Posterior interosseus palsy with an incidental Froment–Raubert nerve presenting as a pseudoclaw hand

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Introduction

Anatomic variations of peripheral nerves are well recognized and reported in literature [4]. It is important to understand these variations because they can explain unusual clinical deficits or findings. The Froment–Raubert nerve is a distal continuation of the motor branch of the posterior interosseus nerve, which innervates the first dorsal interosseus muscle. This report discusses a case of this rare anomalous connection that initially confused the diagnosis of a posterior interosseus palsy.

Case Report

A 17-year-old left-hand dominant baseball pitcher presented with an 8-month history of progressive pain in his left proximal forearm and elbow. His symptoms proceeded to subjective weakness of the small finger that progressed radially to include the ring and middle fingers with posturing in flexion at the metacarpal–phalangeal and

interphalangeal joints. He was given the presumptive diagnosis of an ulnar palsy. Prior to the onset of hand weakness, there were previous episodes of elbow pain that resolved without sequelae. He was referred to a hand surgeon. Initial physical examination was notable for clawing of the middle, ring, and small digits (Fig. 1) with full passive mobility. Additionally, he had subtle weakness of the wrist and extrinsic digit extensors as well as of the extensor pollicis longus and the abductor pollicis longus. He denied any sensory changes but slightly decreased protective sensibility was noted in the ulnar nerve distribution by Semmes–Weinstein monofilament testing (3.61), including the dorsal ulnar cutaneous nerve. A mildly positive Tinel’s sign over the ulnar nerve at the elbow was detected. Nonoperative treatments of splinting and nonsteroidal anti-inflammatory agents had been attempted and had failed to improve his symptoms.

Electrodiagnostic studies (nerve conduction and electromyography (EMG)) were consistent with a posterior interosseus nerve (PIN) neuropathy. These findings included denervation in the extensor carpi ulnaris and first dorsal interosseus with complex repetitive discharges in the latter. The number of motor units in all muscles innervated by the posterior interosseus nerve as well as in the first dorsal interosseus were decreased. Nerve conduction studies of the median and ulnar nerves were normal, including the amplitude of the thenar and hypothenar compound action potentials. The amplitude of the extensor indicis proprius compound muscle action potential was significantly decreased. Notable is that although no neurophysiologic evidence of ulnar nerve pathology was found at the elbow or wrist, evidence of denervation was noted in his first dorsal interosseus muscle on EMG. A complete neurological evaluation including magnetic resonance imaging of the brain, cervical spine, elbow, and forearm were

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Fig. 1 Preoperative view

normal. Subsequent clinical examinations confirmed mild sensory changes in the ulnar nerve distribution by Semmes–Weinstein monofilament testing (3.61). Motor weakness in the wrist and finger extensors also remained constant, with persistent clawing. He was diagnosed with a possible ulnar neuropathy and definite PIN compression syndrome. Operative exploration was performed.

During surgery, the ulnar nerve was first exposed at the elbow. Only a limited area of subtle external compression with small fibrous bands was seen and released at the medial epicondyle. Next, the posterior interosseous nerve decompression was performed using a standard volar forearm approach. The radial nerve was identified proximally and traced distally to locate the superficial radial sensory nerve and the posterior interosseous nerve. Mild fibrosis visually compressing the superficial radial nerve was seen and released with some nerve expansion noted. As the posterior interosseous nerve was mobilized at the tendinous arch at the supinator, significant compression was encountered. The fibrous supinator arch was thickened with a circumferential constriction (Fig. 2a). Release of the supinator fascia and tendon with a limited myotomy was then performed (Fig. 2b).

Fig. 2 Intraoperative view of site of PIN compression: **a** pre-release and **b** post-release

Twenty minutes after tourniquet release, intraoperative nerve stimulation of both the radial and ulnar nerves with recording from the first dorsal interosseus and hypothenar muscles was performed. Stimulation of the radial nerve showed activity in the first dorsal interosseus (Fig. 3a), whereas stimulation of the ulnar nerve had a response only in the hypothenar muscle (Fig. 3b). At 2-month follow-up, the patient had full recovery of his PIN motor and ulnar sensory deficits (Fig. 4a, b).

