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Hand Surgery & Rehabilitation

Hand Surgery and Rehabilitation 35 (2016) 363–366

Clinical case

Rhomboid nerve transfer to the suprascapular nerve for shoulder reanimation in brachial plexus palsy: A clinical report

Transfert du nerf du rhomboïde sur le nerf suprascapulaire pour la réanimation de l'épaule dans une paralysie du plexus brachial : un cas clinique

J.-N. Goubier *, F. Teboul

Institute of brachial plexus and nerve surgery, 92, boulevard de Courcelles, 75017 Paris, France

Received 16 April 2016; received in revised form 8 June 2016; accepted 3 July 2016
Available online 23 September 2016

Abstract

Recovery of shoulder function is a real challenge in cases of partial brachial plexus palsy. Currently, in C5–C6 root injuries, transfer of the long head of the triceps brachii branch is done to revive the deltoid muscle. Spinal accessory nerve transfer is typically used for reanimation of the suprascapular nerve. We propose an alternative technique in which the nerve of the rhomboid muscles is transferred to the suprascapular nerve. A 33-year-old male patient with a C5–C6 brachial plexus injury with shoulder and elbow flexion palsy underwent surgery 7 months after the injury. The rhomboid nerve was transferred to the suprascapular nerve and the long head of the triceps brachii branch to the axillary nerve for shoulder reanimation. A double transfer of fascicles was performed, from the ulnar and median nerves to the biceps brachii branch and brachialis branch, respectively, for elbow flexion. At 14 months' follow-up, elbow flexion was rated M4. Shoulder elevation was 85 degrees and rated M4, and external rotation was 80 degrees and rated M4. After performing a cadaver study showing that transfer of the rhomboid nerve to the suprascapular nerve is technically possible, here we report and discuss the clinical outcomes of this new transfer technique.

Keywords: Rhomboid nerve; Suprascapular nerve; Brachial plexus palsy; Nerve transfer

Résumé

La réanimation de l'épaule dans le cadre des paralysies du plexus brachial demeure un vrai challenge. Actuellement, dans le cadre d'une lésion de la racine C5, un transfert du nerf du chef long du triceps brachial sur le nerf axillaire est proposé pour la réinnervation du deltoïde. Concernant la réanimation du nerf suprascapulaire, le nerf spinal accessoire est actuellement le plus utilisé. Nous proposons une alternative à ce transfert utilisant le transfert du nerf des rhomboïdes sur le nerf suprascapulaire. Un homme de 33 ans, présentant une rupture des racines C5C6 était opéré à 7 mois de l'accident. Concernant la réanimation de l'épaule, un transfert du nerf des rhomboïdes sur le nerf suprascapulaire était pratiqué ainsi qu'un transfert du nerf du chef long du triceps brachial sur la branche antérieure du nerf axillaire. Concernant la flexion du coude, un double transfert de fascicules du nerf ulnaire et du nerf médian sur les nerfs du biceps brachial et du brachial était réalisé. Au suivi de 14 mois, l'élévation de l'épaule était de 85° et la rotation latérale de 80° cotées M4. La flexion du coude était complète et cotée M4. Après une étude anatomique prouvant la faisabilité de ce transfert, nous rapportons et discutons les résultats cliniques de ce nouveau transfert.

Mots clés : Nerf du rhomboïde ; Nerf suprascapulaire ; Paralysie du plexus brachial ; Transfert nerveux

* Corresponding author.
E-mail address: jngoubier@gmail.com (J.N. Goubier).

http://dx.doi.org/10.1016/j.hansur.2016.07.002
2468-1229/

1. Introduction

Shoulder palsy in brachial plexus injuries of the C5 and C6 roots is a real challenge for nerve surgeons. Transfers from the radial nerve branches to the axillary nerve are generally used for anterior deltoid muscle reanimation [1,2]. As for the suprascapular nerve (SSN), the spinal accessory nerve (SAN) is usually transferred for reanimation of the supraspinatus and infraspinatus muscles [3,4]. We propose an alternative technique for reanimation of the SSN using the nerve to the rhomboid muscles, in order to keep the trapezius muscle intact, or potentially to use the SAN for another target.

A cadaver study was performed initially to prove the feasibility of this transfer (Fig. 1). The results showed that tensionless suture of the rhomboid nerve to the SSN was possible in all shoulders, with the diameter of the two nerves being macroscopically compatible (average diameter: 2.9 and 3 mm, respectively) [5]. We now present the results of the transfer of the rhomboid nerve to the SSN in a clinical case.

2. Clinical report

A 33-year-old male patient had partial palsy of his right brachial plexus involving the C5 and C6 roots following a motorcycle accident. Shoulder and elbow flexion were paralyzed. The anterior serratus and rhomboid muscles were clinically present. Electromyography confirmed the clinical examination and MRI excluded root avulsions.

