

Multihit Injury of the Radial Nerve in a 62-year-old Woman: A Case Report

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Summary: We report the case of a 62-year-old female patient with a triple-crush radial nerve injury, diagnosed in subsequent order following a fracture of the left humerus. The patient developed flaccid paralysis of all muscles innervated by the left radial nerve except the triceps brachii and reported a sensory deficit corresponding to the innervation territories of the posterior nerve of the forearm as well as the superficial branch of the radial nerve. Following neurolysis of the radial nerve at the humerus level, wrist extension as well as sensory perception on the dorsal aspect of the forearm recovered, but finger extension and thumb abduction were still impossible. Following neurological evaluation and nerve ultrasound, supinator syndrome was diagnosed and the patient underwent decompression surgery. Following surgical decompression, motor recovery was observable but a sensory deficit remained in the area innervated by the superficial branch of the radial nerve. In consequence, the third crush injury of the left radial nerve, that is, Wartenberg syndrome or cheiralgia paraesthetica was diagnosed. Decompression surgery of the superficial branch of the radial nerve was performed and the patient reported profound amelioration of her sensory symptoms during a follow-up examination at our outpatient clinic 6 weeks postoperatively. (*Plast Reconstr Surg Glob Open* 2022;10:e4414; doi: [10.1097/GOX.0000000000004414](https://doi.org/10.1097/GOX.0000000000004414); Published online 20 June 2022.)

Single-site nerve compression syndromes such as carpal tunnel syndrome or cubital tunnel syndrome are a common occurrence in clinical practice.¹ “Double-hit” injuries of peripheral nerves were reported by Lundborg and Dahlin² but are found far less frequently. “Triple-hit” injuries are extremely rare and only a few clinical cases have been published, anecdotally reporting triple-site lesions of the phrenic nerve following interscalene block³ or tibial nerve injuries in patients with diabetic polyneuropathy.⁴ Here, we describe the course of functional recovery in a female patient with a triple-crush injury of the radial nerve, highlighting key aspects of interdisciplinary diagnosis and treatment of patients with multiple lesions of a single nerve.

CASE REPORT

We describe the case of a 62-year-old woman who had a triple-hit injury of the radial nerve: traumatic paresis at the level of the upper arm, supinator syndrome, and cheiralgia paraesthetica (Wartenberg syndrome). The three lesions were revealed in a subsequent order following a traumatic left humerus shaft fracture in October 2018. Two days after the initial trauma, the humerus fracture was treated by means of nail-osteosynthesis in an external hospital. One day later, a flaccid drop of the left hand which had not been present following the initial trauma was observable and neurolysis of the left radial nerve at the humerus level was performed. Four days postoperatively, neurological diagnostics confirmed a severe axonal lesion of the left radial nerve. Clinical examination revealed an intact left triceps muscle, but all distal muscles innervated by the radial nerve were completely paralyzed. Additionally, the patient reported anesthesia in the areas innervated by the posterior cutaneous nerve of the forearm and the superficial branch of the radial nerve, respectively. The patient was discharged 3 days later with a radial splint and advised to undergo frequent neurological follow-up examinations as well as transcutaneous electrical nerve stimulation. Three months later, the patient was referred to the neurological outpatient clinic. She had regained wrist extension, but with distinct radial deviation, and finger extension, thumb extension and thumb abduction were

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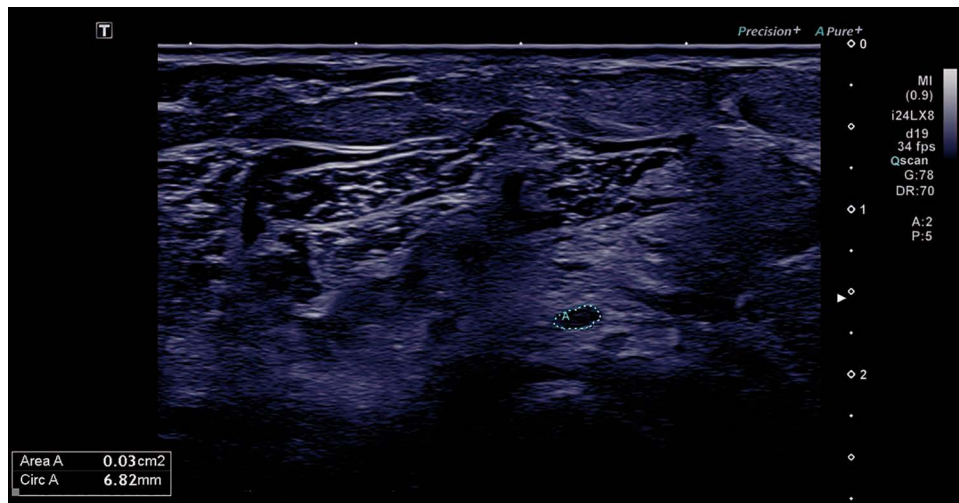


