

Acta Medica Okayama

Volume 12, Issue 2

1958

Article 6

JULY 1958

Tendon transfers for claw hand

Kenya Tsuge*

Tasaburo Tani†

Senji Tanaka‡

Masashi Namba**

*Okayama University,

†Okayama University,

‡Okayama University,

**Okayama University,

Tendon transfers for claw hand*

Kenya Tsuge, Tasaburo Tani, Senji Tanaka, and Masashi Namba

Abstract

We have recently operated on 56 cases of claw hand and described the method of tendon transfer in Hansen's disease which occupied the majority of the cases, and several problems have been discussed from our experiences.

Acta Med. Okayama 157—173 (1958)

TENDON TRANSFERS FOR CLAW HAND

Kenya TSUGE, Tasaburo TANI and Senji TANAKA

*Department of Orthopedic Surgery, Okayama University Medical School
(Director : Prof. T. Kodama)*

Masashi NAMBA

Oku-Ko-Myo-en, National Sanatorium

Received for publication, September 3, 1958

The so-called claw hand is due to paralysis of the intrinsic muscles of the hand, i. e. the dorsal and volar interossei, the lumbricales and the thenar and hypothenar muscles show marked atrophy, and the fingers are in the state of hyperextension at the metacarpophalangeal joints and of flexion at the interphalangeal joints, thus resulting in the clawed fingers, in which the thumb is situated laterally to the hand and its opposition is disturbed. This deformity is the result of paralysis of the ulnar nerve, especially simultaneous involvement of the ulnar and median nerves by such different etiological factors as poliomyelitis, Hansen's disease, trauma, syringomyelia etc. .

Though the function of the dorsal and volar interossei and lumbricales is not completely clarified yet, it is mainly composed of flexion of the metacarpophalangeal joints and extension of the interphalangeal joints, as described in many text books. In case of both ulnar and median nerve paralysis, these intrinsic muscles are paralysed, while the long extensors and flexors still function, thus resulting in the typical clawed fingers. Impairment of opposition of the thumb is the result of paralysis of the thenar muscles, and the subsequent claw hand may prove to be a great handicap to the daily routine irrespective of existence of sensory disturbance.

We have recently tried the following operation technique for the clawed finger and for impaired opposition of the thumb, being served by Bunnell's and Brand's method as referenes, in 48 cases of Hansen's disease, 3 cases of poliomyelitis and other 5 cases.

CORRECTION OF FLEXION DEFORMITY

When the claw deformity lasts for a longer period, the skin on the volar side of the finger shows contracture and the joints ankylosis, and

therefore an attempt at a passive extension of the fingers is often unsuccessful. It is often necessary to correct preoperatively the contracture by concerted exercise or by knuckle-bender splint or metacarpal splint. (Fig. 1-A 1-B) Passive stretching may be most carefully resorted to for cases with sensory disturbances such as Hansen's disease.

In case of laterally fixed thumb for a longer period, it is sometimes impossible to have the thumb passively in opposed position because of

