Arch. Jap. Chir., 46 (1), 38～45, Jan., 1977

臨　　床

Palsy of the Flexor Pollicis Longus and the Flexor Digitorum Profundus to the Index Finger Resembling Anterior Interosseous Nerve Syndrome

YOSHIAKI YANASE, YASUO UEBA, KIYOSHI YAMAMOTO and YASUAKI SUDO

Department of Orthopaedic Surgery, Faculty of Medicine, Kyoto University
(Director: Prof. Dr. TETSUO ITO)

Received for Publication Nov. 20, 1976

Spontaneous paralysis of the muscles innervated by the anterior interosseous nerve is comparatively rare condition. Attention to the anterior interosseous nerve syndrome was first focused by Kiloh and Nevin in 1952, as an isolated neuritis of this major branch of the median nerve. The most cases reported in the past were attributed to the mechanical compression to the anterior interosseous nerve by the following means (Spinner, 1972) :

1) A tendinous origin of the deep head of the pronator teres.
2) A tendinous origin of the flexor sublimis.
3) A thrombosis of crossing ulnar collateral vessels.
4) An accessory muscle and tendon from the flexor sublimis to the flexor pollicis longus.
5) An accessory head of the flexor pollicis longus.
6) An aberrant radial artery.
7) A tendinous origin of a variant muscle, the palmalis profundus.
8) An enlarged bicipital bursa encroaching on the the median nerve near the region of the origin of the anterior interosseous nerve.

But specific mechanical compression is not always observed in the case presenting anterior interosseous nerve syndrome, and the definite cause is not entirely clear yet.

We report here an additional four cases of resembling this syndrome. The characteristics of comparable cases previously reported were reviewed and discussed.

Case Reports

Case 1

A man aged sixty-one was referred here because of loss of distal flexion power of the left thumb and index finger on February 1, 1975. One month before the onset of the paralysis, the patient had awakened with severe radiating pain starting from the upper arm

Key words : Nerve Palsy, Anterior Interosseous Nerve Syndrome, Palsy of the Flexor Pollicis longus, Neuralgic Amyotrophy

Present Address : Department of Orthopaedic Surgery, Faculty of Medicine, Kyoto University, Sakyo-ku, Kyoto, Japan. 〒 606

to the forearm (August 9, 1974). The pain lasted for three days and then disappeared. The dullness of the forearm was increased with arm motion and extension of the elbow joint but was unrelated to movement of the neck, shoulder or wrist.

On the examination six months after the onset, the flexor polllicis longus and the flexor digitorum profundus to the index finger were paralysed (Fig. 1). There was also a trace of weakness in pronation of the right forearm. EMG testing demonstrated low-amplitude potentials in the radial portion of the flexor digitorum profundus and pronator teres ; slowing in median nerve conduction velocity (56.5m/sec.) was also present at the site. The remainder of the neurological examination was normal. Routine laboratory studies, including sedimentation rate and serum creatine phosphokinase determinations, showed normal findings. Roentgenograms of the cervical spine and the cerebro-spinal fluid were normal.

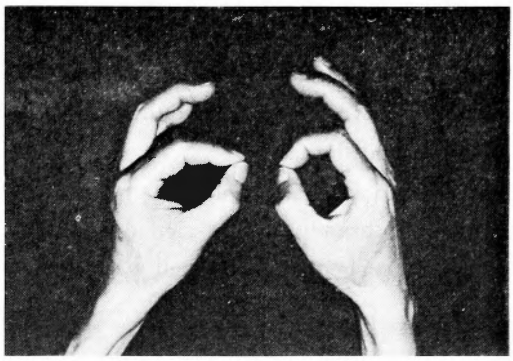

Fig. 1. Case

Surgical exploration of the left median nerve and its anterior interosseous branch was carried out on April 11, 1975. No mechanical compression was discovered (Fig. 2). Muscle biopsy of the pronator teres, flexor pollicis longus, pronator quadratus and flexor carpi ulnaris was carried out. Then four flexor digitorum profundus tendons were sutured together side to side.

