A Unique Case of Restoration of Finger Flexion using Triceps to Biceps Transfer

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Abstract

A global brachial plexus palsy injury is a challenging problem because of the very limited donor nerve options for restoration of the function of the upper limb. The condition becomes extremely complex when one is dealing with a case of failed previous nerve surgery wherein the available nerves have already been used. In such situations, free functioning muscle transfer is the usual choice; however, a proximal vascular injury could preclude this option too. In this study, we present a unique case of restoring finger flexion using the triceps–biceps complex transfer to the finger flexors using a fascia lata graft. The patient was quite satisfied with the grasp achieved by this procedure.

Level of Evidence: V.

Keywords

- global brachial plexus palsy
- finger flexion restoration
- grasp restoration
- tendon transfer
- triceps to biceps transfer

Introduction

A global brachial plexus injury (BPI) is a debilitating condition that results in the loss of both motor and sensory function in the entire upper limb. In spite of the recent advances in brachial plexus surgery, restoring finger flexion remains a major challenge in a patient with avulsion of the lower roots. Limited options include free functioning muscle transfer (FFMT) using the intercostal nerves or banked nerves from contralateral C7; contralateral C7 transfer to the ipsilateral lower roots; and transfer of the recovered biceps to finger flexors with a fascia lata graft.[1–4] However, a patient with failed primary nerve surgery poses an extreme challenge because of the unavailability of the suitable donor nerves for the nerve surgery or for powering the FFMT. The situation is further complicated if the patient has a vascular injury leading to unavailability of an appropriate feeding artery for the FFMT. In this study, we present a very unique case of global brachial plexus palsy in a patient who initially underwent a triceps to biceps transfer for restoring elbow flexion. This transfer was later extended with a fascia lata graft to restore finger flexion. The patient was able to make use of the restored finger flexion and was satisfied with the outcome.

Case Report

A healthy 21-year-old man was involved in a road traffic accident as a pillion rider 19 months before presentation to our unit with paucity of movements in his left upper limb since the injury. The medical records from the institute where he was operated on postinjury revealed that he had undergone an axillary artery repair with nerve transfers performed for shoulder abduction and elbow flexion. The patient noted improvement of shoulder abduction at

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Fig. 1 Clinical presentation at 19 months following injury with absent elbow flexion after multiple nerve transfers.

Fig. 2 Recovery of elbow flexion after the triceps to biceps transfer.

6 months after the surgery, but there was not much improvement in the elbow and the hand function at the time of his presentation to our unit at 19 months postinjury.

His examination at presentation revealed active shoulder abduction of 60 degrees; Medical Research Council (MRC) grade 1 elbow flexion, and flail wrist and hand with absent finger movements. His hand also lacked any sensations and the radial pulse was absent. However, the power of the triceps was MRC grade 4 (►**Fig. 1**). As the previous surgery records did not reveal any nerve transfer to the radial nerve, triceps recovery was attributed to spontaneous recovery. Since he was already at 19 months postinjury, FFMT was the only option available to restore elbow flexion. However, because of the axillary artery injury with absent distal palpable pulse, he was not an ideal candidate for performing an FFMT. Therefore, we proceeded with the only available donor option of the triceps and transferred the whole triceps to the biceps. The patient recovered with good elbow flexion of MRC grade 4 and had full range of elbow flexion at 6 months postsurgery (►**Fig. 2**).

Being satisfied with the recovery of elbow flexion, he desired for reanimation of his hand function. However, FFMT, which appeared to be the only option for restoring finger flexion, was not possible. Having had good experience and outcome with the biceps to finger flexor transfer in patients with global brachial plexus palsy, we thought of using the triceps to biceps transfer itself for restoring the finger flexion. The patient was explained about our plan and he consented for this operation. Wrist was arthrodesed 3 months prior to the planned transfer for finger flexion to allow transmission of the flexion force of the biceps across the wrist to the fingers.

Technique

A **Z**-shaped incision was made across the elbow joint crease, and the biceps tendon with the attached triceps tendon was identified. An 8-cm incision was then made over the volar aspect of the distal third of the forearm and all the flexor digitorum tendons were identified. A tunnel was made from the distal to the proximal wound using a tendon tuneler while assuring to remain deep to the flexor sublimis arch to avoid bowstringing of the transfer. A 25-cm-long and 4-cm-wide fascia lata graft was harvested from the right thigh to bridge the gap between the biceps tendon and the flexor digitorum profundus (FDP) tendons. The fascia lata was tuneled across from the proximal to the distal wound and first it was weaved into the biceps–triceps tendon complex by making three Pulvertaft weaves with nonabsorbable sutures. The distal attachment to the FDPs was made while keeping the elbow fully extended and fingers fully flexed while maintaining a proximal pull on the FDP tendons. The tension in the transfer was confirmed by observing that the full passive extension of the fingers was possible when the elbow was flexed to 90 degrees and on extending the elbow the fingers got fully flexed into the palm. The patient was put on an above-elbow slab with the elbow flexed to 90 degrees and he was instructed to passively extend the fingers while keeping the biceps relaxed and then actively contract the biceps and let the fingers go into flexion. At 4 weeks postsurgery, the plaster was removed and he was allowed to move the elbow actively and perform the finger exercises in the same manner with the elbow extended to variable degrees.