Fig. 1. Neurosonographic evaluation of the deep branch of the radial nerve (A) at the arcade of Frohse before nerve decompression. The nerve's cross-sectional area (blue circle) is significantly enlarged to 0.03 cm^2 in contrast to a reference value of about 0.01 cm^2 in healthy individuals.

still impossible. The reported hypesthesia of the left dorsal forearm and hand was considered appropriate in regard to the time course of recovery. Following electrophysiological testing and nerve ultrasound, a double-crush axonometric lesion was diagnosed, both at the level of the upper arm as well as in the supinator tunnel.⁵ The patient was referred to our department in March 2019 and the arcade of Frohse was divided. Postoperatively, the patient gradually recovered radial nerve function over the course of 18 months and neurological evaluations confirmed regeneration. When she was examined during an outpatient visit 8 months postoperatively, she had regained full muscle power in her left upper extremity including wrist, finger, and thumb extension. However, there was still hypesthesia in the innervation area of the superficial branch of the radial nerve equaling approximately 85% when compared to the unaffected side in the TEN-test.⁶ Additionally, a Hoffmann-Tinel sign was evocable during percussion of the skin area corresponding to the entrapment spot of the superficial branch of the radial between the tendons of the brachioradialis (BR) and extensor carpi radialis longus muscle (ECRL). Electroneurographic evaluations showed a substantial improvement of the left radial nerve's electrophysiological properties, but a nerve ultrasound examination revealed a marked compression of the superficial branch of the radial nerve at the aforementioned compression site (Fig. 1). Therefore, the diagnosis of cheiralgia paresthetica⁷ was confirmed. In February 2021, the patient underwent decompression surgery of the superficial branch of the radial nerve. Intraoperatively, a sharp fascial arch between the tendons of the BR and ECRL was encountered (Fig. 2) and split. The patient was re-examined in our outpatient clinic 6 weeks later, reporting significant amelioration of her sensory deficits (Fig. 3). Normal sensation was now reported in the formerly hypaesthetic area of the forearm and the dorsal aspect of the second digit. The remaining hypaesthetic

area (Fig. 3A) now only included the area of the thumb (Fig. 3B). The Hoffmann-Tinel sign was evocable about 3 cm distal to the decompression site. The patient chose to undergo further follow-up examination at her family physician but was satisfied with the overall functional result.

DISCUSSION

A radial nerve injury at the humerus level, supinator syndrome, and cheiralgia paraesthetica in the same patient are an extremely rare occurrence. Although in the described case the radial nerve was lesioned in three different locations, both the fibers for the superficial and deep branch were in fact compressed two times, therefore justifying defining the lesions as a “duplicate double hit.” Although surgical treatment for the aforementioned nerve lesions is well described in the literature, diagnosis might be difficult. In our opinion, it is paramount to examine the typical distal predilection sites for compression neuropathies following proximal nerve lesions to enable optimal

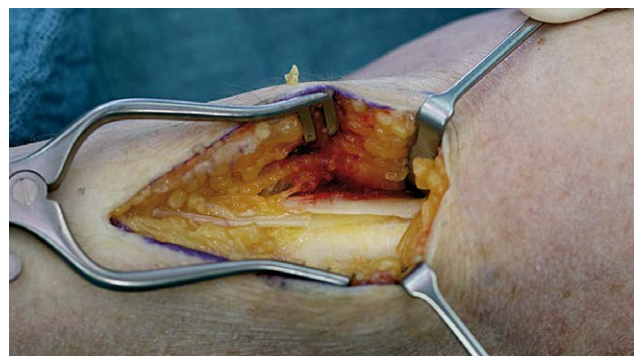


Fig. 2. Intraoperative photograph showing the entrapment of the superficial branch of the radial nerve between the tendons of the brachioradialis muscle (bottom) and the extensor carpi radialis longus muscle (top).

