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High median nerve injury after arthroscopic elbow contracture release with complete recovery at 6 months

Marc J. O'Donnell, MD*, Michael R. Hausman, MD

Leni & Peter May Department of Orthopaedic Surgery, Mount Sinai Hospital, New York, NY, USA

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Elbow joint contracture is a common and debilitating sequela of elbow trauma. Elbow contractures may be treated by open or arthroscopic approaches, with the arthroscopic technique often employed for less severe preoperative contracture and open arthrolysis used for very stiff elbows that require concomitant ulnar nerve release.[10] The generally accepted indications for elbow contracture release, whether open or arthroscopic, include a flexion-extension arc of $<100°$, or flexion contracture $>30°$.[10] The benefits of elbow arthroscopy as compared to open surgery for contracture release include limited skin incision with reduced soft tissue trauma and diminished postoperative pain with improved immediate elbow rehabilitation.[1] Arthroscopy may also improve visualization of intra-articular structures. Arthroscopy of the elbow joint for any indication is considered challenging, and arthroscopic contracture release is considered to be one of the more challenging procedures such that it should be done by a surgeon trained specifically in the technique.

A potential complication of elbow arthroscopy is injury to a nerve. The rate of nerve injury is reported between 0% and 14%, with the vast majority of nerve injuries described as transient and of minor peripheral nerves.[13] Peripheral nerve injury is often cited as the most concerning complications of elbow arthroscopy. In a recent survey of the American Society for Surgery of the Hand membership conducted by Desai et al, 18,430 elbow arthroscopies were performed with an extrapolated rate of nerve injury of 1.2%, with 0.5% being major nerves.[3] The radial and ulnar nerves are considered particularly vulnerable because of their proximity to the capsule, and the median nerve is thought to be somewhat protected by its position anterior to the brachialis muscle. Median nerve injury from elbow arthroscopy, albeit an extremely rare complication, has previously been reported in the literature.[5,8] Median nerve injury has also been reported to occur secondary to arm positioning in full extension during various other non-orthopedic surgeries secondary to nerve entrapment between a swollen brachialis muscle and the lacertus fibrosus.[11] Here we present a case of a patient who sustained a dense high median nerve injury after arthroscopic elbow contracture release for post-traumatic stiffness due to compression beneath a thick, fibrotic lacertus fibrosus in elbow extension. Although a somewhat similar concept to brachialis syndrome, this mechanism of median nerve injury has not been reported with arthroscopic contracture release.

Patient case

The patient is a 43-year-old man who initially sustained a left distal humerus fracture treated with medial column plate fixation and olecranon osteotomy by an outside physician. The distal humerus fracture failed to heal and

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*Reprint requests: Marc J. O'Donnell, MD, 601 Elmwood Ave, Box 665, Rochester, NY 14624, USA.

E-mail address: marc_odonnell@urmc.rochester.edu (M.J. O'Donnell).

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required revision open reduction internal fixation (ORIF) with iliac crest bone grafting. The patient had partial loss of ulnar nerve function after his initial ORIF. The ulnar nerve was found to be entrapped in scar at the time of the revision surgery and a neurolysis was performed. The patient achieved bony union (Figs. 1 and 2) with improvement of his ulnar nerve palsy. The patient thereafter redeveloped elbow joint contracture, which was treated with 2 arthroscopic elbow contracture releases.

The first arthroscopic release was performed almost 6 months after revision ORIF, and achieved elbow motion of extension 20°, flexion 135°, supination 75°, and pronation 75°. There was some heterotopic bone located posteromedially that was resected during the arthroscopy. However, the patient insisted on trying to achieve full motion, and once his improvement plateaued, he was indicated for a second arthroscopic contracture release to achieve full extension. The second arthroscopic contracture release was 1.5 years after the first. After release, our standard protocol was instituted, including splinting in full extension when not exercising (daytime and nighttime splinting for 2 days, then use splint at night and for extended periods of time during the day when not using the arm), hospital admission with an indwelling brachial plexus catheter, indomethacin and short-term dexamethasone, along with aggressive physical therapy. For the first night, the elbow was kept in full extension with a splint, and on postoperative day 1 physical therapy saw the patient to begin passive range of motion of the elbow, and the patient was instructed to also do the same exercises hourly with the assistance of the nursing staff. The brachial plexus block was gradually weaned by anesthesia staff. He was discharged from the hospital on postoperative day 3 with a full range of motion. He was instructed to continue with hourly elbow active and passive motion while at home and was prescribed twice-weekly physical therapy. He was seen back at approximately 10 days postoperation, when he reported numbness throughout the left hand. Examination demonstrated loss of 2-point discrimination in the median nerve distribution, and weakness of thumb, finger, and wrist flexion. This was thought to be either secondary to the brachial plexus block or surgical injury to the median nerve at the elbow. This was initially observed, and after a week with no improvement he underwent electrodiagnostic testing. The motor nerve conduction studies demonstrated a median nerve conduction block at the elbow, with sensory nerve conduction studies similarly demonstrating absent responses of the median nerve. The needle electromyograph demonstrated fibrillations and sharp waves in the flexor carpi radialis, flexor pollicis longus, and abductor pollicis brevis muscles. These findings are consistent with a severe median neuropathy at the elbow. Given these findings, he was indicated for surgery and underwent a median nerve neurolysis with micro-internal neurolysis.

