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4.1 Transfer of pronator teres branch in C7-T1 brachial plexus injury: An electrophysiological and anatomic feasibility study

B. Xu
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Objective:
To screen new, feasible and safe donor nerve to strengthen the finger flexion recovery combined with the transfer of brachialis motor branch in C7-T1 brachial plexus injury.

Methods:
1. Electrophysiological study: The amplitude of the CMAP of each median nerve-innervated muscle after different nerve root stimulation was calculated and compared with each other in 18 patients undergone contralateral C7 nerve transfer.
2. Anatomic study: The median nerve and its muscular branches were exposed and dissected on 10 fresh cadaver upper extremities.

Results:
1. The pronator teres branch receives fibers mainly from C5 and C6.
2. The anatomic study revealed three branching patterns of pronator teres branch. Regardless of its branching pattern, there were constantly three twigs that entered the pronator teres and any of the three twigs was comparable to the anterior interosseous nerve in terms of length, diameter and number of myelinated fibers.

Conclusion:
The pronator teres branch can be used as a donor nerve to strengthen finger flexion in C7-T1 brachial plexus injury.
4.2 Dorsal scapular nerve as an additional neurotizer for better elbow stability and elbow flexion in complete adult brachial plexus palsy patients

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Introduction
Dorsal scapular nerve (DSN) is a first to branch of the C5 nerve root before the latter courses into the brachial plexus (BP). This particular anatomical feature allows for the viability of the nerve in the most of cases with complete brachial plexus palsy (BPP), while also allowing its use as an additional neurotizer in BP reconstructive surgery.

Methods
This case series reviews 14 patients with complete BPP, and with a postganglionic lesion of C5 nerve root and an avulsion of all the other roots. In all patients we used DSN to the BLHT transfer to achieve better elbow stability and elbow extension. The sural and the medial cutaneous nerves of the forearm served as donors for grafts.

Results
Elbow extension satisfactory recovery occurred in 10 patients (71.4%) (M3 in 9 cases and M4 in one case) when DSN was used for grafting to BLHT. Satisfactory recovery of the elbow extension was achieved in 10 patients (71.4%) (M3 in 9 and M4 in one). None of the patients recovered hand and finger extension.

Conclusion
Usually forgotten or excluded in BP reconstructive surgery, the DSN has a potential for outcome improvement, standing as an independent neurotizer, with a minimal functional sacrifice. The transfer to BLHT allows for better elbow stability and some degree of elbow extension extension. In complete BPP patients, a combination with direct graft repair with the use of viable C5 proximal stump leads to the satisfactory useful functional recovery, especially in young patients.
4.3 Medial triceps and anconeus branch transfer for axillary nerve injuries: a case series

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Objective: To describe the outcomes of our experience of axillary nerve injury treated with medial triceps and anconeus branch nerve transfer.

Methods: Results: An average of eight months from injury to reconstruction was recorded. All patients recovered deltoid function, with no reports of loss on active extension of the elbow. In average, of 151° of shoulder abduction was recovered, with strength of M4 in seven patients, and M3 in one. Electromyography documented appropriate reinnervation in all patients. The patients reported overall satisfaction, and scarce morbidity from the donor area. 1872 axons were found in the medial triceps and anconeus branch.

Results and Conclusions: Conclusion: Good results and low donor-site morbidity was found with transfer of the medial tricipital and anconeus brach for axillary nerve injuries via a posterior approach. PRO's evaluated in this study seem to support this theory. An adecuate recuperation of deltoid muscle was registered clinically and electromyographically. These findings seem to point out that this is a useful technique when treating this kind of peripheral nerve injury.
Wang Shufeng reported his technique of direct transfer of the opposite C7 to the lower trunk in CST1 avulsions in 2013. We have adopted his strategy since October 2013. The procedure involves sectioning of the pectoral nerves to aid mobilisation of the lower trunk. The supraspinatus muscle is the only motor of the shoulder that is innervated. Since November 2014, we chose to connect the medial cutaneous nerve of the arm to one or more of the divided pectoral branches in order to harness the growing axons from the opposite C7 to innervate the pectoralis major. So far, we have done this in 27 patients. We have follow-up longer than 16 months in 16 of these patients and 11 of them regained some pectoral function. Contraction of the ipsilateral pectoralis major is noted before that of the biceps and is activated by resisted adduction of the opposite arm or by resisted triceps action. The recovered pectoralis major contributes to the stability of the shoulder. In addition, appearance of pectoral contraction serves to signal the progress of the growing axons along the lower trunk. It also indicates the integrity of the repair to the opposite C7.
4.5 Free neurovascular muscle transplantation – a report of more than 200 cases  
M. Becker and F. Lassner

M. Becker 
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1203 patients with lesions of the brachial plexus have been operated between 2/04 and 12/17: In 220 cases free neurovascular muscle transplantation was performed. Minimal time interval for evaluation was nine months.

In the majority of cases (203) the gracilismuscle was used for the transfer, in 17 patients with combined soft tissue defect the latissimus dorsi muscle.