Fig. 1. Splints for correction of flexion deformity

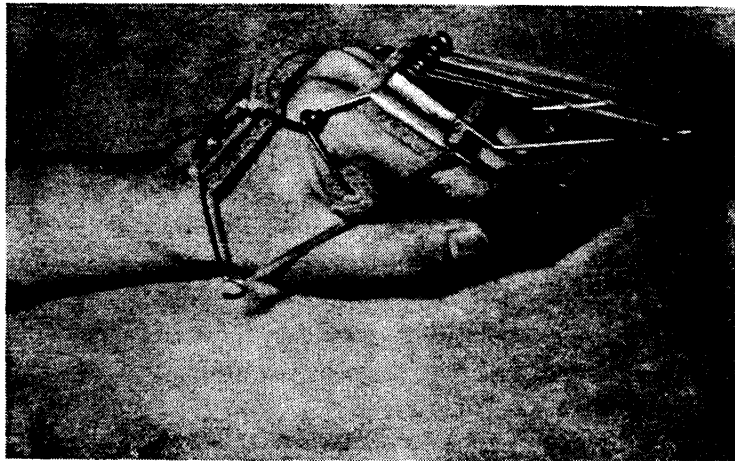


Fig. 1-A

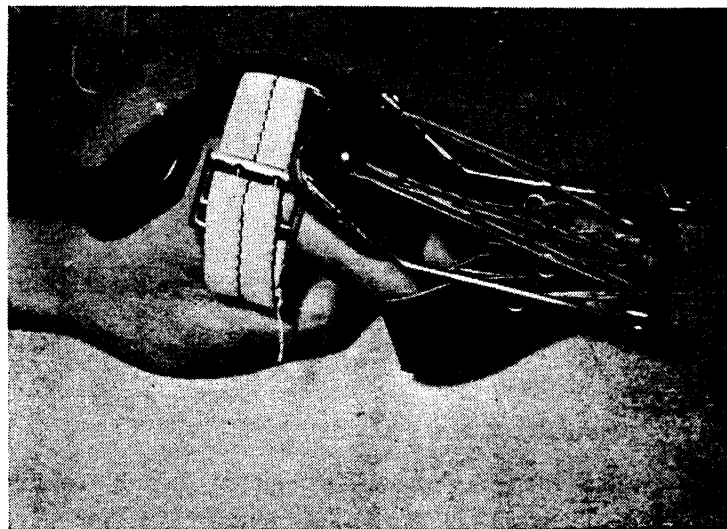


Fig. 1-B

the shortening of the dorsal skin. Therefore, these contracture should be preoperatively corrected with splints or z-plasty or skin graft.

Postoperative active mobility of the fingers should be considered to be in the same extent as the preoperative passive movement so that the removal of the contracture is extremely important.

TEST OF MUSCLE POWER

Muscle power of the forearm should be preoperatively tested exhaustively i. e. that of the flexor sublimis, the flexor profundus and the flexors of the wrist, especially the flexor carpi ulnaris which is to be used for a pulley in surgery for impaired opposition of the thumb.

If the power of these muscles is less than 60 to 70 per cent of the normal, good operative results can hardly be expected and the operative method should be reconsidered and changed.

INDICATIONS FOR OPERATION

Indications for operation are to be determined by the grade of contracture and the muscle power as stated above, especially the latter is important. Contracture should be corrected preoperatively as much as possible, but the contracture does not always contraindicate surgery. The contracture can not often be completely corrected by active exercise or splints, but even in such cases, function of the hand may be considerably improved by surgery. The contracture of the thumb, however, should be corrected in such cases.

In case of heavy contracture, it is often said that the arthrodesis of joint is necessary. But in many cases, only the tendon transfer may bring better results than expected. In case of flexion contracture of the distal phalanx of the thumb, which is often seen in Hansen's disease, however, arthrodesis of joint may be necessary according to its grade.

OPERATION TECHNIQUE

Anesthesia

Brachial plexus block anesthesia with 2% xylocaine has been used in nearly all cases, except for general anesthesia which has occasionally been required. Anesthesia should be given in Hansen's disease in which deep sensation still remains and pain is often complained of.

Tourniquet

Tourniquet has been used in all cases. The pressure of the pneumatic tourniquet on the upper arm is kept between 250 and 300 mmHg. We

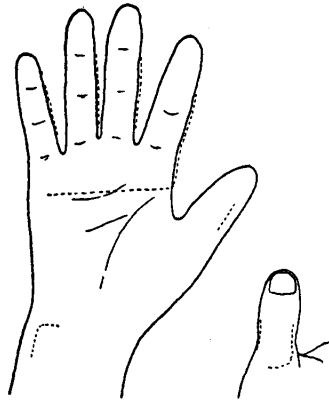


Fig. 2. Incisions of the skin

sometimes stop the blood-flow using only a sphygmomanometer while holding the arm in elevated position for several minutes during disinfectin of the hand. In Hansen's disease, the pressure of the tourniquet is kept 230 to 240 mm.Hg. and is released temporarily for several minutes at the end of one hour or hour and a quarter, as the nerves are liable to be harmed by prolonged ischemia.