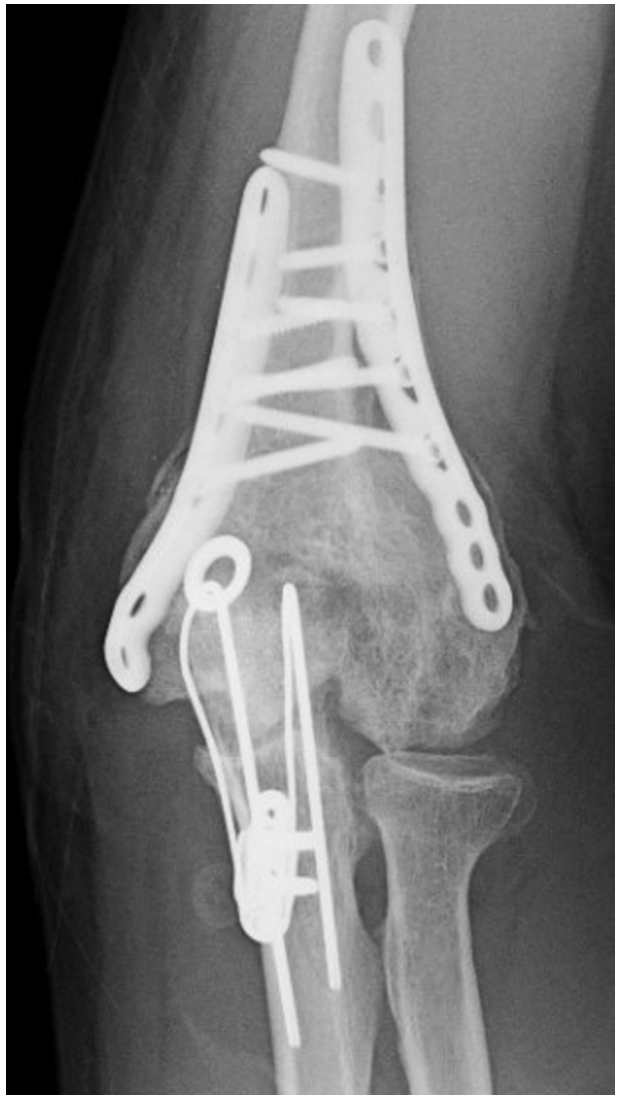

Figure 1 Anteroposterior radiograph demonstrating union of the distal humerus fracture after revision open reduction and internal fixation with iliac crest bone graft with olecranon osteotomy.

On initial dissection, the lacertus fibrosus was found to be very thick, with medial displacement of the biceps tendon and scarring in this region. The nerve was found to be in continuity (Fig. 3) and had suffered no direct trauma from the arthroscope or shaver. However, there was dense perineural fibrosis and an hourglass constriction beneath the lacertus fibrosus. The nerve was supple throughout without any evidence of a neuroma-in-continuity. Neurolysis was performed with the use of an operative microscope. Both external and internal neurolysis was performed to remove any perineural fibrosis. A handheld nerve stimulator was used to assess the nerve intraoperatively. Use of the nerve stimulator intraoperatively showed a flicker of distal motor response in the 0.5-mA stimulation range, which is anecdotally interpreted as a favorable sign for recovery and, therefore, no further treatment was performed. The nerve appeared to have been crushed between the well-developed