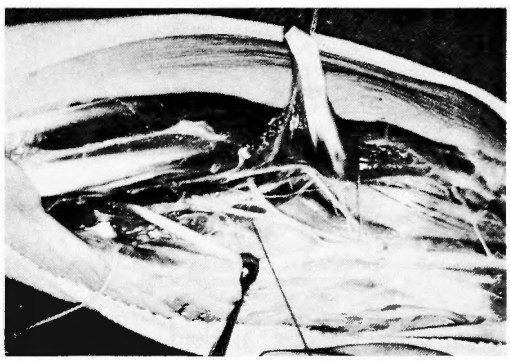

Fig. 2.

The specimen of the pronator teres, flexor pollicis longus and pronator quadratus had typical neurogenic muscle atrophy (Fig. 3), but the flexor carpi ulnaris showed no remarkable change. Six months postoperatively, the patient revealed good return of function in both digits.

Case 2

A woman aged forty-two noted sudden pain in the left cubital region. Shortly thereafter, she was unable to flex the thumb and the index finger. She had no paraesthesia or numbness in the arm and hand though subsequently she developed dull pain in the forearm when she pronated the arm. She

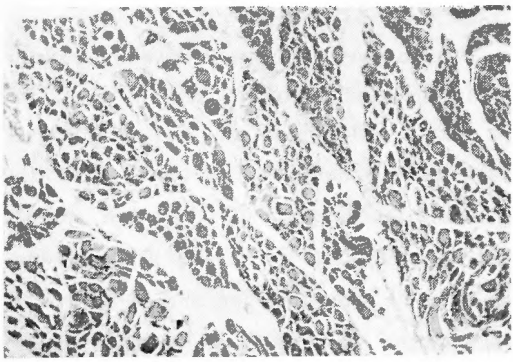

Fig. 3.

was treated conservatively with heat, rest and drugs. The weakness in grasping with the thumb and the index finger persisted, even after the pain disappeared. As there were no signs of clinical improvement after six months, she was admitted to the hospital.

Examination showed paralysis of the flexor pollicis longus and flexor digitorum profundus to the index finger and weakness of pronation (Fig. 4).

There was no sensory impairment and in all other respects the nervous system was normal. The serum Wasserman reaction and the other laboratory examination were all within normal limits.

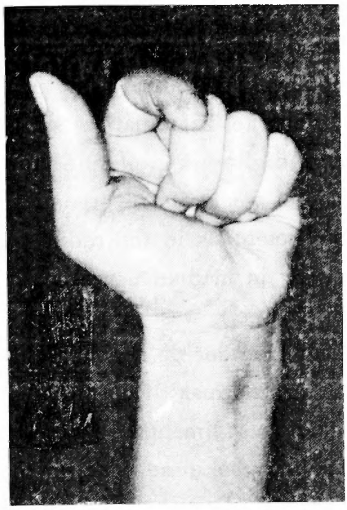

Fig. 4. Case

Exploration of the median nerve and its anterior interosseous branch was carried out on March 28, 1972. Although no specific abnormality was identified on the median nerve and its anterior interosseous branch to account for the paralysis, the color of the muscle bellys of the pronator teres, palmaris longus and flexor pollicis longus was whitish (Fig. 5). The sublimis tendon of the ring finger was transferred to the flexor pollicis longus to restore the thumb flexion, and the flexor digitorum profundus tendons were sutured together by side-to-side anastomosis.

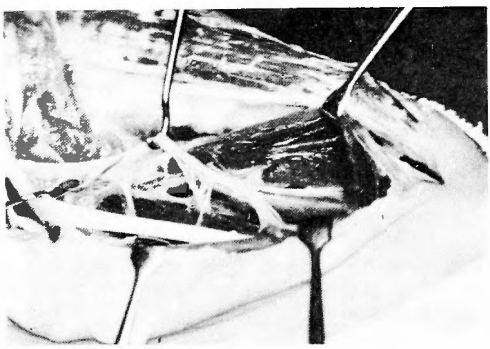

Fig. 5.

A biopsy of the flexor pollicis longus and pronator teres revealed marked variation in fiber diameter and marked increase of endomysial and perimysial connective tissue, indicating myogenic muscle atrophy. One year after operation, she demonstrated good return of function in both digits.

