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ON THE QUESTION OF THE INDICATIONS FOR PRIMARY AND DELAYED SUTURE AND FOR TENOPLASTY OF FLEXOR TENDONS OF THE HAND AND FINGERS

V. I. ROZOV

Among the various injuries of the hand and fingers the injuries to the flexor tendons, particularly those in the region of the synovio-aponeurotic structures take a special place. The repair and the functional restitution of these tendons still remains an unsolved problem as is being proved by numerous observations of Soviet and other authors (Dzhanelidze I. I., Rozov V. I., Vaynshteyn V. G., Nikolayev G. F., Dubrov J. G., Komrachev A. G., Pugachev A. G., Bunnell St., Bloch J., Zagadoun, J., Dubs J., Iselin M., Lier H., Watson A., Morley G., and others).

Hitherto, attention was centred on the primary suture of these tendons, but this involves numerous problems of great practical significance.

The efficacy of the primary suture of flexor tendons at the level of the forearm or the palm is, today, probably beyond any doubt, but the question as to the suture at the level of the synovial sheaths and aponeurotic ligaments still remains disputable.

Recently, Watson (1955) spoke against the primary suture of tendons at this level and Morley (1956) takes a similar view. Both authors regard an early tenoplasty using one extensor tendon of the toes as a free graft to be better than primary suture. Watson presents the results of this type of reconstruction of flexor tendons of digits in 51 patients whose treatment — as was stated by him — he was able to complete.

When considering the suture of flexor tendons it is necessary to distinguish between primary suture performed at the latest 20 hours after injury, and delayed suture performed within 10 to 20 days after injury provided the wound has healed by first intention.

For the proper appreciation of the advantages and disadvantages of either suture it is necessary to note a number of questions connected with the characteristic features of both operations.

1. In primary suture of tendons after trauma the danger of an infection of some kind despite the use of antibiotics is always present.

2. The conditions in an emergency operation are always less favourable than in an operation performed by a qualified surgeon calmly and according to a preconceived plan.

3. In view of these circumstances the chance of subsequent scar formation in the synovio-aponeurotic bed is greater in primary than in delayed suture.

4. When the tendon is severed at the level of the synovio-aponeurotic structures the tendon fragments part, the tendon sheath then remains empty and partly fills with blood. Experiments (Nikolayev, Rozov and others) have proved that obliteration of the tendon sheath starts 20 days after injury whilst the tendon fragments still remain ununited. Delayed tendon suture of the primary type can, therefore, be realized 10 to 20, and sometimes even 30 days after injury without the danger of complications, i. e. purulent infection of the post-operative wound.

5. The surgeon, who intends to perform delayed tendon suture, applies first aid by the surgical treatment and suture of the skin wound and the local application of antibiotics.

In other words: Delayed suture has certain advantages over primary suture in the treatment of tendon injuries at the level of the synovio-aponeurotic structures.

As far as tenoplasty is concerned the following types can be distinguished: Primary tenoplasty (Foss Hauge 1955; Töröková 1959), early tenoplasty, i. e. 20 to 30 days after trauma (Rozov, Watson, Morley and others) and late tenoplasty performed a longer period after the injury (Bunnell, Iselin, Rozov, Nikolayev and others).

Primary tenoplasty will hardly find many adherents because any injury brings with it the danger of purulent infection, and this must be reckoned with particularly in tenoplasty where the operation field is quite extensive.

Late tenoplasty is a suitable method for the reconstruction of flexor tendons of the palm and fingers a long time after injury. According to the majority of authors, however, this operation gives good results only in about 25 to 50%. This is not to be wondered at since any injury, open or closed, is followed by scar formation. These scars develop on the basis of necrotic and granulation tissue always present in an open tendon injury. Cicatrization of the tendons and the surrounding tissue is, therefore, the unavoidable sequence of every injury, and the longer the period that has elapsed since the trauma the bigger and tougher the scars and the more marked the morphological changes in the teno-aponeurotic apparatus. Hence the difficulties in surgical technique which is itself traumatizing, and, therefore, causes scar formation alongside the repaired tendon.

It is, therefore, not surprising that increased attention has recently been paid to early tenoplasty (Watson, Morley, Rozov and others) performed 10 to 20 days after the trauma when the wound has already healed.

On evaluation of the advantages and disadvantages of tenoplasty performed after different time intervals it follows that:

1. Primary tenoplasty entails the great danger of post-operative complications and can be performed only under particularly favourable circumstances.

2. Early tenoplasty, when performed by an experienced surgeon according to a well conceived plan and provided the wound has healed by first intention,

is relatively little traumatizing, because the exposure of the ununited tendon fragments from the synovio-aponeurotic tunnel does not require much effort.

3. Late tenoplasty — as was said before — depends on the dissection of the tendons from the scar tissue which leads unavoidably to the formation of new scars impeding the movement of the repaired tendon.

Of all these three types of tenoplasty early tenoplasty has, decidedly, the greatest advantage.

Speaking generally of tenoplastic operations it is necessary to mention one difficulty which must be reckoned with, i. e. assessing the length of the transplant. As a rule, the length of the graft is chosen so that after its fixation by suture in the finger and the palm the operated finger regains the position of a normal finger. This, however, does not permit account to be taken of the individual tendency of the patient for a certain degree of shrinking of the transplant.

The main cause of unsatisfactory results in the reconstruction of tendons by primary, delayed and late suture, or by tenoplasty, are, as is well known, scars which form at the site of the tendon suture and alongside the graft.

The problem of preventing the tendons from adhering to the surrounding tissue at the site of sutures and alongside the transplant, still remains unsolved. Some authors tried to use artificial materials, homo- and autoplasmic tissue (arteries, veins, fascia and others) but these experiments did not show any positive results.

Recently, at the surgical and pathological department of California University Centre experimental and clinical studies were made on the application of monomolecular cellulose filter tubes for the creation of artificial tendon sheaths in digits (Ashley, Stone, Alonso Artieda, Syverud, Edwards, Sloan, Mooney). The material of these filter tubes does not prevent diffusion of tissue lymph required for the healing of tendons, but, at the same time, it prevents the ingrowing of fibrous cells. The author unfortunately is not acquainted with the clinical results of the application of this special material.

What should, therefore, be the surgical tactics in solving this problem?

The main objective of surgical treatment of an injured tendon is to achieve the smallest possible formation of scar tissue in the surroundings of the suture and the graft and, at the same time, a scar sufficiently tensile.

For this purpose the following main conditions must be created:

1. A tenoplastic operation as well as the suture of tendons must in their respective indications be performed atraumatically with sharp, fine and special instruments.

2. In the post-operative treatment rational exercise and application of heat bring about a gradual loosening of fresh adhesions so that the tendon or the transplant remain sufficiently mobile.

3. Both the surgeon and the patient must realize that postoperative rehabilitation after the reconstruction of a tendon takes several months. The final functional result is obtained after approximately one year.