At 2 months postsurgery, he was encouraged to use the finger flexion power to hold on to things and strengthening exercises were continued. At his last follow-up (14 months), he was satisfied with the outcome and was excited to show how he was making use of his restored finger flexion. He was able to comfortably hold the handle of a bicycle (►**Supplementary Video 1**) and drive it and was also able to easily carry a bag weighing 2 kg with a hook grasp (►**Figs. 3** and **4**).

Fig. 3 Restoration of hook grasp following the proposed transfer of the triceps to biceps complex to finger flexors.

Fig. 4 Preserved elbow flexion following the transfer.

Discussion

In global brachial plexus palsy, the options for restoring finger flexion are limited as these patients often have avulsion of all the roots and the ipsilateral extra-plexal donors are not sufficient to restore finger function. Transfer of the recovered biceps to restore finger flexion has been described and is a reliable option in our experience too.[2] However, transfer of the triceps to biceps complex transfer for restoring finger flexion is a very unique procedure that has not been previously described.

The conventional options for restoring elbow flexion include latissimus dorsi transfer, pectoralis major transfer, Steindler's flexorplasty, triceps to biceps transfer, and FFMT. The first three options were not available in our case as these donors were not functional because of the extensive BPI. Also, as the patient had an axillary artery injury, an FFMT was not considered reliable. His biceps recovery after the previous nerve surgery was only grade 1, but fortunately the triceps brachii had recovered well (grade 4). The grade 4 power of the triceps was thought to be adequate for this case for a transfer as we observed that the patient had substantial biceps–triceps co-contraction and hence we thought that once the triceps was transferred to the biceps together they would provide at least an antigravity elbow flexion. This patient recovered with a very good (MRC grade 4) elbow flexion after the triceps to biceps transfer.

Enthused with his outcome of elbow flexion, the patient expected and requested a procedure to improve his finger flexion. The known techniques for restoring finger flexion in such a global involvement at 19 months postinjury are biceps to finger flexors transfer,[2] brachialis to finger flexors transfer,[5] and FFMT[1] with or without a fascia lata graft. However, none of these were possible in our case because of the lack of power in the donor muscles and the proximal vascular injury.

There is no literature documenting the possibility of using the triceps to biceps transfer to further extend to the fingers for restoring finger flexion. The novelty of the procedure was explained to the patient and he consented to this new technique. We performed the in-continuity transfer of the biceps–triceps complex to the finger flexor via a fascia lata graft to assure the recovered elbow flexion is not disturbed.

Interestingly, the triceps is an even more ideal match than the brachialis, which has been used for restoring finger flexion, as the triceps has a similar excursion to the flexor digitorum muscle.[6] The relative excursion of the triceps brachii medial (64.5 ± 3.8 mm), lateral (66.5 ± 5.4 mm), and long (85.3 ± 9.5 mm) heads is much closer to the 70-mm excursion of the native FDP muscle. This surgical procedure shows promise and has favorable outcomes for elbow flexion and by extension can produce satisfactory results for finger flexion as well. This kind of case should be carefully selected, but this technique can be a useful tool in the reconstruction of the upper limb in patients with global brachial plexus palsy where there is paucity of donor nerves and muscles, or where FFMT cannot be performed because of vascular injury or lack of expertise. It may present a fairly simple solution for a rather complex problem. This patient was extremely satisfied with the outcome and is now requesting for a technique to restore finger extension.

This report provides one more option to restore grasp in such complex situations and could serve as a lifeboat when the first-line options of restoring finger flexion are not possible. Hence, we are reporting this case to promote wider use of the procedure.

Video 1

Use of the restored hook grasp by the patient while riding a bicycle. Online content including video sequences viewable at: https://www.thieme-connect.com/products/ejournals/html/10.1055/s-0044-1801272.

Patient Consent

Written patient consent was obtained from all the subjects before the study. There is no information (names, initials, hospital identification numbers, or photographs) in the submitted manuscript that can be used to identify patients.

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Conflict of Interest

None declared.

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