doi: 10.48095/ccachp202379

Advantages of simultaneous radial nerve and tendon reconstruction – a case report

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Summary

Transection of the radial nerve is frequently associated with humeral shaft fractures that are part of a very complex upper extremity injury. In the presented case, a 19-year-old man with a 10-cm radial nerve defect with a need for nerve grafting to recover complete sensory and motor deficit of the radial nerve. In our case, at the same time we provided the tendon transfer of musculus (m.) pronator teres to m. extensor carpi radialis brevis, m. flexor carpi ulnaris to m. extensor digitorum communis, m. palmaris longus to m. extensor pollicis longus, and long sural nerve graft because of an extensive zone of the injury. The assumption was that if these two procedures are performed in one surgery, it will accelerate overall recovery, restore the functionality of the upper limb more quickly, and thus enable a faster recovery.

Key words

nerve reconstruction – radial nerve injury – tendon transfer – humeral shaft fracture

Kempný T, Votruba T, Xano Z et al. Advantages of simultaneous radial nerve and tendon reconstruction: a case report. Acta Chir Plast 2023; 65(2): 79–83.

Introduction

Nerve defects are one of the most challenging surgical problems. Radial nerve injury is a complication associated with humeral shaft fractures. It belongs among the most prevailing peripheral nerve injuries associated with fractures of long bones. In general, with these types of injuries, the success and speed of recovery is much better in young people, while healing is also related to the degree of injury, its extent and whether there were other associated traumas at the time of injury. Autologous nerve grafts are the gold standard in peripheral nerve reconstruction in nerve injuries that cannot be bridged by direct epineural suturing. In this case report we present a young man who suffered a work injury of the right humerus with radial nerve trauma. In order to improve the motor function, a muscle transposition with a nerve grafting for peripheral nerve injury with extended defect size was performed in one-stage surgery.

Case report

We present a case of a 19-year-old man, without medical history, who suffered an injury in an accident at work. His hand in a glove was caught in a conveyor belt and he suffered a humeral bone fracture with a radial nerve injury. Before surgery, clear clinical signs of paresis of the radial nerve were detected. The right humeral shaft fracture was an indication for acute surgery. The fracture was treated by open reduction and internal fixation with plate osteosynthesis (Fig. 1). A defect of the radial nerve in the length of 10 cm was found intraoperatively. The level of radial nerve injury was the middle part of the humerus. Because the plastic surgeon was not part of the operative team, the founded ends of the radial nerve were marked with non-absorbable monofilament blue 4/0 suture. The second surgery followed after 16 days. The procedure was performed under general anaesthesia in a bloodless operating field with arm abducted under tourniquet control (Fig. 2). The nerve gap was bridged by sural nerve graft, the length of the nerve graft was 12 cm (Fig. 3). The graft was taken from the right leg and sutured to both ends of the radial nerve with 3 cables using nylon 9/0 and 10/0. At the same time, multiple transpositions were performed. To provide wrist extension, distal tendon of m. pronator teres (PT) was transferred to the distal end of m. extensor carpi radialis brevis (ECRB) using end to side suture technique. This manoeuvre reconstructed the dorsiflexion of the wrist. All following tendons were sutured end to end. The m. flexor carpi ulnaris (FCU) tendon to the tendon part of the m. extensor digitorum communis, restoring

Fig. 1. X-ray images of right humeral shaft fracture before and after the treatment by open reduction and internal fixation with plate osteosynthesis.

Fig. 2. Surface marking as well as functional identification of the tendons was an important aspect of preoperative planning.

finger extension, and m. palmaris longus (PL) tendon to m. extensor pollicis longus (EPL), restoring thumb extension. These transfers were sutured using (4/0 non-absorbable) sutures with the Pulvertaft weave technique. The tendons were transferred and sutured in the required tension, so free movement of the hand into flexion and extension was secured. The intraoperative tension of tendon transfers was tight enough to provide full extension of the wrist and digits. The wrist was kept in 30-degree extension with thumb and fingers just short of full extension. The forearm was immobilised in the volar cast with elbow flexed and distal joints in maximal extension. Postoperative rigid fixation in the extension of fingers and wrists was applied for four weeks, assisted physiotherapy began immediately after the wound had healed. The patient received fifteen physiotherapeutic sessions. Electrostimulation of the forearm muscles was performed daily. The rehabilitation aimed to maintain the passive motion of various joints and to limit the risk of adhesions. Abduction of thumb carpometacarpal and interphalangeal joint extension returned to normal range. The patient returned to his work seven months after the second surgery. One and a half years after the surgical solution postoperative measurement of sensitivity by the Semmes-Weinstein monofilament test was determined. A two-point discrimination sensitivity of the dorsum of the hand and fingers was 12 mm. In motor terms, the grade was evaluated at M4 (Fig. 4).

