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IDEAS AND INNOVATIONS

Hand/Peripheral Nerve

Nerve Transfer from the Long Head Triceps Nerve to Posterior Interosseous Nerve for Restoration of Wrist, Finger, and Thumb

Jesús Jaime Zermeño-Rivera, MD*
Nicolás Ignacio Flores-Moltedo, MD*
Bianca Ethel Gutiérrez-Amavizca, PhD†

Summary: In brachial plexus injuries where the radial nerve is damaged, there is loss of wrist, finger, and thumb extension. Surgical options for treating brachial plexus injuries are case dependent. To restore finger and wrist extension, the median nerve is primarily utilized for nerve transfer. We describe a new technique in a young man who suffered a gunshot wound in the left axilla, injuring the radial, median, and ulnar nerves. To restore wrist, finger, and thumb extension, we designed and performed a new technique consisting of nerve transfer, an interposition sural nerve graft from the motor branch of the long triceps portion to the posterior interosseous nerve. Positive outcomes were seen after 18 months with postoperative recovery of the functionality of finger and wrist extension. *(Plast Reconstr Surg Glob Open 2019;7:e2453; doi: 10.1097/GOX.0000000000002453; Published online 28 October 2019.)*

INTRODUCTION

Paralysis or irreparable injury to the radial or median nerve results in considerable impairment of hand function, which directly affects activities of daily living. High radial nerve injury can result in an inability to actively extend the wrist, fingers, and thumb. Median nerve loss deprives the hand of thumb function, especially opposition, which impedes prehension. Loss of the median and ulnar nerves results in loss of sensation, weakness, and diminished coordination of the hand.[1] Nerve transfer is a reliable option to restore extensor function.[2] The aim of this report is to present a new surgical option in peripheral nerve reconstruction to restore extension in the wrist, fingers, and thumb in a patient who has suffered an axillary gunshot wound by transferring the nerve innervating the long head of the triceps to the posterior interosseous nerve due to radial, median, and ulnar nerve damage.

CASE REPORT

A 32-year-old man suffered a 0.45 caliber gunshot wound to the left axilla. Upon admission at 4 hours posttrauma, physical examination found an absence of ulnar, radial, and humeral pulses in the left arm, which was pale and cold without capillary refill. The neurological examination is shown in Figure 1A. Nerve reconstruction was performed in 2 steps. Written informed consent was obtained from the patient, and the study was carried out in accordance with the Declaration of Helsinki and was approved by the local ethics committee.

First Reconstruction

Emergency surgery consisted of exploration, revascularization, nerve reconstruction, and tenodesis. In the surgical exploration, a complete transection of the median nerve, axillary artery, and axillary vein, with thermal damage to the ulnar nerve and 50% narrowing of the radial nerve were observed (Fig. 2). Neurolysis and transoperative neurostimulation were performed at the axilla and inner arm for the ulnar and musculocutaneous nerves, finding action potentials associated with muscular contractions for muscle groups innervated by these nerves. The radial nerve was neurostimulated at the axillary level on the posterior aspect of the arm and at the Arcade of Frohse, finding action potentials and muscle contraction for the triceps in its 3 portions. No contraction of muscles innervated by the posterior interosseous nerve was found, but action potentials were observed without contraction for the branch going to the brachioradialis muscle.

Reconstruction of the median nerve was performed with 2 sural nerve graft cables (12 cm) plus fibrin and 10-0 epiperineural ethilon. Finally, tendon transfers and deep flexor tenodesis were performed for the second, third, fourth, and fifth fingers. To regain thumb function, a tendon transfer from the brachioradialis was performed for the flexor

*From the *Instituto Jalisciense de Cirugía Reconstructiva "Dr. José Guerrerosantos," Jalisco, Mexico; and †Departamento de Químico-Biológicas, Instituto de Ciencias Biomédicas, Universidad Autónoma de Ciudad Juárez, Chihuahua, México.*

Received for publication February 19, 2019; accepted July 19, 2019.