Case 3

A man aged twenty-six developed sudden pain in the cubital region and inability to extend the right elbow joint while using exercise bar. Next day he noted that he could not flex the IP joint of the right thumb. A provisional diagnosis of tendovaginitis of the flexor pollicis longus was made, and the MP joint of the right thumb was explored elsewhere on January 23, 1969 but no abnormality was found in or around the flexor pollicis longus tendon. The initial examination at our clinic on January, 23, 1970 revealed weakness of thumb flexion and weak pronation of the forearm. Flexion power of the DIP joints of the right index and middle finger was weaker than the left.

Surgical exploration of the right median nerve and its anterior interosseous branch

was carried out from the elbow distally on January 27, 1970. The anterior interosseous branch bifurcated approximately 5 cm distal to the medial epicondyle of the humerus. There was mild scarring and redness of the median nerve at the site of bifurcation of the anterior interosseous branch where the median nerve dipped beneath the pronator teres. No constricting fibrous band was found at the point where the median nerve and the anterior interosseous branch dipped beneath the flexor digitorum sublimis. The median nerve and its branch were dissected proximally and distally to ensure no other constrictions to the nerves. The four flexor digitorum profundus tendons were sutured together side-to-side. The palmaris longus tendon was tranferred to the flexor pollicis longus tendon in the distal forearm. Seven months later, flexion power of the IP jonnt of the thumb and DIP jont of the index and middle finger were improved.

Case 4

A man aged eighteen was referred to us because of loss of distal flexion power of the right thumb and index finger. He noted stiffness in the right arm after playing catchball. The symptoms lasted 10 days and then cleared, but shortly thereafter he became unable to flex the IP joint of the thumb and then the DIP joint of the index finger. On examination one month after the onset, the flexor pollicis longus, flexor digitorum profundus to the index finger and pronator quadratus were paralysed. There was no sensory loss, and other the neurological examinations were normal. Five months from the time of the onset, the patient noted improvement in the strength of both thumb and index finger without any treatment. Manual muscle testing showed recovery to the grade 4 in the flexor digitorum profundus to the index finger and to the grade 3 in the flexor pollicis longus.

Discussion

PARSONAGE and TURNER (1948) described 136 cases of neuralgic amyotrophy involving the shoulder girdle. Six involved the thumb and index finger. In one of them, the paralysis was limited to those fingers. KILOH and NEVIN (1952) described two cases of acute "interstitial neuritis of the interosseous nerve", one complete and the other affecting the branch to the flexor pollicis longus. Spontaneous recovery began in both cases a year after the onset.

Table 1 summarizes the pertinent clinical figures ot 53 previously reported cases and the present four. Surgical exploration of the median nerve and its anterior interosseous branch was performed on 29 of the 57 patients ; among them a fibrous band was found in 16, myogenic atrophy in 2, median nerve neuritis in 1, median nerve neuroma in 3 and adhesion in 1. No abnormality was found in 6, and three of them recovered spontaneously. Twenty-two patients did not undergo surgical exploration of the median nerve. Nineteen of these conservatively treated patients improved or recovered completely. The patients underwent tendon transfers because of persistent paralysis.

It has become increasingly apparent that isolated paralysis of the anterior interosseous

