DOI: https://doi.org/10.4038/tsljos.v9i1.27

Clinical Outcomes of Double Fascicular Nerve Transfer for Restoring Elbow Flexion in Brachial Plexus Injuries :A case series

TMS Sandamali[1], M Wickremaratne[1], I Wickemarachchi[1], Y Mathangasinghe[2,3], GK Rajapakse[1],

1 Department of Plastic and Reconstructive Surgery, Army Hospital, Colombo, Sri Lanka

2 Australian Regenerative Medicine Institute, Faculty of Medicine, Nursing and Health Sciences, Monash University, Australia

3 Department of Anatomy, Genetics and Biomedical Informatics, Faculty of Medicine, University of Colombo, Colombo, Sri Lanka.

- TMS Sandamali (MBBS)
- M Wickremaratne (MBBS)
- I Wickemarachchi (MBBS)
- Y Mathangasinghe (MBBS MBiol SEDA)
- GK Rajapakse MBBS, MD (surgery), MRCS9England)FCSSL
- **Corresponding author:**

  TMS Sandamali
  twmsandamalee@gmail.com

Sri Lankan Journal of Orthopeadic
2023 : 08 : 60-63

Introduction

Brachial plexus injuries, though infrequent, afflicting about 1% of polytrauma patients, exert a profound impact [1]. These injuries culminate in compromised motor function and sensation within the affected upper extremity. Young males are predominantly affected and constitute up to 90% of the reported cases [2]. The repercussions of traumatic brachial plexus injuries are far-reaching, inflicting substantial physical disability, psychological distress, and economic hardship on the youth. Motor vehicle accidents account for nearly 70% of these injuries [3].

Brachial plexus injuries can be classified into upper and lower plexus, isolated roots and trunks, and pan-brachial plexus injuries. Patients with upper arm-type brachial plexus injuries (specifically, involving C5-C6 and C5-C6-C7) demonstrate deficits in shoulder elevation, abduction, external rotation, and elbow flexion. Additionally, those with a C7 root injury may experience additional impairment in elbow, wrist, and hand extension. The evolution of reconstructive techniques now offer viable solutions, encompassing nerve repair, nerve grafting, nerve transfer, muscle/tendon transfer, and free-functioning muscle transfer, thereby presenting avenues for restoring functionality in upper arm brachial plexus injuries.

Crucial considerations in the realm of surgical management entail a profound understanding of injury patterns, strategic timing of surgical intervention, prioritization of functional recovery, and adept management of patient expectations. Initially, a conservative approach is adopted for all patients unless a root avulsion or a distal brachial plexus disruption has been confirmed. Patients with an intact brachial plexus undergo a three-month period of observation to monitor signs of regeneration and muscle reinnervation. Patients with limited clinical improvement are complemented by repeat EMG studies. In patients where spontaneous recovery is absent, surgery is advocated at the three-month post-injury juncture [4].

A multitude of options exist for restoring elbow flexion and supination, with the optimal approach contingent upon the availability of donor motor nerves. Pioneered by Oberlin et al. in 1994, the transfer of a single ulnar nerve fascicle to the biceps branch of the musculocutaneous nerve emerged as an early technique for restoring elbow flexion. Building upon this foundation, Mackinnon et al. in 2003 advocated for the reinnervation of both the biceps and brachialis muscles, thereby augmenting the potential for robust elbow flexion recovery [5, 6]. The primary aim of this study was to assess the clinical outcome of elbow function subsequent to a Modified double fascicular Oberlin transfer, a procedure involving the transfer of ulnar and median nerve fascicles to the musculocutaneous nerve motor fascicles. To restore the shoulder function in these patient, a spinal accessory nerve transfer to the suprascapular nerve was performed. This study only focuses on the assessment of elbow function (Flexon and supination).

Patient details

This is a case series of five consecutive patients who underwent Modified Oberlin transfer for upper brachial plexus injuries at Army Hospital Narahenpita Colombo 05, Sri Lanka, from January 2019 to September 2023. The study encompassed five patients, comprising four males aged 22, 35, 32, and 28, and one female aged 65. Notably, all male patients had sustained injuries in road traffic accidents, whereas the female patient's brachial plexus injury was a consequence of the excision of a schwannoma in the left posterior triangle.

Clinical findings

All patients presented with predominant upper brachial plexus injuries, exhibiting a pre-surgical biceps power rating of 0. Among these, three patients had injuries on the right side, while the remaining two sustained injuries on the left side. Electrophysiological studies and MRI of the thoracic outlet were routinely performed to identify root avulsions and establish whether the lesions were pre-ganglionic or post-ganglionic. All patients underwent the Oberlin procedure by a single surgeon approximately 4 months from the date of injury.

