doi: 10.48095/ccachp202486

Isolated musculocutaneous nerve injury in a motorcyclist – a case report

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Summary

Introduction: Isolated musculocutaneous nerve injuries occur rarely due to their anatomical location. We present our patient with a musculocutaneous nerve injury in a motorcyclist. **Case:** The patient was initially treated for a motorcycle accident. Further examination of the patient revealed impaired elbow flexion and numbness of the lateral forearm. Electromyography confirmed impaired function of the musculocutaneous nerve. After 3 months, the patient's condition did not show any improvement, neither electromyography confirmed recovery of the nerve activity, so surgical treatment was planned. In the surgical revision, neuroma-in-continuity was discovered and resected. The resulting nerve defect was 6 cm long. We provided nerve grafting using sural nerve from the right lower limb. After surgery, the patient began physical therapy and electrical stimulation. Two years later, the patient reached complete recovery of muscle strength. **Conclusion:** Due to the lack of improvement after a 3-month period, we proceeded with a surgical revision, which demonstrated a complete lesion of the nerve that could not heal spontaneously. Therefore, we opted for the nerve graft method and the patient regained full function of elbow flexors.

Key words

isolated musculocutaneous nerve injury – motorcycle accident – neurotmesis – isolated nerve injury – nerve transfer

Hora A, Makel' M, Whitley A et al. Isolated musculocutaneous nerve injury in a motorcyclist – a case report. Acta Chir Plast 2024; 66(2): 86–89.

Introduction

The musculocutaneous nerve (MCN) is one of the mixed (sensorimotor) nerves derived from the lateral cord of the brachial plexus (BP) and originating from the C5–C7 spinal segments. After branching off, the MCN proximally pierces the coracobrachialis muscle (CBM) in an oblique way and continues between the brachialis muscle (BM) and the biceps brachii muscle (BBM). During its course within the arm, the MCN gives off motor branches for all three muscles. It terminates distally in the forearm as a pure somatosensory branch called the lateral cutaneous antebrachial nerve, which can feature communication with the superficial branch of the radial nerve [1].

Upon reviewing certain sources, we found that isolated MCN injuries occur rarely; rather they are accompanied by other nerve lesions of the BP and its branches (axillary nerve, supraclavicular nerve, etc.). Furthermore, MCN lesions can be masked by other injuries leading to misdiagnosis [2–5].

The MCN nerve topographical course is unique and at the beginning when it branches off the BP, the MCN is shortly accompanied by the brachial vessels. After diverging from the vascular trunk, it pierces the CBM and continues alone along the ventral side of the CBM and gives off branches for the muscles. Due to the anatomical location deep in between the two heads of the BBM and the CBM, its injuries occur rarely [2,6].

The aim of the article is to describe the clinical presentation and management of a very rare isolated MCN injury.

Description of the case

A 34-year-old, otherwise healthy patient sustained serious injuries to his right (dominant) upper limb and thoracic spine due to a motorcycle collision with a tractor in June 2021. Immediately after the accident, he underwent

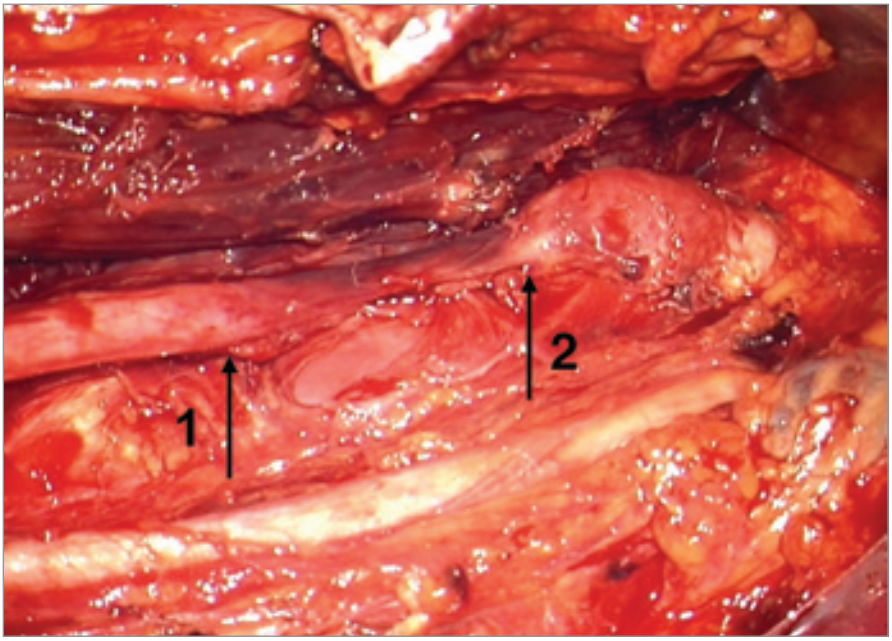

Fig. 1. Preoperative situation showing the neuroma-in-continuity (between arrows, 6 cm long).
1 – distal stump, 2 – proximal stump with terminal thickening of the nerve