Based on reports in the literature and on his own experience the author was recently guided in practice by the following indications for primary and delayed suture and for early tenoplasty:

1. In injuries to tendons in the region between the distal palm and the metacarpophalangeal flexion grooves:

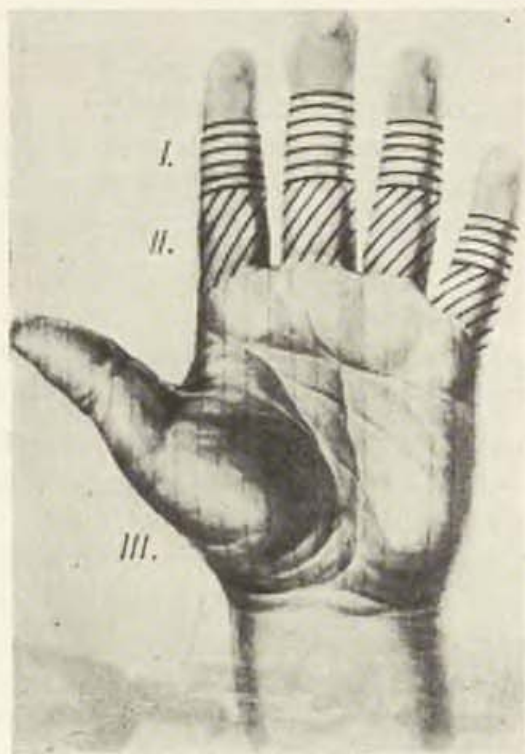


Fig. 1. Typical damage areas of flexor tendons of the hand and the recommended methods of reconstruction. — 1. and 3. area — primary suture until 20 hours, or delayed suture up from the 10th to the 20th day. — 2. area — early tenoplasty from the 10th to 30th day.

a) if the distal fragments of the tendons appear in the wound on passive flexion of the finger, it is necessary to place a primary suture through the profundus tendon and resect both ends of the sublimis tendon. It must be recalled that such a situation arises most frequently when the hand was in the position of extension at the moment of injury;

b) if the ends of the tendons cannot be found in the wound in full flexion of the fingers it is better to sew up the wound and book the patient for an early tenoplasty 10 to 20 days later.

2. In injuries to flexor tendons at the level between the metacarpophalangeal and first interphalangeal flexion grooves:

a) if the distal fragment of the profundus tendon can be found at the level of the middle phalanx on extending the wound distally primary or better still delayed suture of the profundus tendon is indicated. In this instance the tendons of the injured finger are uncovered by an additional incision in the palm and

threaded under the skin into the original wound; the sublimis tendon is resected and the proximal fragment of the profundus tendon threaded through the teno-aponeurotic tunnel by a special guide to reach its distal end, to which it is then sutured;



Fig. 2.

b) if the distal end of the profundus tendon is found at the level of the proximal phalanx it is better to sew up the wound and book the patient for an early tenoplasty.

3. In injuries at the level of the first interphalangeal flexion groove the distal end of the profundus tendon can usually be found at the level of the middle phalanx. Therefore:

a) it is necessary to find the proximal end of the profundus tendon by applying pressure to the muscles of the forearm and at the same time keeping the radiocarpal and finger joints flexed. By this manoeuvre the proximal end of the profundus tendon as a rule appears in the wound and is temporarily caught by an auxiliary suture which serves to apply the necessary pull whilst both ends of the tendon are sutured. The sublimis tendon is also pulled out of the wound and resected through an incision in the palm;

b) if on the above-described manoeuvre the proximal end of the tendon cannot be found it is necessary to make a semi-circular incision in the palm, separate the severed ends of both tendons and pull them out of the wound. Then with the aid of a guide the profundus tendon is threaded through the synovio-

aponeurotic tunnel into the original wound on the finger for suturing. The sublimis tendon should be resected;

c) both operations can be performed as primary or better delayed suture.

4. In injuries at the level of the middle phalanx only the profundus tendon is severed. In such a case:

a) the proximal fragment of the profundus tendon can usually be found in the wound of the finger by the above-described method. The aponeurotic annular ligament is slightly incised on one side in order to make tendon suture possible;

b) if it is not possible to find the proximal end of the profundus tendon in the wound it is necessary to make an incision in the palm to separate the profundus tendon and thread it through the tunnel with a guide so that it can be sutured to its distal end.

Here it is necessary to draw attention to a very important technical detail. On threading the proximal fragment of the profundus tendon through the aponeurotic tunnel it must be led in its bed underneath the sublimis tendon and through the fork of the sublimis insertions.

In injuries to the thumb in the region of the phalanges and the thenar with severing of the flexor pollicis longus tendon primary or delayed suture is indicated. Here it needs to be pointed out that the proximal end of this tendon can nearly always be found lying in its bed between the insertions of the flexor pollicis brevis when the wound is extended towards the palm.

According to the indications described above the following operations were performed at the Institute in the last three years:

1. Primary suture in 27 patients on 35 fingers
2. Delayed suture in 18 patients on 23 fingers
3. Early tenoplasty in 18 pat. on 24 fingers

A total of 63 patients and 82 fingers

For the control of the functional results after operation on tendons it was necessary to use a rather simple method of evaluation, because in a number of cases the author had to evaluate the results only from written replies.

a) A good result was recorded when the operated finger could be flexed actively at all joints or if there was certain limitation of flexion in the distal interphalangeal joint.

	Number of patients	Number of fingers	Results		
			good	satis- factory	unsatis- factory
Primary suture	17	21	13	1	7
Delayed suture	10	13	9	3	—
Early tenoplasty	13	16	13	—	3

b) A satisfactory result was recorded where in the presence of a flexion contracture not greater than 140 to 150° of the proximal interphalangeal joint, flexion of 90° could be attained, and the patient was satisfied with the result.

c) An unsatisfactory result was recorded where the finger remained contracted in flexion or extension with only slight mobility of the proximal interphalangeal joint.

The results obtained by a check-up of patients with injuries to flexion tendons of digits are shown in the table on page 266.

From the presented data it emerges that in suitable indications primary suture as well as delayed suture and early tenoplasty give quite satisfactory results, but that delayed suture and early tenoplasty have evident advantages over primary suture which confirms the author's assumption made above (Fig. 1 and 2).

S U M M A R Y

The reconstruction of flexor tendons of the fingers of the hand at the level of the synovio-aponeurotic structures is still an unsolved problem.

On the basis of his own experience and reports in the literature the author deems it expedient to distinguish three levels of injuries to the tendons on the palm and the fingers. In dependence on the level of injury to the tendon, primary or delayed suture, or early tenoplasty is indicated.

In primary or delayed suture the main point is that during the period of healing (20 to 21 days) the suture of the tendon should not come to lie at the so-called "mute" middle level.

When comparing the results of primary and delayed suture the author prefers delayed suture.

In cases where neither primary nor delayed suture is indicated, early tenoplasty which results according to the author's experience are quite satisfactory, is advisable.

Adhesions at the site of the suture and alongside the graft are an intricate biological problem requiring comprehensive study by surgeons, biologists, biochemists and other specialists.

Under the present circumstances efforts to prevent adhesions are aided by well-tried means, such as atraumatic technique and rational post-operative treatment comprising both favourable conditions for the healing of the tendon and rational exercises for a long period.

В Ы В О Д Ы

К вопросу о показаниях к первичному, отсроченному шву и тендопластике сухожилий

В. И. Розов

Восстановление сухожилий сгибателей пальцев кисти в пределах синовиально-апоневротических образований до настоящего времени составляет не вполне разрешенную проблему.

На основании нашего опыта и литературных данных мы считаем целесообразным выделить три зоны повреждений сухожилий на ладони и пальцах. В зависимости от

повреждений сухожилий в той или другой зоне ставятся показания к первичному, отсроченному шву или ранней тендопластике.

При первичном, отсроченном шве основная задача заключается в том, чтобы шов сухожилия до сращения (20—21 день) находился в пределах крайних зон синовиально-апоневротических образований, примерно вне так называемой «немой» средней зоны.

Сравнивая первичный и отсроченный шов сухожилий, мы склонны отдать предпочтение отсроченному шву. По нашим данным первичный шов на 21 пальце дал хороший результат на 13, удовлетворительный на 1 и плохой на 7. Соответственно отсроченный шов на 13 пальцах — на 9 хорошо и 3 удовлетворительно.

