

# Combined Median, Ulnar, and Radial Nerve Injury after a Spiral Humeral Shaft Fracture

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**Summary:** We report the case of a 43-year-old woman who presented with combined radial, median, and ulnar nerve palsies and a spiral humeral shaft fracture after falling down stairs. Postinjury, the patient did not recover full median, ulnar, and radial nerve function despite aggressive hand therapy. Electrodiagnostic studies and imaging findings were concerning for traction neuropraxia or transection, radial nerve neuroma, and scar encasement of the radial, median, and ulnar nerves. The patient underwent radial, median, ulnar, and musculocutaneous nerve neuroplasty, nerve wrap application, nerve stimulation and laser angiography. Surgical exploration revealed no transection injuries to the median, ulnar, or musculocutaneous nerves. The radial nerve was tethered to the fracture site and enlarged, but no neuroma was observed. Laser angiography demonstrated intact perfusion to all nerves. The patient went on to recover full nerve function. Although isolated radial nerve palsies associated with closed humeral shaft fractures are typically observed initially, management of combined nerve palsies is controversial. This case serves to caution surgeons to perform a thorough neurovascular examination on patients with humeral shaft fractures to identify combined nerve palsies. (*Plast Reconstr Surg Glob Open* 2024; 12:e6087; doi: [10.1097/GOX.0000000000006087](https://doi.org/10.1097/GOX.0000000000006087); Published online 21 August 2024.)

Radial nerve injury due to a humeral shaft fracture is common because of its anatomic proximity and limited excursion.<sup>1</sup> However, other associated nerve injuries are rare.<sup>2</sup> This report describes the presentation, diagnosis, and management of a 43-year-old woman who presented with combined radial, median, and ulnar nerve injuries after a spiral humeral shaft fracture. To our knowledge, a combined radial, median, and ulnar nerve palsy at the time of injury, secondary to a spiral humeral shaft fracture, has never been reported. This case emphasizes the importance of performing a thorough neurovascular examination on patients with humeral shaft fractures to identify any combined nerve palsies.

## CASE REPORT

A 43-year-old woman with a medical history of psoriatic arthritis presented with a combined radial, median,

and ulnar nerve palsy after a spiral humeral shaft fracture sustained during a fall down stairs (Fig. 1). On motor examination, the patient had 0 of 5 strength in thumb, finger, and wrist extension, 3 of 5 strength in flexor pollicis longus, 4 of 5 strength in interossei. On sensory examination, the patient had decreased sensation in radial nerve distribution and intact sensation in ulnar and median nerve distribution. The proximal humeral shaft fracture was treated nonoperatively with a fracture brace.

During postinjury surveillance, the patient did not recover radial nerve function and continued with median and ulnar nerve motor weakness. Electromyogram and nerve conduction studies (EMG/NCS) performed at 2- and 3-months postinjury demonstrated severe radial nerve neuropathy, as well as ulnar and median nerve neuropathies with interval improvement at 3 months postinjury. Magnetic resonance imaging with neurography (MRN) performed 3 months postinjury demonstrated T2 hyperintensity in the radial, median, and ulnar nerves with perineural scarring at the site of the fracture, indicative of a traction injury. The radial, median, and ulnar nerves were observed to be in continuity. An ultrasound of the brachium performed 3 months postinjury demonstrated perineural

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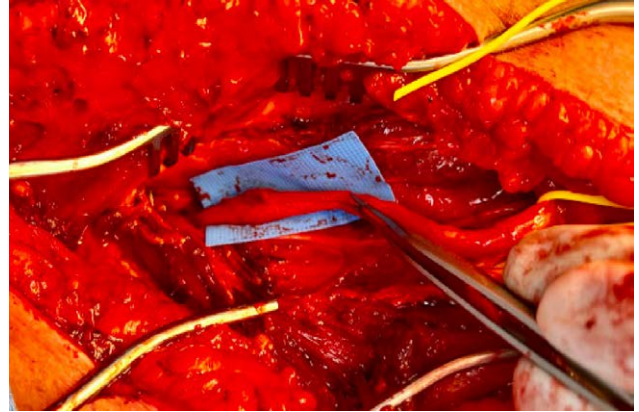
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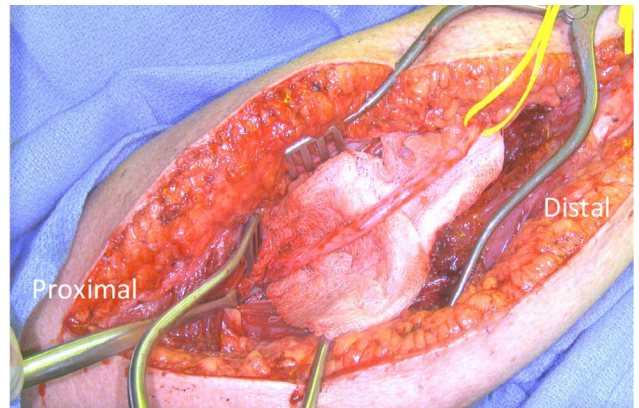
**Fig. 1.** Radiograph demonstrating a spiral humeral shaft fracture after fracture brace placement.

scarring and decreased gliding of the radial, median, and ulnar nerves, as well as concern for radial nerve neuroma. Enlargement of the radial nerve at the level of the fracture was also observed on MRN and ultrasound.

