SURGICAL TREATMENT OF SPASTIC "THUMB-IN-PALM" DEFORMITY

IVAN MATEV, SOFIA, BULGARIA

From the Institute of Reconstructive Surgery, Prosthetics and Rehabilitation, Sofia

Deformities of the hand constitute one of the essential problems in the treatment of cerebral palsy. The difficulties in the management of this condition are caused by: 1) the central localisation and widespread nature of the affection in the extremities; 2) the fact that treatment can only be palliative; and 3) the frequent impairment of the intellectual ability and emotional stability of the patient.

The variability of the clinical picture of the spastic hand and the uncertainty in predicting the outcome of surgery necessitate a cautious and individual approach to these problems. Nevertheless surgery can offer a significant improvement in carefully selected cases.

The basic deformities in the spastic hand are pronation of the forearm, flexion of the wrist and fingers and flexion-adduction of the thumb.

The flexion-adduction contracture of the thumb is a common and severe deformity. The thumb is acutely flexed into the palm and comes to lie under the flexed fingers. The deformity is a compound one and usually combines contracture of the carpo-metacarpal joint in flexion, adduction and lateral rotation, the metacarpo-phalangeal joint in flexion and lateral rotation, and the interphalangeal joint in flexion. These clinical manifestations result from an imbalance between the intrinsic and extrinsic musculature of the thumb in favour of the flexor and adductor muscles. The adductor pollicis, first dorsal interosseous, flexor pollicis brevis and abductor pollicis brevis are the muscles mainly responsible for the development of the "thumb-in-palm" deformity.

Depending upon the predominance of the spasticity in the adductor or abductor brevis group, the thumb assumes either a position closely approximated to the second metacarpal, or its volar surface approaches the palm obliquely in the direction of the little finger.

The persistent spasm of the intrinsic muscles and flexor pollicis longus leads to stretching of the antagonist muscle groups—abductor pollicis longus and extensor pollicis longus and brevis—thus increasing the deformity. In an attempt to hold the thumb out of the palm, the patient tends to bring the wrist into extreme flexion and ulnar deviation. This position lengthens the route of the extensors and the abductor longus and increases their effect, while at the same time it relaxes the flexor pollicis longus. In mild cases this manoeuvre allows the thumb to be drawn out of the palm and permits a grasp to be accomplished, though in a weak position of the wrist joint. In the more severe forms only passive opening of the thumb is possible, and in the most severely affected cases it is impossible to extend the thumb even with the aid of external force.

METHODS OF OPERATIVE TREATMENT

The various operations that have been devised for the treatment of this condition may be classified in four groups: 1) Operations indirectly affecting the thumb: arthrodesis of the wrist joint in ulnar deviation (Goldner 1955). 2) Division of the deep motor branch of the ulnar nerve. 3) Tenotomy of the adductor pollicis, stripping of the first dorsal interosseous from the first metacarpal bone and elongation of the flexor pollicis longus, sometimes supplemented by transplantation of some of the radial wrist muscles to reinforce the extensor-abduction action (Goldner 1955, Mejenina 1959, Strezov 1960, Swanson 1960, Gorynski and

Jedrzejewska 1961). 4) Arthrodesis of the carpo-metacarpal joint (Ikonomov 1951, Gorynski and Jedrzejewska 1961) or of the carpo-metacarpal and metacarpo-phalangeal joints (Pollock 1962).

The most reliable procedure for correcting the deformity is arthrodesis of the carpo-metacarpal and metacarpo-phalangeal joints, but this has the disadvantage of reducing mobility. Resection of the deep branch of the ulnar nerve is not recommended.

THE AUTHOR'S TECHNIQUE

Tenotomy of the adductor pollicis and first dorsal interosseous muscles appears to be an essential factor in the treatment of the deformity. It is performed through a dorso-ulnar approach, stripping the adductor from the ulnar sesamoid and the interosseous muscle from the first metacarpal bone. Unfortunately, tenotomy of the adductor weakens the flexor power of the proximal phalanx and the metacarpo-phalangeal joint becomes hyperextended (Fig. 1). This deformity is increased if active muscles are transferred to the extensors of the thumb. Nearly all the patients of our series treated in this manner developed a permanent hyperextension of the proximal phalanx. In order to prevent this deformity Goldner (*loc. cit.*) arthrodesed the metacarpo-phalangeal joint in slight flexion.

FIG. 1

The commonly accepted tenotomy of the adductor pollicis and first dorsal interosseous through a dorso-ulnar approach has been performed. The metacarpo-phalangeal joint assumes a permanently hyperextended position. The thumb-in-palm attitude of the first metacarpal remains unchanged.

