

Contralateral cervical 7 as a potential donor in nerve transfer of adult brachial plexus injury especially in root avulsion case: A case report

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Abstract

Introduction: Contralateral cervical 7 (CC7) nerve transfer can be used in the absence of neurotizer in the BPI total root avulsion case. CC7 nerve transfer was introduced by Gu et al. in 1986, and aimed to restore motor and sensory function in the hand. The purpose of this paper is to report BPI patients with nearly total root avulsion using CC7 nerve transfer to the median nerve.

Case Presentation: A man suffered a motorcycle accident in March 2010. There was a complete loss of motor and sensory in the right upper limb. From the examination, it was obtained that the cervical root avulsion of C5-6, C7 postganglionic rupture and cervical root avulsion of C8-T1. In April of 2010 has been done root neurotization C4 to C5, C3 root neurotization was to the suprascapular nerve, neurotization of the phrenic nerve to C6, neurotization C7 to C6 with graft, and neurotization CC7 to median nerve with vascularized pedicle ulnar graft. An evaluation was made at the donor and recipient sites. From the first admission he had total motoric loss to the last evaluation for 5 years post operation of motoric in the recipient site showed range of motion (ROM) of elbow flexion recovered to M4 with ROM 135°, shoulder abduction reached M3 30°, finger flexion recovered to M2, and hand sensation came up to S1. There was no morbidity on the donor site from the first evaluation.

Conclusion: Therefore, CC7 can be a potential donor in nerve transfer of adult BPI root avulsion cases without causing morbidity in the donor site.

Keywords: Brachial plexus injury; Total root avulsion; Contralateral C7 transfer; Median nerve

1. Introduction

The most common cause of Brachial Plexus Injury (BPI) is high-velocity motorcycle accident due to traction and stretch upon the brachial plexus when the patients fall on their shoulder [1]. BPI is a common injury in Indonesia (76,1%) since the motorcycle is the main transportation used in the country. Complete C5-T1 BPI was the most cases in Dr. Soetomo General Hospital in Surabaya, Indonesia [2]. In the case of total root avulsion nerve repair and nerve graft cannot be done, neurotization (nerve transfer) is the last option to restore the function. Donor sources for the nerve transfer that can be used are accessory nerve, phrenic nerve, intercostal nerve, hypoglossal nerve, and contralateral seventh cervical nerve root (CC7) [3].

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Contralateral seventh cervical nerve root (CC7) is indicated when there is no available neurotizer on the affected side, used as one of the neurotizer in multiple neurotization in total root avulsion injury, and when one of the multiple neurotization fails for any type of avulsion injury [4]. CC7 donor was introduced by Gu et al. in 1986 and aimed to restore motor and sensory nerve function in the hand. This CC7 nerve transfer was done in the case of nearly total root avulsion.

2. Case Report

A 21-year-old man suffered a motorcycle accident that hit a motorcycle in March 2010. At that time, a positive Claude Bernard-Horner's sign was found and there was a complete loss of motor and sensory function in the right upper limb. Without an electrodiagnostic studies, we could expect that the patient had a right preganglionic brachial plexus injury. A written informed consent was obtained from the patient prior to this publication.

The patient underwent exploration 1 month after the injury and we found cervical root avulsion of C5-6, C7 postganglionic rupture, and cervical root avulsion of C8-T1. In April 2010 has been done root neurotization was C4 to C5, C3 root neurotization to the suprascapular nerve, neurotization of the phrenic nerve to C6, neurotization C7 to C6 with graft, and neurotization CC7 to Median Nerve with an ulnar nerve graft. CC7 transfer of this patient was from pedicled vascularized ulnar nerve graft (based on superior ulnar collateral artery) affected site. Figure 1 shows that the incision was made from the middle of the arm proximal to the superior ulnar collateral artery to the posterior medial epicondyle until the wrist joint. The ulnar nerve was freed and routed to CC7 through a subcutaneous neck tunnel. The proximal ulnar nerve stump was coapted to the median nerve and the distal ulnar nerve stump was coapted with posterior division of CC7.



Figure 1 The pedicled vascularized ulnar nerve graft on the affected side was freed from the arm to the wrist

Follow-up was made at the affected site and the donor site. One month postoperative there was no ROM of shoulder abduction, no ROM of elbow and finger, and no ROM of finger and wrist. There was no sensory or motoric loss in the donor site from the first time postoperative evaluation. Three months postoperative elbow flexion just started to show in the sleeping position (M2) at about 60 degrees. No other movement was found and sensory evaluation was S0. Two years postoperative elbow flexion showed an improvement. Elbow flexion against gravitation in a sitting position (M3) about 90 degrees. Shoulder abduction started to show contraction in the deltoid muscle (M1).

