

TREATMENT OF CUT FLEXORS

By

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The severance of the flexor tendons of the hand is a rather common injury, the danger of which is obvious. It sets the surgeon a difficult problem to solve. Fortunately, thanks to the work of the North American school, the prognosis has changed considerably in the last few years and though the solution is not easy the results justify the trouble taken.

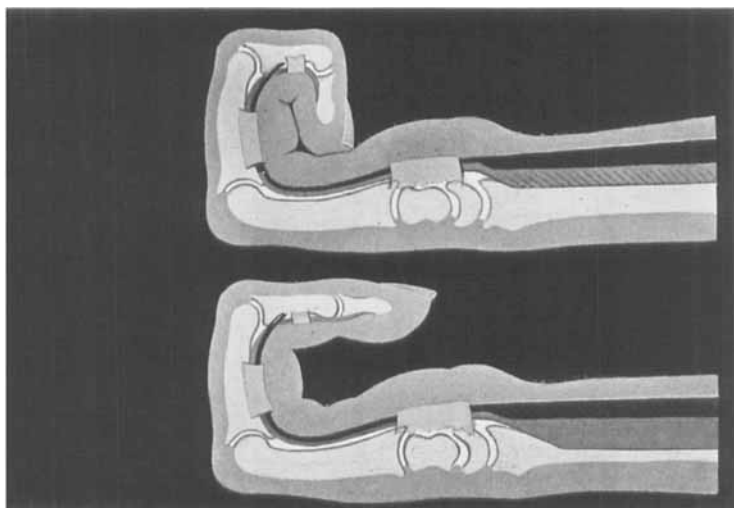
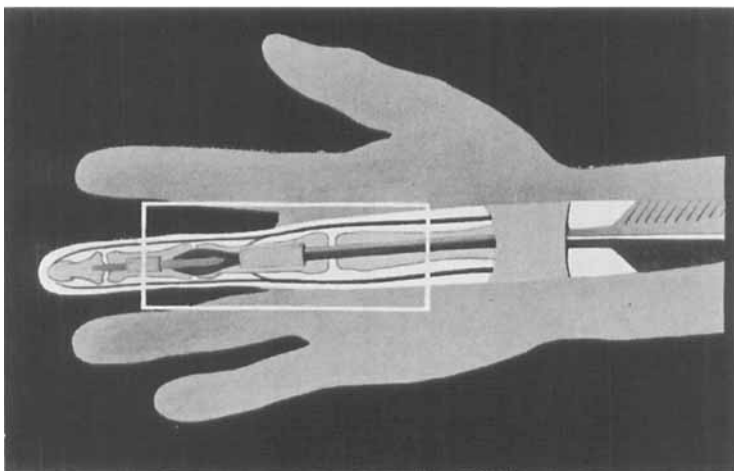
I shall not lose time in discussing the points of view of other authors on this subject since their opinions can be found in the literature. I shall try to show you the technique I employ and the results.

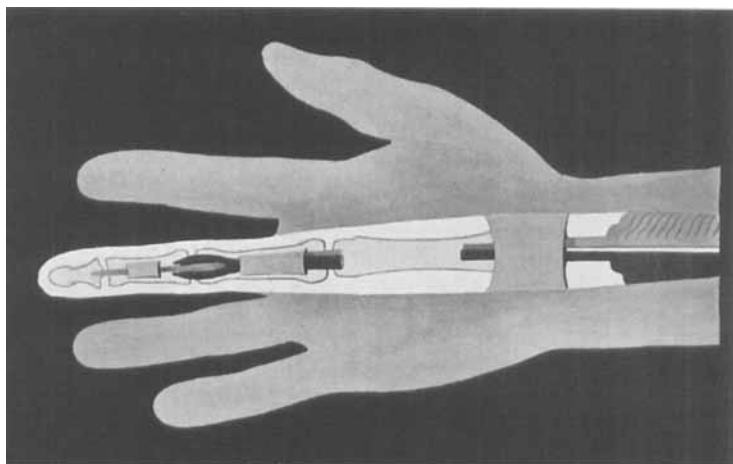
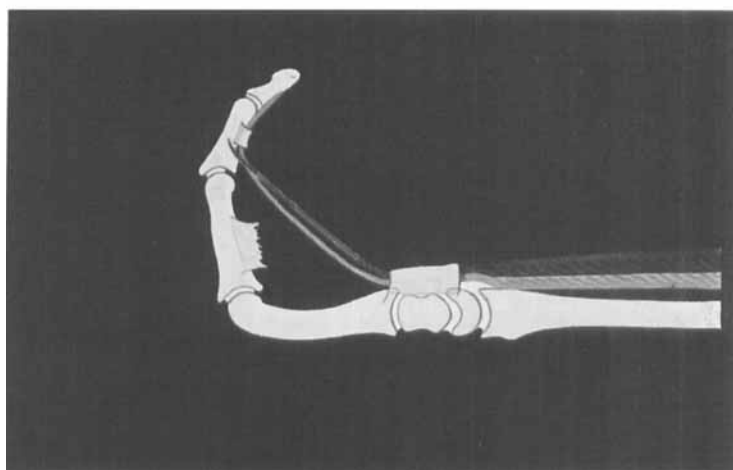
We find in anatomy texts that some structures of the hand are described minutely whereas others are hardly mentioned. We are taught in considerable detail the anatomy of the vessels which reach the tendons through the mesotendon. We are also taught the minute anatomy of the digital, radial and ulnar sheaths with their carpal prolongations. The carpal spaces so well described by Kanavel are also given attention. On the other hand, the digital nerves and the reflexion pulleys are respectively considered as mere terminal branches of the median and ulnar nerves and very nearly as enlarged zones of the tendinous sheaths.

