ORIGINAL ARTICLE

MUSCLE TRANSFER FROM TRICEPS TO BICEPS IN PATIENTS WITH CHRONIC INJURY OF THE UPPER TRUNK OF THE BRACHIAL PLEXUS

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ABSTRACT

Objective: To evaluate the results from transposition of the triceps for elbow flexion in patients with chronic and complete injury to the upper trunk of the brachial plexus. Methods: This was a retrospective study, including only patients who had biceps grade 0 and triceps grade 5, who underwent anterior transfer of the triceps muscle, performed between 1998 and 2005. The affected side, sex, type of accident, strength of elbow flexion, complications and patient satisfaction were investigated in 11 cases. Results: 10 patients were male; the age range was from 24 to 49 years, with a mean of 33.7 years. The minimum time between injury and surgery was 21 months (range 21-74 months). The left side was affected in eight cases, and the right only in three. Good results were obtained in 10 patients, who acquired elbow flexion strength of grade 3 (two cases) and grade 4 (eight cases), while one evolved unfavorably with grade 2 strength. Two cases had complications (initial compartment syndrome and insufficient tensioning). All the patients said that they were satisfied with the procedure. Conclusion: Anterior transposition of the triceps muscle provided patient satisfaction in all cases except one, attaining strength grade 4 in eight cases, grade 3 in two cases and grade 2 in one case.

Keywords – *Musculoskeletal system; Brachial plexus; Elbow*

INTRODUCTION

Traumatic lesions of the brachial plexus mainly affect young adults in full productive activity, causing variable degrees of functional deficit that are often irreversible. Accidents involving motorcyclists are the main factor responsible for the increasing numbers of patients. According to Abraciclo[1], sales of motorcycles in Brazil increased from 460,000 per year in 1998, to 1.8 million in 2008.

Ideally, treatments for lesions of the brachial plexus are carried out at a subacute stage, by means of neurolysis, interposition of grafts and/or neurotization. In such cases, it is possible to achieve restoration of elbow flexion in 60% of the cases[2]. At the chronic stage, the results from these techniques are disappointing. The use of muscle-tendon transfers is recommended, in particular Steindler flexorplasty[3,4], transfers of the latissimus dorsi[5], pectoralis major and triceps muscles[6,7], along with muscle transplants[8,9].

The aim of the present study was to evaluate the results from transposition of the triceps for elbow flexion in patients with chronic complete injury of the upper trunk of the brachial plexus.

MATERIALS AND METHODS

A retrospective study was conducted, in which only patients who presented biceps grade 0 and triceps grade 5 were included (Table 1). These patients underwent

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anterior transfer of the triceps muscle between 1998 and 2005, performed by surgeons within the Hand and Microsurgery Group of the Institute of Orthopedics and Traumatology, Hospital das Clínicas, University of São Paulo School of Medicine. The side affected, sex, type of accident, elbow flexion strength, complications and patient satisfaction were investigated.

This last issue was assessed by means of the following question: "Were you satisfied with this surgery?", to which the response could be "yes" or "no".

Table 1 – Grading of muscle strength

Grade 0	Absence of muscle contraction
Grade 1	Muscle contraction, without joint movement
Grade 2	Movement without overcoming gravity
Grade 3	Movement that overcomes gravity
Grade 4	Movement that overcomes gravity and some resistance
Grade 5	Normal muscle strength

Source: Seddon HJ[10]

SURGICAL TECHNIQUE

The patients were positioned in dorsal decubitus, and a posterolateral incision was made in the distal third of the upper arm;

Dissection was performed in layers, with identification and protection of the ulnar nerve; and the tendon of the triceps was separated, with proximal dissection;

The insertion of the triceps in the olecranon was sectioned, with proximal dissection of the musculature (Figures 1 and 2);

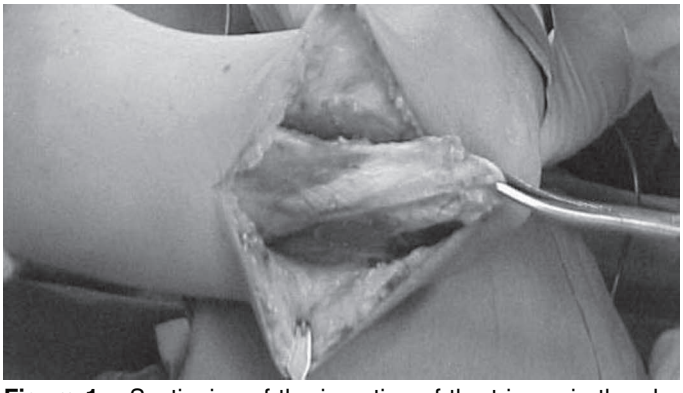

Figure 1 – Sectioning of the insertion of the triceps in the olecranon

An anterior incision was made in the elbow, with identification of the tendon of the biceps and dissection of the subcutaneous tissue, posterolaterally; and

Figure 2 – Proximal dissection of the triceps, with separation of the triceps from the humerus and from the ulnar nerve

Anterior transposition of the tendon of the triceps was performed, with suturing to the tendon of the biceps (Figure 3).