Surgical exploration was deemed appropriate. Time before surgery was 7 months. Transfer from one fascicle of the ulnar

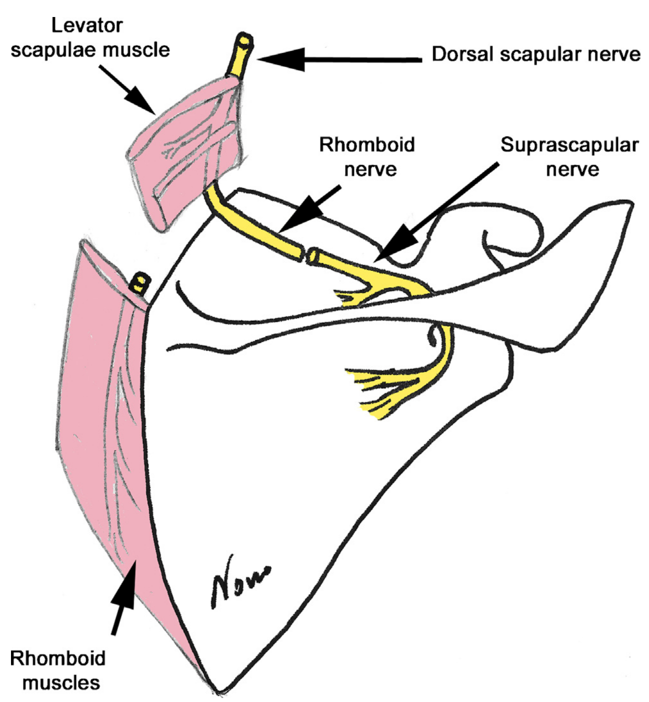

Fig. 1. Transfer of the rhomboid nerve to the suprascapular nerve: the levator scapulae is released from the medial border of the scapula to expose the dorsal scapular nerve. The nerve to the rhomboid muscles is released until it reaches the upper edge of the rhomboid muscles, divided, and then turned toward the suprascapular nerve in the supraspinatus fossa (from Goubier and Teboul [5]).

and median nerve to the biceps and brachial branches was performed. For the shoulder palsy, transfer from the long head of the triceps branch (LHTB) to the anterior branch of the axillary nerve for the anterior deltoid muscle was carried out. A transfer from the rhomboid nerve to the SSN was also performed.

The patient was positioned in lateral decubitus. A posterior approach along the spine of the scapula was performed. The trapezius was detached close to its scapular insertion in order to access the supraspinatus fossa. Then, the deep aspect of the supraspinatus muscle was reflected in order to access the suprascapular notch. At this level, the SSN was located, and freed by sectioning the transverse ligament of scapula to obtain the maximal length possible so as to make subsequent suturing easier.

The levator scapulae muscle was detached from the medial border of the scapula, and then retracted to expose the deep aspect of the dorsal scapular nerve. Once exposed, the branches to the levator scapulae muscle and rhomboid muscle were isolated. Electrical stimulation of the rhomboid nerve, starting with low intensity (0.02 mA) was performed to confirm normal innervation. The branch for the rhomboid muscle was freed as far as possible in the muscle and in the dorsal scapular nerve in order to obtain the maximum possible length. The branch was then cut close to the muscle and brought into contact with the SSN (Fig. 2). Then, the rhomboid and SSN were sutured under microscopy, with three separate 11-0 nylon sutures supplemented with fibrin glue. The trapezius muscle was reinserted to the spine of scapula. The skin was closed without a suction drain. The upper limb was immobilized in a splint for three weeks, after which rehabilitation was started with passive motion of the upper limb. Once the first contractions occurred, electrical stimulation of re-innervated muscles was performed.

At 7 months' follow-up, elbow flexion range-of-motion was complete and strength was rated M4 (according to Medical Research Council scoring). At 14 months' follow-up, active shoulder forward flexion was 85 degrees and rated M4. Active external rotation of the shoulder (measured from full internal

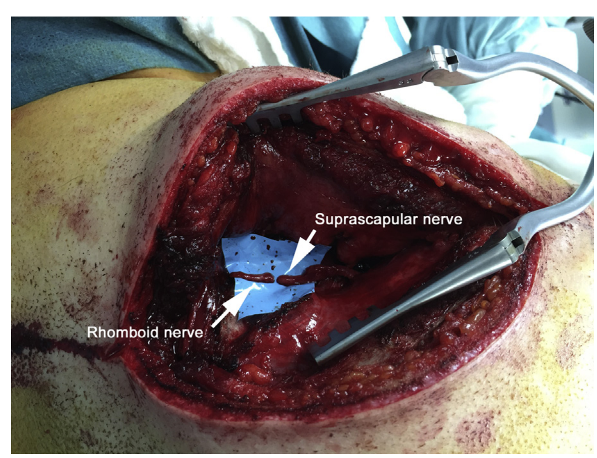

Fig. 2. Transfer of the rhomboid nerve to the suprascapular nerve with a posterior approach (right shoulder). This transfer can be performed without any tension. With this approach, the nerve is sutured close to the suprascapular muscle, encouraging faster recovery.

rotation elbow in contact with the thorax with a goniometer) was 80 degrees and rated M4. No complications such as hematoma, infection or skin necrosis were noted.