Там, где первичный или отсроченный шов не показан, целесообразно применить раннюю тендопластику, которая по нашим данным дает вполне удовлетворительный результат: из 16 оперированных пальцев в 13 получен хороший результат.

Вопрос о сращениях в местах швов сухожилий и по ходу трансплантатов представляет собою сложную биологическую проблему, которая требует глубокого изучения с участием хирургов, биологов, биохимиков и других специалистов.

В настоящих условиях в борьбе со сращениями помогают испытанные средства в виде атравматичной техники, рациональной послеоперационной терапии, включающей в себя сочетание благоприятных условий для сращения сухожилия, в виде иммобилизации кисти в течение 3-х недель с дозированными возможными активными движениями пальцев, тепловых процедур и специальной гимнастики в течение длительного периода.

R É S U M É

Contribution à la question de la ténoplastie primaire et secondaire des fléchisseurs de la main

V. I. Rozov

La reconstruction des fléchisseurs des doigts de la main au niveau des formations synovio-aponeurotiques reste toujours un problème ouvert.

A la base de nos propres expériences et de celles des autres auteurs nous considérons raisonnable de reconnaître 3 régions d'endommagement des tendons de la paume de la main et des doigts. A l'égard de la région, où c'est déroulé le traumatisme des tendons, on indique la suture primitive, secondaire, ou la ténoplastie précoce.

Le principal dans la suture primitive ou secondaire — c'est de la situer de la manière qu'elle ne se trouve pas dans la soit-dite zone muette moyenne au moment de la soudure, c'est-à-dire à partir du 20—21^{er} jour de la guérison.

Faisant comparaison entre la suture primitive et secondaire, nous préférons la secondaire.

Dans des cas où il n'y a pas de préférence ni pour la suture primitive ni pour la secondaire, la ténoplastie précoce, dont les résultats sont assez encourageants quand à nos propres expériences, reste la méthode de fait.

Les adhésions autour des piqure et le long de la ténoplastie représentent un problème biologique très important, exigeant du travail expérimental sous la collaboration des chirurgiens, des biologistes, des biochimistes aussi bien que d'autres spécialistes envisagés.

A l'état actuel du combat contre les adhésions nous n'avons à nos aides que des moyennes jusqu'alors éprouvées, c'est-à-dire la technique atraumatique et les soins post-opératoires faisant favorables les conditions de la guérison du tendon, les exercices rationnels à la longue y compris.

ZUSAMMENFASSUNG

Zur Indikationsfrage der primären und sekundären Fingerbeuge-Sehnennaht und Plastik

V. I. ROZOV

Die Wiederherstellung der Fingerbeuge-Sehnen in der Höhe der synovial aponeurotischen Gebilde ist bis heute ein ungelöstes Problem.

Auf Grund von eigenen Erfahrungen und Literaturangaben glauben wir als zweckmässig 3 Gruppen von Sehnenverletzungen an der Handfläche und an den Fingern zu unterscheiden. Die Indikation einer primären, sekundären Suture oder frühzeitigen Sehnenplastik ist von der Zone abhängig in der es auch zur Sehnenverletzung kam.

Die Hauptaufgabe der primären und sekundären Suture beruht darin, dass die Sehnen-Suture bei der Adhäsion (20.—21. Tag) nicht in der sog. „stummen“ Zone vor sich geht.

Vergleichen wir die primäre Suture mit der sekundären Suture, geben wir der sekundären Suture den Vorzug.

In Fällen, wo weder eine primäre noch sekundäre Suture indiziert ist, ist die Durchführung einer frühzeitigen Tendoplastik zweckmässig, deren Ergebnisse, unseren Erfahrungen nach, völlig befriedigend sind.

Die Frage der Adhäsionen in der Suture und dem Sehnen transplantat entlang ist ein kompliziertes biologisches Problem, das ein tieferes Studium in Zusammenarbeit mit Chirurgen, Biologen, Biochemikern und anderen Fachleuten erfordert.

Bei dem heutigen Stand sind im Kampf mit Adhäsionen bewährte Mittel, wie atraumatische Technik und eine rationelle postoperative Behandlung behilflich, die einerseits günstige Bedingungen zur Sehnenheilung, andererseits auch langfristige Übungen einschliessen.

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OUR TECHNIQUE OF PEDICLE SKIN FLAPS AND ITS USE IN THE SURGERY OF THE HAND AND FINGERS

J. HOLEVICH

Free skin grafting and grafting of skin attached to a nutrient pedicle are frequently used in reconstructive surgery of the hand and fingers. Many investigators have dealt with this problem (Parin, B. Blokhin, Bunnell, Iselin, Karfík, Demjén, Morel-Fatio, Vilain, Marcer, Bonola and others).

The subject of this paper is the description of a modified pedicle skin flap technique which we developed in 1953. Until then we had been using methods which are well known in the literature: the Italian method, pedicle flap followed by coverage of the donor area, free skin grafting, bridge flap, tubed flaps, and pocket-graft.

An analysis of the results revealed that none of the methods cited above fulfils all the requirements of reconstructive surgery of the hand. Each has its shortcomings. The disadvantage of the Italian method is the formation of granulation tissue on the exposed surface of the pedicle base. Bunnell considers it an inevitable evil. The exposed area becomes dried, which causes thrombosis of the veins and impairs the blood supply to the flap, leading at times to necrosis. Infection easily gains access to the wound, particularly if the ligaments and joints are exposed. Covering the donor area with a free graft does not do away with this danger since in almost every case a narrow granulating surface remains at the base of the covering flap. Tension as a result of involuntary movements or of the weight of the hand itself is transmitted to the covering flap. The base of the pedicle is raised and a cavity forms beneath it. At times partial dehiscence of the sutures may occur.

Maceration and infection originating at the exposed base are the most common features of the bridge flap and the pocket-graft.

The Filatov flap eliminates the basic shortcoming of the Italian method, but it is not always possible to cover a large surface 30 cm. or more in length in one stage. In such a case Bunnell recommends excision of only part of the scar in the first stage. In cases of extensive scarring he advises surgery only in the most severely deformed areas. With such a method it is not always feasible to cover large defects in cases of recent injuries. A wedge-shaped graft can only

cover a not-too-large surface on the fingers or part of the hand. The many stages and the long period of treatment are also disadvantages of the tubulated flap. For these reasons the tubulated graft is used for large defects of the hands and forearm. Its importance, however, remains undiminished as a universal method in reconstructive surgery.

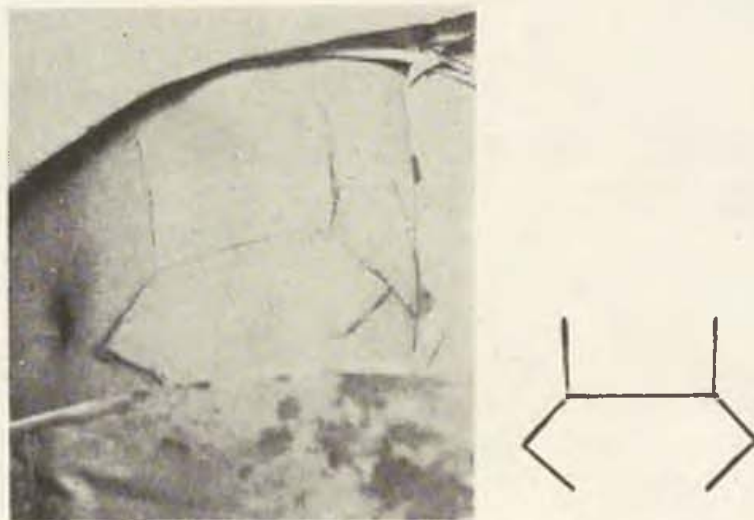


Fig. 1. Method of incisions on the wall of thorax and abdomen.