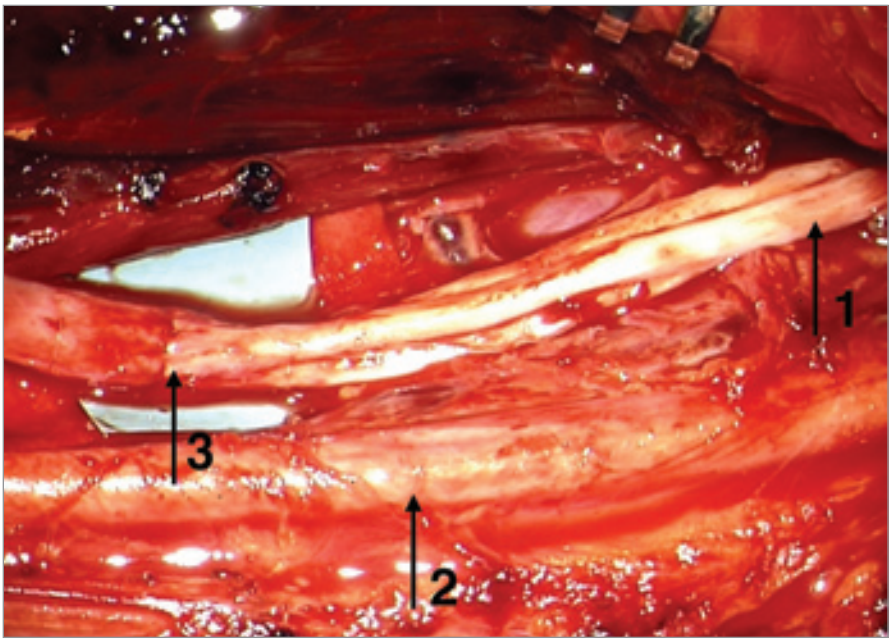

Fig. 2. The sural nerve grafts anastomosed to MCN proximally (arrow 1) and distally (arrow 3), the median nerve and surrounding structures (arrow 2).

T4–T8 posterior spine stabilization for multiple thoracic spine fractures and right thumb repositioning due to its luxation. There were no other soft tissue injuries. A whole-body CT scan did not show any other bone injury. Neurological examination showed complete paralysis of elbow flexion and hyperesthesia of the right lateral forearm. He was fully mobilized during a week's hospitalization and then discharged to home care.

The patient was counselled and invited for a follow-up and EMG examination. We performed a needle stimulation combined with nerve conduction studies on the right-sided brachial muscles, which showed an extensively reduced motor unit response, a low amplitude of motor unit potential, and a complete loss of reaction to stimulation of the right MCN. These findings were limited to muscles innervated by the right MCN [5]. After 3 months, clinical signs of a nerve injury, as well as EMG results did not show any improvement. Despite intensive rehabilitation including electrostimulation for 3 months period, no signs of improvement occurred. On the EMG, the MCN showed no response to stimulation. Moreover, medical research council (MRC) scale for muscle strength) of elbow flexion had zero points on the scale [7]. All these findings indicated an isolated MCN injury.

We decided for surgical revision under general anesthesia. A vertical incision was made over the medial sulcus towards the axilla and individual branches of the BP were meticulously dissected. After identifying the MCN, direct stimulation without any response was performed. Other branches of the BP did not show any pathology. By further dissection, we discovered that the proximal part of the MCN was engulfed in scar tissue resolving in a neuroma-in-continuity. The final defect was 6 cm long (Fig. 1).

Given the severity of the injury, it was too large for primary repair, so we decided for nerve grafting using sural nerve to bridge the defect (Fig. 2).

The sural nerve was used, taken from the right lower limb in a length of 18 cm and divided into three individual grafts to match the diameter of the MCN. The scar defect was excised and bridged with these prepared grafts using 10/0 nylon sutures. The resulting wound was sutured in layers.

The patient had his arm fixed in a sling for 2 weeks postoperatively. He started intensive physical therapy and regular electrical stimulation. He attended

regular follow-up appointments and his condition significantly improved. The first clinical signs of muscle reinnervation occurred after 6 months. Muscle strength was restored and progressively increased. The result of the treatment was recorded upon examination after 2 years, when the patient regained muscle strength BMRC 4+ and a full range of motion (Fig. 3).

Fig. 3. Follow-up visit of the patient 2 years after the procedure, muscle strength of the right upper limb was restoreda, the patient managed elbow flexion against resistance (M ≥ 4).

Discussion

BPIs after motorcycle injury occur very often. Polytrauma, and various minor injuries such as fractures, luxation, contusion and damage to peripheral neurovascular bundles often occur in motorcycle accidents [8,9].

Isolated MCN injuries are rare and can be easily misdiagnosed with BBM tendon rupture or cervical radiculopathy [2,4]. Proximal MCN lesions may cause both motor and sensory deficits in the arm. In contrast, a distal nerve injury only causes sensory loss. This allows us to identify the likely position of the lesion based on the clinical findings [4].