Two and a half years postoperative elbow flexion in a sitting position (M3) was increased to 135 degrees. Shoulder abduction shows strength improvement from M1 to M2 45 degrees in 6 months of evaluation. Finger flexion showed contraction (M1).

Four years postoperative elbow flexion increased from M3 to M4 with a constant 135-degree range of motion. Finger flexion was up to M2. Five years postoperative elbow flexion was still up to M4 with 135 degrees ROM. Shoulder abduction was finally against gravitation (M3) 30degrees. Hand sensation was improved to S1. No morbidity in the donor site until the last evaluation.

3. Discussion

In the total root avulsion case, restoration of the function needs more donors and C7 contralateral might be one of the options. The cervical 7 root forms the middle trunk that is not the only source for division so that sacrifice C7 will not cause a problem in the motoric and sensory of the donor site. A study by Zhang and Gu showed the recovery of motor and sensory function varies on the recipient's nerve. The best motor result \geq M3 was 78% on the musculocutaneous nerve. Median nerve recipient motor function \geq M3 was 55%, with the rest of the patients recovering to M1, and M2, even not recover at all (M0). Sensory recovery \geq S3 on the median nerve recipient was 63.8% [4]. Another study by Chuang in 2011 considered successful outcomes when the patients achieved strength M3 or greater. In group CC7 transfer to median nerve 30 of 55 patients (55%) achieved M3 or greater and almost all patients achieved finger sensation with protective sensory recovery on the radial 4 fingers. They preferred to do CC7 to the musculocutaneous and median nerve followed by FFMT for finger flexion to achieve better results. 64% of patients did not feel the sensory changes in the donor site and 89% felt no weakness in the donor site. Few patients had sensory and motoric deficits resolved in 1 to 7 months [5].

This case is a nearly total root avulsion leaving C7 postganglionic rupture. Using the C7 contralateral neurotization to the median nerve to restore the hand function. From the five-year evaluation of the recipient site, finger flexion was up to M2 and the hand sensory was S1. CC7 transfer of this patient was from vascularized pedicle ulnar graft affected side anastomosed with posterior division CC7 as the posterior division contains more motor fibers than anterior division [6]. The absence of a sensory deficit in the donor site from the first evaluation might be possible because we left the anterior division. Likewise, sensory development in recipients was not very good because the posterior division has only a few sensory fibers. Motor improvement was not so successful (M2) in this patient which could be caused by several factors. The long-distance nerve regeneration that must be undertaken could be one of the causes of failure to return to function [5]. Zhang and Gu proposed to do the CC7 transfer in two stages. First stage the distal stump of the ulnar nerve is coapted to CC7 to allow nerve regeneration while the proximal part of the ulnar nerve is intact to preserve the blood supply of the ulnar nerve graft before dividing its proximal part to the recipient nerve. The better result appeared to be in patients with better blood supply of the nerve graft. Superior ulnar collateral artery is preferred to performing ulnar artery and vein anastomosis. Whole and partial use of CC7 is said to also influence the success of the nerve transfer. A retrospective study by Gao and Hu et al from 1999 to 2006 stated that the motor function recovery for the entire C7 group was significantly better than the partial C7 group but no differences in the recovery of sensory function between groups [7]. Along with the retrospective study, an in vivo study using rats of Gao et al in 2018 concluded that harvesting of the entire contralateral C7 root achieved significantly better recovery than partial harvesting, even if only part of the entire root was used for transfer [8].

Education to the patient to sacrifice the CC7 is quite troublesome since complications postoperative in few studies were vary. Reduction in pinch and grip strength also paraesthesia in the area of median nerve distribution after CC7 transfer were reported in several studies although most of the motoric and sensory deficit will return in a few weeks to months [4–6, 9]. Obvious motor weakness was found in 3 of 123 patients in the study of Li. There was a significant decrease in the extensor digitorum communis and triceps muscle strength. Although it was improved later to M3 or M4, the patients ever felt dissatisfied knowing there was morbidity in the healthy site [10]. Systematic review among 904 included patients, 19 patients in seven studies (2 percent) did not completely recover from functional loss within the follow-up period [11]. Though this outcome of CC7 nerve transfer was not as successful as the other study, in a totally paralyzed case, we have to remember that to someone who has nothing, a little is everything. Having no morbidity in the donor site is also an important thing to evaluate since this morbidity can cause disappointment and dissatisfaction to the patient.

4. Conclusion

CC7 nerve transfer can be one option of the neurotizer in total root avulsion cases. It improves the function of the recipient nerve although not all the patients achieved functional results because many factors influence the success of the result. Most patients who experience donor site morbidity return within weeks to months. In this report, we did not find morbidity in the donor site.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict of interest in this study.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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