THE ARCADE OF FROHSE AND ITS RELATIONSHIP TO POSTERIOR INTEROSSEOUS NERVE PARALYSIS

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A cause for spontaneous paralysis of the posterior interosseous nerve has been sought for many years. In recent times an increasing number of reports on this subject has appeared. Sharrard's (1966) cases were of particular interest because the approach to the problem was direct. If the paralysis did not subside within six weeks, exploration was carried out promptly. He described a fibrous band across the nerve, release of which restored function. Capener (1964) reported similar experiences and likened the compression to that seen in carpal tunnel syndrome. Later (1966) he described a sharp aponeurotic edge of the supinator in relation to "tennis elbow."

This paper reports an anatomical study of the upper limbs in twenty-five adults and ten full-term foetuses and describes a probable anatomical factor, the arcade of Frohse, in traumatic and non-traumatic progressive paralysis of the posterior interosseous nerve. Through this arcade, described by Frohse (Frohse and Fränkel 1908), the posterior interosseous nerve passes to enter the plane between the two heads of the supinator muscle.

The most proximal part of the superficial head of the supinator muscle may be tendinous and form a fibrous arch. Arising in a semi-circular manner from the tip of the lateral epicondyle, its fibres arch downwards 1 centimetre and then gain attachment to the medial aspect of the lateral epicondyle just lateral to the articular surface of the capitulum. The posterior interosseous nerve passes under the edge of this fibrous arch (Figs. 1 and 2). The adult specimens dissected in this study showed considerable variation in the thickness of the fibrous arch and the size of the opening for passage of the nerve. In addition to its origin along the radial [lesser sigmoid] notch of the ulna, the superficial head of the supinator arises from the lateral aspect of the lateral epicondyle. In 70 per cent of specimens dissected, the medial half of the arcade was membranous (Fig. 3), being inserted into the medial aspect of the lateral epicondyle adjacent to the capitulum. In the remaining 30 per cent the medial half of the arcade was of the same firm tendinous consistency as the lateral half (Fig. 4). The firm fibrous arcade of Frohse was thus present in these specimens, with the posterior interosseous nerve passing beneath.

In three adult specimens full pronation of the forearm produced pressure on the posterior interosseous nerve by the sharp tendinous edge of the origin of the extensor carpi radialis brevis muscle (Fig. 5).

It was not possible to demonstrate a sharp tendinous arcade of Frohse in any newborn full-term foetus. The most proximal part of the superficial head of the supinator was always muscular.

During the past ten years the author has treated ten cases of posterior interosseous nerve paralysis. Of these, nine had been caused by an injury and one not. In the latter case a fifty-five-year-old waiter suffered spontaneous painless onset of complete paralysis of the posterior interosseous nerve involving the extensors of the thumb and finger. Wrist extension was normal. The paralysis disappeared after immobilisation of the arm in a sling for four weeks. When he was last seen four years after recovery there had been no recurrence nor the development of any systemic disease affecting peripheral nerves. Local causes (tumour, ganglion, rheumatoid disease, etc.) as described most recently by Bowen and Stone (1966) and

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by Marmor, Lawrence and Dubois (1967) for the paralysis had been initially sought but not found. The history and course in this case suggest the possibility that a narrow "bouton" type of opening in the fibrous arcade of Frohse, as noted by Paturet (1951), may have been present. The patient had no exploratory operation because full strength returned to the affected muscles and there was no recurrence in the four years during which he was followed.

Of the nine cases following injury, the forearm was explored in six because recovery did not occur spontaneously. The principle that the nerve should be explored if there were no electromyographic or clinical evidence of recovery within six to eight weeks was strictly followed.

In a typical case a sixty-eight-year-old woman was seen seven weeks after a comminuted undisplaced fracture of the radial head with paralysis of the posterior interosseous nerve. There was no clinical or electrical sign of recovery. Exploration of the posterior interosseous nerve was undertaken through an anterior approach and a fibrous band corresponding to the arcade of Frohse was found. After its release, the underlying compressed posterior interosseous
Figure 3—Photograph of a specimen in which the medial part of the arcade is membranous, while the lateral portion is tendinous. Figure 4—Photograph of a specimen in which the whole length of the arcade is tendinous. Its borders can be seen extending upwards on both sides of the nerves.

Figure 5—Photograph of one of the three specimens in which full pronation of the forearm caused the sharp tendinous edge of the origin of the extensor carpi radialis brevis muscle to increase compression of the posterior interosseous nerve. Figure 6—Photograph of the posterior interosseous nerve at operation after decompression by splitting the arcade. The nerve was pale and flattened with adhesions to adjacent tissues.
nerve was found to be pale and flattened with adhesions to the adjacent soft tissues (Fig. 6). Internal neurolysis with saline was performed. The branches of the recurrent radial vessels in the area were found to be thrombosed. Six weeks later, return of function of the muscles innervated by the posterior interosseous nerve was evident.

DISCUSSION

Compression of the posterior interosseous nerve becomes a distinct possibility when a fibrous arch of Frohse is present, especially if it is thick and the space for the nerve narrow. Oedema of adjacent structures, neoplasm or inflammatory swelling may compress the nerve against the hard, unyielding, tendinous edge of the arch. Guillain and Courtellemont (1905) reported a case of posterior interosseous nerve paralysis in an orchestral conductor who did not suffer injury. This paralysis may well have been produced by repeated pronation and supination of the forearm with resulting pressure from an already tight tendinous arch. Another cause for compression of the nerve may be hyperextension of the elbow with a tethering effect on the nerve, anatomically predisposed to by a narrow arcade.

Woltman and Learmonth (1934), Otenasek (1947) and Mulholland (1966) undertook operation three to ten years after the onset of the paralysis but did not observe any restoration of function after operation. These failures were probably due to delay in operating, with irreversible changes in the nerve.

The absence of the fibrous arcade of Frohse in the full-term foetus and its presence in 30 per cent of adult arms suggest that the arcade is probably formed in the most proximal part of the superficial head of the supinator in response to repeated rotary movement of the forearm.

SUMMARY

1. The arcade of Frohse, a fibrous arch over the posterior interosseous nerve, may well play a part in causing progressive paralysis of the posterior interosseous nerve, both with and without injury.
2. Paralysis of the muscles supplied by this nerve with no evidence of recovery after six weeks, either electromyographic or clinical, should be treated by exploration and splitting of the arcade of Frohse.

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