DOI: 10.1097/GOX.0000000000002453

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

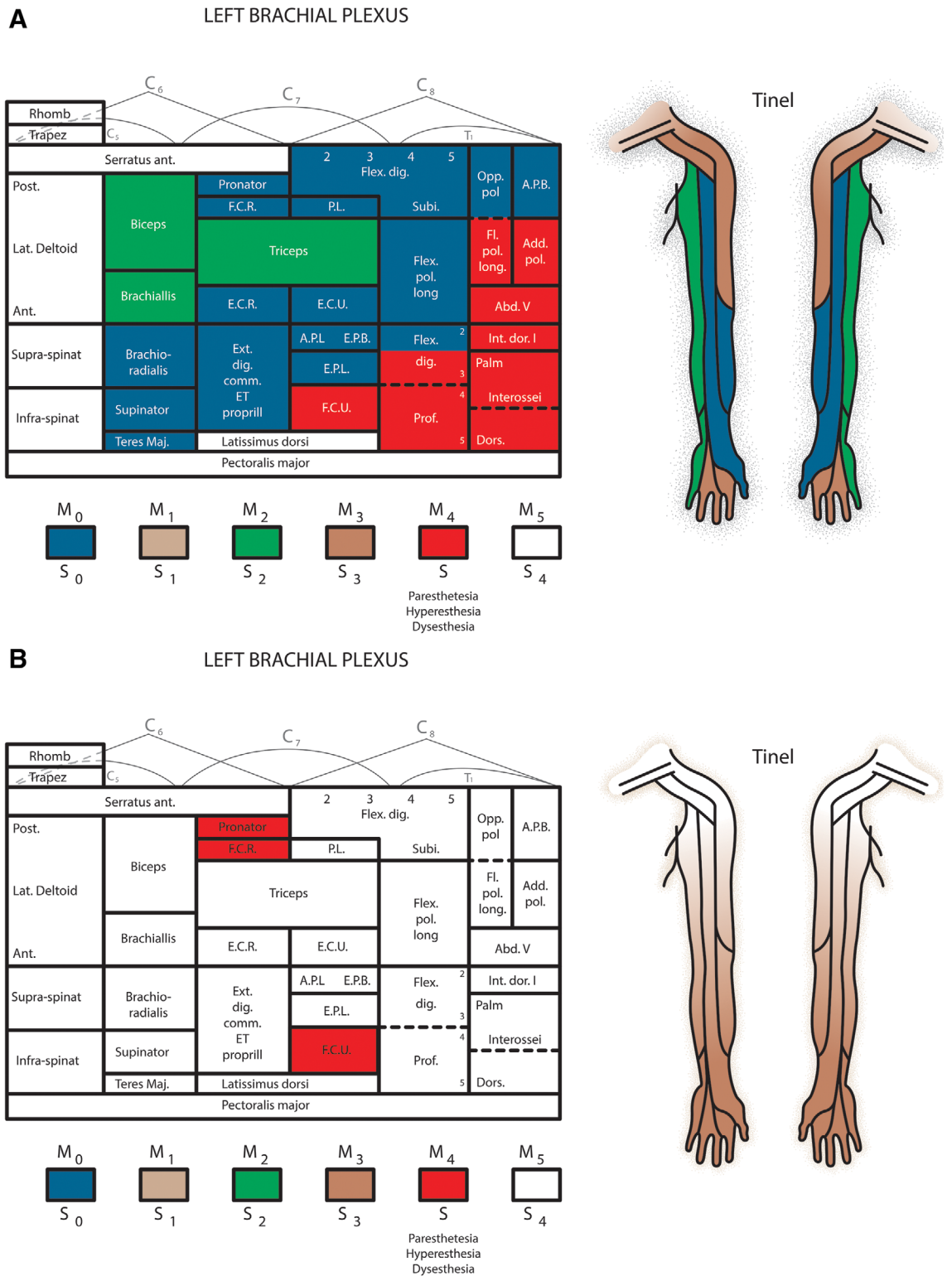

Fig 1. A, Motor innervation was evaluated according to the British Medical Research Council scale for testing muscle strength ranking from M0 (no movement) to M5 (normal power), and sensory recovery was graded using Mackinnon-Dellon scale ranking S0 (no recovery of sensibility) to S4(complete recovery) at the time of the injury. B, Motor innervation and sensory function evaluated at 18 months after surgery.