Five months postinjury, the patient underwent nerve exploration. Radial nerve neurolysis was performed through a posterior approach to the humerus. The radial nerve was observed to be enlarged, flattened, swollen,



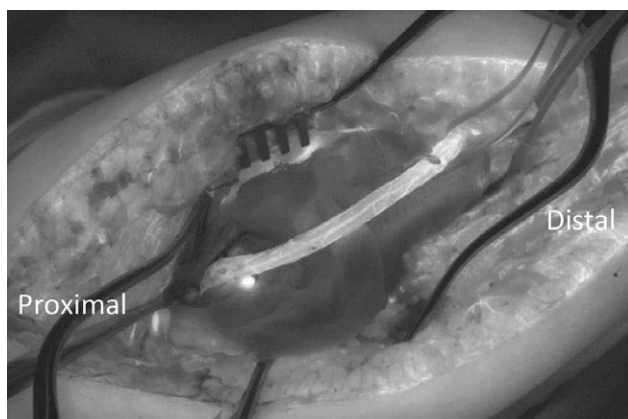
**Fig. 2.** Intraoperative photograph demonstrating the radial nerve after neurolysis with a bulge noted at site of fracture overlying blue background.



**Fig. 3.** Intraoperative photograph of the radial nerve.

white, and tethered to the site of the fracture (**Fig. 2**). However, the radial nerve was in continuity, and no neuroma was observed (**Fig. 3**). Nerve stimulation revealed distal finger and wrist extension. An anterior approach to the median, ulnar, and musculocutaneous nerves was performed at the brachium. The median, ulnar, and musculocutaneous nerves did not demonstrate signs of injury. Nerve stimulation also demonstrated finger flexion and interosseus muscle function. As an adjunctive tool, laser angiography of the radial (**Fig. 4**), median, musculocutaneous, and ulnar nerves demonstrated full perfusion and confirmed the viability of the nerves. [See **Video 1 (online)**, which displays the intraoperative laser angiography demonstrating perfusion of the radial nerve with identification of radial nerve enlargement and swelling at the fracture site.] [See **Video 2 (online)**, which displays intraoperative laser angiography demonstrating perfusion of the median, musculocutaneous, and ulnar nerves, with no apparent injury noted.]

Circumferential neurolysis of the radial, median, ulnar, and musculocutaneous nerves was performed. The radial, median, and ulnar nerves were wrapped with Axogen axoguard nerve protector. The patient continued with therapy and eventually recovered full nerve function.



**Fig. 4.** Corresponding laser angiography to Figure 3, demonstrating perfusion of the radial nerve.

## DISCUSSION

Humeral shaft fractures have a high rate of associated radial nerve injury due to the anatomic proximity of the radial nerve and relative lack of excursion.<sup>1,3</sup> However, median and ulnar nerve injury following humeral shaft fractures is rare, as they lie further away from the humerus and have greater excursion.<sup>3</sup> Patel et al<sup>4</sup> reported a case of combined median and radial nerve palsies following a distal humeral shaft fracture. Surgical exploration was performed 3 weeks postinjury, revealing both nerves in continuity but surrounded by thick scar; neurolysis resulted in full nerve recovery.<sup>4</sup> Similarly, Rohilla et al<sup>5</sup> reported a case of combined radial and median nerve palsy secondary to a humeral shaft fracture in which early surgical exploration revealed intact nerves without injury, with subsequent complete recovery.

Preferred management of combined nerve injury has not been established. Initial, nonoperative management of an isolated radial nerve palsy associated with a closed humeral shaft fracture has been favored because of the high rate of spontaneous recovery and similar recovery rate with early and delayed surgical intervention.<sup>6</sup> Although most radial nerve palsies are contusions that improve without intervention, nerve laceration and incarceration warrant early surgical intervention, as delayed exploration can lead to irreversible nerve injury, motor end plate loss, and muscular atrophy. A recent systematic review supports early exploration of radial nerve palsies following humeral shaft fractures.<sup>6</sup> Opponents of early exploration, however, advocate for zone of injury demarcation for a more accurate assessment or resolution of a radial nerve palsy.

Multiple nerve injuries may be a relative indication for surgical intervention. Multiple nerve palsies following humeral shaft fracture have been associated with a decreased chance of nerve recovery.<sup>2</sup> In the few median, ulnar, or combined nerve palsy cases reported, both early and delayed surgical intervention led to neurologic recovery.<sup>4,5,7–10</sup> In this case, MRN revealed radial, median, and ulnar nerves in continuity with concern for traction injury, and surrounding scar tissue concerning for entrapment. Enlargement of the radial nerve was observed on ultrasound, concerning for neuroma. The patient's mild improvement with therapy

initially directed toward nonoperative management; however, postinjury imaging, along with the patient's persistent motor weakness after five months, led to exploration. It is unclear if nonoperative management would have led to the same outcome in the same period of time. However, while imaging findings were ultimately discordant with operative findings with regard to radial nerve neuroma, surgical exploration was necessary to address a potential cause of the patient's neuropathy.

This case is noteworthy for the identification of combined median, radial, and ulnar nerve palsies at the time of injury associated with a spiral humeral shaft fracture. Surgical exploration confirmed nerve viability. The combined nerve injuries were likely a traction injury due to forcible separation of the fracture fragments. This case serves to caution physicians to perform a thorough physical examination in patients with spiral humeral shaft fractures, and to consider early surgical exploration when there is a combination of nerve palsies.

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## DISCLOSURE

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

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