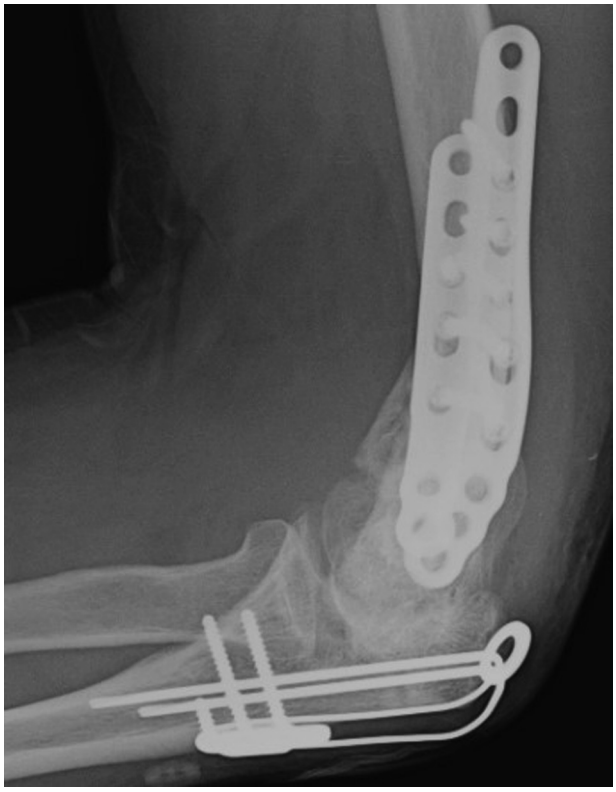

Figure 2 Lateral radiograph demonstrating union of the distal humerus fracture after revision open reduction and internal fixation with iliac crest bone graft with olecranon osteotomy.

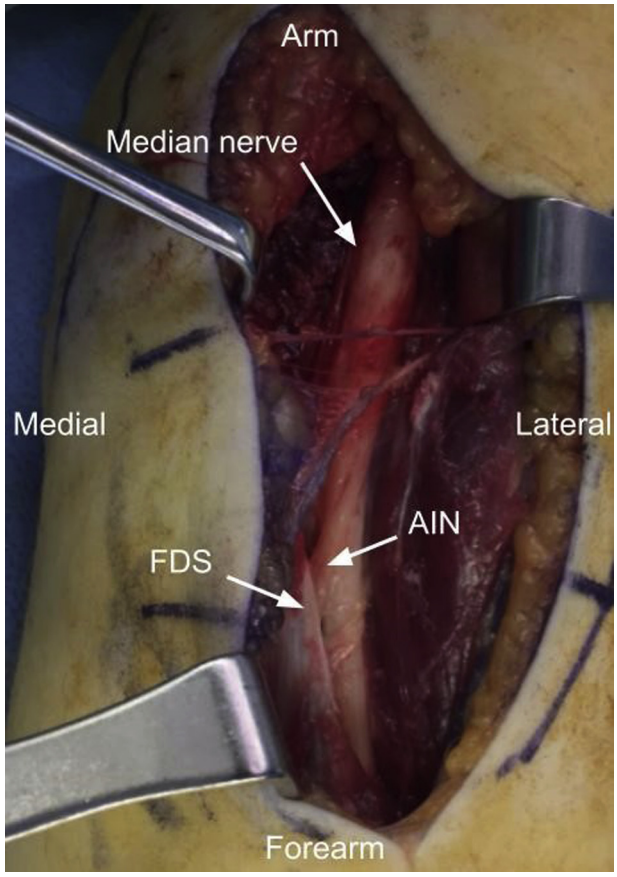

Figure 3 Intraoperative photograph demonstrating continuity of median nerve. *AIN*, anterior interosseous nerve; *FDS*, flexor digitorum superficialis.

lacertus fibrosus and anteromedial scar tissue that had formed as a result of the 2 open reduction and internal fixation procedures.

The patient was seen at 2, 6, and 12 weeks postoperatively, and there were no signs of improvement on examination apart from a distally traveling Tinel sign at the proximal forearm. At his 6-month visit, he demonstrated complete recovery of median nerve motor and sensory function. He had normal 2-point discrimination in the median nerve distribution of 5 mm, and M5 muscle strength of the flexor carpi radialis, flexor pollicis longus, and index and middle finger flexor digitorum superficialis and flexor digitorum profundus.