The operative technique of the modified Italian method developed by us is as follows:

Two skin flaps are cut on the appropriate side of the thoracic and abdominal wall, one on a top and the other on a bottom pedicle. The flaps may be 30 to 35 cm. wide, depending on the distance from the medial to the axillary line, and 12 to 15 cm. long. The width of the flap at the top pedicle should be about a fourth greater than the length of the defect. This is especially important in covering defects on the dorsal surface of the hand as a large excess of skin is imperative for insuring full movement of the fingers. In order to insure nutrition for the flap, its width should not be less than its length. Triangular flaps with an angle of 90° are made from both sides of the flap at the bottom pedicle (Fig. 1 and 2).

After the flaps are cut, the edges of the resulting triangular defects are sutured together. Thus a flap is shifted to the site of the flap on the top pedicle without the slightest tension. The lateral projections of the lower flap may be removed later by partial excision. To prevent a pocket or an exposed wound surface from being left, the upper free edge of the bottom pedicle flap is sutured in the following manner: At first the subcutaneous tissue is sutured to the subcutaneous tissue or to the superficial fascia in the extension of the upper pedicle flap (Fig. 3). The edges of the skin of the flap are then sutured to the edge of the defect in the hand (Fig. 4). The skin on the hand is incised for a distance of several millimeters for better adaptation, and incisions less than 0.5 cm. are made on the sides. The sutures are made with the knots lying on the outer side. Donati-Blair sutures are often used in these cases. It is advisable to use perlon

as the suture material so as to prevent maceration. This suture is the key to the operation because it makes it possible to attain complete coverage of the wound and healing by first intention. Furthermore, it fixes the hand to the abdomen, and the covering flap is placed on the wound surface without the slightest tension, without cavity formation due to raising of the flap, and without danger



Fig. 2. Cutting the flap.

of necrosis. Finally, the flap of the top pedicle is used (after removal of excess subcutaneous tissue) to cover the defect on the hand (Fig. 5).

Artificial syndactylia is performed before covering the defect if the scarring extends over to the fingers.

In other cases depending on the shape and localization of the skin defect, the flaps may be fashioned in such a way as to permit exchange. Usually, the flaps do not extend beyond the midline of the abdomen.

In cases of small skin defects such as on the dorsum of the finger, this technique is combined with a donor graft from the isolateral inguinal region or from the contralateral axillary region.

Plaster cast fixation was not used in the postoperative period. A Velpeau dressing was found to be sufficient. In certain instances the forearm is fixed by a suture to the thorax, as an additional measure to prevent separation of the hand from the abdomen. In the first few hours after operation it is extremely important to insure proper positioning of the hand, by means of a bandage, to prevent acute angulation of the covering flap. Dermatol or sulphonamide is applied under the flap, and the wound is dressed daily from the fourth day on. The nutrient pedicle is severed after 20 to 25 days.

Our method has been used in 59 patients, in whom 62 operations were performed, for the following causes:

1. cicatricial contracture of the hand due to burns — 35
2. cicatricial contracture due to severe injury — 11
3. contracture due to electrical burns — 2

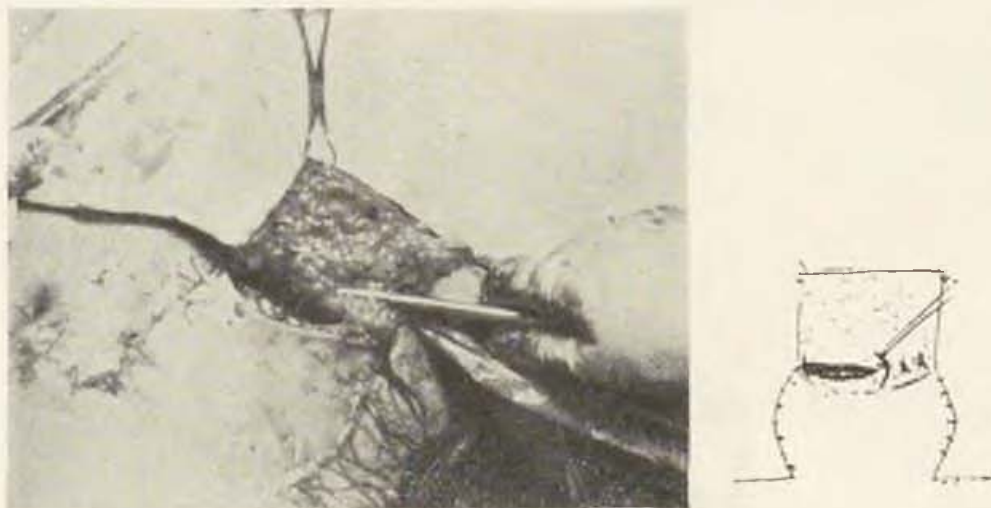


Fig. 3. Flap on lower pedicle has been shifted and covers donor area. The sutures may be seen in the subcutaneous tissue.

4. X-ray damage — 2
5. parakeratosis of the palm — 2
6. large skin defects in fresh injuries of the hand — 1
7. tuberculosis of the skin — 1
8. coverage of nail defect of the hand in cineplasty of the forearm.

Our technique was used most commonly in the treatment of severe ramiform, cicatricial contractures of the hands and fingers (32 cases). This type of injury has certain peculiarities which have been described by different workers and also by us (damage or complete destruction of the ligaments, deformity, pathological dislocation, ankylosis etc.). In order to preserve the shape and function of the hand in such cases it is absolutely necessary, firstly, to have a large reserve of skin which is sufficiently elastic and mobile and, secondly, to reconstruct carefully the damaged ligaments, veins and so forth.

In injuries of a different character and localization our method was used only for large, multiple and severe damage. Only in the case of one patient, who had parakeratosis of the palm, was a pedicle flap used even though the pathological process had not gone very deep.

The method was used only once for fresh injuries. We are of the opinion that the use of our method is indicated in tissue destruction combined with large skin defects.

The postoperative period was uneventful in 41 patients. In the remaining patients the following complications were observed:

1. Small areas with venostasis and necrobiosis of the flap folds. This complication is almost invariably due to bad positioning of the hand in the post-operative period with consequent puckering at the base of the flap.

2. Dehiscence of the sutures at the base of the flap. In two patients almost all of the sutures were excised in this area, and in several other patients, only

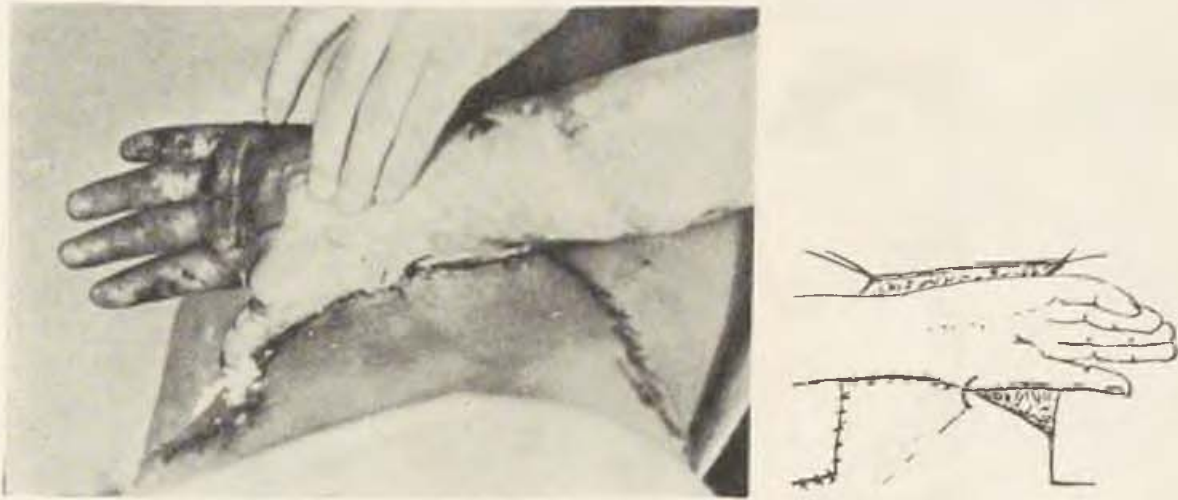


Fig. 4. Suture between flap covering donor area and corresponding side of defect.