Table 1. Summary of clinical figures of anterior interosseous nerve syndrome

Author	Age	sex	Proximate Cause	Pain	Involved Muscles	Surgical Findings	Prognosis
Parsonage, M.J. et al. (1948)	?	?	spontaneous	+	FPL, FDP (I)	no surgery	?
Kiloh, L.G. et al. (1952)	52	M	spontaneous	+	FPL, FDP (I II)	no surgery	recovered
	28	M	spontaneous	+	FPL	no surgery	recovered
Thomas, D.F. (1962)	?	?	contusion		FPL, FDP (I), PQ	no surgery	recovered
	?	?	spontaneous	−	FPL	no surgery	recovered
Warren, J.D. (1963)	20	M	fracture		FPL, FDP (I)	no surgery	recovered
	69	F	fracture		FPL, FDP (I)	no surgery	recovered
D'A Fearn, C.B. et al. (1965)	9	M	spontaneous	+	FPL, FDP (I II)	fibrous band	recovered
Stern, M.B. et al. (1967)	30	M	contusion	+	FPL, FDP (I)	fibrous band	recovered
Tajima, T, et al. (1967)	28	F	spontaneous	+	FPL, FDP (I)	myogenic atrophy	recovered
	39	M	spontaneous	+	FPL	tendon transfer	functioning
	40	F	spontaneous	−	FPL, FDP (I)	tendon transfer	functioning
Vichare, N.A. (1968)	50	M	spontaneous		FPL, FDP (I), PQ	fibrous band	recovered
	48	F	spontaneous		FPL, FDP (I)	no findings	recovered
	43	M	spontaneous	+	FPL, FDP (I), PQ	tendinous band	recovered
	60	M	fall	+	FPL, FDP (I), PQ	fibrous band	recovered
Sharrad, W.J.W. (1968)	42	M	sudden extension of the elbow joint	+	FPL, FDP (I)	fibrous band	recovered
Farber, J.S. et al. (1968)	20	M	spontaneous	+	FPL, FDP (I), PQ	no surgery	mod. improved
	45	M	plaster cast		FPL, FDP (I), PQ	no surgery	mod. improved
Yoshimatsu, S. et al. (1968)	43	M	Monteggia fracture		FPL, FDP (I)	no entrapment	recovered
	48	M	spontaneous	+	FPL, FDP (I)	no surgery	recovered
Kojima, T. et al. (1968)	47	F	spontaneous	−	FPL, FDP (I)	fibrous band	recovered
	57	F	spontaneous	−	FPL, FDP (I)	sublimis edge	improved
	54	F	spontaneous	+	FPL, FDP (I)	sublimis edge	improved
	22	F	spontaneous	+	FPL, FDP (I)	no surgery	recovered
	34	M	spontaneous	−	FPL, FDP (I)	fibrous band	recovered
	20	M	spontaneous	?	FPL, FDP (I)	fibrous band	recovered
Mills, R.H. (1969)	40	F	spontaneous	+	FPL, FDP (I)	musculo-fibrous band	recovered
Matsuzaki, A. et al. (1969)	26	M	spontaneous	+	FPL, FDP (I)	no findings tendon transfer	FDP : recovered
	56	F	fracture	+	FPL, FDP (I)	neuritis	?
	30	F	spontaneous	+	FPL, FDP (I)	no surgery	?
Spinner, M. et al. (1996)	8	M	fracture	−	FPL, FDP (I)	no findings	recovered
	4	M	fracture	−	FPL, FDP (I), PQ	open reduction	recovered
	other 4 cases ; Details unknown						
Spinner, M. et al. (1970)	24	F	heavy lifting	+	FPL	tendon transfer	functioning
	13	M	lifting	+	FPL, FDP (I), PQ	fibrous band	recovered
	27	M	small laceration		FPL, FDP (I), PQ	md.nerve neuroma tendon transfer	functioning
	33	M	contusion	?	FPL, FDP (I), PQ	thrombosed vessel	recovered
	24	M	bending pipe	+	FPL, FDP (I), PQ	no surgery	mod. improved
	28	M	spontaneous		FPL, FDP (I)	no surgery	recovered
	58	F	pressure on forearm	+	FPL, FDP (I)	no surgery	recovered
	22	M	spontaneous		FPL, FDP (I)	no surgery	recovered
	18	F	fracture	+	FPL	tendon transfer	functioning
	46	M	fracture	+	FPL	tendon transfer	functioning

Schmidt, H.	60	F	spontaneous	+	FPL, FDP (I)	fibrous band	recovered
et al. (1971)	40	F	spontaneous	−	FPL, FDP (I)	fibrous band	recovered
O' Brien, M.D. et al. (1972)	23	M	spontaneous	−	FPL, FDP (I, II)	no surgery	?
Hamabuchi, M. et al. (1973)	47	M	spontaneous	+	FPL, FDP (I)	fibrous band	recovered
Maeda, K.	76	F	catheterization	−	FPL, FDP (I, II)	no surgery	recovered
et al. (1973)	70	M	contusion	−	FPL, FDP (I)	pseudoneuroma	recovered
Smith, B.H. (1974)	22	F	spontaneous	+	FPL, FDP (I)	no surgery	improved
Lake, P.A.	37	F	spontaneous	+	FPL, FDP (I). PQ	no findings	recovered
(1974)	33	F	spontaneous	−	FPL, FDP (I)	no surgery	recovered
	57	F	catheterization	+	FPL, FDP (I, II)	no surgery	imporoved
Yanase, Y.	61	M	spontaneous	+	FPL, FDP (I), PQ	no findings	functioning
et al. (1976)	42	F	spontaneous	+	FPL, FDP (I)	no findings (myogenic atrophy)	functioning
	26	M	extend elbw	+	FPL, FDP (I), PQ	mild scarring	functioning
	18	M	catch ball	+	FPL, FDP (I), PQ	no surgery	mod. recovered