Fig. 3. Operation of claw hand

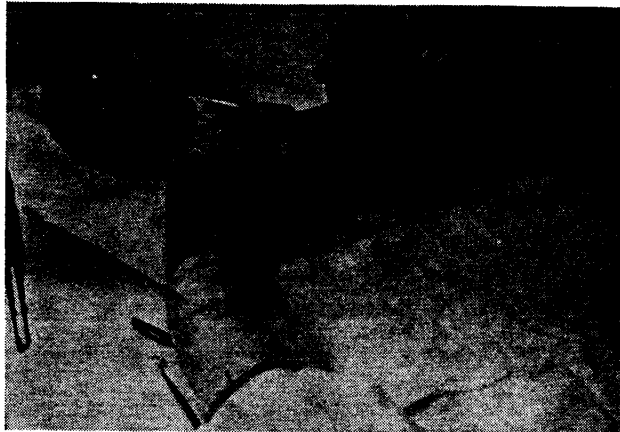


Fig. 3-A



Fig. 3-B



Fig. 3-C

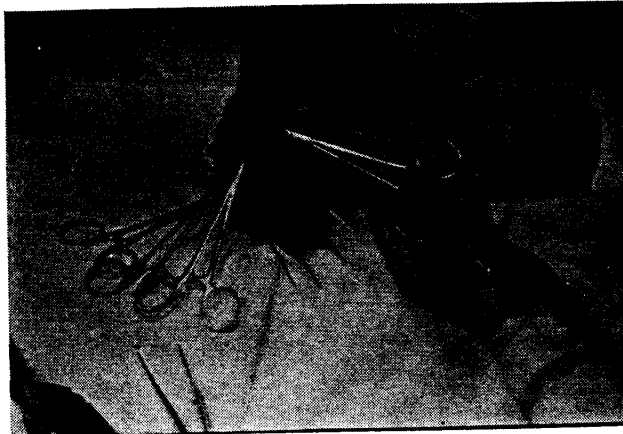


Fig. 3-D



Fig. 3-E



Fig. 3-F

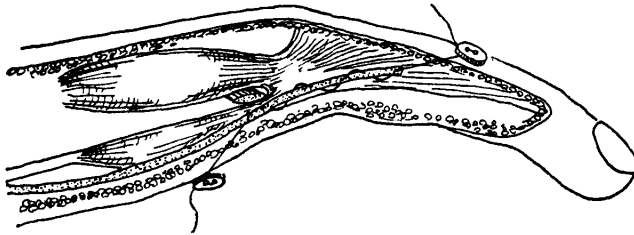


Fig. 3-G



Fig. 3-H

Fig. 4. Fixation of sublimis tendon by running suture.



1) Incision (Fig. 2) Mid-lateral incision is placed only on the radial side of the fingers. In making transverse incision of the palm, a care must be exercised as to avoid injury to the digital nerves.

2) The skin at the mid-lateral incision on each finger is separated wide, subcutaneous tissue is then carefully dissected and the lateral band of aponeurosis is secured. A part of the tendon sheath is longitudinally opened and the tendon of the flexor sublimis is hooked, held by mosquito clamp, and then cut.

3) Those tendons of the flexor sublimis, being already cut, are brought out through the transverse incision of the palm (Fig. 3-C).

4) Those tendons are then brought through the lumbrical canal to the mid-lateral incision of the fingers (Fig. 3-D), where the tendon of the flexor sublimis of the index finger is to that of the finger, while that of the middle finger is divided into two parts, one of which is to that of the middle finger and the other is to that of the ring finger. The tendon of the little finger is brought to that of the same finger. Thus the remaining tendon of the ring finger is later utilized for the opposition operation of the thumb.

5) After suturing the transverse incision of the palm (this incision should be closed priorly, because this part will later be in contact with the buttons as shown in Fig. 3-F and suturing may become difficult otherwise), fingers are fixed in the corrected position of intrinsic plus by having the Kirschner's wires passed subcutaneously from the tip of the finger to the metacarpo-phalangeal joint (Fig. 3-D), thus saving the troubles on the part of assistants and the procedures are more convenient.

6) The tendons which have been previously brought outside through the mid-lateral incisions, are sutured to the lateral band of the aponeurosis under a moderate tension using running suture with No. 34 wires (Fig. 4). This procedure may be conveniently started from the little finger and completed at the index finger and after completing the procedure, the finger should be carefully handled. The above-stated are the proce-

dures for the clawed fingers. The opposition operation of the thumb follows them.