Discussion

Anomalous innervation of the first dorsal interosseus muscle by the radial nerve is known as the Froment–Raubert nerve, and this explains the finding of first dorsal interosseus muscle denervation on the preoperative EMG. It is probably unrelated to the digital clawing (pseudoclaw) described with a PIN palsy seen in this patient [8, 9]. The Froment–Raubert nerve is a distal continuation of the PIN that innervates the first and often second and third dorsal interosseous muscle. Froment [2] first described the distal continuation of the PIN, and Rauber [7] also reported a similar finding. Spinner [8] referred to this anomalous connection as the Froment–Raubert nerve. Previously, Bichat [1] also had described a distal communication of the PIN with the deep branch of the ulnar nerve.

Compression of the PIN can occur anywhere along its anatomic course by extrinsic or intrinsic factors. Reported extrinsic causes include ganglion cysts, lipomas, and fractures. Intrinsic compression involves fibrous bands at the radiocapitellar joint, large blood vessels known as the leash of Henry, a leading proximal tendinous edge of the extensor carpi radialis brevis, and the Arcade of Froese [3, 9]. This

Fig. 3 a, b Intraoperative muscle recordings

latter site refers to the proximal edge of the supinator, which is the most common site of compression [10].

Symptoms of posterior interosseous syndrome may include partial or complete paralysis of the muscles innervated by the PIN. Lack of finger extension at the metacarpophalangeal joints and thumb extension is noted with complete paralysis. The wrist extends in a dorsal radial direction due to unopposed extensor carpi radialis longus action. When the compression is progressive and first involves the small finger, progressing radially, the appearance can mimic an ulnar palsy [9, 10]. This is the “pseudoclau hand,” since there is no actual hyperextension at the metacarpal phalangeal joint as seen in an ulnar palsy [8, 9]. In fact, extensor digitorum communis function is

weak or absent [11]. Because of the soft clinical findings (Tinel’s, sensory changes) of cubital tunnel syndrome in this patient, the digital posturing was initially considered as a result of a mild ulnar palsy. The clawing of the middle finger, however, is not explained by an isolated ulnar palsy. Additionally, the MP posture of all the involved digits was relatively neutral. Intraoperative neurophysiological findings confirmed, in fact, the presence of radial innervation of the first dorsal interosseus and explained the preoperative EMG findings of that muscle that directly are, in fact, related to the previous diagnosis of a PIN compression. Involvement of the second and third interosseus muscles was not demonstrated and would not in any event explain the hand deformity that is an example of the “pseudoclau.”

The incidence of the Froment–Raubert nerve is unclear. A study looking at the anatomic variations of the course of the PIN in the forearm was performed on both arms of 29 cadavers [5]. Only one specimen was described to have the Froment–Raubert nerve, with the PIN terminal branch entering the third dorsal interosseous muscle [5]. This would set the incidence of this anomalous connection at 3.4%. Another cadaveric study, however, using immuno-histochemical analysis of PIN motor axons found 28.5% of specimens terminated in the muscles of the first web space [6]. This is similar to the reported incidence of the more recognized Martin–Gruber (ulnar–median) anastomosis. Technical differences in assessing the termination of the PIN nerve may account for the variability in the reported numbers. Even so, the prevalence of the Froment–Raubert nerve may not be as rare as previously thought.

The significant incidence of both median and radial nerve anastomosis to the ulnar nerve highlights the importance of understanding the muscular innervations of the ulnar nerve during a clinical exam. This redundancy in the neural connections sometimes allows for the maintenance of some hand intrinsic function even with the loss of ulnar nerve function.

A thorough understanding of various anomalous neural connections in the upper extremity allows for interpretation of potentially confusing clinical presentations in patients

Fig. 4 a, b Postoperative range of motion

and help guide surgical treatment. Thought to be a rare finding, the Froment–Raubert nerve may actually be a more common variant whose incidence is underappreciated.

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