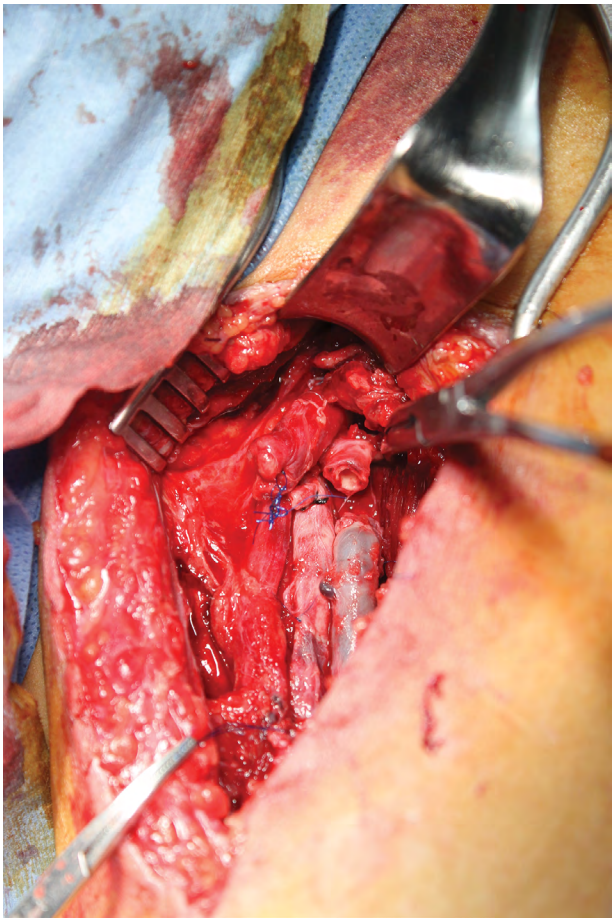

Fig. 2. Firearm injury to the left axillary region.

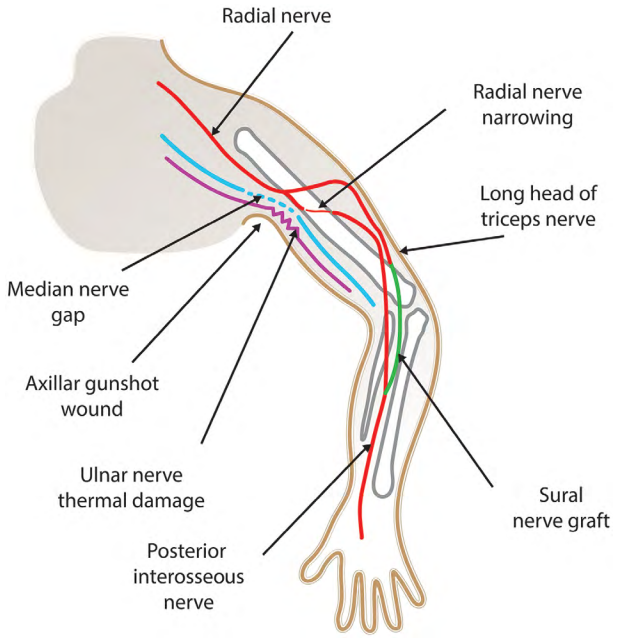

Fig. 3. Schematic of the reconstructive technique of nerve transfer of the long portion of the head of the triceps to the posterior interosseous nerve in an axillary gunshot wound.

pollicis longus, and a static thumb opponensplasty with palmaris longus. In the third month of postsurgical follow-up, signs of denervation of the posterior interosseous nerve were observed, and a second surgery was decided on to revive the function of posterior interosseous nerve.

Second Surgery

The second surgery, performed at 3 months posttrauma, consisted of a reinforcing tenodesis for deep flexors of the second, third, fourth, and fifth fingers, and tendon transfer for the extensor digiti minimi of the fifth finger for dynamic opponensplasty. Reconstructive resources for the posterior interosseous nerve were depleted because they were used as a complement to allow reconstruction of the median nerve, so a nerve transfer was performed from the long portion of the triceps head to the posterior interosseous nerve. A posterior approach was used in the arm to identify the motor branch of the radial nerve that innervates the long head of the triceps. An additional incision was made on the lateral side of the forearm, identifying the radial nerve with sensory branches, the posterior interosseous nerve, and the supinator branch of the radial nerve.