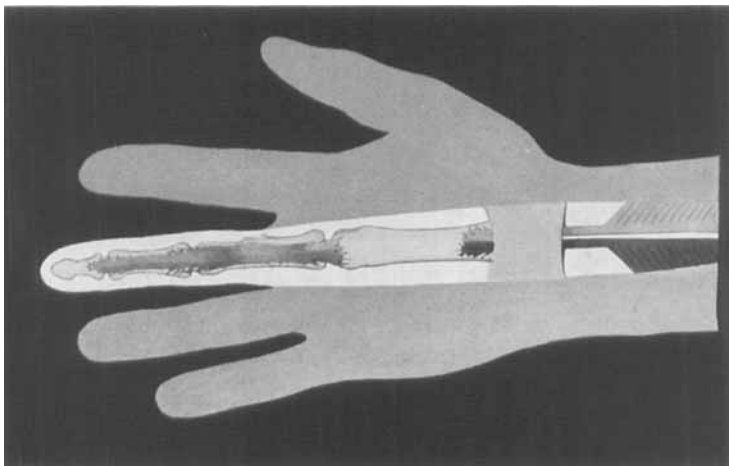
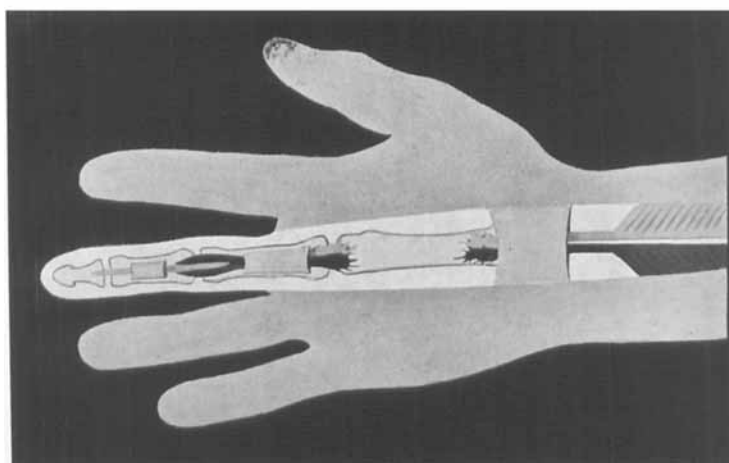
This anatomy belongs to the time when surgery of the hand was restricted to the treatment of the infections and phlegmons. It is not my intention to alter this, but I do wish to start from another point of view when studying the surgical technique for restoring flexors.

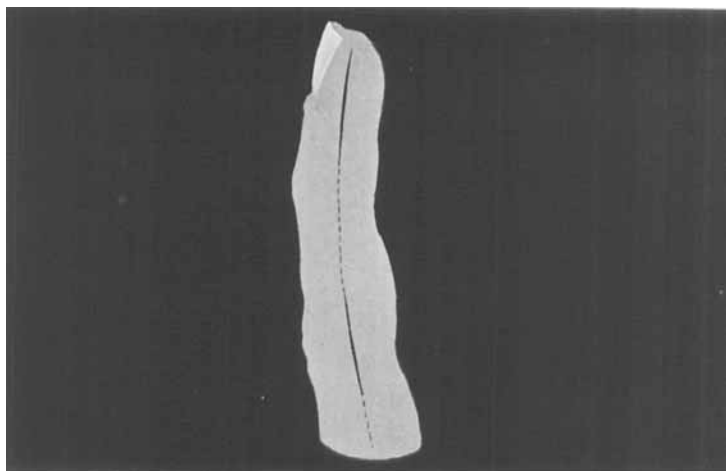
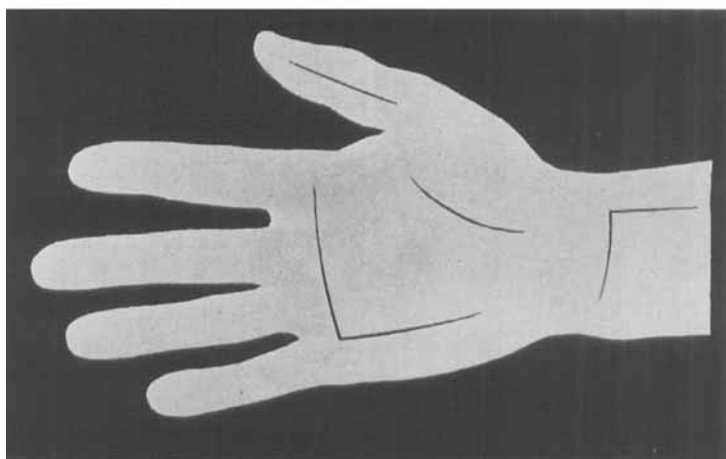
To see clearly the problems which confront us in the section of flexors, our anatomy will be confined (Fig. 1) to the digital nerves, the pulleys, and the flexor tendons.

