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Radial Nerve Palsy at the Elbow

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Abstract

We studied the clinical features and images along with surgical findings of 8 cages of radial nerve palsy due to a space-occupying lesion (SOL) at the elbow. Based on image findings, we examined compressing masses and their extent, we contrasted them with operative findings of the radial nerve, and we surmised the site of impairment. Compressing masses were ganglions in 6 cages, an old radial head dislocation in 1 case, and engorged radial recurrent vessels in 1 case. The extent of the SOLs was roughly 15–40 mm from the interepicondylar line and 0–30 mm from the radiohumeral joint. In operative findings, only the posterior interosseous nerve (PIN) was compressed in 5 cases, while both the PIN and superficial branch were compressed in 3 cases. No apparent correlation between operative findings and the type of palsy was found. The radial tunnel has yet to be defined clearly, but the radial nerve palsy is readily understandable in cases of SOLs via the definition of the radial tunnel as the tubular structure from the radiohumeral joint to the outlet of the supinator muscle.

Introduction

The posterior interosseous nerve (PIN) innervates the extensor digitorum communis (EDC), extensor digiti minimi (EDM), extensor carpi ulnaris (ECU), abductor pollicis longus (APL), extensor pollicis longus and brevis (EPL and EPB), and extensor indices proprius (EIP). When palsy results, wrist extension is possible, but it deviates radially and prohibits extension of the thumb and extension of the MP joints from the index to the little finger, exhibiting "drop finger." With radial nerve palsy due to SOL at the elbow, there are cases of PIN palsy as well as palsy of the superficial radial nerve. In addition, disorders featuring intense pain because of entrapment of the PIN have also been reported to differentiate it from lateral humeral epicondylitis[1)2)]. We studied the clinical features and images along with surgical findings in cases of radial nerve palsy due to SOL of the elbow. This work clarified the site of impairment and provided a differential diagnosis while also mentioning the anatomical position of the radial tunnel and its significance.

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Table 1. Overview of cases

Case	Sex	Age	Side	Surgery
1	M	50	R	Neurolysis + Tendon Transfer
2	F	31	R	Neurolysis + Tumor Removal
3	M	61	L	Neurolysis + Tumor Removal
4	F	32	R	Neurolysis + Tumor Removal
5	M	45	R	Neurolysis + Tumor Removal
6	M	43	L	Neurolysis + Tumor Removal
7	M	58	L	Neurolysis + Tumor Removal
8	F	66	R	Neurolysis + Tumor Removal

Materials and Methods

Materials were 8 cases seen by our hospital and affiliated hospitals over a 14-year period from January 1990 to December 2003; in these cases, surgery was performed for radial nerve palsy due to SOL of the elbow (Table 1). Cases included 5 males and 3 females; age upon initial examination was 31–66 years of age (mean 48 years of age). The affected side was the right in 5 cases and the left in 3. Of the 8 total cases, a nerve conduction study was performed on 3 cases; the amplitude of the compound muscle action potential of the EDC decreased with stimulation proximal to the site of impairment in 2 cases, and a conduction delay was seen in 1 case. Neurolysis and removal of compressing masses along with release at the arcade of Fröhse were performed in 7 cases; in the case with an old radial head dislocation, only neurolysis and release at the arcade of Fröhse were performed. Cases which hour-glass like fascicular constriction in the nerve were excluded in this study. In 1 case, tendon transfer was added. The symptoms preceding palsy and type of palsy (Hirayama classification[3]), presence/absence of dyskinesia and paresthesia)

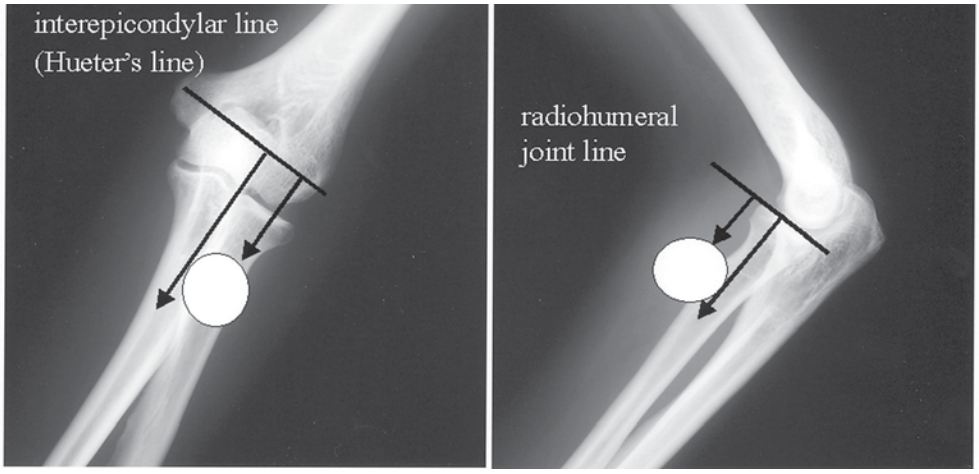

Figure 1. Method of measuring the extent of SOL (mm). The area proximal to the line is negative.