At a second operation on one of the patients who had developed this deformity we were able to confirm how this had resulted from the adductor and first dorsal interosseous myoteny. In this instance a palmar approach was used for the exposure of the thenar muscles. The skin incision was made in the palmar crease at the base of the thenar eminence. The flexor tendons of the ulnar four fingers were retracted ulnarwards together with the neurovascular bundles, exposing the adductor pollicis muscle. This muscle had been tenotomised at its distal end at the previous operation and it was apparent that the contracture had been completely relieved. Flexor pollicis brevis and abductor pollicis brevis were contracted. These muscles were divided, leaving the proximal fibres of the short abductor intact at their attachment to the

carpal bones and ligamentum carpi transversum; the muscle mass was then bluntly displaced in the direction of the metacarpo-phalangeal joint of the thumb. The transverse carpal ligament was divided and the tendon of flexor pollicis longus placed superficial to the ligament because this muscle prevented full abduction of the thumb; and by this means a relative elongation of the muscle was achieved. In order to achieve abduction of the first metacarpal, transference of the extensor carpi radialis longus to the insertion of abductor pollicis longus through a separate dorso-radial incision was performed. The outcome of the operation was surprising (Figs. 2 to 4). The previously contracted thumb was abducted to the functional position and the hand was capable of active grasp.

During the past four years seven patients (five women and two men) aged from seventeen to twenty-four years have been operated upon by this procedure. Six suffered from infantile cerebral palsy and one had traumatic hemiplegia.

DETAILS OF THE OPERATION

The operation is performed in two stages: in the first the intrinsic muscles pulling the thumb in the direction of the palm are dissected, and in the second when deemed necessary abduction of the first metacarpal and extension of the proximal phalanx are augmented.

First stage—The palmar approach is used (Fig. 5). The adductor pollicis, flexor pollicis brevis and the distal two-thirds of abductor pollicis brevis are detached from their insertions. The

FIG. 2

FIG. 3

FIG. 4

Case 1. Figure 2—Thumb-in-palm deformity with predominance of the short abductor-opponens muscle group. The volar surface of the thumb touches the palm obliquely in the direction of the little finger. A twenty-three-year-old woman suffering from infantile cerebral palsy, in whom arthrodesis of the radiocarpal joint had been previously performed. Figures 3 and 4—The same patient eighteen months after correction of the thumb by the technique described. The long radial wrist extensor was transferred to the base of the first metacarpal. The thumb with its metacarpal is drawn out of the palm and there is no hyperextension deformity of the metacarpo-phalangeal joint. (Excision of a burn scar in the distal third of the forearm was performed at the same time.)

muscular mass is retracted bluntly towards its distal insertion leaving intact the neurovascular bundles (Figs. 6 and 7). At the bottom of the hand the deep motor branch of the ulnar nerve is found with its accompanying vessels. Next the first dorsal interosseous muscle is divided near the first metacarpal, after adequate retraction of the disinserted muscles proximally.

Second stage—Through a semilunar skin incision on the dorso-radial aspect of the wrist the long abductor, the extensors of the thumb and the extensors of the wrist are exposed. Depending upon the special features of individual cases, the following procedures have been used: shortening of the tendons of the abductor pollicis longus and extensor pollicis brevis, transplantation of the extensor carpi radialis longus to the extensor pollicis brevis, or transposition of the same extensor carpi radialis to the first metacarpal.

After operation a plaster-of-Paris splint is applied for twenty-five days with the thumb in abduction, and subsequently the thumb is maintained in abduction a further month with a cotton gauze ball.

RESULTS

The patients in this series have been observed for one and a half to two years after operation. All the patients can hold the thumb out of the palm and the thumb approximates to the normal functional position (Figs. 8 to 10). The grasping ability of the hand is considerably improved and two of the patients are even able to perform correct active grasp and pinch (Figs. 11 to 13).

DISCUSSION

In the past insufficient attention has been paid to the abductor pollicis brevis and flexor pollicis brevis muscles as causative factors in the "thumb-in-palm" deformity. With the widely accepted tenotomy of adductor pollicis and stripping of the first dorsal interosseous from the first metacarpal, insufficient abduction is achieved and the metacarpal usually remains drawn into the palm. The detachment of the adductor from the ulnar sesamoid bone

FIG. 5

FIG. 6

FIG. 7

Figure 5—Diagram showing the palmar skin incision. Figure 6—After retraction of the flexor tendons of the fingers ulnarwards, together with the neurovascular bundles, the adductor pollicis (1), flexor pollicis brevis (2) and a large part of the short abductor (3) are exposed. Figure 7—The muscles are stripped from the carpal bones and the transverse carpal ligament and moved by blunt dissection towards their distal insertions. Deep in the palm is seen the deep motor branch of the ulnar nerve. Through the same exposure the greater part of the first dorsal interosseous muscle is detached from the first metacarpal.

decreases the flexor power acting upon the proximal phalanx and the metacarpo-phalangeal joint frequently becomes hyperextended. This position is accentuated by the action of the extensor pollicis brevis and longus muscles as the patient endeavours to draw the thumb fully away from the palm. The hyperextension of the proximal phalanx weakens the effective strength of the thumb and disturbs the appearance of the hand.