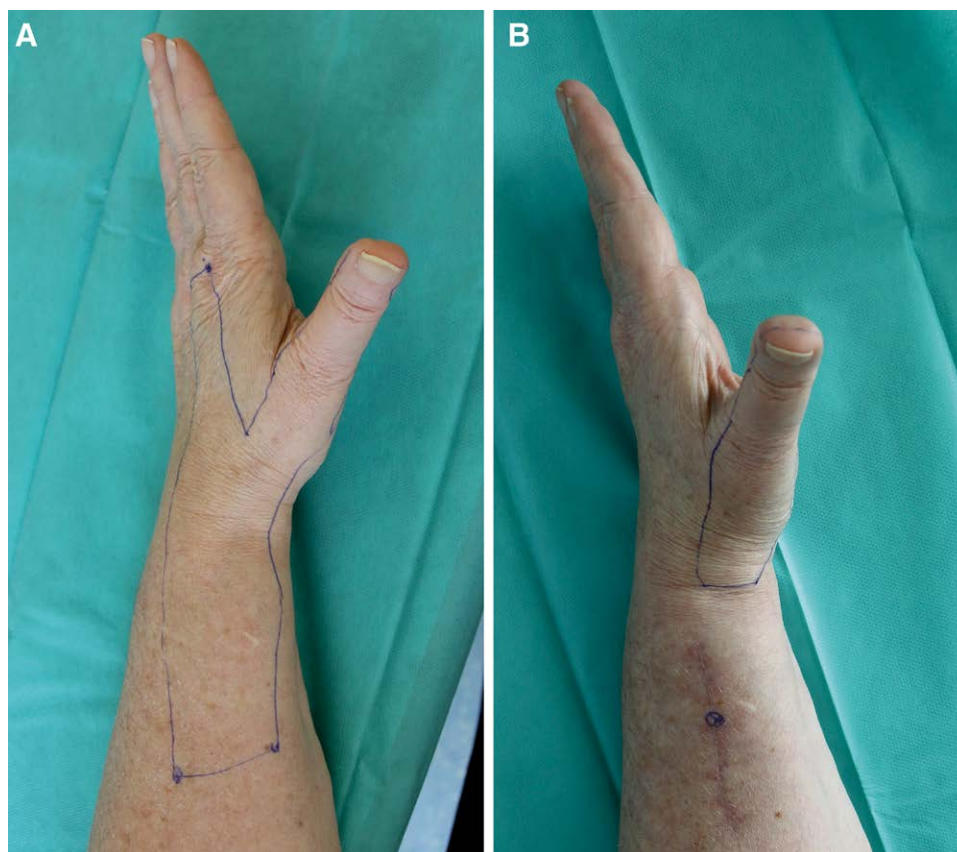


Fig. 3. Sensory symptoms prior to and after decompression surgery of the superficial branch of the radial nerve. Preoperative (A) and postoperative (B) sensory deficits in the patient with cheiralgia parvaesthetica are indicated by pen drawings. Although the hypaesthetic area involved both the thumb and the dorsal aspect of the hand preoperatively, it was reduced to the area of the thumb 6 weeks postoperatively. The blue cross with the circle around it indicates the spot where the Hoffmann-Tinel sign was evocable during percussion of the forearm. As visible in the right panel, the patient recovered full strength of digit and thumb extension.

functional recovery. As for the presented case, the patient recovered wrist extension following decompression surgery of the radial nerve at the humerus level, which could be misleadingly interpreted as full motor recovery. Wrist extension, however, is mediated both by the ECRL and the extensor carpi radialis brevis muscle. As the branches to the ECRL are sent off proximal to the supinator tunnel, wrist extension might recover in patients with supinator syndrome, but due to the insertion site of the ECRL tendon, marked radial deviation will be observable during wrist extension. Furthermore, the diagnostic value of neurosonographic evaluations to localize the nerve lesion is emphasized by this case report. The pathophysiology of “multiple-hit” peripheral nerve injuries remains to be elucidated in full detail with impairment of axonal transport; up- and downregulation of ion channels and inflammatory changes in the dorsal root ganglia proposed as most plausible mechanisms.⁸ Early preventive release of distal compression spots following proximal nerve injury was advised by several authors.^{9,10} “Watch and wait” can also be applied, as regeneration may also proceed unhindered. However, our case underpins that the possibility of distal nerve compression following proximal nerve injury

must be kept in mind and surgically addressed in a timely manner given its occurrence.

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