7) Through the skin incision of the ulnar side of the wrist (Fig. 2), the tendon of the flexor sublimis of the ring finger is brought outside and crossed over the tendon of the flexor carpi ulnaris, then on the proximal phalanx of the thumb, L-shaped and mid-lateral incisions are made, through which the crossed sublimis tendon is subcutaneously passed and brought outside (Fig. 3-F). In case of paralysis of the flexor carpi ulnaris which functions as a pulley, we have to make a pulley as illustrated in Fig. 5.

8) For fixing the sublimis tendon to the thumb, the distal end of the tendon is divided into two parts, which are passed through the two holes made on the proximal phalanx from the ulnar side to the radial, then crossed and sutured together (Fig. 3-G).

The fingers are thus brought into the position of marked intrinsic plus and the thumb into that of marked opposition, contrary to the claw hand (Fig. 3-H). The transfer of the tendons is schematically illustrated in Fig. 6.

9) After the procedure has been completed, a pressure dressing is applied from the forearm to the tip of finger, having the claw hand in excessively corrected position and the wrist joint in a little flexed position with sufficient gauze or aseptic cotton on the palm and other parts. Gauze is better put as much as possible between fingers. Then the plaster of paris is applied, and the Kirschner's wires are withdrawn.

10) Postoperative care: The arm should be postoperatively held in elevated position, and antibiotics be better given. The dressing is undisturbed for two weeks after surgery, when the sutures are cut and the splints are applied. Wires are withdrawn three weeks after surgery and then concerted exercise is started.

Preoperative features and postoperative improvement of some cases are shown in Figs. 7, 8, 9, and 10.

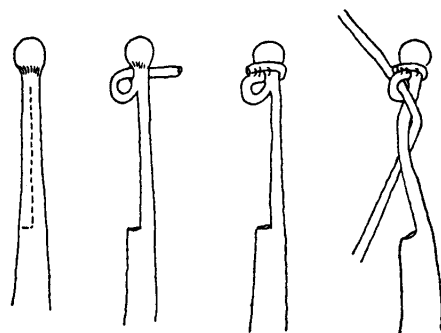


Fig. 5. Preparation of pulley with flexor carpi ulnaris in case of the paralysis of the muscle

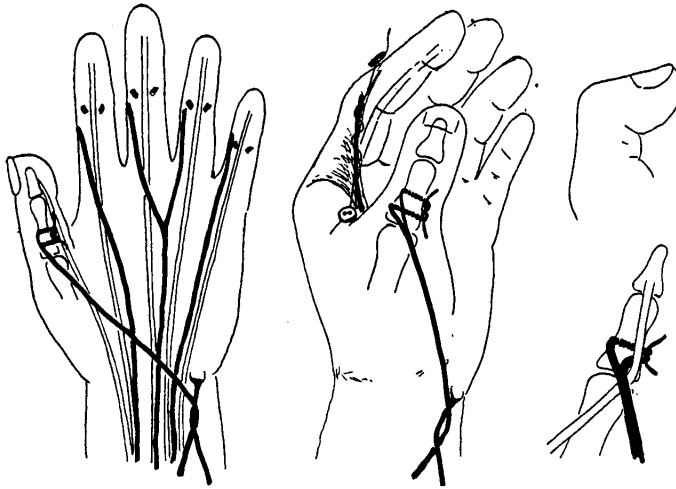


Fig. 6. Models of claw hand operation



Fig. 7. Male. 32 yrs. old, with Hansen's disease.

A. Before operation



B. After operation

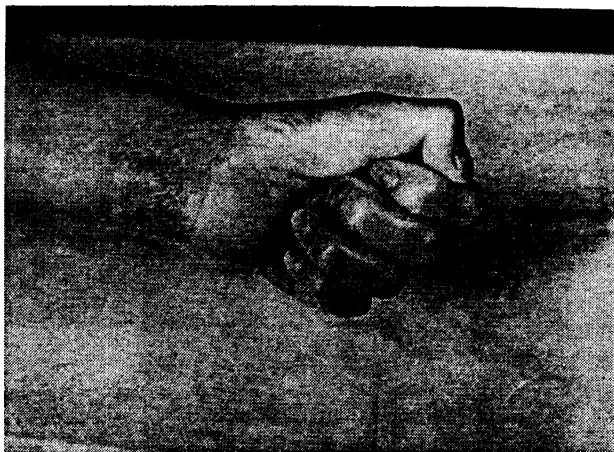
Fig. 8. Female, 30 yrs. old, with Hansen's disease