The surgical procedure described aims at the elimination of these disadvantages. Detachment of the adductor pollicis, flexor pollicis brevis, first dorsal interosseous and the distal two-thirds of the abductor pollicis brevis frees the thumb with its metacarpal from the

FIG. 8

FIG. 9

FIG. 10

Case 2—One of the most severely affected cases in the series reviewed. A male aged twenty years with spastic hemiplegia from a brain injury sustained two years previously. Figure 8—Condition of the hand before operation. In an earlier operation the digital flexors had been elongated at their musculo-tendinous junction, the pronator teres had been tenotomised and the radial wrist flexor had been transferred to the digital extensors. Figures 9 and 10—The hand two years after operation by the technique described, with shortening of the long abductor and short extensor tendons.

FIG. 11

FIG. 12

FIG. 13

Case 3. Figure 11—Thumb-in-palm deformity with predominance of the adductor and first dorsal interosseous muscles. A woman aged twenty-two years suffering from infantile cerebral palsy. Figures 12 and 13—Two years after operation on the thumb with simultaneous tenotomy of the ulnar wrist flexor (the extensor-abduction apparatus of the thumb was not reinforced). The thumb with the metacarpal is held out of the palm. Grasp and pinch are normal. The metacarpo-phalangeal joint assumes a functional position.

palm. By moving the muscle mass in a distal direction, but preserving the neurovascular bundles intact, hyperextension of the metacarpo-phalangeal joint is prevented by retaining flexor control of the proximal phalanx. When necessary, the transfer of extensor carpi radialis

longus or brevis to the base of the first metacarpal, or to the overstretched abductor pollicis longus and extensor pollicis brevis, increases the abduction power of the thumb.

In this series the thumb was operated upon at the same time as, or some time after, correction of the flexion contractures of the wrist and digits, at which time the flexor pollicis longus was also lengthened if necessary.

The spastic paralysis in all the cases reviewed was of the non-athetoid type. The patients were all of fairly normal mentality, one being of completely normal mental and intellectual ability. The sensibility of the hand was satisfactory in all instances.

SUMMARY

The technique described aims to eliminate the drawbacks of the commonly accepted operative procedures for correction of the spastic "thumb-in-palm" deformity without fusion of the thumb. In all seven patients followed up for one and a half to two years after operation the thumb regained a functional position, being held out of the palm together with the metacarpal without hyperextension of the metacarpo-phalangeal joint.

I would like to acknowledge my thanks to Mrs B. Brosig for the photographs and to Mr K. Melixetian for the translation.

REFERENCES

- GOLDNER, J. L. (1955): Reconstructive Surgery of the Hand in Cerebral Palsy and Spastic Paralysis Resulting from Injury to the Spinal Cord. *Journal of Bone and Joint Surgery*, **37-A**, 1,141.
- GORYNSKI, T., and JEDRZEJEWSKA, H. (1961): Chirurgiczne leczenie zniekształcen i zaburzeń czynnościowych kciuka w porażeniach mózgowych. *Chirurgia Narządów Ruchu i Ortopedia Polska*, **26**, 53-59.
- IKONOMOV, I. (1951): Contributions to the Reconstructive Surgery of the Hand. *Sofia, Works of Medical Academy*, vol. **31**, p. 186. (Bulgarian text.)
- MEJENINA, E. (1959): Surgical Treatment of Cerebral Spastic Paralysis in Childhood. *Ortopedia, Travmatologia and Protezirovanie*, No. 12, 18-24. (Russian text.)
- POLLOCK, G. A. (1962): Surgical Treatment of Cerebral Palsy. *Journal of Bone and Joint Surgery*, **44-B**, 68.
- STREZOV, IV. (1960): Reconstructive Surgical Treatment of Spastic Paralysis of the Hand. *Hirurgija*, vol. **13**, 593. (Bulgarian text.)
- SWANSON, A. B. (1960): Surgery of the Hand in Cerebral Palsy and the Swan-neck Deformity. *Journal of Bone and Joint Surgery*, **42-A**, 951.