Of the two tendons (Fig. 2) the *sublimis* works by bending the second phalanx over the first one and the latter over the metacarpal, the last interphalangeal articulation being kept flaccid. The *profundus* flexor bends the third phalanx over the second, the second over the first and the latter over the metacarpal. Therefore the *profundus* flexor

*Fig. 2.**Fig. 1.*

*Fig. 4.**Fig. 3.*

*Fig. 6.**Fig. 5.*

*Fig. 8.**Fig. 7.*

completely replaces the sublimis, but the latter cannot replace the former. This allows us to simplify still more the structures which are essential to us, reducing them to three; the digital nerves, the reflexion pulleys and the profundus flexor.

In Figure 3, you can see the importance of the reflexion pulley. The lack of this point of support for comparatively reducing the slipping of the tendons makes flexion impossible.

There is a zone, called by Bunnell "no man's land", that extends, marked in white in Figure 1, from the third upper part of the palm of the hand to the second pulley. No tendon suture will be made in this zone, since the danger of adhesion is too great.

When a flexor tendon is divided (Fig. 4) the proximal ends are retracted after the muscular contraction, whereas the distal ends remain inert "in situ". After fifteen days the distal and proximal ends adhere to the neighbouring tissues (Fig. 5).

For a period of two months after the lesion we are able to make the proximal end stretch as far as the distal one. After two months the muscular contracture has become definitive and it is already impossible to bring together the divided ends. After one year (Fig. 6), the distal parts lose their individuality and we can no longer see clearly which is the tendon, the sheath and the pulley.

When dealing with an injury of the flexors, we shall continue the surgical cleansing of the cutaneous and osseous wound, if any, delaying the solution of the nervous and tendinous problem until the right moment. It is not advisable, save in very rare cases in which the tendinous wound is practically clean surgically, to continue the suturing of the tendons immediately. It must be borne in mind that when seeking in the palm the retracted tendon ends with the possible retreat of the distal ends toward the digitis—when the damage was made with the fingers in flexion—it is necessary to make large incisions which involve a danger of contamination, and that the smallest inflammatory reaction leads to failure of the intervention. Therefore, when fifteen or twenty days have elapsed and the soft zones have healed we continue tendon repair making a free tendon graft or a suture in the very rare cases in which the latter is possible. We try to effect the suture when the lesion is not in the "no man's land" zone. Unfortunately, most of the tendinous damage to the flexor is at such a level that we are compelled to make a free tendon graft.

In cases in which two or more months have elapsed free tendon grafting is imperative, irrespective of the zone where the tissues were divided since the retraction of the flexor muscle is definitive.

In cases where more than one year has elapsed we shall instruct

the patient to perform exercises in order to develop the muscle whose tendons were divided, since if these muscles have degenerated owing to inactivity we shall be compelled to disregard this and make use of the sublimis of the fourth finger or some extensor of the carpus to effect the tenoplasty.

Before performing free grafts to the flexors we have to take care that the patient has good passive mobility in the metacarpophalangeal and interphalangeal joints and that there are no deep scars in the skin of the palmar surface. For this purpose, we continue a preoperative treatment of heat and massage, or the metacarpophalangeal capsulectomies which give such a good result. The interphalangeal rigidity that does not yield to the massage and heat treatment is very difficult to solve. We believe that no surgical intervention should be made to improve it. The interphalangeal arthroplasties are not advisable.

The lesions of the skin in the palm must be restored by pedicle flaps, since free (skin) grafts have no fat subcutaneous tissue and are not suitable for the good working of the tendons.

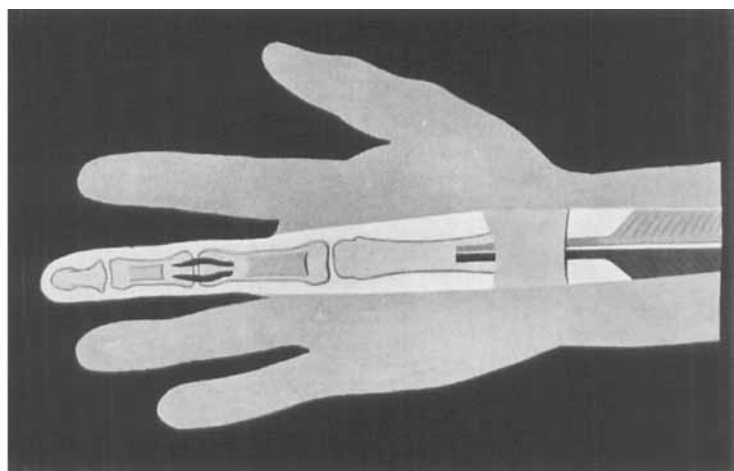
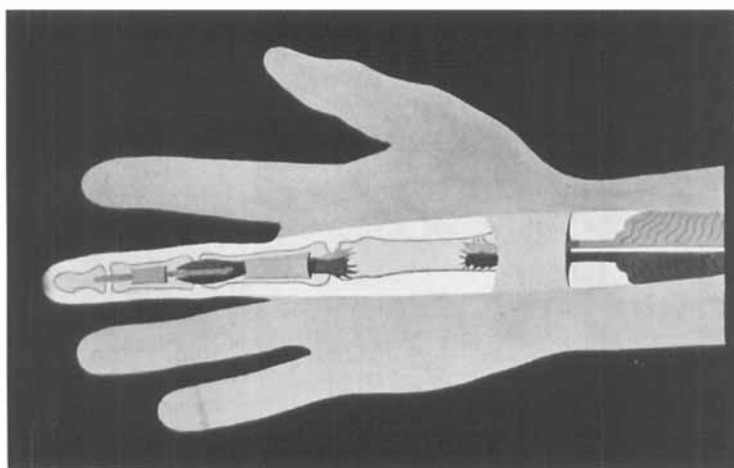
OPERATIVE TECHNIQUE