Table 2. Compressing masses, symptoms, and type of palsy. PIN: posterior interosseous nerve, SRN: superficial radial nerve

Case	Cause of palsy	Initial symptom	Type of nerve palsy
1	Dislocation of radial head	None	drop finger & thumb, PIN
2	Ganglion	Heaviness of the elbow	drop finger & thumb, PIN
3	Ganglion	None	drop finger & thumb, PIN
4	Ganglion	Heavinell of the elbow	drop finger & thumb, PIN + SRN
5	Ganglion	None	drop finger & thumb, PIN
6	Ganglion	None	drop finger & thumb, PIN
7	Ganglion	Heaviness of the elbow	drop finger & thumb, PIN
8	Venous plexus	None	drop finger & thumb, PIN

in these cases were studied. In addition, compressing masses and their extent were examined based on image findings. Measurement used the distance from the interepicondylar line (Hueter's line) and the distance from the radiohumeral joint (Fig. l). This was contrasted with operative findings for the radial nerve and the lesion was surmised.

Results

Compressing masses were ganglions in 6 cases, an old radial head dislocation in 1 case, and engorged radial recurrent vessels in 1 case. Symptoms preceding palsy were heaviness of the elbow in 3 cases and awareness of a mass in 2 cases. No cases complained of neck pain, pain similar to lateral humeral epicondylitis, fever, or cold symptoms. The tyre of palsy was type I (drop finger & thumb) in the Hirayama classification in all cases. In 7 cases isolated PIN palsy was noted, in addition to palsy of the superficial radial nerve noted in 1 case (Table 2).

The extent of SOL and operative findings was roughly 15–40 mm from the interepicondylar line and 0–30 mm from the radiohumeral joint, as shown in Table 3.

Table 3. Extent (mm) and operative findings

Case	Distance from the interepicondylar line (Hueter's line)	Distance from the radiohumeral joint line	Perioperative findings (compression site)
1	16–27	0–11	PIN, SRN
2	16–38	0–22	PIN
3	5.7–44	0–29	PIN
4	15–44	0–30	PIN, SRN
5	40–55	15–30	PIN
6	26–40	12–24	PIN
7	17–30	–5.0–25	PIN, SRN
8	17–30	5.0–25	PIN

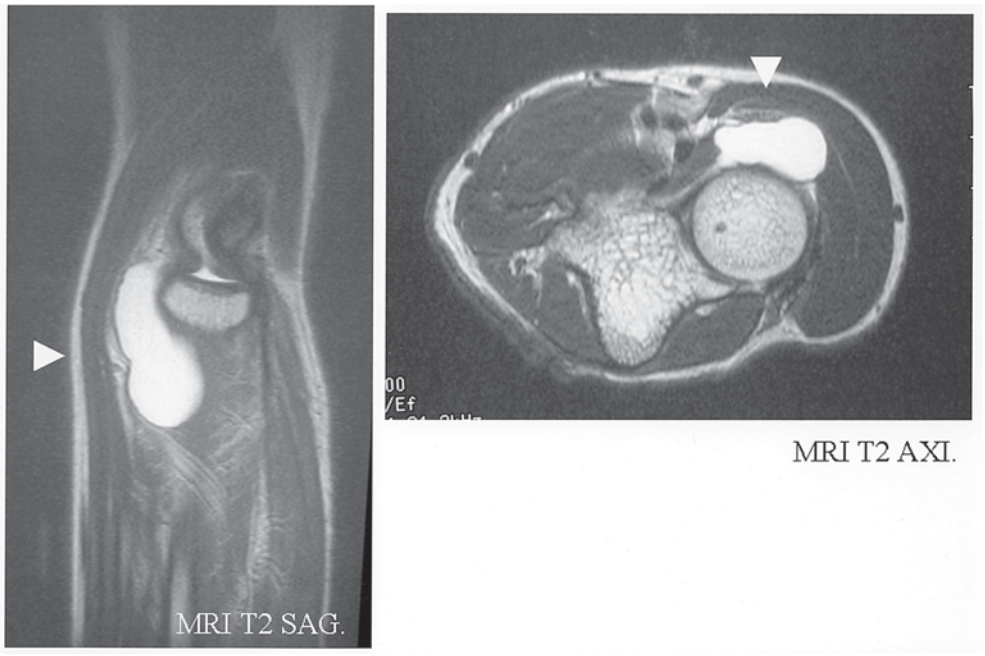

Figure 2. Case 7.
A 58-year-old man was seen when he noted drop finger on the left hand. There was a 2:P decline in muscular strength in the ECU, EDC, and EPL. There was no paresthesia. In MRT2 weighted images, a bilobular, hyperintense area (△) was seen distal to the radiohumeral joint. Surgery was neurolysis and tumor removal along with release at the arcade of Fröhse. The mass was a ganglion. Postoperatively, muscular strength improved to 4:G.

