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## Case Report

## Early Surgical Decompression for the Treatment of Hourglass-Like Constriction of the Posterior Interosseus Nerve

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Posterior interosseus nerve (PIN) syndrome refers to a rare compressive neuropathy of the PIN resulting in motor dysfunction of the forearm extensor compartment. Often, surgical exploration will reveal extrinsic structures that mechanically compress the nerve. Less frequently, PIN syndrome has been reported with a visible hourglass-like constriction and no identifiable causative adjacent structures. In our report, we describe an adolescent patient with PIN syndrome and associated hourglass-like constriction of the PIN. For diagnosis, we used physical examination, preoperative imaging, nerve studies, and intraoperative findings. To monitor recovery, we performed serial neurological examinations and documented patient-reported functional outcomes. The patient underwent early surgical decompression (< 6 weeks from presentation). Complete resolution of pain was reported 2 weeks after surgery. Complete resolution of wrist extension motor function occurred at 28 weeks after surgery. We demonstrate effective pain relief and complete motor recovery with early surgical release in this adolescent high-level athlete.

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Posterior interosseus nerve (PIN) syndrome refers to a rare compressive neuropathy of the PIN resulting in motor dysfunction of the forearm extensor compartment.<sup>1</sup> The PIN is the terminal motor branch of the radial nerve, branching just proximal to the radiocapitellar joint.<sup>1</sup> Potential etiologies of PIN syndrome include acute trauma, mechanical compression, and an inflammatory canal syndrome with compression in the proximal third of the forearm.<sup>1</sup> Hourglass-like compression is a less frequently described etiology of PIN syndrome that lacks an identifiable mechanical cause; it has been previously hypothesized to be a sequelae of an inflammatory response to infection or an autoimmune process.<sup>2</sup> Hourglass-like constriction of peripheral nerves has recently been reported in focal peripheral nerve paralysis.<sup>3</sup> In this case, we describe an adolescent patient with PIN syndrome associated with hourglass-like constriction of the PIN.

## Case Report

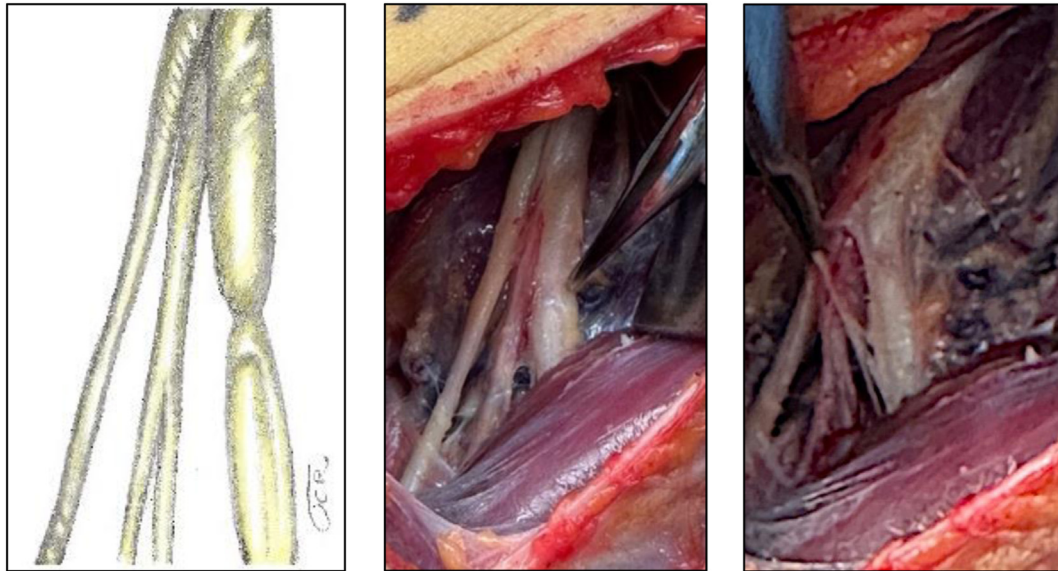
A 16-year-old right-handed male lacrosse player presented for initial evaluation of sharp, stabbing pain in the left proximal forearm and weakness with active extension of his fingers. Approximately 2 weeks prior to initial clinical evaluation, he reported a popping sensation in the left arm when reaching for an object with no other trauma described. Immediately, the patient reported persistent pain in the left dorsal-ulnar forearm with radiation anterior to the radiocapitellar joint as well as difficulty with shoulder forward flexion which the patient attributed to pain. A radiographic trauma series of the shoulder was negative for any visible abnormality. The forearm pain was described as a stabbing, constant pain worse with active elbow extension. He also reported an associated sharp, stabbing pain at night in the same location. He denied numbness in his forearm, wrist, or hand. Within 2 days of the onset of pain, the patient had significant difficulty with finger extension. He underwent hand therapy with his school athletic trainers without improvement in symptoms prior to evaluation by the authors. At initial clinical evaluation, neurological examination revealed complete palsy of the left extensor pollicis longus, extensor digitorum communis (EDC), and extensor carpi ulnaris. He

