HAND and MICROSURGERY

Case Report
Hand Microsurg 2022;11:111-115
doi:10.5455/handmicrosurg.43035

eJM eJManager OPEN ACCESS

Non-traumatic pediatric posterior interosseous nerve entrapment neuropathy

Emir Kütük, Waziri Juma Msangi, Eren Cansü

ABSTRACT

Posterior interosseous nerve entrapment neuropathies may occasionally occur in adults. Although it is seen in children, it is often thought to be related to trauma. In this article, we present a case of posterior interosseous nerve entrapment in the pediatric age group, which is not related to trauma. We operated on a 10-year-old patient with complaints that persisted for 1 month. We clearly saw and photographed the entrapment area during the surgery. We observed a significant improvement in our patient's symptoms and examination after surgical treatment. We presented the patient's pre- and post-operative examination images. We hope that this publication can be a guide for surgeons, since the information about the approach to pediatric patients is very limited in the literature.

Key words: *PIN, posterior interosseous nerve, entrapment, pediatric nerve, radial nerve*

Introduction

There are basically 3 causes of atraumatic posterior interosseous nerve (PIN) damage: entrapment neuropathy, Parsonage-Turner syndrome (PTS), and spontaneous "hourglass" constriction (SHGC) [1]. In this case report, we present the diagnosis and surgical treatment of a 10-year-old girl with PIN entrapment. We also describe the post-operative follow-up and recovery period.

Case Report

10-year-old girl was admitted with starting her right hand and wrist complaints of weakness and inability of finger extension approximately 1 month before. She had no complaints such as pain, numbness or paresthesia. The patient said that she had not had any recent trauma. When the patient was 5 years old, she was operated by us with closed reduction + percutaneous K-wire fixation for a right humerus supracondylar fracture after a fall. No sensory or motor deficits were detected in the preoperative and postoperative examination at that time. In her examination, it was found that she could not lift the thumb and other fingers of the right hand, and she could lift her wrist in radial deviation (Figure 1). Elbow extension, finger and wrist flexion were normal and sensory examination was normal.

Author affiliations : *Department of Orthopedics and Traumatology, Marmara University, School of Medicine, Istanbul, Turkey*
Correspondence : *Emir Kütük, MD, Department of Orthopedics and Traumatology, Marmara University, School of Medicine, Istanbul, Turkey*
e-mail: emirkutuk@live.com
Received / Accepted : *May 19, 2022 / August 12, 2022*

Figure 1. Preop images of the patient.

Electromyography (EMG) and ultrasonography (USG) were found to be compatible with acute entrapment of the radial nerve under the supinator muscle (Table 1). Exploration and nerve decompression was applied to the patient. It was entered between the extensor carpi radialis longus (ECRL) and the brachioradialis. It was determined that the posterior interosseous nerve (PIN) was hypertrophic in the proximal at the level where the extensor carpi radialis brevis (ECRB) muscle passed under, and showed a change in diameter and color (Figure 2). The areas that compress the supinator and ECRB muscles were loosened.

The patient's complaints were completely resolved in the postoperative 1st month (Figure 3). Finger extension returned to normal and muscle strength was found to be 5/5.

In our patient, it may be thought that the nerve was exposed to trauma due to the distal humerus fracture and related surgery, but the absence of nerve damage at the time of the fracture and the 5-year postoperative period without complaints kept us away from this probability. In addition, the fact that the complaints are only related to PIN damage indicates that the entrapment is in an area distal to the elbow.

Basically, two classifications for PIN entrapment are defined as Ochi [2] and Wu [3]. Among these clas-

Table 1. EMG results performed in our physical therapy clinic.

Motor Nerve	**Lat SD [ms]**	**Amp SD [mV]**	**CV SD [m/s]**	**Amp% SD [%]**
Right Median				
Wrist – APB	3.7	10.8		
Bel Elb - Wrist	7.2	9.0	51.4	-16
Left Median				
Wrist – APB	3.1	12.7		
Bel Elb - Wrist	6.5	11.7	55.9	-8
Right Ulnar				
Wrist – ADM	2.4	13.9		
Be Elb – Wrist	5.9	13.6	58.0	-2
Ab Elb – Be Elb	5.8	13.6	66.7	-0
Left Ulnar				
Wrist – ADM	2.2	16.4		
Be Elb – Wrist	4.8	16.2	59.6	-1
Ab Elb – Be Elb	5.8	16.0	60.0	-1
Sensory Nerve	**Lat SD [ms]**	**Amp SD [mV]**	**CV SD [m/s]**	**Amp% SD [%]**
Right Median				
Dig III - Wrist	3.5 / 1.5	20	52	
Left Median				
Dig III – Wrist	3.2 / 0.8	52	58.3	
Left Ulnar				
Dig V – Wrist	2.6 / -0.4	38	60.1	
Left Ulnar				
Dig V – Wrist	2.5 / -0.7	41	58.5	
Right Radial				
IOD 1 – Forearm	1.85	31	59.3	
Left Radial				
IOD 1 – Forearm	2.0	21	65.2	
Muscle Innervation	**Fib**	**PSW**	**Amp**	**Recruit**
Right ext indicis				
Radialis, C7 C8)	++	++		
Right interosseous dors I				
(Ulna ramus prof, C8 T1)	0	0	Normal	Normal
Right ext carpi rad long				
(Ulna ramus prof, C8 T1)	0	0	Normal	Normal
Right abd dig min (man)				
(Ulna ramus prof, C8 T1)	0	0	Normal	Normal
Right abd pollicis brev				
(Medianus, C8-T1)	0	0	Normal	Normal
Conclusion: It is consistent with total axonal injury of the right radial nerve at the elbow level.				