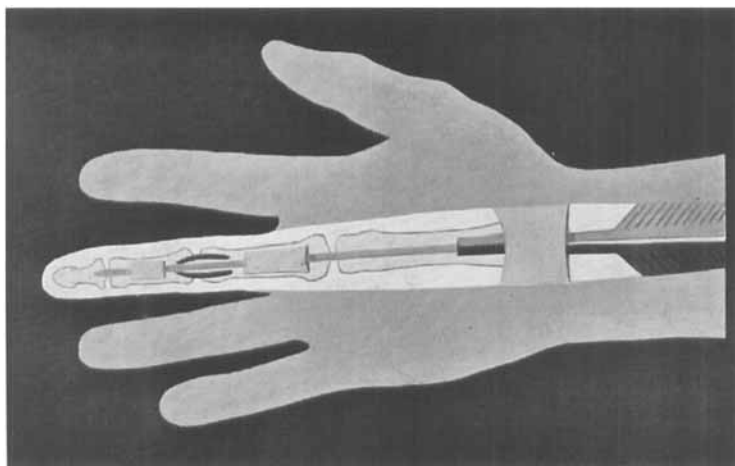
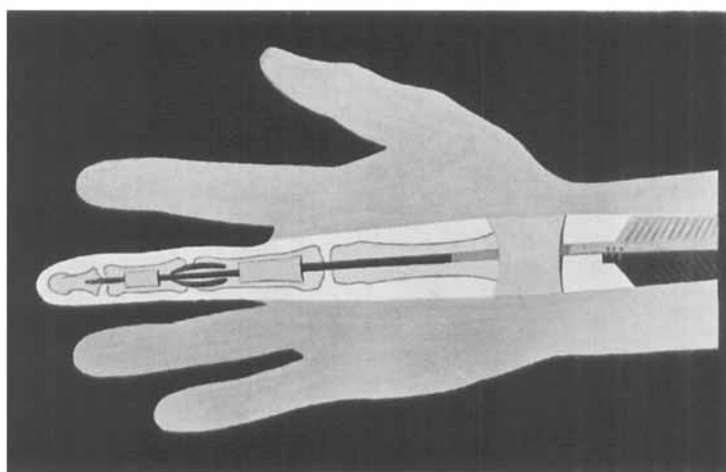
Brachial block anesthesia. Ischemia through pneumatic tourniquet.

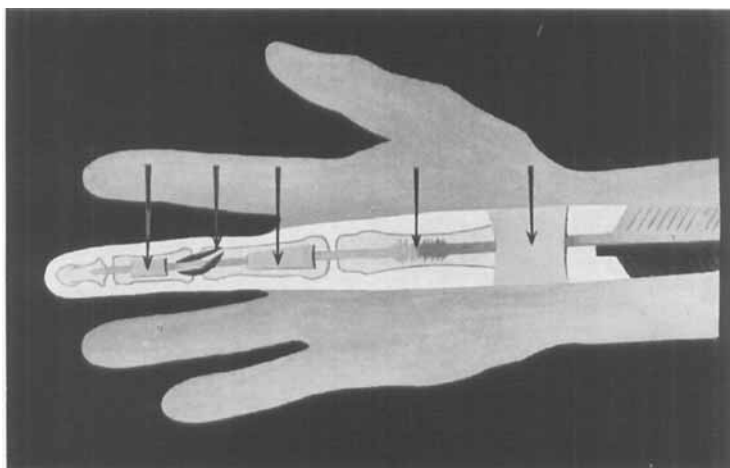
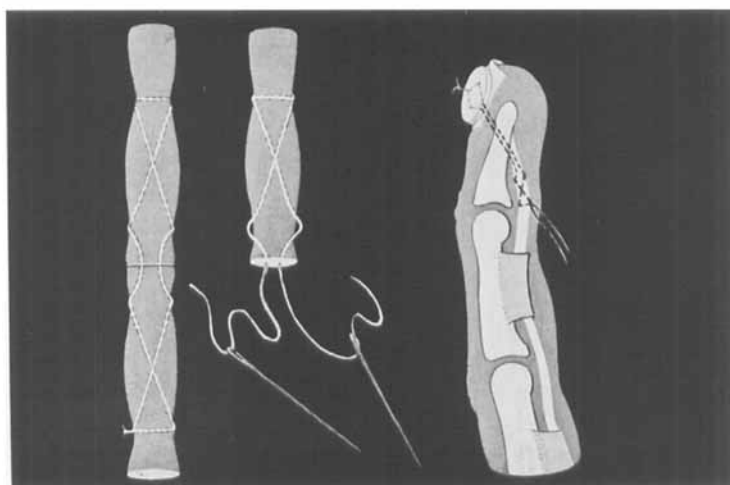
The incisions (Fig. 7), will follow the lines of the hand, forming an inverted L in the palm. In the forearm the incision will also be L-shaped. In the fingers, the thumb excepted, the incisions will be discontinuous (Fig. 8), i.e. 2 cms level with the first interphalangeal joint and 2 cms in the ball of the finger; both incisions can be united in case of technical difficulty. In the thumb two incisions will be made, a lateral one following the outer border of the finger without crossing the metacarpophalangeal joint and a curved one parallel to the so-called life line.