A terminoterminal proximal neurorrhaphy with 10-0 ethilon plus fibrin from the motor branch of the long triceps portion to the sural nerve graft was then performed. A subcutaneous tunnel was created in the posterior portion of the arm through which the graft was advanced up to the lateral aspect of the forearm. In addition, terminal–terminal distal neurorrhaphy of the sural nerve graft was performed using the epiperineural technique ethilon 10-0 plus fibrin to the posterior interosseous nerve. The technique essentially consisted of nerve transfer with interposition of the sural nerve graft (15 cm) from the motor branch of the nerve innervating the long head of the triceps to the posterior interosseous nerve (Fig. 3).

The left upper extremity was immobilized for one month, and rehabilitation began after the second month. The clinical team evaluated the progression of Tinnel's sign, joint mobility range, and motor and sensory function for 18 months postoperatively (Figs. 1B and 4). Motor innervation was evaluated according to the British Medical Research Council (M0–M5) with satisfactory motor recovery was defined as grade M4 or M5. Sensory nerve function was graded using classification of sensory recovery according to the Mackinnon–Dellon scale (S0–S4), and satisfactory sensory recovery was defined as grade S3 or S4. In motor evaluation, M5 and S4 were observed for muscles innervated by the posterior interosseous nerve, at 18 months post surgery.

Due to good immediate postoperative joint rehabilitation, joint mobility was able to be evaluated at 3 and 18 months. Joints that depend on the posterior interosseous nerve (wrist extension, thumb extension, and metacarpophalangeal joint extension for fingers 2, 3, 4, and 5) exhibited clinical improvement.

DISCUSSION

Multiple techniques for reconstruction of the posterior interosseous nerve are described in the literature,

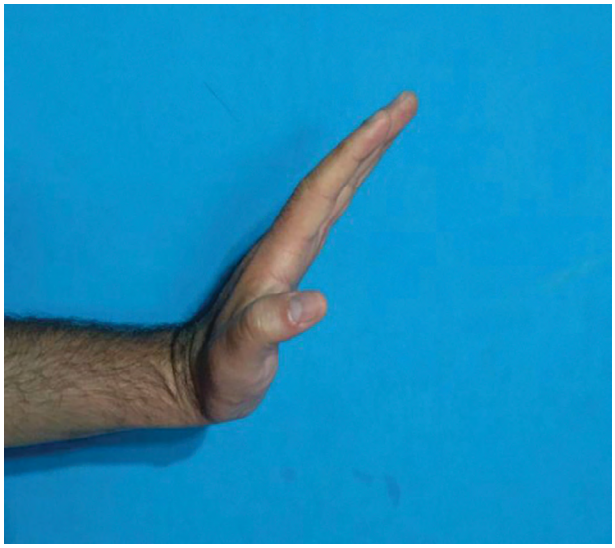

Fig. 4. Clinical outcome at 18 months post surgery. Patient was able to perform the extension movements of the thumb, wrist, and fingers.

mainly median[3] and supinator nerve transference.[4] In our patient, the radial nerve injury was high, with thermal damage secondary to the bullet injury to the median and ulnar nerves, but the triceps branches were conserved. After a 3-month follow-up, irreversible damage was demonstrated with severe axonotmesis and active degeneration of the posterior interosseous nerve. These conclusions were supported by electromyography and clinically by progression of Tinel's sign. Discrete improvement (M3) was shown in a branch of the supinator nerve, which could not be relied upon for successful transfer of the posterior interosseous nerve; therefore, it was intact and used for a tendon transfer from the brachioradialis to the flexor pollicis longus.

A transfer of a motor branch of the radial nerve innervating the long head of the triceps with graft interposition for the posterior interosseous nerve because there was no useful median nerve branch due to the ulnar nerve being damaged by heat. The supinator of the radial nerve was not used because it was partially injured, and the obtained muscle strength would not have been adequate.

CONCLUSIONS

Nerve transfer from the long head triceps nerve to the posterior interosseous nerve can be an option in nerve reconstruction of a high lesion of the radial nerve and to increase the reconstructive armamentarium for brachial plexus and peripheral nerve lesions. This nerve transfer could be useful for select patients who present a complete high lesion in the radial and median nerves, as long as the nerve branches for the triceps muscle are preserved.

Gutiérrez-Amavizca Bianca Ethel, MD, PhD
Departamento de Químico-Biológicas
Instituto de Ciencias Biomédicas
Universidad Autónoma de Ciudad Juárez
Anillo Envolvente del PRONAF y Estocolmo s/n, Ciudad
Juárez, Chihuahua 32310, México
E-mail: ethel90210@gmail.com.

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