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**Figure 1.** Predecompression and postdecompression of the PIN. Illustrative (left) and surgical (middle) depictions of fasciculations with hourglass-like constriction found just distal to the PIN division from the main nerve trunk, adjacent to superficial branch of the radial nerve and ECRB branches. Neurolysis with release of the fascial band and resultant area of lucency indicating fascicular compression (right).



**Figure 2.** Recovery of wrist and finger extensor function. Left: Antigravity function of wrist index finger EDC and middle finger EDC at 13 weeks. Middle: Improved wrist extension, EPL and EDC of index and middle fingers with continued weakness of ring and little fingers at 18 weeks. Right: Complete return of wrist and finger extensor function at 28 weeks. EPL, extensor pollicis longus.

had tenderness distal and radial to the radiocapitellar joint. There was no sensory impairment. The patient underwent a series of tests 3 weeks after initial onset of symptoms that included magnetic resonance imaging, EMG and nerve conduction study, all of which were normal. Magnetic resonance imaging neurography was not available in our facility. Additionally, the patient and his family denied any family history of acute neuropathy. These tests were repeated 2 weeks later because of persistent symptomatology. All studies at both time points were unremarkable for any abnormality. Repeat physical examination revealed recovery of his concomitant shoulder pain over the course of 4 weeks with continued unchanged deficits in wrist extension. Despite normal physiologic testing, the clinical and neurological findings were consistent with PIN compression syndrome. Because no clinical improvement occurred with 5 weeks of conservative management, surgical neurolysis of the PIN was offered to the patient. After extensive discussion, both the patient and the family elected to proceed with surgical decompression of the radial tunnel and PIN release.

The patient underwent surgical intervention 5 weeks after symptom onset under general anesthesia. A tourniquet was applied and used on the upper extremity just before incision. An incision was made over the dorsal midline mobile wad musculature, full thickness flaps were elevated, and a stripe of inflamed

tissue was noted at the interval of EDC and extensor carpi radialis brevis (ECRB). The PIN was identified after careful dissection of this interval and mobilization of the supinator. The distal aspect of the supinator fascia was divided. The brachioradialis and extensor carpi radialis longus interval was then developed anteriorly, and the proximal radial nerve and PIN were further exposed. The fascia over the radial nerve was released proximally, and three divisions of the nerve were noted. The proximal aspect of ECRB and the Arcade of Frohse were released, and the supinator fascia over the PIN was divided until continuous with the distal dissection. No known potential areas of extrinsic compression (eg, well-developed leading edge of ECRB or Arcade of Frohse) were identified.

Upon examination of the nerve, we found an hourglass-like constriction proximal to the leading edge of the ECRB. There was no obvious external compressive structure and a translucent appearance to the nerve was noted within the area of focal narrowing. Given the intraoperative findings and relatively short course of symptoms, we elected to perform a neurolysis rather than an autograft or neurolysis. Gentle lysis of adhesive bands within the epineurium at the affected site was performed. Once the nerve was completely released, the nerve immediately regained volume and returned to its expected tone and opacity (Fig. 1).