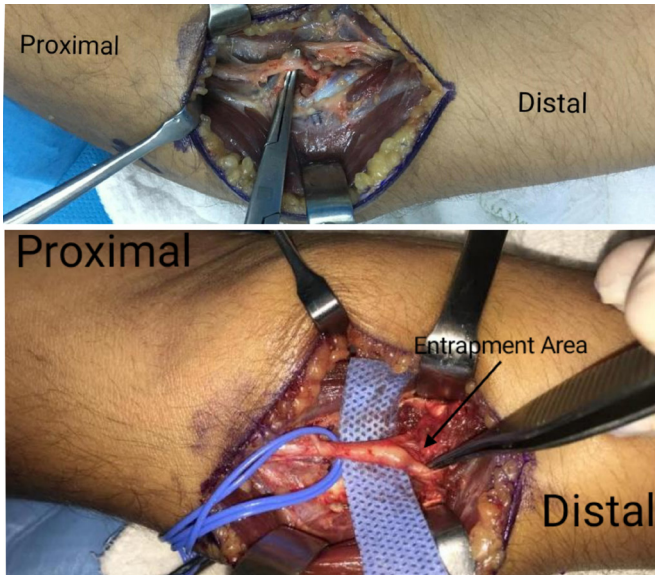

Figure 2. In the photographs taken during the operation, it is seen that the PIN is edematous in the proximal part of the compression.

Figure 3. Photos taken in the 1st month after the operation.

sifications made using USG, the Wu classification is simpler and divides the fascicular constriction defined by Ochi (Type 2) into mild, moderate and severe forms.

1. The Ochi classification
2. The Wu classification

- Mild: Ochi Type II with < 25% fascicular thinning
- Moderate: Ochi Type II with 25%-75% fascicular thinning
- Severe: Ochi Type II with >75% fascicular thinning

We evaluated our case as modarete in the Wu classification.

Discussion

Examination is extremely important for diagnosing patients with PIN damage. Since the ECRL muscle is usually innervated before the radial nerve divides into its deep and superficial branches, the typical appearance of PIN paralysis consists of radial deviation in wrist extension due to preserved ECRL and sometimes ECRB, as well as limitation in finger and thumb extension (Figure 1). The PIN is a pure motor nerve, the terminal branch of the radial nerve. Therefore, sensory loss is not expected in patients with PIN damage. In PIN injuries, the muscles innervated by this nerve may be affected to varying degrees. Also, PIN damage can be confused with radial tunnel syndrome (RTS). Since the PIN is a pure motor nerve, patients with PIN damage will g o to hospital without any sensory complaints, whereas patients with RTS have sensory complaints. The incidence of PIN entrapment is 10 times higher than that of RTS (0.03–0.003) [4].

The most likely entrapment zones for the PIN are:

- Under the edge of extensor carpi radialis brevis
- Leash of Henry (Vascular collar)
- Arcade of Frohse(Edge of supinator muscle)
- Within the supinator muscle itself
- Between the two heads of supinator muscle

The Arcade of Frohse is mainly to blame for PIN entrapment. According to a study by Thomas SJ et al. in 2000, it was stated that 32% of cadavers had tendinous changes in the supinator muscle and there might be anatomical predisposition to PIN entrapment [5]. In addition, Hashizume H. et al. in 1996, they published a series of 31 cases, the youngest of whom was 17 years old, all with non-traumatic PIN injury. In 14 patients, entrapment was detected in the supinator muscle region. Other patients have diagnoses such as lipoma, ganglion, radial head dislocation. It was reported that complaints regressed in 24 out of 25 patients treated surgically, while complaints regressed in 5 out of 6 patients treated conservatively [6].

There is no clear explanation for the outcome dif-

ferences generated by nonsurgical management of atraumatic PIN palsy between adults and youths. Since atraumatic PIN entrapment is extremely rare in children, there is insufficient literature to compare the radial nerve between pediatric and adult patients. Overall, the prognosis is excellent in the pediatric patient group with isolated radial nerve palsy, with spontaneous complete recovery in most neonates in 5–6 months (6–8 weeks on average) [7,8]. There is a publication comparing ulnar nerve entrapment in children and adults, although it does not indicate atraumatic PIN injury. Simple decompression of the ulnar nerve at the elbow also has much higher rates of failure in children than in adults [7].

