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Triceps nerve to deltoid nerve transfer after an unsatisfactory intra-plexus neurotization of the posterior division of the upper trunk

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ABSTRACT

INTRODUCTION: Our literature review did not reveal any study on the results of triceps to deltoid nerve transfer done as a secondary procedure after an unsatisfactory primary intraplexus neurotization of the posterior division of the upper trunk.

PRESENTATION OF CASES: We report on three adults with C5–C6 brachial plexus injury who had an unsatisfactory deltoid function following primary intraplexus neurotization. Patients presented to our clinic late (14–16 months after injury). All patients had poor shoulder abduction ($<40^\circ$) despite the presence of visible and palpable deltoid contractions. A triceps to deltoid nerve transfer resulted in an excellent shoulder abduction ($>150^\circ$) in all patients.

DISCUSSION: The primary surgery in our patients acted as a “baby-sitter” procedure; explaining the good results of the late secondary distal nerve transfer.

CONCLUSION: Good results may be obtained from a late distal nerve transfer for the deltoid muscle as long as there is partial innervation of the muscle.

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1. Introduction

Adults with isolated axillary nerve palsy and those with isolated brachial plexus C5–C6 avulsion are usually treated with primary nerve transfers [1–3]. In these cases, the axillary nerve is neurotized using one of the motor branches of the triceps nerve [1,2]. Although the results of this distal nerve transfer are generally good, a failure rate of up to 25% has been reported [4]. One of the major factors affecting the outcome is the delay from injury to the nerve transfer [4].

In this paper, we report on three adults with C5–C6 brachial plexus injury who had an unsatisfactory deltoid function following primary intraplexus neurotization of the posterior division of the upper trunk. All three patients presented to our clinic late (14–16 months after injury); at which time a triceps nerve to deltoid nerve transfer was done. The results of such a late secondary distal nerve transfer are presented. The work has been reported in line with the SCARE criteria [5].

2. Presentation of cases

Three adult patients sustained C5–C5 brachial plexus injury and had primary exploration and reconstruction of the brachial plexus as shown in Table 1. In all cases, neurotization of the deltoid muscle was done using sural nerve grafts coapted from the available roots to the posterior division of the upper trunk.

All patients presented to our clinic late (14–16 months after injury) and had the main complaint of poor shoulder abduction. Motor assessment of shoulder and elbow at the time of presentation to our clinic is shown in Table 2. All three patients had excellent recovery of active elbow flexion and a satisfactory recovery of active external rotation of the shoulder. However, there was poor active shoulder abduction ($20\text{--}40^\circ$) despite the presence of full or near-full passive range of motion of the shoulder. In all patients, there was visible and palpable contractions of the deltoid muscle indicating partial innervation.

All patients underwent triceps nerve to deltoid nerve transfer through a standard arm incision along the posterior border of the deltoid muscle. We first identified the cutaneous branch of axillary nerve piercing the deep fascia of the upper arm. The cutaneous branch was then followed proximally to the axillary nerve. The anterior division of the axillary nerve was identified and transected as proximal as possible. The radial nerve was then identified at the triangular space. The motor branch to the lateral head of the triceps was identified and transected as distal as possible. The triceps

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Table 1
Demographic data of our three patients.

Patient Number	Age/Sex	Brachial plexus injury	Time from injury to primary brachial plexus surgery	Intraoperative findings at the time of primary brachial plexus surgery	The method of reconstruction in primary brachial plexus surgery
1	30/Male	Iatrogenic (post excision of a vascular lesion in the neck)	2 months	C5 and C6 roots transected near the vertebral foramen	Sural nerve graft from C5/C6 roots to upper trunk
2	25/Male	Traumatic (Car accident)	3 months	C5 rupture C6 avulsion	<ul style="list-style-type: none"> • Spinal accessory to supra-scapular nerve transfer • Sural nerve grafts from the C5 root to the anterior and posterior divisions of the upper trunk
3	28/Male	Traumatic (car accident)	4 months	C5 avulsion C6 rupture	<ul style="list-style-type: none"> • Spinal accessory to supra-scapular nerve transfer • Sural nerve grafts from the C6 root to the anterior and posterior divisions of the upper trunk

Table 2
Motor assessment of the shoulder and elbow at the time of presentation to our clinic (prior to distal nerve transfer).