The patient reported significant amelioration of pain in the immediate postoperative period; however, he experienced persistent PIN palsy at the 2-month clinical evaluation after neurolysis. Therefore, an EMG was obtained that demonstrated severe left PIN neuropathy with evidence of axon loss. The patient began to regain function of the EDC at 13 weeks after neurolysis. Strength evaluation at 18 weeks revealed Medical Research Council (MRC) grade 4 for EDC index finger, MRC 5 for EDC middle finger, MRC 3 for EDC ring finger, MRC 4 for EDC little finger, and MRC 3 for extensor pollicis longus without any pain or tenderness over the radial tunnel. Evaluation at 28 weeks after surgery revealed complete recovery (MRC 5) of all extensor motor function. The patient subsequently resumed all baseline sports and activities (Fig. 2). Written informed consent was obtained from the patient for publication of this case report and accompanying images.

## Discussion

This case describes a paralyzing hourglass-like constriction of the PIN that could not be attributed to extrinsic compression. Several cases of spontaneous PIN palsy have been reported, with patients similarly presenting with acute pain followed by flaccid paralysis of the affected muscles.<sup>4,5</sup> Reports of surgical exploration of patients from other authors also revealed an hourglass-shaped constricted segment of the PIN that was unrelated to any potentially compressive nearby structures.<sup>3–9</sup> The clinical features of our case are consistent with prior reports.

Many of these reports investigated the utility of preoperative imaging with ultrasound and preoperative EMG as methods to image the areas of constriction and to demonstrate described nerve study findings consistent with peripheral nerve compression.<sup>4,6</sup> Our case uniquely demonstrated no preoperative evidence of neuropathy on EMG, with the only evidence of PIN compression being found by EMG 8 weeks after neurolysis. We performed two separate preoperative magnetic resonance imaging scans that did not reveal hourglass-like constriction of the nerve, consistent with previous reports.<sup>5</sup>

Focal hourglass-like constrictions of a nerve have typically been described in the upper extremity, affecting the radial nerve and median nerve individually or concomitantly.<sup>7</sup> Constrictions of the PIN without an identified cause have typically been found between the trifurcation of the radial nerve (into superficial branch of the radial nerve, PIN, and ECRB branches) and the Arcade of Frohse.<sup>2</sup> In post-traumatic cases, a stretch injury may be responsible for lesions within the epineural and perineural tissue resulting in fibrosis.<sup>9</sup> In spontaneous lesions, inflammatory foci within the nerve and mechanical torsion because of rolling of the nerve and its fascicles during elbow and forearm motion may be the cause of this condition.<sup>9</sup> The previous literature has suggested a possible autoimmune etiology to these lesions, which could lead to a cascade of local inflammatory processes.<sup>2,4</sup>

The optimal time for surgical intervention has not yet been determined. One author recommended that exploration of the nerve be offered to patients who did not show any signs of recovery by 3 months after onset, whereas another author advocates for a longer course of conservative management.<sup>2,9</sup> In a series of spontaneous axillary nerve palsy, the authors supported surgical exploration as soon as the diagnosis of an isolated peripheral nerve palsy is made if no motor potentials are found on EMG readings or if worsening occurred on two successive EMG readings.<sup>10</sup> In our case, we operated within 6 weeks of pain onset, citing the persistent worsening of symptoms and negative physiologic testing and

imaging in the setting of a clear and consistent clinical picture. A different report on upper-extremity hourglass-like compression of peripheral nerves demonstrated response to surgical decompression when performed at a mean of nine months after symptom onset with recovery to full motor function MRC 5 occurring in only 40% of their patients.<sup>9</sup>

Limited data and guidelines exist regarding appropriate surgical management of focal neuropathies because of their low incidence. In progressive cases unresponsive to nonsurgical care, a range of surgical interventions have been performed including internal neurolysis, resection with neurorrhaphy, and resection with nerve grafting. Wu et al<sup>6</sup> based their intraoperative surgical decision making on patient age, delay in treatment, and the degree of thinning of the nerve, with older and more severe nerve constrictions requiring neurorrhaphy or autograft. Pan et al<sup>4</sup> demonstrated improved functional outcomes at 24 months with internal neurolysis versus conservative management for their cohort of several different upper-extremity peripheral nerves. In our case, we proceeded with internal neurolysis of the PIN with excellent results at 28 weeks after surgical intervention.

Our case demonstrates that early surgical exploration based on unequivocal clinical findings may be appropriate in the setting of normal preoperative testing and imaging in patients with spontaneous peripheral nerve palsy. In the case of an adolescent high-level athlete, patient-centered care with shared decision making, early intervention, and close follow-up may lead to superior return in motor function and pain relief.

## Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

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