Discussion

Although median nerve injury during elbow arthroscopy has been reported, these injuries were most likely caused by direct trauma to the nerve from the surgical instruments.[5,8] To our knowledge, this is the first report of a compression neuropathy caused by tightening of the lacertus fibrosus in elbow extension. The median nerve is located anterior to the brachialis muscle and, therefore, is usually the most remote and protected nerves around the elbow. As previously discussed, the majority of nerve injuries after elbow arthroscopy are transient and of minor peripheral nerves. Multiple previous studies have demonstrated major peripheral nerve injury after elbow arthroscopy.[9,13] The most commonly cited injured major nerves include ulnar, radial, and posterior interosseous.

The mechanism of injury to the median nerve in our patient appears to be a compression injury between a well-developed lacertus and a band of anteromedial scar tissue probably related to the takedown of the medial intermuscular septum done to perform the ORIF and revision ORIF of the distal humerus fracture. Splinting the elbow in extension tightened these 2 bands of thick, inextensible tissue, crushing the median nerve between them. This is similar to the concept of brachialis syndrome, which we previously reported, in which the median nerve becomes compressed between the lacertus fibrosus and the swollen brachialis muscle belly while the arm is placed in full extension.[11] Hagert has also described lacertus tunnel syndrome as another cause of proximal median nerve compression at the elbow, again with the lacertus fibrosus as the culprit.[6] Part of our postoperative elbow arthroscopy protocol is a long-arm extension splint, with serial removal of the splint for therapy. In our patient, the thickened lacertus and medial displacement of the biceps tendon also

likely contributed to the development of median nerve entrapment. The incidence of this condition is not known, and our purpose in describing this case is to report on a condition that can cause median nerve damage that has not previously been reported, but is treatable if the correct diagnosis is made. We can speculate on factors that may predispose a patient to this condition, such as a previous surgery extending proximally along the humerus, such as humeral fracture fixation surgery, resulting in tough, inelastic scar. This proposed mechanism of median nerve compression after elbow arthroscopy has yet to be described.

Intraoperative findings dictate the treatment of median neuropathy at the elbow. In our patient, the nerve was found to be intact, and therefore treatment consisted of nerve decompression with release of the lacertus fibrosus, superficial and deep heads of the pronator teres, and the superficial arch of the flexor digitorum superficialis. If the nerve is found to be lacerated or have a firm and woody texture consistent with neuroma-in-continuity, then nerve repair or reconstruction would be necessary. Options for nerve reconstruction are many, including autograft vein conduit, synthetic conduits, allograft nerve, and autograft nerve, along with tendon transfers.[4,7] In our patient, complete recovery of the dense median nerve injury occurred approximately 6 months postoperatively, which is a reasonable time period given the level of injury.

The use of an intraoperative nerve stimulator is helpful to assess the continuity of the nerve fascicles and to help make the difficult decision regarding the nerve's capacity to recover or the need for reconstruction with graft or nerve transfer. Although not rigorously proven, there is a consensus, based on empirical observation, that if any distal motor response is seen in the 0.5-mA range and 25-100 microseconds of pulse width that the nerve will recover completely or nearly so. If no response is seen in the 0.5-mA range, but any response is seen in the 2-mA range, then recovery to at least motor grade III can be anticipated, but with no response in the 2-mA range, then recovery is unlikely and reconstruction or nerve transfer should be performed. In this case, the stimulator was applied to individual fascicles of the median nerve to ensure that the fascicles of the anterior interosseous nerve as well as the terminal median nerve were intact.[2,12] This can be performed before and after neurolysis to assess if there is an increased response while using the same level of stimulation. Nerve stimulation is currently the most common and simplest way to assess for peripheral nerve functionality intraoperatively, apart from continuous nerve monitory or a wide-awake test as typically done in spine surgery.

This case has also led us to reconsider our postoperative protocol, which formerly let the elbow remain in full extension overnight, with therapy beginning the day following surgery. We now begin to flex the elbow within hours of surgery on an hourly basis and also lighten the nerve block to assess nerve function. These protocol modifications apply to all patients who undergo arthroscopic elbow contracture release. This is consistent with the practice of others who place the nerve block postoperatively after confirming nerve integrity. Furthermore, this case illustrates the importance of performing a thorough neurologic examination prior to plexus catheter placement to establish a baseline.

Conclusion

We report a rare but possibly devastating complication of median nerve palsy after arthroscopic elbow contracture release. Our patient underwent median nerve neurolysis, and at his 6-month postoperative appointment had complete recovery of his neuropathy. The suspected mechanism of injury in our patient was compression of the nerve between a band of scar along the anteromedial aspect of the humerus and the thickened lacertus fibrosus, which has yet to be described in the literature. Avoiding prolonged positioning in full extension should help to prevent this problem and we now avoid this position.

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