Discussion

In an updated systematic review, Ilyas et al. claim that in the observation of 7,262 humeral shaft fractures, the overall prevalence of radial nerve palsy was 12.3% (890/7,262) [1]. In Ring's study, it has been shown that injury on the upper limbs, especially on the radial nerves, occurs more often in men then in women. It is attributed to certain factors such as

occupation, driving accidents and insignificant safety issues [2]. Moreover, the incidence of radial nerve palsy is also influenced by the trauma mechanism. Those caused by a high-energy mechanism such as motor vehicle accidents, gunshot wounds, and direct impacts are more often associated with radialis nerve palsies than injuries caused by a low-energy mechanism [3]. Patient's age, type of trauma as well as associated traumas and comorbidities are also important factors affecting recovery [4,5]. Despite numerous studies, the management of radial nerve palsy associated with humeral shaft fractures remains a demanding surgical intervention with uncertain results, which significantly affects patient's life. Nerve grafting has dramatically changed the treatment paradigm of radial nerve injury. The radial nerve belongs to the group of mixed nerves with a predominance of motor fibres and excellent reinnervation potential [6]. As for motor function loss, we mainly talk about the result of insufficient grip due to the loss of extension of the wrist, thumb and metacarpophalangeal joints of the fingers [7]. The loss of sensory function associated with the said lesion is mainly skin hyposensitivity above the anatomical snuff box. The loss of the sensitive part usually does not cause problems for the patient, as long as no neuroma forms at the site of the lesion. The motor function loss is far more burdensome [8].

In the same way, Burkhalter claimed that the biggest loss in radial nerve injury is the loss of motor function, more precisely, it is the weakness of the power grip [9]. He believed that the most important part of these injuries is actually the recovery of the grip, through the early tendon transfer of PT to ECRB. This step should eliminate the need for an external splint while restoring a significant amount of power grip to the patient's hand. Tendon transfers have been used to manage radial nerve palsy for more than a century. Tendon transfers are an alternative method to restore function after radial nerve injury or paralysis with good results.

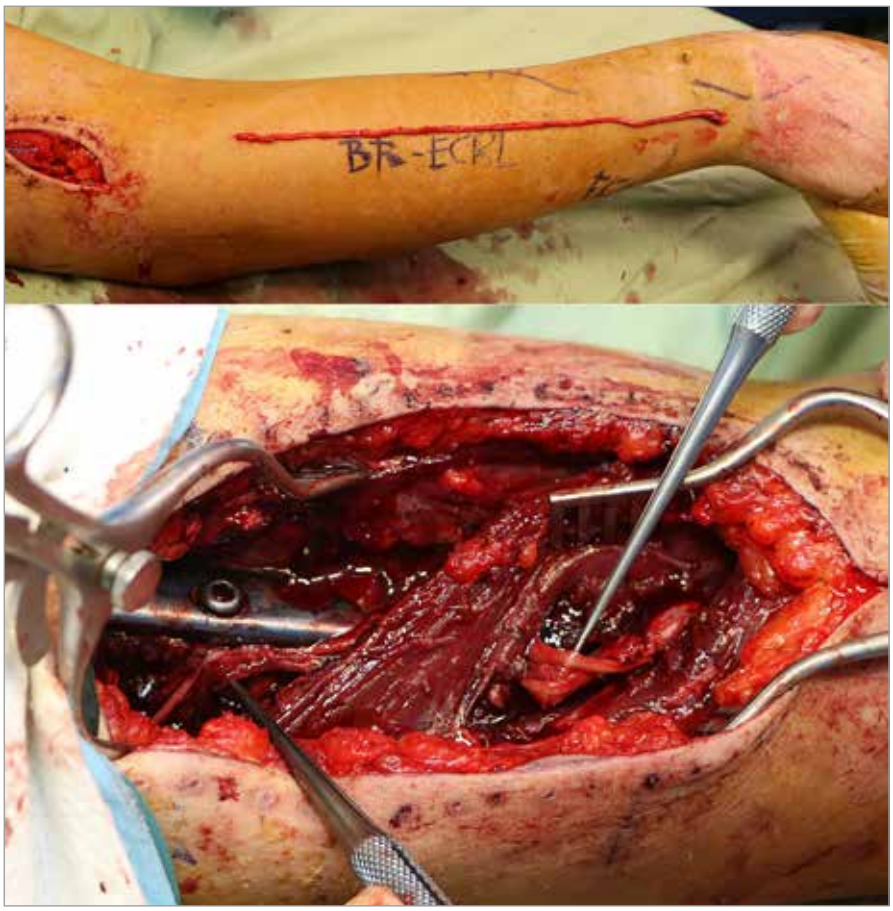

Fig. 3. Sural nerve grafting.