Trauma is an important etiological factor. According to a study by Tomaszewski R. et al in 2000, 220 patients with supracondylar humerus fractures, neurovascular complications were found in 16.81% (22 children) of patients with displaced fractures. The most injured nerve was the median nerve with 68.18% (15 children). While this was followed by the ulnar nerve with 27%, 5% of the patients (1 child) were the radial nerve. Therefore, we can say that PIN damage is not in the first two places in supracondylar fractures[9].

There are also atraumatic cases. There are basically 3 causes of atraumatic PIN damage: entrapment neuropathy, Parsonage-Turner syndrome (PTS), and spontaneous "hourglass" constriction (SHGC) [1]. MRI, USG, and EMG can also be used to aid diagnosis. The course of PIN is well defined in the literature. In PIN entrapment, the status of PIN can be seen through MRI, especially in the supinator muscle area, and it can help the diagnosis. In EMG, especially in advanced cases, prolonged motor potential or motor block can be seen in the muscles innervated by the PIN. Also, comparing the nerve diameter to that of the healthy side using USG may be helpful in diagnosis. In our case, as can be seen in the operation photos, there was a significant increase in the diameter of the PIN.

Escolar DM et al published the results of 16 children patients (between 6-17 age) with isolated radial nerve palsy, with a mean follow-up of 16.5 years by EMG; 8 (50%) of these radial neuropathies were atraumatic. EMG documented radial neuropathy localized to the proximal main radial nerve trunk in 2 cases (13%), the distal main radial nerve trunk in 9 (56%), and the PIN in 5 (31%). Only one of the 5 patients with PIN damage was atraumatic. It was due to sclerotherapy for blue nevus and was progressive. The patient was followed up without surgery. They dedected a marked resistance to needle insertion suggests fibrosis that may impair reinnervation. Significant improvement was noted in 13 of 16 radial neuropathies within 6–12 weeks for demyelinating lesions and up to 17 months for axonal injuries. They say that, rarely, exploration may be required for a child with chronic progressive radial neuropathy or post-fracture radial neuropathy that does not improve at 3 months [8].

Investigation of etiological causes and treatment are also important in patients with PIN palsy. If the correct diagnosis is made, success can be achieved with medical treatment. A case of C.jejuni-associated neuropathy resolved due to successful medical treatment of the underlying cause [10].

Treatment should be well decided. Despite our limited experience in this case, we recommend surgery to patients with obvious compression findings after 1 months.

Conflict of interest statement

The authors have no conflicts of interest to declare.

References

1. Sigamoney KV, Rashid A, Ng CY. Management of Atraumatic Posterior Interosseous Nerve Palsy. J Hand Surg Am 2017;42:826-30.
2. Ochi K, Horiuchi Y, Tazaki K, Takayama S, Nakamura T, Ikegami H, et al. Surgical treatment of spontaneous posterior interosseous nerve palsy: a retrospective study of 50 cases. J Bone Joint Surg Br 2011;93:217-22.
3. Wu P, Yang JY, Chen L, Yu C. Surgical and conservative treatments of complete spontaneous poste-

rior interosseous nerve palsy with hourglass-like fascicular constrictions: a retrospective study of 41 cases. Neurosurgery 2014;75:250-7.
4. Moradi A, Ebrahimzadeh MH, Jupiter JB. Radial Tunnel Syndrome, Diagnostic and Treatment Dilemma. Arch Bone Jt Surg 2015;3:156-62.
5. Thomas SJ, Yakin DE, Parry BR, Lubahn JD. The anatomical relationship between the posterior interosseous nerve and the supinator muscle. J Hand Surg Am 2000;25:936-41.
6. Hashizume H, Nishida K, Nanba Y, Shigeyama Y, Inoue H, Morito Y. Non-traumatic paralysis of the posterior interosseous nerve. J Bone Joint Surg Br 1996;78:771-6.
7. Costales JR, Socolovsky M, Sánchez Lázaro JA, Costales DR. Peripheral nerve injuries in the pediatric population: a review of the literature. Part II: entrapment neuropathies. Childs Nerv Syst 2019;35:37-45.
8. Escolar DM, Jones HR Jr. Pediatric radial mononeuropathies: a clinical and electromyographic study of sixteen children with review of the literature. Muscle Nerve 1996;19:876-83.
9. Tomaszewski R, Wozowicz A, Wysocka-Wojakiewicz P. Analysis of Early Neurovascular Complications of Pediatric Supracondylar Humerus Fractures: A Long-Term Observation. Biomed Res Int 2017;2017:2803790.
10. Kuwabara S, Misawa S, Sakamoto S, Hattori T. Isolated posterior interosseous nerve palsy subsequent to Campylobacter jejuni enteritis. Eur Neurol 2004;52:63-4.