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Original article

Elbow flexion restoration using pedicled latissimus dorsi transfer in seven cases

Réanimation de la flexion du coude par transfert pédiculé de latissimus dorsi dans une série de sept cas

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Abstract

Purpose. – The aim of this study is to analyse the results of a series of pedicled latissimus dorsi transfers to restore elbow flexion. Moreover, we describe a new technique of distal fixation of the muscle to the proximal third of the ulnar diaphysis to increase the lever arm and improve strength.
Methods. – We retrospectively reviewed seven patients aged from 18 to 49 years. Elbow flexion paralysis was secondary to destruction of the anterior arm compartment in four cases and to brachial plexus palsy in three cases. The humeral insertion of the latissimus dorsi was relocated on the coracoid process in five cases and not relocated in two cases. The patients were assessed using the Medical Research Council grading system, the maximum weight lifted by the wrist and the active elbow range of motion.
Results. – At the last follow-up (mean 26.6 months), five patients recovered M4 elbow flexion strength (0.5 to 8 kg), one patient recovered M3 strength and the last transfer failed because of triceps brachii co-contractions. The mean active elbow flexion was 91° (range, 45 to 130°). Patients with destruction of the anterior arm compartment and particularly whose forearm was not paralyzed had better strength than patients with a brachial plexus palsy (3.25 versus 1 kg). A skin island with the latissimus dorsi muscle flap was particularly useful in case of arm soft tissue defect.
Discussion. – A destroyed anterior compartment of the arm is a good indication for latissimus dorsi transfer to restore elbow flexion. The muscle is usually too weak in high brachial plexus palsy. Finally, the latissimus dorsi needs an objective, reproducible and reliable preoperative evaluation.
Level of evidence. – Level IV.

Keywords: Latissimus dorsi; Brachial plexus; Elbow flexion; Palliative transfer; Pedicled flap

Résumé

Objectif. – Le but de l'étude était d'analyser les résultats d'une série de transferts pédiculés du latissimus dorsi pour restaurer la flexion du coude. De plus, nous décrivons une nouvelle technique de fixation distale du muscle au tiers supérieur de la diaphyse ulnaire afin d'augmenter le bras de levier ainsi que la force développée.
Méthodes. – Nous avons revu rétrospectivement sept patients âgés de 18 à 49 ans. La paralysie de flexion du coude était secondaire à une destruction de la loge antérieure du bras dans quatre cas et à une paralysie du plexus brachial dans trois cas. L'insertion humérale du latissimus dorsi était transférée sur la coracoïde dans cinq cas, et laissée en place dans deux cas. L'évaluation des patients a porté sur la force de flexion du coude mesurée selon le score Medical Research Council, sur le poids maximum soulevé au poignet et sur les mobilités actives du coude.
Résultats. – Au recul moyen de 26,6 mois, cinq patients ont récupéré une force de flexion du coude de grade M4 (0,5 à 8 kg), un patient a récupéré une flexion de grade M3 et le dernier transfert a échoué du fait de co-contractions du triceps brachial. La flexion active moyenne du coude était de 91° (de 45° à 130°). Les patients ayant eu une destruction de la loge antérieure du bras, et particulièrement ceux dont l'avant-bras n'était pas

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paralysé avaient une force plus importante que ceux ayant une paralysie plexique (3,25 versus 1 kg). Une palette cutanée combinée au muscle était utile en cas de perte de substance associée des parties molles du bras.
Discussion. – La destruction de la loge antérieure du bras est une bonne indication au transfert de latissimus dorsi pour réanimer la flexion du coude. Le muscle est régulièrement trop faible dans les paralysies plexiques hautes. Enfin, nous ne disposons pas pour l'instant de procédé d'évaluation préopératoire objectif, fiable et reproductible du latissimus dorsi.
Niveau de preuve. – IV.

