.55%)
	Right: 72 (44.44%)
Fractures	Clavicle: 37 (22.83%)
	Scapular: 15 (9.25%)
	Ribs: 32 (19.75%)
Vascular injury	Axillary: 23 (14.19%)
	Subclavian: 69 (9.87%)
	Brachial: 3 (1.85%)
Follow-up	4.68 ± 2.88 years[a]
Denervation time	16.90 ± 26.95 months
	≤8 months: 92 (56.79%)
	>8 months: 70 (43.20%)
Severity score	Mean 5.76 ± 5.56
	≤10: 114 (70.37%)
	>10: 26 (16.04%)
Type of lesion	Supraclavicular: 140 (86.41%)
	Infraclavicular: 22 (13.58%)
Graft	Total: 130 (80.24%)
	≤7 cm: 20 (12.34%)
	>7 cm: 86 (53.08%)
	Vascularized: 24 (14.81%)
Target	Triceps: 106 (65.43%)
	Radial–posterior cord: 56 (34.56%)

[a] Results were analyzed in patients who had more than 18 months follow up.