in part. This complication usually arises as a result of inadequate adaptation (the Donati-Blair stitches have only recently been used), unsuitable suture material, or maceration from inadequate postoperative care. On the other hand, it should not be forgotten that the sutures are stretched by the weight of the hand or movements of the patient. The sutures on the covering flap have the purpose of reducing the tension.

3. Subcutaneous haematomata. This complication occurs quite often. To circumvent it a perfect haemostasis, and a light compressive dressing are necessary for the first 24 hours.

4. Partial suppuration was seen only once.

The complications described did not have any important effect on the final result of the operation. Plastic repair was successfully completed in all of the patients. Only in complications connected with dehiscence of the sutures at the flap base (which, incidentally, made possible the use of the Italian method) was the skin less elastic. In all other cases the skin of the flap preserved its normal elasticity and its mobility on the tissue layers beneath it. Moreover, it was not raised above the neighbouring skin. Deformity was eliminated even in the most severe cases. The functional results varied according to the degree of damage to the deeper tissues and mainly according to the condition of the joints. Reconstruction of both methods of grasping objects was achieved in patients in whom contractures and pathological dislocation were not accompanied by bone ankylosis. In patients with multiple bone ankylosis, grasping was achieved only with the finger tips.

The introduction of our method enabled us to carry out bolder reparative operations combined with skin grafting in one or two stages.

The following procedures were combined with skin grafting:

1. osteotomy — 3
2. osteoplasty — 2



Fig. 5. Defect of the hand covered by the flap on upper pedicle.

3. metallic osteosynthesis — 3
4. free ligament grafting — 3
5. plastic operation by means of a pedicle flap of the paratenon —
6. neurolysis or suture of nerves — 2
7. extension of ligaments — 6
8. capsulotomy — 13
9. arthroplasty — 2
10. muscle shifting — 4
11. shifting of fingers — 1
12. cineplasty of the forearm muscles — 8.

All of these procedures were performed somewhat in opposition to the commonly accepted view that the deep tissue layers should be reconstructed a month or more after skin grafting. Our experiences have confirmed not only the possibility but also the superiority of comprehensive reconstruction in a single stage with the method described.

The technique and results of the operations on the deeper tissue are not the subjects of this paper. Only the pedicle flap of the paratenon described by us will be discussed here. The loose epifascial tissue of the abdominal wall is used. At first, the epifascial tissue is cut together with the skin flap, then it is divided and the ligaments are covered. With the pedicle flap method for covering the paratenon it is less likely that necrotic changes will occur (Fig. 6—8).

The following reparative procedures were performed in two stages:

1. arthrodesis — 1
2. shifting of ligaments — 3
3. free transplantation of ligaments — 6
4. phalangization — 2



Fig. 6. Skin flaps (1 and 2) and pedicle epifascial covering (3).



Fig. 7.



Fig. 8.

Fig. 7. The ligaments may be seen without their paratenon covering, after excision of scars on dorsal surface of hand. — Fig. 8. Ligaments covered by epifascial capsule. The skin flap is prepared to cover the defect of the hand.

5. division of fingers — 7
6. arthroplasty — 1
7. torsion osteotomy — 1
8. osteoplasty — 2.

Analysis of recent and previous results shows that our modification of the Italian method is the method of choice for covering large skin defects of the dorsum or palms of the hand arising from excision of large scars. This method



Fig. 9a. Patient I. M. T. before operation.



Fig. 9b.



Fig. 9c.



Fig. 9d.

Fig. 9b, c, d. Patient I. M. T. after operation.

also permits the covering of defects in severe fresh injuries and in other diseases of the hand.

The advantages of the method are:

1. the possibility of covering large skin defects, in one stage, and reducing the duration of treatment



Fig. 10a. Photograph of patient B. D. I. before operation.



Fig. 10c.



Fig. 10d.

Fig. 10c, d. The same patient after operative treatment.

2. complete coverage of the entire wound surface, whereby it becomes feasible to reconstruct the ligaments, joints and so forth simultaneously with the skin grafting.

3. lack of tension of the covering flap and the absence of cavity formation at the base

4. it does away with the necessity for immobilization by a plaster cast.

The following cases are presented from our series of patients.

1. Patient I. M. T. (protocol number 30/55) came to the Institute with disfiguring scars from burns on the neck and upper right limb. He had severe extension contracture of the hand. The thumb was drawn towards the palm. The extensor ligaments were destroyed. X-rays showed ankylosis of the metacarpophal-

langeal joints on the first, second and third finger and the interphalangeal joints of the first and second finger. The patient was not able to grasp any objects. The following was performed: excision of the scars, multiple capsulotomy, arthroplastic resection of the second and third carpo-metacarpal joint, followed by covering of the large defect on the hand and forearm by means of the method



Fig. 11 a.

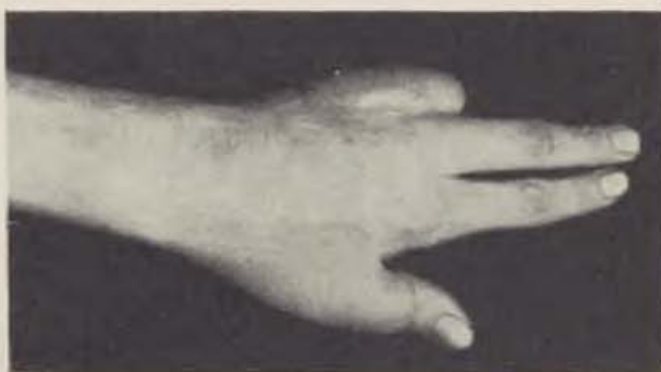


Fig. 11 c.

Fig. 11a. Photograph of the hand of B. T. M. before operation.



Fig. 11 d.



Fig. 11 e.

Fig. 11d, e. The same patient after operative treatment.

described. Plastic repair of the ligaments of the extensors of the fingers was done in the second stage together with shifting of the m. flexor carpi radialis. The result of the operation was the reconstruction of the appearance and function of the hand and fingers. Only limited mobility of the second interphalangeal joint remained. The interphalangeal joint of the thumb remained immobile (Fig. 9 a, b, c, d).

2. Patient B. D. I. (protocol number 6053) 15 years old. At the age of six months he fell into a fire and as result of the burns acquired a severe deformity of the left hand and fingers. Four fingers had severe extensor contracture. There was also a pathological dislocation of the metacarpophalangeal joint. The distal parts of five fingers were missing. Grasping of objects of any kind with the hand was impossible. Operation was performed on October 10, 1958 and consisted in the following: excision of the scars, skin grafting with a pedicle flap, tenolysis

and extension of the ligaments and shifting the m. extensor carpi brevis in place of the m. extensor digitorum communis. The little finger was amputated. As end result was the correction of the deformity of the hand and fingers. Flexion of the fingers was not perfect, however. The patient was able to grasp objects with the ends of his fingers as well as large objects (Fig. 10, a, b, c, d).