We shall extirpate (Figs. 9-10) the distal ends of the severed tendons, leaving one centimetre or two of the insertion slips of the sublimis. Sometimes one is compelled to cut the pulleys; if this happens or if the pulleys have been destroyed by trauma, they should be restored as they are essential elements. Resuturing will be carried out, if possible, otherwise a reconstruction with fascia or still better with free tendon graft ought to be made.

After that, we suture the digital nerves, if necessary with Tantalum wire, and begin the tenoplasty itself in which we employ two techniques. The first (Fig. 11) consists in extracting the sublimis tendon through the forearm incision and using it as free graft. At the same time we suture the muscular belly of the sublimis to the profundus in

*Fig. 10.**Fig. 9.*

*Fig. 12.**Fig. 11.*

*Fig. 14.**Fig. 13.*

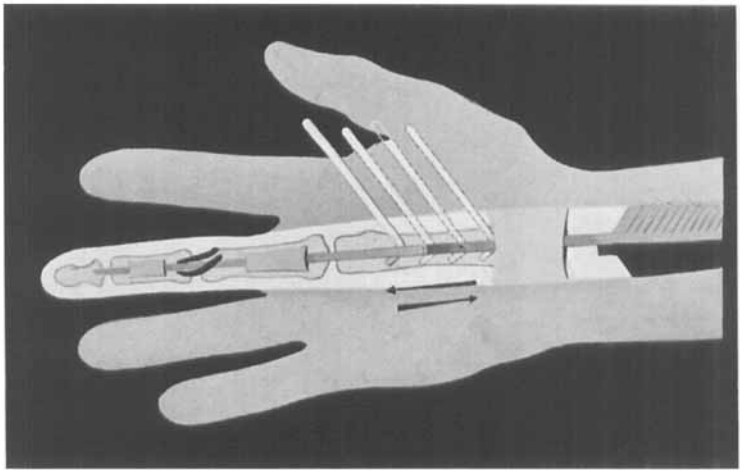


Fig. 16.

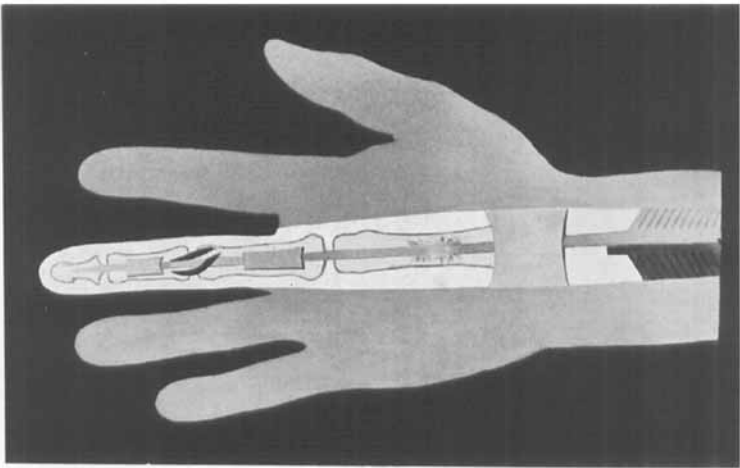
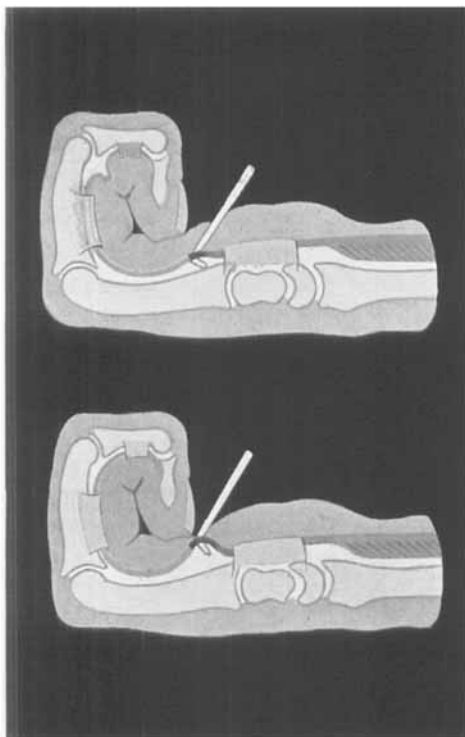
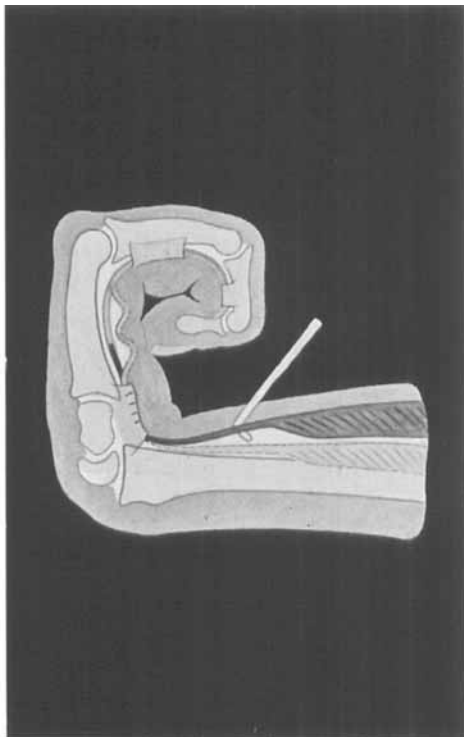
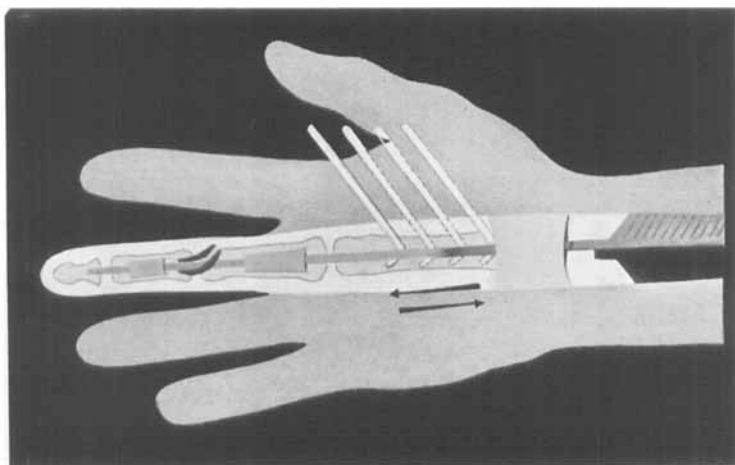