In operative findings, only the PIN was compressed in 5 cases while both the PIN and superficial branch were compressed in 3 cases (Table 3). No apparent correlation between operative findings and the type of palsy was found. A typical case is shown in Fig. 2.

Discussion

Orthopedic disorders causing drop finger include, in addition to PIN palsy, cervical myelopathy (radiculopathy) and extensor tendon rupture. In our cases, some were misdiagnosed upon initial visit. Examination of the patient's medical history such as neck pain is fundamental when differentiating PIN palsy from cervical disorders, and assessment of deep tendon reflex and paresthesia, particularly in a manual muscle test is critical. In addition, differentiation from extensor tendon rupture can be assessed by dynamic tenodesis. In some cases of rheumatoid arthritis, assessment of range of motion is difficult due to wrist joint deformity; differentiating from PIN palsy due to synovial cyst at the elbow is more difficult[4]. A needle EMG is useful in such cases. Diagnosis of cases complicated with cervical lesions and PIN palsy

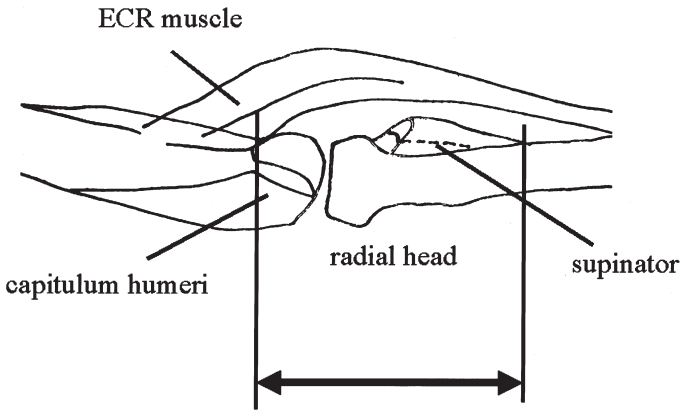

Figure 3. Radial tunnel.

is considered difficult. In the cases of greater decline in muscular strength and muscular atrophy in muscles innervated by the PIN, confirrning repeated use of the upper limbs preceding palsy and a history of sharp pain in the elbow, looking for a mass in the radial head and a Tinel's sign, and performing an electrophysiological study are necessary.

The radial nerve branches into the motor branch (PIN, deep branch) and sensory branch (superficial branch) at the elbow. Konjengbam et al.[5] stated that based on anatomical findings the region of bifurcation is an average of 8.93 mm distal to the interepicondylar line and an average of 8.47 mm proximal to the radiohumeral joint. The extent of SOL in our cases was roughly 15–40 mm and 0–30 mm, respectively, so damage is likely to have been received beyond the region of bifurcation. In operative findings, compression of both the deep and superficial branches was seen in 3 cases although paresthesia was noted in only 1 of the 8 cases. The cause for this is thought to be because compression from the SOL was intensified since the PIN was fixed by the arcade of Frohse[6]. Ogino et al.[7] stated that the force of extension on the PIN through pro-supination of the forearm may be associated with palsy, although none of our cases complained of exacerbated palsy accompanying forearm movement.

Radial tunnel syndrome is reported as a PIN disorder that causes intense neuralgia but exhibits no palsy[1)2)]. In our cases of radial nerve palsy due to SOL, 3 cases complained of heaviness and discomfort of the elbow but no cases complained of chronic pain. The authors previously reported a case of surgery for radial nerve entrapment with synovial osteochondromatosis[8)]. This case was compared to surgical findings for the current 8 cases, but differences in pathology were not noted. Although the nerve compression was the same, pathology in some cases exhibited palsy while it caused only pain in others. Elucidation of this pathology is a topic for the future.

The inlet of the supinator muscle, known as the arcade of Fröhse, is a site where the PIN is readily compressed. There are views that this site is the radial tunnel, although Lister et al.1) and Roles et al.[2)] have described the tubular structure from the radiohumeral joint to the outlet of the supinator muscle as the radial tunnel. We

also propose defining the radial tunnel that they cited as a site prone to radial nerve palsy. This site is a fibrous-osseous canal consisting of muscle, tendons, ligaments, the articular capsule, and the radial head. Similar to carpal tunnel, the appearance of palsy is understandable in cases of pinching at the arcade of Fröhse as well as SOLs (Fig. 3).

Conclusions

1. The clinical features and images along with surgical findings of 8 cases of radial nerve palsy due to SOL of the elbow were studied and their characteristics and differential diagnosis described.
2. No apparent correlation between extent of SOL and the type of palsy was found.
3. The radial tunnel was defined as the tubular structure from the radiohumeral joint to the outlet of the supinator muscle.

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