A number of procedures by individual authors such as Perthes, Stoffel, Jones, Bunnell, Bauer, Mc Pherson, Merle d'Aubigné, or Riordan have been described [10–12]. Their aim is to reconstruct the extension of the wrist (most often PT to ECRB in most procedures), extension of the thumb (most often EPL or one of the m. flexor digitorum superficialis (FDS) is used) stabilization of the metacarpal (MTC) of the thumb (most often m. flexor carpi radialis (FCR) on m. abductor pollicis longus (APL), but some authors recommend to spare the muscle) and mainly to provide extension of the fingers (according to Jones classically FCU on m. extensor digitorum (ED) of the II.–V. fingers, alternatively FDS of the III. and IV. fingers can be used over the interosseous membrane) [10].

The appropriate time to perform transfers for radial nerve palsy is controversial. Early transfer of PT to ECRB is advocated and recommended by many authors. The authors believed that the greatest functional loss in a patient with radial nerve injury is weakness of power grip. Burkhalter [9] advocated for an early PT to ECRB transfer to eliminate the need for an external splint, and, at the same time, to restore a significant amount of power grip to the patient's hand.

The authors are convinced that even PL to EPL transfer has no impact on hand function and can also be performed immediately. Early FCU to ED II–V transfer is probably the most controversial, yet we believe that preserving maximal hand function and maintaining finger range of motion is more important than limiting it by partial loss of FCU function. Should restitution of extensor function occur, the transfer can be reversed.

Fig. 4. Mobility of the right upper limb one and a half years after the asurgical treatment.

Nerve transpositions provide another option for reconstruction of a paresis of the n. radialis. They are based on the assumption that the nervus medianus provides several dispensable branches for FDS available for transfer. Branches for the PL, pronator quadratus, and m. flexor carpi radialis (FCR) can be taken advantage of if these muscles are not needed for future tendon transfer [13]. However, the advantage of tendon transposition over nerve transposition is the immediate possibility of function; there is no need to wait for reinnervation results.

When direct nerve repair is not feasible due to a significant gap between the nerve endings, an autologous nerve graft is chosen to repair the nerve defect. From all the large nerves, the radial nerve is the most suitable for nerve suturing and the use of nerve grafts, because it contains mostly motor fibres and the site of nerve injury is usually close to the motor plates [9,13–15]. In the literature, it is stated that autologous nerve grafts are preferred over nerve conduits for gaps longer than (> 3 cm), for more proximal injuries and for critical nerves [16]. However, if it is not possible to use an autologous nerve graft, e.g. in patients with extensive peripheral nerve injury or insufficient amount of donor nerve for harvest, effective alternatives such as acellular nerve allografts, artificial nerve repair conduits or venous conduits can be chosen [17].

Conclusion

There is no surgical procedure that can be recommended to serve as a standard for any patient in this circumstance related to such an extensive zone of injury. Both methods, tendon transfers and nerve grafting can be used to repair the damage of radial nerve due to any aetiology. The main idea behind this surgery was to perform both procedures at the same time and thereby shorten the time from the injury to a good functional result. In order to shorten the limb's own functionality, we used this combined procedure because the actual neurotisation would take a very long time and the patient needed to be self-sufficient as a priority for his own sustenance and survival. As a standard, tendon transpositions are only used when there is no motor reinnervation of the muscles. Practically, the surgeon must tailor the surgery to the patient's needs. It is necessary to develop a unique and generally accepted evaluation scheme for the results of tendon transfers and nerve grafting that will enable comparisons of results achieved.

Conflict of interest: All authors declare that they have no conflict of interest.

Funding: The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Roles of authors: Tomáš Kempný – originate concept and design of the study, operation of the patient, critical revision of the manuscript; Júlia Bartková – corresponding author analysis and interpretation of data, crafting of the manuscript; TomášVotruba, Xani Zuke, Ramadani Florin, Břetislav Lipový, Zdeněk Dvořák, Jakub Holoubek – consulting authors, review of the literature, critical revision of the manuscript. All authors have read and approved the final version of the manuscript. All authors declare that this paper or its part is not concurrently under review in another journal or publication.

Disclosure: Informed consent was obtained from all patients for being included in the study. All procedures performed in this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the Helsinki declaration and its later amendments or comparable ethical standards.

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Submitted: 23. 5. 2023
Accepted: 29. 7. 2023

CORRIGENDUM

doi: 10.48095/ccachp20221

Mini-invasive technique of sclerotherapy with talc in chronic seroma after abdominoplasty – a case report and literature review

In the article "Mini-invasive technique of sclerotherapy with talc in chronic seroma after abdominoplasty – a case report and literature review" published in Acta Chirurgiae Plasticae 2022; 64(3–4): 143–147, a correction has been made to the author list.

Co-author Ignacio Stoppani, who was not listed in the final version of the manuscript submitted by the authors, has been added to the author list at the request of the authors. Neither the editorial board nor the journal production office had any responsibility for this omission.

The correct author list is shown below:

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