3. Patient B. T. M., 15 years old (protocol 849/1956). At the age of a year and a half his left hand was scalded by boiling water. Treatment then consisted simply of dressings. The patient came to the Institute with severe cicatricial deformity of the hand and fingers. He had pathological dislocation of the metacarpophalangeal joints of the first, fourth and fifth fingers. Grasping of objects was impossible. On May 17, 1956 the scars on the dorsal and palmar surface of the hand and fingers were excised. The m. extensor pollicis was extended by means of a small incision on the forearm. Capsulotomy of the metacarpophalangeal joint was carried out. Two month later scars on the dorsal side of the hand were excised in order to overcome the severe contracture of the remaining parts of the fourth and fifth fingers. The basal phalanx of the fifth finger was removed and the basal phalanx of the fourth finger was put in its place. The defect was covered by skin grafting. After two years there was complete restitution of function of the first three fingers and good cosmetic appearance. The patient is at present doing heavy physical work (Fig. 11 a, b, c, d, e).

SUMMARY

After an analysis of the advantages and disadvantages of the usual methods of skin grafting used in reconstructive surgery of the hand, the author presents his modification of the Italian method. He states that the modification is suitable especially for covering large skin defects of the dorsal or palmar surface of the hand and forearm. The important points of the operative technique are described and illustrated (Fig. 1—8).

The advantages of the modified Italian method are:

1. the donor area is covered with full skin without tension on the sutures;
2. no granulating surface is formed, which insures healing by first intention and reduces the danger of infection or necrosis of the flap;
3. the flap is attached without tension to the defect on the hand, and no cavity is formed beneath it;
4. it is not necessary to immobilize the limb with plaster casts;
5. if the ligaments are deprived of their paratenon apparatus, the author supplements his skin grafting with an original method of pedicle grafting of the paratenon surface;
6. the smooth healing of the wound by first intention makes it possible to perform, in a single stage, skin grafting, suture positioning, surgery of the ligaments, shifting of muscles, arthrotomy of the joints, arthroplasty and so forth.

The modified Italian method has been so far used in 59 patients (62 operations), particularly in cases of severe extensor cicatricial contractures of the hand. All of the patients successfully completed the treatment. Slight com-

plications arose, such as subcutaneous haematomas, small areas of necrobiosis of the flap, dehiscence of some sutures and so forth which had no effect on the final result. Only once there was partial suppuration of the wound.

ВЫВОДЫ

Наша техника пластики кожным лоскутом на ножке и ее применение в хирургии кисти и пальцев

Я. Холевич

Анализируя преимущества и недостатки известных в литературе способов кожной пластики, применяемых в восстановительной хирургии кисти руки, автор предлагает свою модификацию итальянского метода. Он считает, что этот способ является удобным, прежде всего, для закрытия больших кожных дефектов тыльной или ладонной поверхностей кисти и предплечья. Описаны и иллюстрированы особенности оперативной техники (рис. 1—8).

Преимущества описываемого способа пластики следующие:

1. донорский участок кожи закрывается полноценной кожей без натяжения швов;
2. в основании закрывающего дефект лоскута нет никакой гранулирующей поверхности, чем обеспечивается заживление первичным натяжением и уменьшается опасность инфекции или некроза лоскута;
3. лоскут накладывается без натяжения на дефект кисти и под ним не образуется никакой полости;
4. нет необходимости производить иммобилизацию при помощи гипсовой повязки;
5. если сухожилия лишены своего скользящего аппарата, автор дополняет свою технику кожной пластики оригинальным способом пластики скользящей оболочки на ножке;
6. гладкое заживление раны первичным натяжением создало возможность произвести в одном этапе кожную пластику, наложение шва и пластику сухожилий, перемещение мышц, артротомию суставов, артропластику и т. п.

Предложенная модификация итальянского метода до сих пор была применена у 59 больных (62 операции), прежде всего, при тяжелых разгибательных рубцовых контрактурах кисти. Все больные закончили лечение успешно. Наблюдались незначительные осложнения, как подкожная гематома, небольшие участки некробиоза лоскута, расхождение некоторых швов и другие, которые, однако, не отразились на результате операции. Только один раз имело место частичное нагноение раны.

RÉSUMÉ

Notre technique de plastie avec le lambeau pédiculé et son emploi dans la chirurgie de la main et des doigts

J. Holevich

En analysant les avantages et les mésavantages des méthodes employées en plastie de la peau, telles sont décrites dans la littérature pour la reconstruction de la main, l'auteur nous décrit sa modification de la méthode italienne. Il est d'avis que cette méthode est surtout convenable pour la couverture des grands défauts de la peau du dos de la main ou de la paume et de l'avant-bras. En même temps il décrit et dessine les finesses de la technique opératoire [fig. 1—8].

Les avantages de la plastie citée ci-dessus sont suivants:

1. La surface perdue se couvre par de la peau saine sans que la suture se trouve sous tension.

2. Ce lambeau pédiculé ne donne naissance à aucune granulation, ce que nécessite la guérison per primam intentionem, en annulant le danger de l'infection et de la necrose du lambeau.
3. Le lambeau couvre le défaut de la main sans tension et aucune cavité ne se forme au-dessous.
4. Il n'est pas nécessaire d'immobiliser à l'aide du plâtre.
5. Au cas que les tendons sont dépourvus de leur appareil glissoir, l'auteur complète sa méthode de plastie de la peau par une méthode tout-à-fait originale avec une plastie de l'appareil glissoir en pédicule.
6. La simple guérison de la plaie per primam intentionem rend possible de réaliser dans une étape la plastie de la peau, la suture et la plastie des tendons, le remplacement des muscles, l'arthrotomie des joints, l'arthroplastie etc.

La modification de la méthode italienne fut employée chez 59 des malades (ce que représente 62 opérations), surtout chez les contractures en extension des graves cicatrisations de la main. Tous les malades sont guéris parfaitement. De petites complications, telles que les hématomes sous-cutanés, les petites necrobioses du lambeau, les ruptures partielles de la suture etc. n'ont point endommagé les résultats de l'opération. Il n'y a qu'une seule fois qu'une suppuration de la plaie survint.

ZUSAMMENFASSUNG

Unsere Technik der gestielten Hautlappenplastik und deren Verwendung in der Hand- und Fingerchirurgie

J. Cholevič

Bei der Analyse der aus der Literatur bekannten Vorzüge und Mängel der Hautplastiken, die in der rekonstruktiven Handchirurgie verwendet werden, unterbreitet der Autor seine Modifikation der italienischen Methode. Er teilt mit, dass diese Art vor allem für Deckung grosser Hautdefekte des Handrückens oder der Handfläche und des Vorderarmes geeignet ist. Eigenheiten der Operationstechnik werden beschrieben und abgebildet (Abb. 1—8).

Die Vorzüge der beschriebenen Plastik sind:

1. Die Hautfläche wird mit vollwertiger Haut gedeckt, ohne dass sie gestreckt wird.
2. Bei der Bildung des den Defekt deckenden Lappens besteht keine Granulationsoberfläche, wodurch eine Einheilung per primam sichergestellt und eine Infektionsgefahr oder Lappennekrose herabgesetzt wird.
3. Der Lappen wird ohne Zug an den Handdefekt angelegt, wobei es unterhalb zu keiner Höhlenbildung kommt.
4. Die Durchführung einer Immobilisation mittels Gipsverband ist nicht notwendig.
5. Soweit die Sehnen des Gleitapparates entledigt sind, ergänzt der Autor seine Technik der Hautplastik durch eine originelle Methode einer gestielten Plastik der gleitenden Oberfläche.
6. Die glatte Wundheilung per primam erlaubt die Durchführung der Hautplastik, Anlegen der Nähte und Sehnenplastik, Muskeltransfer, Gelenksarthrotomie, Arthroplastik usw. in einer Etappe.