Figure 3 – Suturing of the triceps to the tendon of the biceps

RESULTS

Between 1998 and 2005, a group of 11 patients were operated. Among these, 10 were male. The patients' ages ranged from 24 to 49 years, with a mean of 33.7 years. The minimum time between the injury and the surgical procedure was 21 months (ranging from 21 to 74 months). Motorcycle accidents caused the injuries in

10 patients and falling from a height in one case. The left side was affected in eight cases, while the right side was affected in only three cases.

Transfer of the triceps muscle to the biceps provided good results in 10 patients, among whom eight acquired elbow flexion strength of grade 4 (Figure 4) and two acquired grade 3. In one case, the result was unsatisfactory since the patient acquired grade 2 flexion strength. Two patients evolved with complications. In one case, fasciotomy was indicated because of the suspicion of an initial condition of compartmental syndrome, which evolved satisfactorily with a final result of grade 3 elbow flexion strength. The other case required reoperation because of insufficient tensioning when suturing the biceps. This patient also evolved with grade 3 strength (Table 2).

Figure 4 – Patient presenting elbow flexion strength grade 4

DISCUSSION

Patients with injuries to the brachial plexus present extremely variable clinical conditions, since such lesions can have effects ranging from partial and transitory loss of sensitivity in the affected arm to total and permanent lack of sensitivity and motricity. These latter cases are generally due to complete detachment of the roots.

Given the diversity of possible lesions and clinical presentations, surgeons need to make detailed assessments and record the somatic areas and muscle strength of all the muscle groups[9].

Table 2 – List of patients, showing age, sex, side affected, type of accident, time between injury and procedure and final muscle strength

Case	Initials	Age	Sex	Side	Type of accident	Time from injury to surgery	Muscle strength
1	A.R.S.	41y	M	L	MC	4y 3m	G4
2	J.C.S.T.	38y	M	L	MC	6y 2m	G4
3	E.F.S.	25y	M	L	MC	2y 11m	G4
4	E.S.O.	31y	M	L	MC	2y 8m	G4
5	A.L.A.	33y	M	L	MC	3y 4m	G4
6	F.A.C.	28y	M	R	MC	2y	G4
7	B.D.R.A.	28y	M	L	MC	1y 9m	G4
8	F.B.S.	49y	M	L	Fall from height	6y	G4
9	J.C.M.	47y	M	L	MC	3y 11m	G3
10	F.R.S.	24y	M	R	MC	3y 8m	G3
11	S.A.S.	27y	F	R	MC	2y 1m	G4

Source: Hand and Microsurgery Group, Institute of Orthopedics and Traumatology, Hospital das Clínicas, University of São Paulo School of Medicine
MC = motorcycle

Incapacity to flex the elbow gives rise to a significant functional limitation of the limb, especially in cases of isolated lesions of the upper trunk, in which hand movements are generally preserved.

We agree with the majority of surgeons in choosing elbow flexion as the top priority in the treatment plan.

Surgical treatment should ideally be implemented during the acute phase, since neurolysis, end-end sutures, graft interpositions and neurotization can be performed[10], with the aim of reinnervating the target muscles.

In chronic cases, elbow flexion can be restored through muscle-tendon transfers. Among such possibilities are transpositions of the latissimus dorsi[5], pectoralis major[11], pectoralis minor, coracobrachialis[9,12] and triceps[6,7,13] muscles, and Steindler flexorplasty[3,4,13], along with muscle transplants, among which the gracilis can be highlighted[9,14].

Azze *et al*[11] described good results from transpositions of the pectoralis major and latissimus dorsi, while emphasizing that the latter presents better cosmetic results and the first option is indicated for female patients.

Pardini *et al*[13] compared transpositions of the triceps and flexor-pronator muscles. They emphasized the importance of patient selection for indicating tenoplasty of the triceps, since in cases of patients who use crutches

or wheelchairs and those who need elbow extension in their hobbies, this technique is contraindicated and better results are obtained with triceps transposition.

In a series of three cases, Rostoucher *et al*[2] reported good results from triceps transposition, obtaining grade 4 and 5 muscle strength. In addition, Hoang *et al*[6] obtained good results from seven patients who were operated.

Rühmann *et al*[7], demonstrated good results in 10 cases, in which elbow flexion strength between grades 3 and 5 was obtained.

These results are similar to what was obtained in the present study, given that out of the 11 patients operated, eight acquired grade 4 strength, two acquired grade 3 and one acquired grade 2.

Anterior transposition of the triceps is an important alternative for restoring elbow flexion, since the procedure is relatively simple and safe, and it provides good functional results and satisfactory evaluations from the patients.

The main disadvantage of this technique is the lack of active extension of the elbow, which is performed by gravity. Although this discomfort is considerable, it does not contraindicate the procedure, given that all the patients were satisfied with the result.

CONCLUSION

Anterior transposition of the triceps muscle provided patient satisfaction in all the cases except one. Grade 4 strength was obtained in eight cases, grade 3 in two and grade 2 in one. In cases of chronic lesion of the upper trunk of the brachial plexus, surgical indications for this technique are viable.

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