Fig. 15.

*Fig. 17.**Fig. 18.**Fig. 19.*

order to keep the whole flexor strong. Then we suture the graft in the base of the palm to the tendon of the profundus and compel it to pass by the inner side of the pulleys up to the distal phalanx where we insert it.

We make use of the second technique (Fig. 12) when the proximal end of the sublimis tendon is not long enough. In such cases the graft used is the palmaris longus or any of the extensors of the toes. We suture the graft in the palm to the sublimis and profundus tendons, and it is then passed through the pulleys until it reaches the phalanx.

We are not concerned about the tendon sheath. Formerly, influenced by the works of Leo Mayer, Thatcher and Ransohoff, we put in stainless steel plates which we took away after three weeks in order to introduce the grafts through the residual cavities. The results were bad, however, so we abandoned the procedure. I believe that the tendon sheaths are restored by the actual working of the tendons and I could clearly observe this in many cases in which I had to intervene again.

The tendon sutures which are made at any part, save the insertion in the distal phalanx, are performed with stainless steel and the point in double X (Fig. 13). The insertion on the distal phalanx is made with the pull-out-wire technique of S. Bunnell. The skin is sutured with silk or wire.

After three weeks we extract the suture by the pull-out-wire and the patient commences active movement.

COMPLICATIONS

The most frequent are: adhesions (Fig. 14), and failures of suture owing to premature exercise (Fig. 15).

The adhesions (see the arrows) take place in the carpal ligament, at the tendon suture and in the reflexion pulleys. Those of the carpal ligament are dangerous as well as those of the first pulley; less dangerous are those that take place in the tendinous suture provided that this has been made deep in the palm, since in such cases the adhesions are formed with the interosseus which always allows a certain motion. The least dangerous are those of the second pulley since very little tendinous slipping is required to bend the phalanx.

When a patient shows important adhesions after three or four months, it is better to make more interventions. To this purpose we commence (Fig. 16) cutting the adhesions at the line of tendon suture: then we bend the fingers passively (Fig. 17) and effect a traction of the tendon through which we shall detach adhesions in the pulleys. If they are very strong, it is necessary to incise the finger sideways and

dissect them with the scalpel. If we assume that there are adhesions on a level with the carpal canal, an incision is made in the forearm and, bending the fingers over the carpus and this over the forearm, we repeat the procedure carried out when dealing with the adhesions of the pulleys (Fig. 18).

These tendolyses are sometimes as difficult as the plastic operation itself and can be repeated two or three times. Fortyfour hours after operation the patient begins to flex the fingers.

Failure of the suture is treated by (Fig. 19) leaving free the tendinous ends; a scar cylinder is left between them.

In pages 212-217 are shown a few typical results obtained after treating 25 cases of free tendon grafts in the hand.

S U M M A R Y

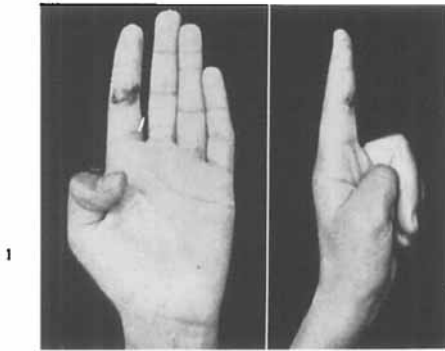
The author describes his personal approach to the treatment of injured flexors of the hand. Anatomically he confines himself to three major elements, the digital nerves, the reflexion pulleys and the profundus flexor. Surgically he presents a technique of free tendon grafting in which either one of two procedures may be employed. Finally he reports the complications ensuing from the above treatment and shows the results of some cases.