A. Before operation

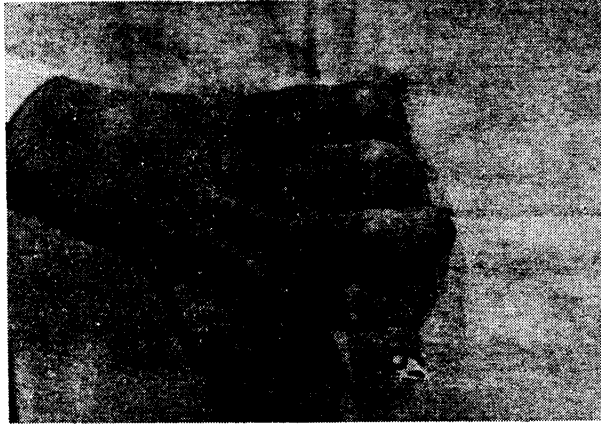


B. Stretching of fingers after operation



C. Grasping after operation

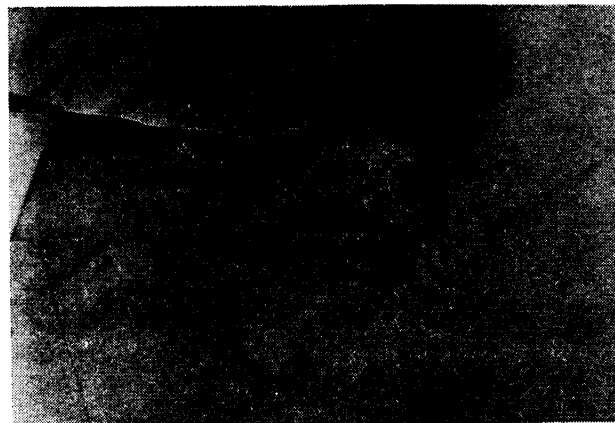
Fig. 9. Male, 52 yrs. old, with Hansen's disease



A. Marked bending contracture of fingers before operation



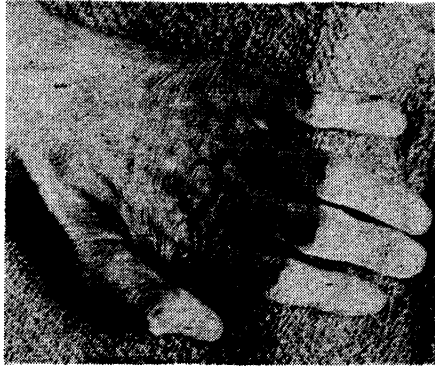
B. Stretching of fingers after operation



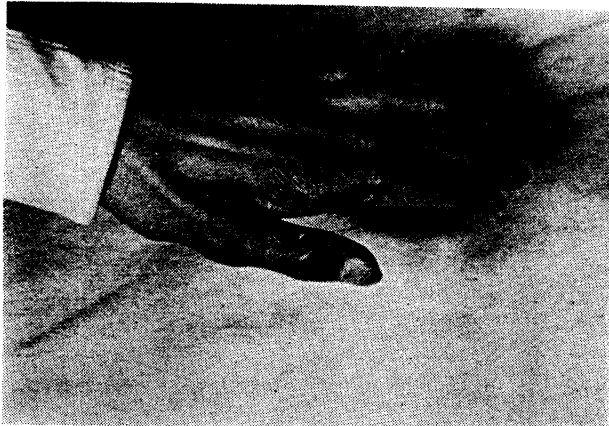
C. Grasping after operation

K. TSUGE, T. TANI, S. TANAKA and M. NAMBA

Fig. 10. Male, 42 yrs. old, with Hansen's disease



A. Before operation



B. Stretching of fingers after operation



C. Opposition after operation

DISCUSSION

Atraumatic procedures are especially required for this operation, otherwise good results are hardly obtained and general principles of hand surgery should be strictly applied. One and half hours are usually needed for whole of the procedures, while two or three hours may be required by inexperienced techniques, in which the procedures may be better divided in two, i. e. the operation for clawed fingers and that of the thumb.