3. Discussion

The rhomboid nerve is the terminal branch of the dorsal scapular nerve (DSN) from the proximal part of the C5 root. Innervation of the DSN from C4 and C3, however, is not rare [6]. In anatomical studies cited by Malessy, innervation of the rhomboid muscle always occurs from the C4 root and in 30% of cases from C3 [6]. In a study of 38 patients undergoing surgery for brachial plexus injury with C5 root rupture, Malessy showed only two patients with paresis of rhomboid muscles, rated M4. Indeed, this could be explained by the anatomical localization of injuries in C5 rupture, which often occur at the superior trunk below the origin of DSN [2,7]. In theory, this nerve transfer could also be used in brachial plexus injuries with C5 root avulsion, owing to C4 innervation. Malessy showed that in 10 patients undergoing surgery with C5 avulsion, only two were paralyzed (rated M1 and M3). In all cases, clinical examination and electromyography of the rhomboid muscle are obviously necessary to evaluate DSN function. The levator scapulae muscle, the first muscle innervated from the DSN, may be easily tested by asking the patient to shrug his or her shoulder against resistance. Palpation of the contracted levator scapulae discriminates its belly from the overlying superior part of the trapezius. Rhomboid muscle function, however, may be difficult to differentiate from trapezius muscle contractions, especially in patients with excess fat. The patient must brace his or her shoulder against resistance. This maneuver leads to palpable contraction of the rhomboid muscles and a shift of the medial scapular margin towards the spine [6]. Muscle activity of rhomboids may be easily recorded with electromyography, nevertheless, it is not reliable enough to quantify this activity perfectly. Whatever the results of the clinical examination or electromyography, only electrical stimulation of the DSN during the operation will confirm that the rhomboid muscles are functioning correctly.

According to the literature, 10% of rhomboid nerves may have multiple branches that could complicate this transfer [6]. We did not experience this situation in our patient or in our cadaver study [5]. Obviously, if during the surgery, the rhomboid nerve transfer is not technically possible because of multiple branches, the spinal nerve may be used through the same approach. The spinal nerve may be easily located and harvested under the reflected trapezius muscle [8]. Moreover, the posterior approach may be laterally extended to perform a radial nerve transfer to the axillary nerve if elbow extension is preserved [5,8].

Winged scapula has been described after DSN injury in the literature [9]. We did not note this complication after harvesting the rhomboid nerve in our patient. In our technique, however, the nerve to the levator scapulae muscle was preserved, helping to stabilize the scapula with the anterior serratus muscle.

Results in terms of active external rotation are encouraging. In our patient, external rotation may be attributed to SSN reanimation. Spontaneous recovery of the teres minor can be excluded. The axillary nerve was divided as proximally as possible, above its division into three terminal branches, to increase the length of the anterior division. This was done to facilitate the transfer to the branch of the long head of the triceps and to focus all nerve fibers on the deltoid muscle. Obviously, these clinical results have to be confirmed with more patients. As for shoulder abduction, it may be difficult to dissociate recovery from axillary nerve transfer and rhomboid nerve transfer.

If done in a timely manner, a graft from the upper trunk (C5-C6) associated with the triceps branch to the axillary nerve, and ulnar nerve fascicle transfer may improve results in terms of shoulder abduction, external rotation and elbow flexion in patients [10]. Because of the lengthy 7-month period between the accident and surgery, no grafts were performed in our patient [11].

Our series is still too small to compare the results with SAN transfer, which is currently the standard for SSN reanimation [11,12]. Results of SAN transfer to SSN were satisfactory in terms of external rotation for C5–C6 brachial injuries [11,13]. In some cases, rupture of the brachial plexus involves the SSN origin, limiting the possibility of performing a direct transfer from the SAN. Moreover, in 6% of brachial plexus injuries, the SAN may be injured [14]. For these patients, our transfer could be an alternative. Moreover, for C5–C6 root rupture, only posterior shoulder and brachial approaches could be performed for shoulder and elbow reanimation, reducing the need for an unaesthetic cervical approach. Lastly, suturing of the rhomboid nerve to the SSN is performed close to the supraspinatus and infraspinatus muscles, which encourages faster motor recovery compared to suturing of the SAN to the SSN in the cervical approach. Obviously, all of these results should be confirmed in a larger series of patients with longer follow-up.

Disclosure of interest

The authors declare that they have no competing interest.

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