R E S U M E

L'auteur décrit les expériences qu'il a acquises personnellement sur le traitement des lésions des fléchisseurs de la main. Anatomiquement, il se borne à relever trois éléments majeurs: nerf collatéral, les poulies de reflexion et fléchisseur commun profond. Il présente une technique chirurgicale de ténoplastie dans laquelle on peut utiliser deux manières de procéder. Enfin, il rend compte des complications que peut entraîner le traitement susmentionné et montre les résultats obtenus dans quelques cas.

Z U S A M M E N F A S S U N G

Der Verasser beschreibt seine persönliche Behandlung des Problems der geschädigten Beugesehnen der Hand. Anatomisch beschränkt er sich auf drei Hauptelemente, die kollateralen Nerven, die transversen Sehnenscheiden-Ligamente und die Profundussehnen. Chirurgisch legt er eine Technik vor, mittels der entweder ein oder zwei Verfahren angewendet werden können. Zum Schluss berichtet er über die Komplikationen, die bei Anwendung der beschriebenen Technik entstehen können und zeigt die Ergebnisse in einigen Fällen.



TECHNIQUE 1

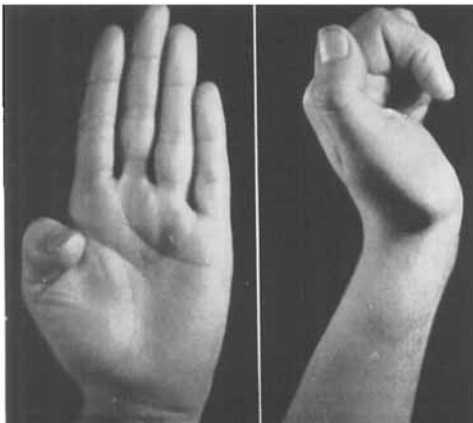
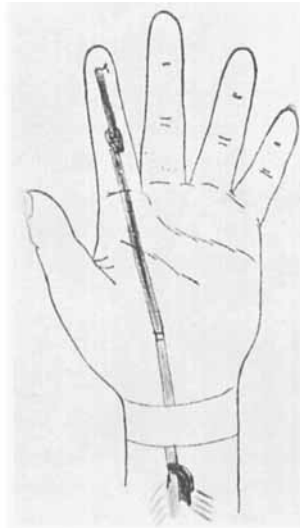
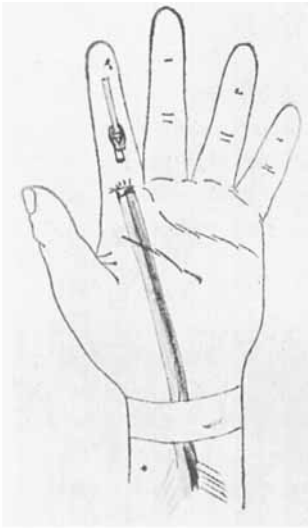
Case 4

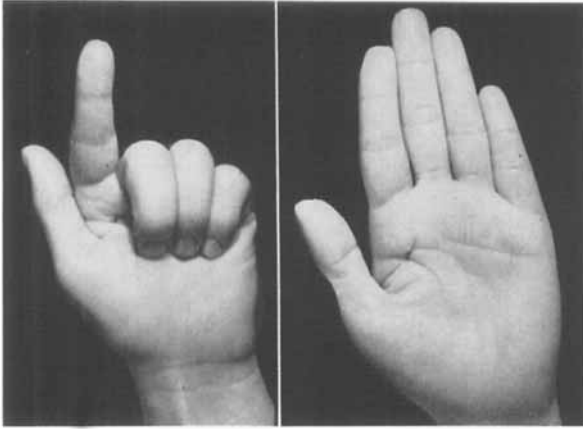
1-2 The hand before operation.

3 The lesion.

2 4 The operation.

5-6 Result after one tendolysis; The patient did not accept a second one.

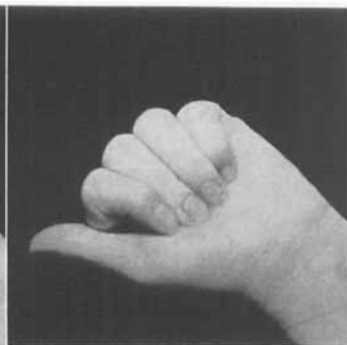
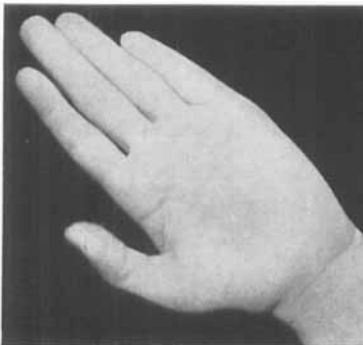
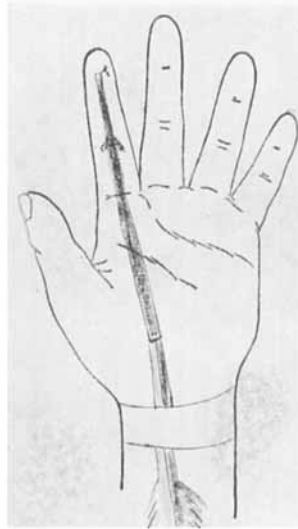
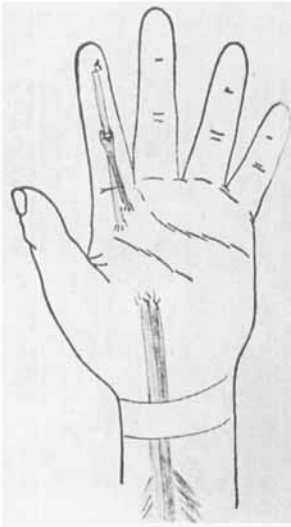