From our experiences, several problems in these procedures will be discussed in the following.

A. The operation for clawed fingers :

Bunnell described about the multiple tendon transfer, in which each tendon of the flexor sublimis is divided in two parts and sutured to the radial and ulnar sides of each finger. According to his method, the tendon is transferred to each side of the finger, while we have transferred only to the radial side as Brand suggested. We formerly transferred the tendon to the ulnar side only in the little finger for the purpose of making the procedures easier, in which ulnar deviation of the little finger sometimes occurred, therefore Brand's method has been used lately. From our experiences, in case of transferring the tendon only to the radial side of each finger, radial deviation of the fingers never occurs and the power of pinching and extending of the finger is sufficiently well obtained.

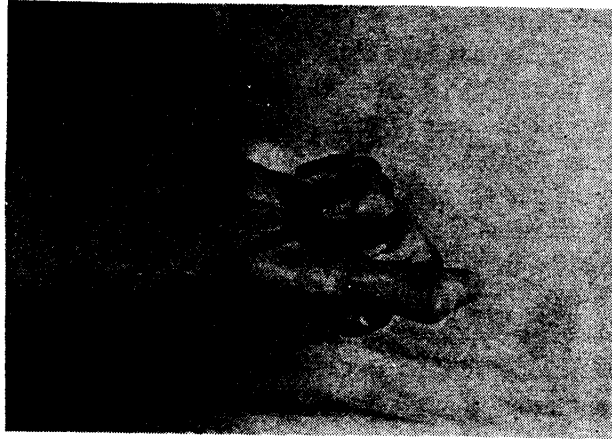
By this method a good deal of the time of operation is saved and Bunnell's multiple tendon transfer may not be necessarily used.

2) The tension under which the tendon of the flexor sublimis is sutured to the lateral band is extremely important. If it is too strong, the correction of the clawed fingers may be well obtained, while the flexion of the fingers is impaired with the state of intrinsic plus contracture. If too weak, the correction of the clawed fingers is insufficiently made. Therefore, a moderate tension is necessary. For this purpose, taking the fact of slight loosening by suturing into consideration, the sutures may be better placed under a little stronger tension. Especially in case of contracture of the fingers, the tension may be much stronger.

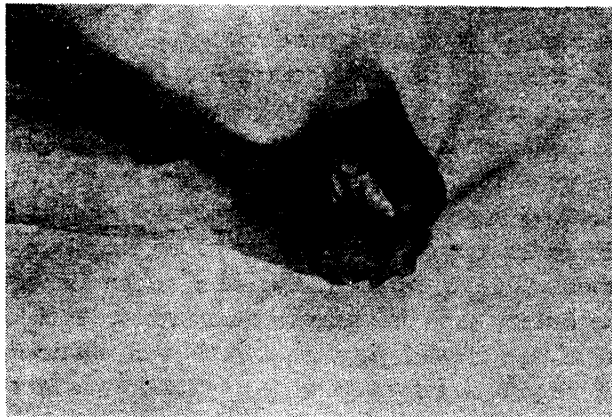
Fig. 11 shows the case in which the tips of the fingers can not reach to the palm because of too strong tension of the tendons and the metacarpophalangeal joints are hyperflexed. The principle that the flexion of the finger is more important than extension should always be taken into consideration.

3) The suture of the tendon to the lateral band should be made with running suture of wires. Though the spiral suture may be more conve-

Fig. 11. Cases showing a too-strong tension in transferred sublimis tendon



A. Tips of fingers do not touch the palm



B. The hyperflexion of metacarpo-phalangeal joint

niently made, its withdrawal is very difficult.

4) The insertion of Kirschner's wire in each finger to keep the corrected position makes it very easy to suture the tendon under a moderate tension and also makes the fixation or management of the finger and the operative procedure convenient for the operator and assistants. The wire is withdrawn immediately after operation, without leaving any disturbances.

5) The indication for operation of the arthrodesis in case of clawed fingers is considered to be extremely limited, because preoperative cor-

recting exercise and transfer of the tendon often bring much better results than expected.