nerve may be due to compression or injuries of various other kinds such as closed fractures of the forearm, penetrating wounds or operative procedures. Compression of the nerve may be external as the pressure of a plaster cast or a handbag carried over the forearm, or internal in association with various local anormalies such as the presence of fibrous band, a tendinous origin of the superficial flexor of the middle finger or thrombosis of the anterior interosseous artery. However, there are some cases with no history of specific injuries and no abnormal fidings at oparation.

Our cases showed typical anterior interosseous nerve palsy ; weakness of flexion power of the thumb and index finger without sensory impairment. The first case showed no mechanical or anatomical disorder of the median nerve and its branches but the specimen of the pronator teres and flexor pollicis longus showed typical neurogenic muscle atrophy suggesting isolated neuritis of the median nerve. In the second case, there was no mechanical and anatomical changes on the nerve but the pronator teres and the flexor pollicis longus showed myogenic muscle atrophy. In the third case, there was mild scarring and redness at the site of bifurcation of the anterior interosseous nerve where the nerves dipped beneath the pronator teres. The median nerve or anterior interosseous nerve might be susceptible to be compressed at this point while the elbow is extended or the arm is supinated. In the last case, the spontaneous recovery of the paralysis is very suggestive of transient neurapraxia after minor trauma.

Based on our experience and review of the literature, the cause of the syndrome is not only due to compression on the nerve but also many other factors, e. g. anterior horn cell lesion, neuralgic amyotrophy, radiculitis, peripheral neuritis or myogenic muscle atrophy. It is agreed that in sustained anterior interosseous nerve paralysis of unknown cause, surgical exploration of the nerve is indicated. We prefer to carry out tendon transfer for persistent paralysis.

Summary

Four cases resembling anterior interosseous nerve syndrome are described. At surgery, no constriction fibrous band was found in two cases. In the cases, the pronator teres was affected too. It is suggested the etiology of the syndrome is not only an entrapment neuropathy of the anterior interssseous nerve but also other various factors (radiculitis, neuritis,……etc.).

Acknowledgement

We would like to express his appreciation to Professor TETSUO ITO M.D., Department of Orthopaedic Surgery, Faculty of Medicine, Kyoto University, for helpful encouragement.