There are several options for approaching the repair of a complex nerve injury. It is important to choose the right method to achieve the best outcome for the patient [7]. For non-penetrating BP injuries, it is advised to wait at least 3 months and undergo physical therapy, because half of those BP injuries tend to be reversible and may heal spontaneously [1,2,5,10]. For penetrative nerve injury, the surgical treatment should be started as soon as possible [10].

We found various cases that reported restoration of function after conservative treatment, where the patient was given anti-inflammatory drugs, corticosteroids, repetitive electrostimulation combined with excessive physical therapy and rest for several months [2,5]. However, these cases did not always end up with a good outcome. The patient's treatment may be prolonged and the nerve function may not always be fully restored, confirmed by EMG. When conservative measures fail to provide improvement, surgical intervention may be necessary [7].

According to the study by Seddon [11], nerve injuries can be divided into neuropraxia, axonotmesis and neurotmesis, the least severe of which is neuropraxia [2,12]. The mechanism of MCN injury is most often compressional or tractional. Inadequate extension at the shoulder and elbow can result in pathological stretching of the nerve beyond its physical limits. In addition to that, frequent bending at the elbow, excessive hypertrophy of the muscle and insufficient blood supply can further impair the nerve function. In cases of partial axonotmesis, improvement of symptoms may occur within days to weeks before the actual treatment has begun. Axonotmesis usually heals spontaneously after 3–9 months, often with return to original function. Neurotmesis is the most serious type of nerve injury and requires surgical management [2,4,5,7,12].

A CT-myelography or MRI is usually recommended to rule out cervical roots avulsion in typical BP injury cases [1]. However, due to an isolated MCN injury, we felt that this examination would not change our plan to revise only this nerve with the aim of its reconstruction by nerve grafts or nerve transfer.

Microsurgical techniques may be employed to repair the injured MCN. This involves direct nerve suture (end-to-end), or nerve grafting if the nerve gap is too significant. In cases where direct repair is not feasible, nerve transfers from adjacent nerves can be considered to restore function. The nerve graft method is based on removing a nerve graft from the patient with a sufficient size and length to bridge the defect. The length and diameter of the harvested graft is important in relation to the original bundle. A graft from the sural nerve of the lower limb is often used for this procedure [7]. The sural nerve harvesting is characterized by minor, tolerable morbidity. Symptoms usually occur during the first few months after surgery, and the related sensory loss progressively recovers in most patients and does not cause significant limitations in activities of daily living, similarly to our patient [13].

The nerve transfer method used typically in cases of cervical roots avulsions

or foraminal ruptures consists of removing a healthy fascicle, most often from the ulnar or median nerves in the vicinity of the defect and transferring it directly to the individual MCN muscle branches. This creates only one site of anastomosis needed to join the ends [7]. In this study, the double Oberlin nerve transfer was performed [10]. It is a surgical method that transfers fascicles from the median and ulnar nerves to the MCN to regain elbow flexion; however, without preserving the sensitivity. The fascicles were transferred directly to the muscle branches of the MCN [14]. This method only allows motor recovery; however, only one nerve anastomosis is required. Furthermore, performing neurotization as soon as possible (ideally within 6 months of injury) is another favorable prognostic factor [7,10,14,15].

In a meta-analysis, Donnelly et al. [15] reported that a double Oberlin nerve transfer for partial BP nerve injuries increases the treatment outcome by 11% compared to single fascicular transfer (most commonly using the median and ulnar nerve) with a British medical research council scale (BMRC) ≥ 4 (degree of muscle strength M0–M5) [10,13,15,16]. However, for patients with pan-nerve injury, the use of the nerve interposition graft method was described with the highest chance of reaching BMRC ≥ 4; a success rate of 45% has been demonstrated. Furthermore, with each additional delay in reconstruction, the chance of achieving M ≥ 4 decreased by 7% [10,15,16].

Conclusion

MCN injuries are very rare, and the choice of the correct treatment is still uncertain. However, according to a comparison of various sources, we chose the surgical treatment. In our case, first signs of function restoration occurred 6 months after the injury with successful outcome (full muscle recovery and BMRC ≥ 4 after 2 years). In such cases, nerve graft method is desirable to use, with a good outcome [2,5,7,10].

Roles of the authors

A. Hora – writing and creating original draft; M. Makel' – writing, reviewing and editing; A. Whitley – reviewing and editing; D. Kachlík – reviewing anatomical relations, editing; R. Kaiser – main attending physician, writing, reviewing and editing.

All named authors participated on this project and have read the final manuscript.

Disclosure: I confirm that this document has been created without the use of any financial resources. No ethical standards of the national research committee and the Helsinki declaration and its later amendments or comparable ethical standards were violated in the care of the patient, data collection and design of the work and the patient consented to everything. His anonymity is preserved. This is a previously unpublished case report, which has been produced only by the authors listed above, who created and edited it and are aware of its final version.

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Submitted: 6. 2. 2024
Accepted: 25. 7. 2024