Fig. 9 shows the case in which a marked contracture has been improved by surgery. In any case, arthrodesis should be finally applied. All of the above stated concerns only of simple contracture, and if bony ankylosis of the finger in bad position exists, osteotomy and arthrodesis are indicated.

B. Opposition operation of the thumb

1) For restoring the opposition movement of the thumb, the method utilizing the sublimis tendon of the ring finger is very profitable from the point of getting the source of strong power. The flexor carpi ulnaris often is paralysed in Hansen's disease and may be hardly utilized as a source of power.

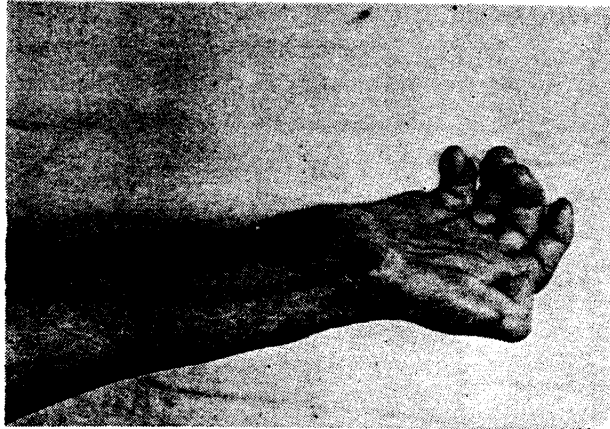
The tension of the flexor carpi ulnaris, which is utilized as a pulley when the sublimis tendon of the ring finger is used for opposition operation of the thumb, should be carefully examined by palpation and in case of paralysis of the tendon, even in doubtful cases, it is necessary to make a pulley as illustrated in Fig. 5.

2) For fixing the end of the transferred tendon to the proximal phalanx of the thumb, we have used the method illustrated in Fig. 6, with which a moderate tension can be freely and easily obtained and the fixation is satisfactorily secured, thus making early exercise possible. We consider this method to be more convenient than Bunnell's pull-out method. In Hansen's disease, flexed contracture of the distal phalanx of the thumb is often seen and the power of pinch can not be sufficiently obtained, even though opposition movement may be restored. In these cases, the contracture can be successfully corrected by lateral translocation of the extensor pollicis longus as shown in Fig. 6. In old cases, with strong contracture, however, correction may be impossible and arthrodesis may be necessary.

3) According to Bunnell, transferred tendon is necessarily passed from the pisiform bone, subcutaneously to the metacarpo-phalangeal joint and to the basal part of the proximal phalanx of the thumb. Fig. 12 shows the case in which the transferred tendon has gradually moved dorsally to the carpo-metacarpal joint, resulting in impaired opposition movement because the passway of the tendon was situated too closely to the dorsal side. Reoperation in this case has fortunately been successful. Therefore, the passway of the tendon should be carefully determined.

4) The transferred tendon to the thumb is better to have a little stronger tension, for obtaining a good opposition movement. But if too

Fig. 12. A case showing inability of opposition due to the lateral translocation of transferred tendon



strong, such deformities as hyperextension of the metacarpo-phalangeal joint and flexion on the distal phalanx may be occasionally seen, resulting



Fig. 13. A case showing hyperextension of metacarpo-phalangeal joint of thumb due to a too-strong tension of transferred tendon

in a slightly impaired flexion movement of the metacarpo-phalangeal joint (Fig. 13). Even in case of these deformities, the opposition movement is well preserved and the function is usually not disturbed.

Sutures are then cut out after two weeks, and the wires are withdrawn after three weeks, when active motion is started. After three to six months, the muscle power is sufficiently restored and pinch and grasp are usually obtained satisfactorily.

SUMMARY

We have recently operated on 56 cases of claw hand and described the method of tendon transfer in Hansen's disease which occupied the majority of the cases, and several problems have been discussed from our experiences.

REFERENCES

1. BRAND, P.W. : The reconstruction of the hand in leprosy. *Leprosy Review* 24, 104, 1953
2. BUNNELL, S. : Surgery of the hand. Philadelphia, Lippincott. 1956
3. RIORDAN, D.C. : Tendon transplantations in median-nerve and ulnar-nerve paralysis.
J. Bone and Joint Surg. 35-A, 312, 1953