Die beschriebene Modifikation der italienischen Methode wurde bisher bei 59 Kranken (62 Operationen), vor allem bei schweren extensorischen narbigen Handkontrakturen durchgeführt. Alle Patienten beendeten erfolgreich die Behandlung. Es kamen unwesentliche Komplikationen, wie subkutane Haematome, kleine Lappennekrose Flächen, Dehiscenz von einigen Nähten und andere vor, die das Operationsergebnis nicht beeinflussten. Nur in einem Falle kam es zu einer Eiterung.

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RECONSTRUCTION OF THE HAND AND FINGERS BY MEANS
OF FILATOV'S TUBED FLAP WITH TRANSPLANTATION OF BONE,
CARTILAGE OR PLASTIC MATERIAL



Fig. 3.



Fig. 4.

Fig. 3. Patient S., aged 24 years. Loss of fingers on one hand following gunshot injury and burn. Reconstruction of thumb by bone and skin transplantation (1949). Rtg-vasography — P. N. Mazayev's method — 5 months following transplantation of Filatov flap, 4 months after the bone grafting from tibia. Blood vessels in soft tissues are evident (our observation). — Fig. 4. Patient E., aged 16 years. Congelation of all fingers of both hands. Rtg vasography 6 months following transplantation of Filatov's flap (1948) to the stump of the hand. We can see the blood vessels entering the skin flap quite distinctly.

J. Holeyich

OUR TECHNIQUE OF PEDICLE SKIN FLAPS AND ITS USE IN THE
SURGERY OF THE HAND AND FINGERS



Fig. 10 b. X-ray of patient B. D. I. before operation.



Fig. 11 b. X-ray of the hand of patient B. T. M. before operation.

A. S. Imamaliyev

EXPERIMENTAL AND CLINICAL TRANSPLANTATION
OF HEMI-JOINTS



Fig. 5.



Fig. 6.



Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.



Fig. 11.



Fig. 12.

V. D. Golovanov, M. E. Tkacheva

PROBLEMS OF PRIMARY ALLOPLASTY
OF SKULL DEFECTS



Fig. 1. Patient Š-kov. X-ray of the skull before operation.

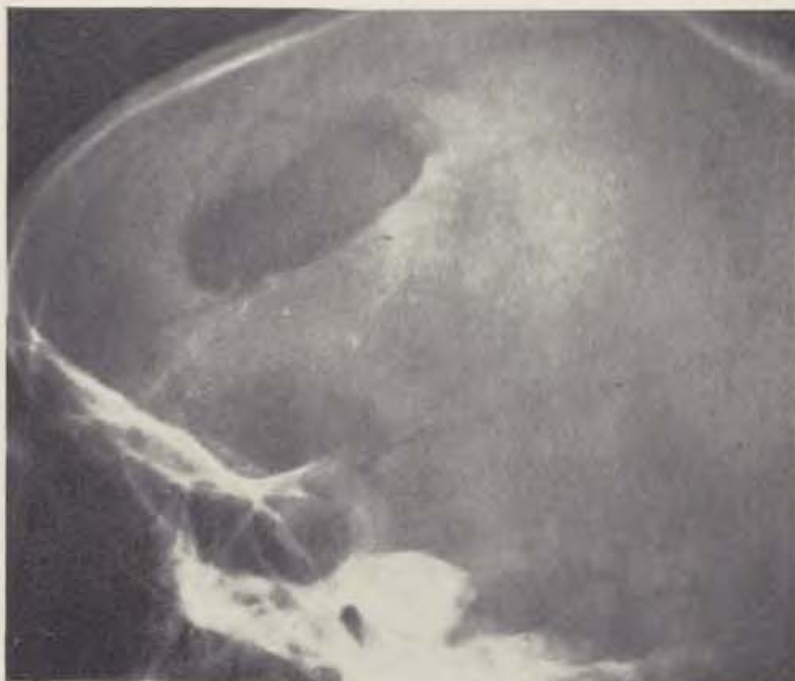


Fig. 2. The same patient. X-ray of the skull after operation.

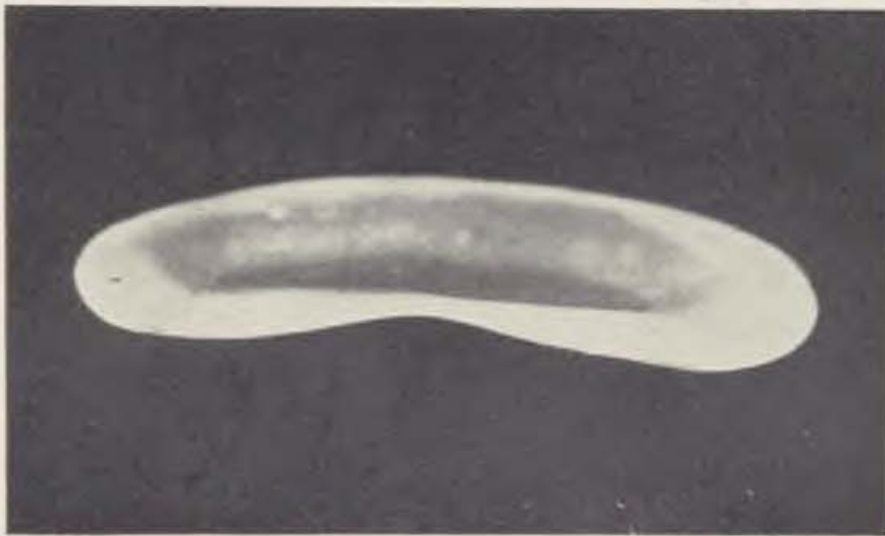


Fig. 3. Polyethylene implant.



Fig. 4. Patient D-in. X-ray before operation.

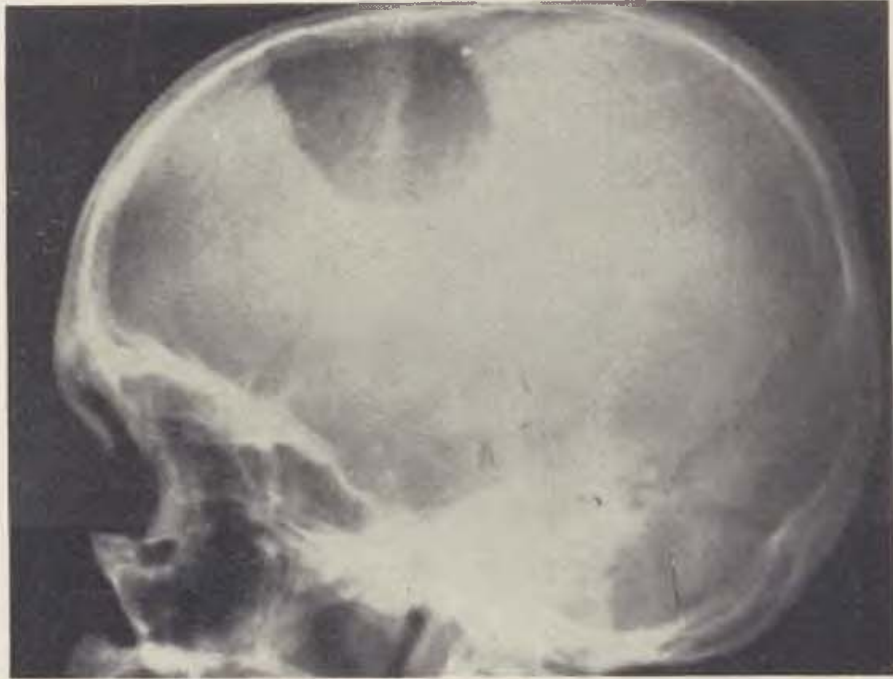


Fig. 5. The same patient. X-ray after operation.