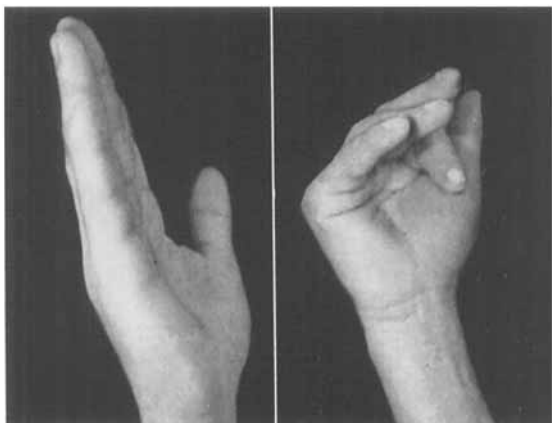
TECHNIQUE 2

Case 7

- 1-2 The hand before operation.
- 3 The lesion found.
- 4 The operation (graft, palmaris long).
- 5-6 Result without tendolysis.



1



2

*Cases with
both techniques.*

Case 2

1-2 The hand before the
operation.

3 The lesion found.

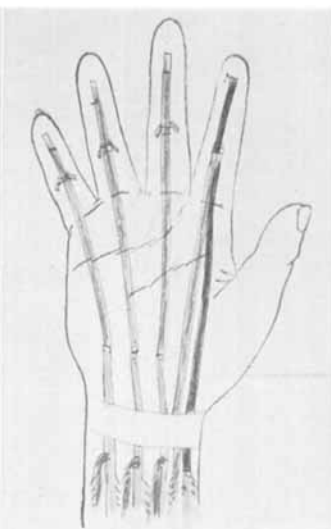
4 The operation; grafts,
3 sublimis and the
palmaris long.

5-6 The result without
tendolysis.

3



4



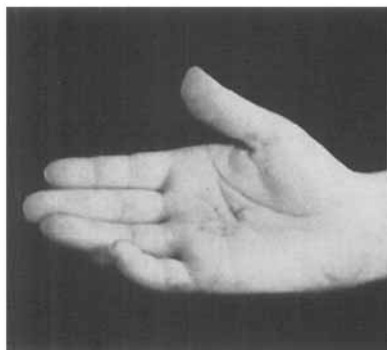
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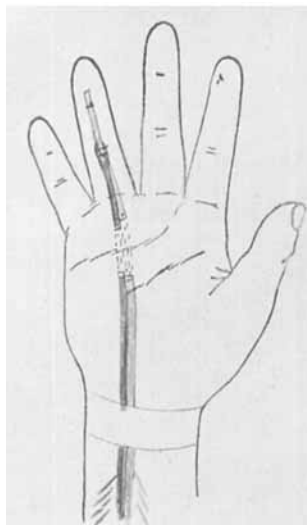
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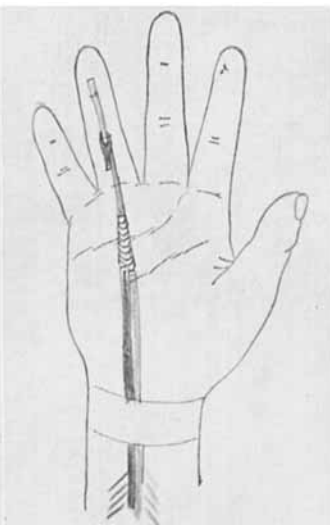
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*Failure
of the suture.*

Case 1

1-2 The hand before the operation.

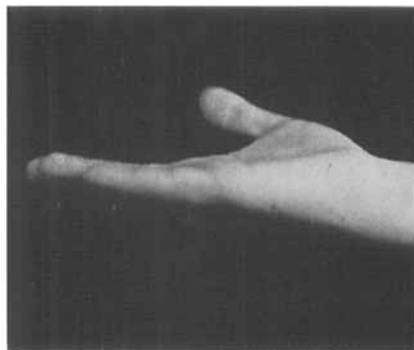
3 The lesion.

4 The operation.

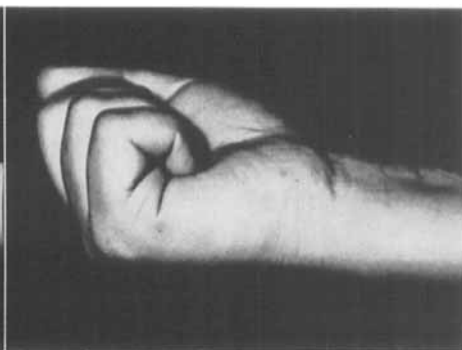
A scar cylinder was left between the tendon ends.

5-6 The result.

5



6





Atypical grafting.

Case 1

- 1-2 The hand before the operation (a bomb's lesion).
- 3 The lesion found.
- 4 First operation; tendon grafting with sublimis tendons, osteotomy of the first metacarpal. I tried to use stainless steel wire as tendon for the thumb, but it failed.
- 5 Second operation: tendon graft in the thumb with an extensor of the toes and operation for the opposition with extensoris brevis and extensor carpi radialis.
- 6-7-8 The result.