In 94 cases muscle transfer was used for biceps substitution. In 80 Cases function defect of the forearm were the indication for neurovascular mauscle grafting. 11 patients demonstrated with facial paralysis. In the remaining cases duncional defects of the shoulder and the lower leg were reconstructed.

Reinnervation was achieved by different procedures according to the different levels of nerve lesions. They vary from direct nerve suture to serial, combined nerve grafts with a total length of more than 50cm. In these cases nerve grafting was performed in the first step, after biopsy the neurovascular transfer was performed. Age of the patients was from 2,5 to 65 years.

Nine muscle grafts were lost, four by vascular reasons and five by missing reinnervation. Most common problem (7%) was a seroma at the donor site.

Best results were achieved with defined motor nerve donors, even in longer distances. Nerval reinneration from mixed donors showed more variety concerning muscle power and endurance.
4.6 Finding a standard – Results in brachial plexus surgery for the adults

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The limited number of cases in surgery for traumatic brachial plexus injuries in the adults often does not allow statistically well defined conclusions. Statements concerning influencing factors such as age, delay between trauma and surgery and concurrent surgical concepts are of low evidence in most single series. Metaanalyses are a common tool used to solve this problem. But up to now metaanalyses in brachial plexus injuries were limited by the restricted comparability of published results. Most studies only present one item, such as range of motion, force, function or satisfaction. Different outcomes and documentation are used. Statistical analyses follow unequal rules. Several well prepared protocols for comprehensive follow-up are established, but their use seems not to be feasible beside prospective controlled studies. The presentation will introduce the different protocols and focus on the problem of standardizing results for pain, sensory, range of motion, force and function in consideration of former contributions at the Narakas-meetings. Special attention will be given to feasibility taking into account limited conditions in different countries and cultural requirements. The presentation can only be the starter for an ongoing discussion with the aim to compromise in developing a recommended standard outcome assessment.
4.7 COMBINE -Core Outcome Measures in Brachial plexus INjuries

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4.8 Effectiveness of rehabilitation in traumatic brachial plexus injuries: retrospective study of 102 cases assisted in a single hospital in Latin America


Introduction / Objectives: Traumatic brachial plexus injuries may be disabling and there are few studies in the literature that evaluate the effectiveness of rehabilitation. The main objective of this study was to analyse the influence of interdisciplinary rehabilitation on functional capacity and return to work/study, as well as level of satisfaction with treatment after traumatic brachial plexus injury.

Material and methods: A retrospective study of 102 patients admitted to a single hospital in Latin America between June 2012 and May 2017. The rehabilitation interventions, self-perception of what influenced return to work, functional capacity (DASH) and satisfaction with treatment (visual analogic scale, 0-10) were analysed. SPSS software was used for statistical analysis and a considered level of significance of p 0.05.

Results: Functional capacity improved after rehabilitation (p 0.05), especially in men with incomplete lesions. Return to work/study occurred in 74% of the population. Strength and functional capacity improvements were predictors for return to work/study (p 0.05). Furthermore, age, gender, educational level, type of work and level of satisfaction differed between patients who returned and did not return. Satisfaction was graded between 8.9 and 9.5 in 95% of the cases. Twenty-nine patients answered the question regarding self-perception of what influenced return to work. They indicated “necessity”, “my desire”, “rehabilitation” and “not become depressed”.

Conclusion and perspectives: Interdisciplinary rehabilitation influenced functional capacity and return to work or study. It should thus be part of the treatment plan in patients with traumatic brachial plexus injuries.
4.9 Rehabilitation of Upper Extremity Nerve Injuries Using Surface EMG Biofeedback: Protocols for Clinical Application

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Introduction:

Motor recovery following nerve transfer surgery depends on the successful reinnervation of the new target muscle by regenerating axons. Cortical plasticity and motor relearning also play a major role during functional recovery. Successful neuromuscular rehabilitation requires detailed afferent feedback. The aim of this paper was to present the value of structured rehabilitation protocols.

Materials & Methods:

Patient group 1 included nerve injury patients who received nerve transfers to restore biological upper limb function, while group 2 comprised patients where biological reconstruction was deemed impossible and hand function was restored by prosthetic hand replacement. The rehabilitation protocol for group 1 included guided sEMG training to facilitate initial movements, to increase awareness of the new target muscle and to facilitate separation of muscular activities. In patient group 2 sEMG biofeedback helped identify EMG activity in biologically “functionless” limbs and improved separation of EMG signals upon training.

Results:

Functional outcome measures were assessed with standardized upper extremity outcome measures. The British Medical Research Council scale for group 1 and Action Research Arm Test for group 2. Before actual movements were possible, sEMG biofeedback could be used. Patients reported that this visualization of muscle activity helped them to stay motivated during rehabilitation and facilitated their understanding of the re-innervation process. sEMG biofeedback may help in the cognitively demanding process of establishing new motor patterns.

Conclusion:

After standard nerve transfers individually tailored sEMG biofeedback can facilitate early sensorimotor re-education by providing visual cues at a stage when muscle activation cannot be detected otherwise.