STEPHY Publishers

SOJ Neurology and Neuroscience

Mini Review

ISSN: 2770-677X

Upper Limb Re-education after Traumatic Injury to the Volar Face of the Forearm – Case Study

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Abstract

Peripheral nerve injury may result in dysfunction of motor and/or sensitive branch of the nerve. Its classification is dependent on the type of injury and its degree of severity. This case study is related to a traumatic injury with glass to the volar face of the forearm, on the dominant upper limb in a 24 year old male.

Keywords: Occupational therapy, Trauma, Upper limb re-education

Introduction

A neurotmesis happens when there's a physical interruption of the nerve with transection of the nerve trunk. Therefore, its regeneration is impossible without surgical intervention. Due to the proximity of the skin surface to important structures, such as muscles, nerves, vessels and the superficial and deep fascia,[1] vital for the good functioning of the flexor surface,[1] the absence of an intact skin cover can reveal itself problematic.

In this particular case, the trauma with glass material caused the transection of the following structures: brachial artery and its radial branch, median nerve, superficial branch of the radial nerve, brachioradialis muscle, flexor carpi radialis muscle, pronator teres muscle, digitorum superficialis and digitorum profundus muscle. Therefore an emergent surgery was performed due to the patient's life risk.

Surgical reconstruction of the arterial axes of the brachial artery were necessary, using the interposition of venous grafts from the saphenous vein. Volar fasciotomies, neurorrhaphies of the median nerve and the superficial branch of the radial nerve, myorrhaphies and partial skin autograft were performed.

Metodology

Based on the data collected were identified sensitive, motor and skin changes. The evaluated parameters were pain, scar assessment, girth measurement, range of motion, muscle strength, sensitivity and upper limb functionality. Thus, some evaluation measurements were applied such as: Pain Numeric Rating Scale, Vancouver Scale, Girth Measurement of forearm and hand, Goniometry, Manual Muscle Testing, Semmes-Weinstein Monofilaments and Disabilities of the Arm Shoulder and Hand.

An electromyography after 3 months post trauma was performed. No motor or sensory response was obtained in the nerve conduction study from the median nerve, nor was the recruitment of motor units observed in the needle examination of the abductor pollicis brevis muscle.

Quick Response Code:

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Received: 29 September, 2022 **Published:** 19 October, 2022

Citation: Cruz R, Duarte A, Coelho JL. Upper Limb Re-education after Traumatic Injury to the Volar Face of the Forearm – Case Study. *SOJ Neuro Neurosci*. 2022;2(1):1–2. DOI: 10.53902/SOJNN.2022.02.000510

During the rehabilitation program it was required to proceed with the scar modelling on the anterior face of the wrist, to execute a splint in order to improve the functionality of the patient's hand and also a neoprene splint to control the oedema. A program of sensory re-education was introduced, as well as electrical stimulation therapy.

Results

In spite of only three months of the rehabilitation program we were able to see an evolution on the evaluated parameters. The results of the Vancouver Scale had improved on every level, although vascularity and pliability had stand out. The girth measurement of the distal forearm had decreased 3.7 cm and the girth measurement of the proximal forearm had decreased 1.7 cm.

On a motor level, we were capable of introducing the Jamar Hydraulic Hand Dynamometer to test grip strength, after the restoration of the flexion against gravity of the index finger in all its range of motion.

Regarding sensitivity on the palmar of the hand, thenar eminence and proximal thumb phalanx passed from no sensation to deep pressure sensation only. The distal phalanx of the middle finger passed from no sensation to diminished protective sensation.

Disabilities of the Arm, Shoulder and Hand had an improvement from 95.8 to 21.6 points.

Discussion/Conclusion

Many factors play an important role on the peripheral nerve regeneration: degree of severity, time elapsed between the injury and its surgical repair, location of the lesion along the nerve pathway, age of the patient and appropriate axonal re-innervation.[2]

It is known that the median nerve injuries at the wrist level take three to four months until the first clinical signs of re-innervation on the hand are observedl.[3] In addition to this, injuries at the upper arm level take longer time than more distal ones, until these signs are shown at the hand level.[3] In this particular situation only three months have elapsed since the beginning of the rehabilitation program. Even so, a positive evolution in the different evaluated parameters were noticeable, namely at a motor level, the combined flexion of the index finger was restored, which translates in a better level of functionality as determined by the final score of the Disabilities of the Arm, Shoulder and Hand. As for the sensitivity, there were slight improvements in the thenar eminence and dorsal surface of the hand, although sensitivity recovery has showed to be a considerable challenge.

Profound functional reorganizational changes in the somatosensory cortex happens after an upper limb nerve injury, essentially due to misdirection of the regenerating axons.[3] After a median nerve transection there is a 'black hole' in the somatosensory brain cortex that is immediately occupied by adjacent cortical areas. Therefore the well-defined cortical representation of the hand changes.[3]

In a Dutch study, "59% of the patients with median or ulnar nerve repairs returned to work within 1 year with an average time off work of 31 weeks".[5] In this case, the patient tried to restart his professional activity as a chef, only ten weeks after the injury and was not successful.

Lundborg[4] realized there was a constant evolution in sensory and motor recovery after five years which may indicate ongoing sensory and motor axonal maturation. This improvement may reflect the impact that central nervous mechanisms such as, cortical reorganization processes, resulting from a continuous relearning ability, had on reestablishment of peripheral connections long after these connections were settled.[1]

These data sounded promising for a case still at the beginning of its rehabilitation process. A continuous follow up on this case is required once we find relevant the elaboration of a case series, similar to this one, to shed further light on recovery from an upper limb trauma involving a nerve injury.

Acknowledgments

None.

Funding

None.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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