Surgical procedure

Patients were placed in a supine position with the arm abducted and externally rotated. An incision was made over the medial aspect of the arm and the deep fascia was divided. The muscular cutaneous nerve, median nerve, and ulnar nerve were identified. The motor branch of the muscular cutaneous nerve to the biceps and brachialis was identified and divided. A motor branch of the ulnar nerve was identified using a nerve stimulator and a nerve fascicle was divided by intraneural neurolysis. The biceps was re-innervated with the ulnar nerve fascicle using 8-0 proline and the median nerve fascicle was separated by intraneural neurolysis and reinnervated to the brachialis motor branch using 8-0 proline (Figure 1). Direct coaptation of the nerve fascicles was performed without the need for nerve grafts and nerve glue was applied to secure the coaptation. The deep fascia was sutured with 5-0 poliglecaprone, and the skin was closed with 5-0 poliglecaprone.

Post-operative management

A broad arm sling was used postoperatively, and patients were discharged within 72 hours of the procedure. They were advised to perform both active and passive wrist and finger movements starting from post-op day 1, and elbow function was evaluated during weekly clinic visits. Electrical nerve stimulation was initiated at 3 weeks post-op, and physiotherapy was arranged. Elbow flexion power was assessed using the Medical Research Council (MRC) scale 6 and 8 months postoperatively.

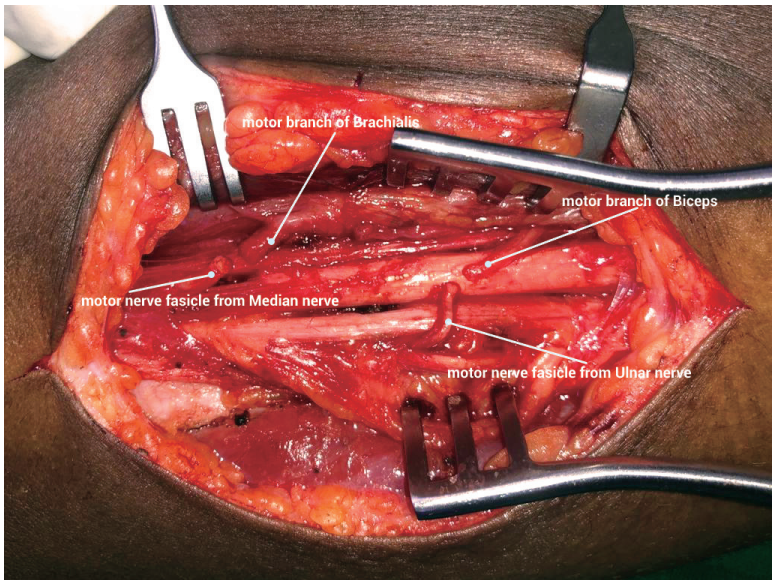

Figure 1: Motor nerve fascicles of Ulnar and Median nerve transfer to the Biceps and Brachialis motor branches of the Musculocutaneous nerve before coaptation.

Post-operative follow up

At the 6-month post-surgery, all patients demonstrated functional elbow flexion and supination power surpassing a score of 3. Subsequently, the median elbow flexion power at 8 months post-surgery was 4 (q1=3, q3=4) (Figure2) Furthermore, none of the patients exhibited any sensory or motor deficits within the ulnar or median territories subsequent to the surgical intervention.

Figure 2 : Functional Outcome After Six Months. (Flexion-to the left of the series of photographs and supination to the right of the series of photographs

Discussion

The current study underscores the effectiveness of Modified double fascicular Oberlin transfer in addressing upper brachial plexus injuries predominantly involving the C5-C6 nerve root. Our results demonstrate an excellent improvement of elbow flexion power within 6 months postoperatively. Despite these promising findings, it should be noted that the study sample was small and a larger cohort will be able to provide a more comprehensive picture.

Additionally, while the study assesses the immediate postoperative outcomes, a longitudinal evaluation would offer valuable insights into the durability of the functional improvements with the use of a standard Brachial Plexus Outcome Measure (BPOM) score .

Conclusion

The transfer of expendable motor fascicles from the ulnar and median nerves proves to be a highly effective method for reinnervating both the biceps and brachialis muscles, culminating in robust elbow flexion and supination. Notably, this approach offers an additional biomechanical advantage by neurotization of the brachialis muscle, a pivotal contributor to elbow flexion. The synergistic activation of these key muscles underscores the exceptional functional restoration achieved through this surgical intervention. This technique not only optimizes motor performance but also holds significant promise for enhancing the overall quality of life for individuals with upper brachial plexus injuries.

Take home message

A modified double fascicular Oberlin transfer: the transfer of ulnar and median nerve fascicles to the musculocutaneous nerve motor fascilces of the biceps and the brachialis muscles; leads to a good revocery of elbow function in upper brachial plexus injuries

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Conflicts of interests

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

This research received no specific grants from any funding agency in the public, commercial or not-for-profit sector.

Acknowledgements

None

Data availability statement

The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author/s.