References

1) Farber, J. S. and Bryan, C.R.S. . The anterior interosseous nerve sndrome. J. Bone and Joint Surg., **50-A** . 521-527, 1968.
2) Fearn, C.B.d'A, and Goodfellow, J.W. : The anterior interosseous nerve palsy. J. Bone and Joint Surg., **47-B** 91-93, 1965.
3) Hamabuchi, M., Sano, K. and Hama, H. Anterior interosseous nerve paralysis. Ann. Kansaiden-ryoku Hosp., **4** : 34-39, 1973. (Japanese)
4) Kiloh, L.G. and Nevin, S. . Isolated neuritis of the anterior interosseous nerve. Brit. Med. J., **1** 850-851, 1952.
5) Kojima, T., Imamura, M., Harase, M., Migita, A. and Ietsune, T. : Six cases of pronator syndrome. Orthop. Surg. (Tokyo), **19** 1147-1149, 1968.
6) Lake, P. A. : Anterior interosseous nerve syndrome. J. Neurosurg., **41** 306-309, 1974.
7) Maeda, K. and Nakamura, R. : Anterior interosseous nerve paralysis and posterior interosseous nerve paralysis. Orthop. Surg. (Tokyo), **24** 122-127, 1973.
8) Matsuzaki, A., Kobayashi, A., Mitsuyasu, M., Morooka, M., Honda, T. and Takeshima, Y. Five cases of neuralgic amyotrophy with neuroparalysis of the anterior interosseous nerve as a main symptom. Orthop. Surg. (Tokyo), **20** : 916-923, 1969.
9) Mills, R.H., Mukerjee, K. and Bassett, I.B. Anterior interosseous nerve palsy. Brit. Med. J., **2** : 555, 1969.
10) O' Brien, M.D. and Upton, A.R.M. Anterior interosseous nerve syndrome ; A case report with neurophysiological investigation. J. Neurol. Neurosurg. and Psych., **35** 531-536, 1972.
11) Parsonage, M. J. and Turner, J. W. A. Neuralgic amyotrophy ; The souldergirdle syndrome. Lancet, **1** : 973-978, 1948.
12) Schmidt, H. and Eiken, O. The anterior interosseous nerve syndrome ; Case report. Scand. J. Plast. and Reconstr. Surg., **5** : 53-56, 1971.
13) Sharrad, W.J.W. Anterior interosseous neuritis of a case. J. Bone and Joint Surg., **50**-B : 804-805, 1968.
14) Smith, B.H. and Herbst, B.A. : Anterior interosseous nerve palsy. Arch. Neurol., **30** : 330-331, 1974.
15) Spinner, M. : The anterior interosseous-nerve syndrome : With special attention to its variations. J. Bone and Joint Surg., **52**-A 84-94, 1970.
16) Spinner, M. and Schreiber, S.N. : Anterior interosseous-nerve paralysis as a complication of supra-condylar fractures of the humerus in children. J. Bone and Joint Surg., **51**-A : 1584-1590, 1969.
17) Spinner, M. Injuries to the major branches of the forearm. W.B. Saunders Co., 78, 1972.
18) Stern, M.B., Rosner, L.J. and Blinderman, E.E. : Kiloh-Nevin syndrome Report of a case and review of the literature. Clin. Orthop., **53** 95-98, 1967.
19) Tajima, T., Miyamoto, S. and Sasano, M. : Evaluation of the etiology of palsy of the flexor pollicis longus and the flexor digitorum profundus of the index finger. Orthop. Surg., (Tokyo), **18** : 391-393, 1967.
20) Thomas, D.F. : Kiloh-Nevin syndrome. J. Bone and Joint Surg., **44**-B : 962, 1962.

21) Vicharre, N.A. Spontaneous paralysis of the anterior interosseous nerve. J. Bone and Joint Surg., **50**-B : 806-808, 1968.
22) Warren, J.D. Anterior interoseous nerve palsy at a complication of forearm fractures. J. Bone and Joint Surg., **45**-B : 511-512, 1963.
23) Yoshimatsu, S., Takayanagi, S., Harase, M. and Takemura, T. Two cases of anterior interosseous nerve paralysis. Orthop. Surg. (Tokyo), **19** : 1143-1144, 1968.

和文抄録

前骨間神経症候群を疑わせる症例について

京都大学医学部整形外科学教室（主任：伊藤鉄夫教授）

梁瀬義章，上羽康夫

山本　潔，須藤容章

前骨間神経麻痺は1952年 Kiloh & Nevin 正中神経の主要枝である前骨間神経の Isolated neuritis であると報告して以来注目されてきたが，その原因は多様である．我々は最近母指の IP 関節と示指の DIP 関節の屈曲障害を主訴とした4症例を経験し，その中3症例に手術を施行した．手術例3例とも正中神経やその枝には fibrous band による圧迫や挟扼は認めず，また長母指屈筋，示指深屈筋以外に円回内筋にも萎縮が認められた．しかし正中神経支配域の知覚障害はなく，その他の神経的検査にも異常はなかった．非手術例は発症5ケ月後より母指，示指の筋力は回復した．

過去に報告された53例の臨床像と我々の症例の経験より，本症候群の原因に fibrous band などによる機械的圧迫だけでなく，神経炎や限局性の筋原性萎縮，前角細胞の障害など種々な因子が考えられる．神経の生検で neuritis を証明している者もあるが，その病因には触れていない．治療は種々いわれているが，我々は1～2ケ月は保存的に経過観察し，改善傾向がなければ神経剝離術を行ない原因の確認をすべきと考えている．更に治癒傾向のない症例には腱移行術が適応と考えている．