Mots clés : Latissimus dorsi ; Plexus brachial ; Flexion du coude ; Transfert palliatif ; Lambeau pédiculé

1. Introduction

Flexion of the elbow is a vital function in daily living particularly for bringing the hand to the mouth and dressing oneself. Biceps brachii and brachialis muscles are the primary elbow flexors. Elbow flexion insufficiency is caused by either paralysis of the flexor muscles (by brachial plexus palsy or historically, poliomyelitis) or by destruction of the muscles (by trauma, infection or after tumour resection). Furthermore, the terminal vascularisation pattern of biceps brachii and brachial muscles makes them vulnerable to ischemic necrosis.

One of the most important aims in brachial plexus surgery is recovery of active elbow flexion, obtained by neurotisations or nerve grafts [1]. In cases of nerve surgery failure or impossibility, palliative transfers are used. Several transfers have been described: medial epitrochlear muscles transposition by Steindler, pectoralis major transfer, triceps brachii transfer, sternocleidomastoid transfer, and free muscle transfers like gracilis.

Following the use of latissimus dorsi transfer to restore elbow extension [2], elbow flexion transfer was developed by Schottstaedt et al. [3] and Hovnanian [4] without relocation of the humeral insertion. Zancolli and Mitre [5] described the bipolar technique that is presently most commonly employed.

The latissimus dorsi muscle is a wide flat muscle extending from dorsal and lumbosacral regions to the humeral shaft. It is triangular in shape, with its base at the spine and the apex at the axilla. Its blood supply comes from the thoracodorsal artery, a branch of the subscapular artery. The thoracodorsal nerve (roots C5 C6 C7) is responsible for the innervation of the muscle. It participates in arm adduction, retropulsion and internal rotation, but functional donor site morbidity is minimal except in patients participating in sports or paraplegics [6].

We present a series of seven patients with paralysis of elbow flexion who had a pedicled latissimus dorsi transfer. Moreover, we describe a new technique of distal fixation to the ulna.

2. Patients and methods

2.1. Patients' description

Between 2003 and 2009, a pedicled latissimus dorsi transfer was performed in seven men to restore elbow flexion. Informed consent was obtained from each patient; our institution does not require institutional review board approval.

In three patients, the elbow flexion deficiency was due to brachial plexus palsy; in the four others, the anterior compartment of the arm had been destroyed by ischemic necrosis (two cases) or local trauma (a car accident and a tiger bite). Patients were operated at a mean delay of 19 months (range, 6 to 48 months) after the initial trauma. The initial strength of elbow flexion was graded as lower than M2 (according to the Medical Research Council grading system) in every patient but one (M3). Preoperative latissimus dorsi strength was assessed by asking the patient to perform arm adduction against resistance. Six patients had grade M5 and one patient had M4 after partial recovery of complete radicular brachial plexus palsy. In five patients, both the origin and insertion of the muscle were detached (bipolar transfer), isolating the muscle on its neurovascular pedicle. The origin was then attached more proximally to the coracoid process. In the two other cases, the latissimus dorsi was left attached at its humeral insertion to avoid dissection of the axilla. A skin island was harvested with the muscle in the five cases with soft tissues defects.

Assessment of the results comprised the elbow flexion strength measurement and the active elbow range of motion. The strength of elbow flexion was measured using the Medical Research Council grading system with the elbow flexed at 90°. The maximum weight sustained at the level of the wrist was recorded for patients able to flex the elbow against resistance.

2.2. Operative technique

The surgery was performed under general anaesthesia in the supine position.

First, the latissimus dorsi muscle was mobilized on its neurovascular pedicle through a longitudinal incision at its anterior edge reaching the axilla. For bipolar transfer its insertion at the humeral shaft was sectioned. The tendon was passed beneath the pectoralis major tendon and attached onto the coracoid process. An extension of the incision toward the deltopectoral groove was usually not necessary.

Several arm cutaneous incision patterns were used depending on the quality of soft tissue and thus on the necessity of harvesting a cutaneous paddle.

When the soft tissues of the arm were intact (as in two cases of brachial plexus palsy), the flap was muscular only and was tunneled at the anterior aspect of the arm. Another short longitudinal incision was made above the elbow for the distal fixation.

In the five cases that required skin coverage, the flap was myocutaneous. An incision was made at the anterior aspect of the arm in three cases, or between the coracoid process and the