Patient Number	Time from injury to presentation to our clinic	Motor assessment at the time of presentation to our clinic		
		Active shoulder abduction	Active shoulder external rotation	Active elbow flexion
1	14 months	20°	15°	100°
2	15 months	35°	20°	100°
3	16 months	40°	20°	110°

motor nerve was transposed and coapted to the deltoid nerve using fibrin glue. The arm was immobilized for three weeks.

At final follow-up 12–16 months later, active shoulder abduction improved to reach 160°, 150° and 150° in patients 1–3 respectively.

3. Discussion

Our literature review did not reveal any studies on the results of secondary triceps nerve to deltoid nerve transfer after an unsatisfactory primary intra-plexus neurotization of the posterior division of the upper trunk. The main finding of our paper was that the results of this distal nerve transfer were good despite the significant delay; as long as there was partial innervation of the muscle from the primary procedure.

We were aware that the delay period (14–16 months after injury) in our patients was too long to guarantee a good outcome; and we discussed this with our patient [6]. However, we still recommend the distal nerve transfer to our patients because the deltoid muscle had visible and palpable contractions indicating partial innervation from the primary intraplexus neurotization surgery. Experimentally, partial muscle innervation preserves future re-innervation potential and allow substantial muscle recovery [7]. Our results indicate that this is also true in humans.

There are many ways that have been used to attenuate denervation-induced muscle atrophy, such as low frequency direct electrical muscle stimulation, acupuncture, and temporary sensory innervation [8,9]. None of these methods were done to our patients. Another technique used for facial palsy patients is known as the “baby-sitter” procedure [10]. Patients with unilateral facial palsy undergo a formal cross-facial nerve graft; in addition to partial neurectomy of the ipsilateral hypoglossal nerve with coaptation to the ipsilateral facial nerve. The ipsilateral hypoglossal nerve is very close to the target (denervated) facial muscles and provide early innervation of the paralyzed muscles. This protects the muscles until it is time for repair of the cross-facial nerve graft to the

ipsilateral facial nerve. Modifications of this baby sitter procedure has been published for facial palsy [11]. The primary brachial plexus nerve grafting in our patients acted, in theory, as a baby-sitter procedure for the deltoid muscle.

Finally, two points regarding the surgical technique of triceps nerve to deltoid nerve transfer should be noted. Identification of the axillary nerve may be done using either a dissection of the interval between the long and lateral heads of the triceps [2] or by proximal dissection of the cutaneous branch of the axillary nerve [1]. We prefer the latter technique. Another technique modification of the procedure is the choice of donor motor nerve of the triceps. Originally the nerve to long head of triceps was utilized [2]. Others prefer the nerve to the medial head [1] or the nerve to the lateral head [12]. We usually utilize the nerve to the lateral head.

4. Conclusion

Good results may be obtained from secondary triceps nerve to deltoid nerve transfer (done 12–16 months after injury) following an unsatisfactory primary intra-plexus neurotization of the posterior division of the upper trunk as long as there is partial innervation of the deltoid from the primary procedure.

Conflict of interest

None.

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Ethical approval

The study was approved by the Research Committee of National Hospital (Riyadh Care), Riyadh, Saudi Arabia.

Consent

Written informed consent was obtained from the three patients for publication of this case report. A copy of the written consent is available for review by Editor-In-Chief of this journal on request.

Author contribution

All authors contributed significantly and in agreement with the content of the manuscript. One author did the literature review and other authors participated in data collection.

Guarantor

M.M. Al-Qattan.

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