Anterior Interosseous Nerve Transfer for Ulnar Neuropathy: How, When and Why

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Introduction

Compressive neuropathies of the upper extremity are one of the most common diagnoses seen in orthopedic practices. A vast majority of patients are seen early in the natural history of the disease. In this state, patient complaints may vary but it is unlikely that any permanent damage has taken place. In the latter stages, prolonged nerve damage of motor fascicles and resultant lack of neural input to motor units can produce progressive muscle wasting.

Secondary muscle atrophy and weakness due to compressive neuropathy can be managed in a variety of ways. Tendon transfers are often the treatment of choice particularly for advanced carpal tunnel syndrome with loss of thumb opposition. For longstanding compression of the ulnar nerve and loss of a majority of the intrinsic muscles, tendon transfers remain a common and viable option. Alternatively, in cases where motor recovery is still possible, nerve transfers can aid in restoring lost function.

The terminal extent of the anterior interosseous nerve (AIN) is a very popular and widely utilized donor nerve for transfer. Similar to tendon transfers, certain principles must be followed in order to have a successful outcome. The aim of this paper is to detail the surgical steps of the procedure using a case report and identify the indications for its use.

Case Report

A 53-year-old male presented with a nearly one-year history of numbness and tingling in the ulnar nerve distribution on the right side. He had recently noticed weakness and was beginning to drop objects. He reported that his hand seemed smaller compared to the contralateral side. On presentation to his hand surgeon, he had already undergone an electromyography and nerve conduction study which demonstrated cubital tunnel syndrome with evidence of denervation to the first dorsal interosseous muscle. On exam, the patient had a positive Tinel sign over his cubital tunnel and had weakness and atrophy of his ulnarly innervated hand muscles. Due to his advanced symptoms, it was suggested that he undergo a cubital tunnel release. In addition, an AIN transfer was proposed to augment his recovery.

Within a few weeks of his consultation, the patient was taken to the operating room for a cubital tunnel release and AIN transfer. The ulnar nerve was released throughout its course at the elbow utilizing a standard open incision technique. To perform the nerve transfer, an extensile, curvilinear incision was placed over the distal ulnar forearm. The ulnar neurovascular bundle was identified deep to the flexor carpi ulnaris on the radial side. The ulnar artery and nerve were separated carefully, and the takeoff of the dorsal sensory branch of the ulnar nerve was identified. This was found about 9 centimeters proximal to the ulnar styloid. This landmark is important due to the intrinsic topography of the ulnar nerve. At the level of the distal forearm, distal to the takeoff of the dorsal sensory branch, the motor fascicles occupy the ulnar most portion of the continuation of the ulnar nerve.

Next, identification and dissection of the anterior interosseous nerve was performed. This was completed by retracting the flexor carpi ulnaris and the ulnar neurovascular bundle ulnarly while sweeping the remaining tendons and muscles radially. Placing a large Deaver retractor on the radial side helped facilitate exposure. At the base, the pronator quadratus was easily identified. At the proximal most portion of the muscle, the anterior interosseous artery, vena comitantes, and nerve were encountered entering the muscle. The nerve was the most radial structure lying just superficial to the interosseous membrane. Intramuscular dissection of the AIN was then performed until it began to branch in to several smaller branches. The nerve was then freed proximally to ensure an adequate arc of rotation and tensionless neurorrhaphy.

With the AIN free and transposed near the ulnar nerve, the area of nerve coaptation was identified. This location was distal to the dorsal sensory branch, and again, was on the ulnar side of the proper ulnar nerve. Under loupe magnification and utilizing micro instruments, careful dissection of the nerve took place. A small area of epineurium was removed from the ulnar nerve at the neurorrhaphy site. A total of three 9-0 nylon suture were then used to connect

the AIN to the ulnar nerve in the area of motor fascicles. Fibrin glue was used to reinforce the coaptation. The transfer was noted to have a smooth course to the ulnar nerve and there was no tension.

Discussion

AIN transfer to the ulnar nerve has been performed for more than 20 years.[1] Since that time, it has become a popular adjunctive procedure for people with ulnar nerve compression and evidence of intrinsic hand muscle wasting. A large body of evidence supports its utility and reinnervation of the intrinsic hand muscles.[1-4] This is perhaps best demonstrated in cases of high ulnar nerve injury when one would not expect any motor recovery from the ulnar nerve itself .[1] The transfer is utilized to solely provide or "supercharge" the neural input of the native nerve.

There are variations in technique that have been described. The two main differences that exist are in the extent of nerve decompression and identification of motor fascicles. Some surgeons advocate for release of the cubital tunnel as well as Guyon's canal in order to ensure there are no sites of impingement. This also allows for identification of the motor branch which can be traced proximally to the site of transfer. Alternatively, or in addition, nerve stimulators can be used to better identify the appropriate fascicles.

The indications for AIN transfer in compressive neuropathy of the ulnar nerve are widely inclusive if muscle atrophy is present. A recent study by Dengler et. al found that only advanced age was predictive of treatment failure.[2] This study included assessment of electromyography and nerve conduction studies and found that there were no values from those studies which predicted an unsuccessful nerve transfer.

Historically, nerve deficits of the upper extremity were treated with bracing and tendon transfers. However, as our understanding of nerve pathology and healing has improved, the use of nerve transfers has become a common treatment approach. There is even some evidence to suggest patients fare better with nerve transfers than tendon transfers .[5] The AIN is a popular choice for both radial and ulnar nerve deficits due to its relatively long course with terminal innervation to a redundant muscle (pronator quadratus). [5,6] As we gain more experience and knowledge of how these transfers can be utilized, this procedure and others like it will be used even more frequently.

References

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