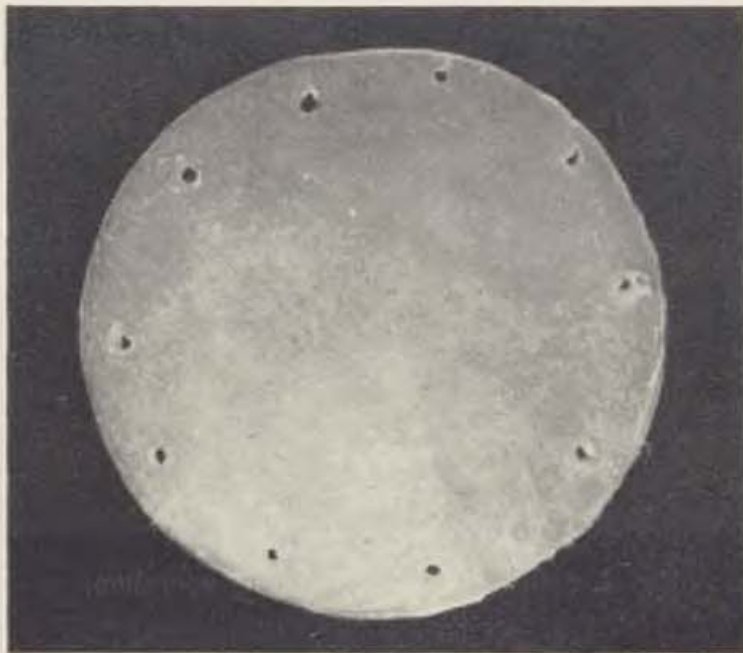


Fig. 6. Polyethylene implant.

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Director: Doc. J. Holevitch

SEVERE BURN FLEXION CONTRACTURES OF THE HAND IN EARLY CHILDHOOD. -- THE CHILD'S HAND EN CUIRASSE

I. MATEV

The highest incidence of burns involving the volar surface of the hand occurs in Bulgaria mostly among children under 3—4 years of age.

The severity of burn deformities depends as a rule on the extent of the area affected, the depth of the lesion, type of causative agent, time elapsed after the burn and the adequacy of early treatment. Among children the degree of deformity does not correspond to the depth of the lesion. The manifested turgor and joint hypermobility of the child's hand account for complete flexion contracture of the fingers even after slight and superficial burns.

Contractures originate in the reflex flexion of the digits aimed at the reduction of pain and are fixed by the development of fibrosis. Deformity increases and rapidly becomes rigid. The child's hand en cuirasse is inhibited its normal rate of growth. The possibilities of anatomical and functional restoration by means of surgery decrease in proportion to the elapse of time.

On the basis of six years' experience with 120 patients operated upon at various ages, we are in a position to draw a definite conclusion that the burn-contracted hand requires early surgical treatment, during the third month after the accident at the latest, despite the age of the patient and even in infancy. The age of 4—5 years, emphasized by Iselin as the most suitable for surgery, estimated from personal experience, seems to be high. It is very easy to gain full extension of the flexed digits of a child aged 2, by performing a radical excision of the cutaneous and subcutaneous scars, owing to the fact that the muscles and tendons with their sheaths, as well as the vessels and articular capsules do not present any resistance. The condition changes considerably among children aged 4—5. The muscle-tendon-joint contracture which leads to bone and joint alterations is already a severe obstacle. We have very often faced this fact which alone is sufficient to justify immediate operative treatment, i. e. during the early period when skin retraction is still not complicated by the muscle-tendon-joint contracture.

In fact there is a certain analogy between the emergency treatment of the burn-contracted hand and that of congenital dislocation of the hip joint. In both

months decide the final outcome. The considerations concerning maturation of the fibrosis or the growing up of the child are not sufficiently convincing. The most suitable age for operating on sucklings that have sustained burns is the second year of life.



Fig. 1.



Fig. 2.

Fig. 1. E. B. S. aged one and a half years. Hot stove burn sustained two months previously.
— Fig. 2. Two years after the operation. Complete recovery is obtained.

In this country the problem of the surgical treatment of the burn-contracted hand among children was studied for the first time by Chervenakov in 1941 and 1942 in several excellent papers and a detailed monograph (1948—1949).

This paper is based on our personal experience in the operative treatment of 20 children (23 hands) most of them aged 1—4, with severe flexion contractures of the hands. One, several or all fingers were completely closed. The contractures were as a rule combined with syndactyly. The causative agents of the burn were hot stoves, fires and boiling water. The burns had occurred without exception during the first 2 years of life. The operative treatment was performed 2 months to 4 years after the accident. The longest follow-up period is 4 years.

Two main problems require solution: 1. the operative correction of deformities followed by plastic covering of skin defects and 2. preservation of correction achieved during the long period of the child's growth.

The first problem proved to be the easier. A radical excision of fibrosis in width and depth is the most important condition for the easy and full straightening of the fingers and for obtaining permanent results. It is characteristic that conditions which at first seem hopeless (Fig. 3—8) such as fingers firmly adherent to the palm, high syndactyly and the absence of distal phalanges prove only to be fibrosis of the skin and subcutaneous tissue. Intact vessels and nerves, tendons and tendon sheaths with almost normal elasticity lie beneath them. In

the present series we have not seen destructive alterations of the deeper tissues excepting the distal phalanges of the fingers. The vascular-nervous bundles are usually bent along the flexed phalanges and prove to be slightly shortened. If they still show some resistance when the fibrosis is excised and the fingers are



Fig. 3.



Fig. 4.



Fig. 5.

Fig. 3. I. S. G. — aged one year and three months. Fire burn occurred three months previously. — Fig. 4. 8 months after the first operation — correction of wrist contracture and syndactyly of the thumb. Full-thickness graft a little larger than the wound was used. — Fig. 5. A full restoration of the wrist is attained and thumb web is normalized.

straightened out, blunt subcutaneous separation proximally relaxes them completely. The lateral bands of the dorsal aponeurosis are very frequently displaced to the volar aspect of the fingers and should be incised around the proximal joint.

Relieved of the fibrous armour, the hand acquires its normal volume and form. The skin defect is always found to be more extensive than was expected.

Full thickness or only $\frac{3}{4}$ thickness skin grafts are used to cover the wounds. Grafts are usually taken by the free-hand technique from the lower parts of the abdomen and the donor areas are sutured directly. Notwithstanding the well known advantages of local plasty, it was used only three times and always in combination with free grafting. It was never necessary to employ a pedicle flap.

It is generally accepted that free grafts, when placed on the recipient areas need some tension for their "take". Tension is usually attained with grafts of equal size or a little smaller than the wound.

Personal observation on the evolution of the free skin grafts used in repairing burn-contracted hands in small children shows that secondary graft shrinkage is very slight and recurrence of finger deformities due to skin deficiency is not observed during the next four years, if the skin grafts are taken a little larger ($\frac{1}{5}$ — $\frac{1}{6}$) than the wound.

Full thickness skin grafts taken in excess survive well both on a subcutaneous recipient area and on the loose connective tissue, covering tendon sheaths and neurovascular bundles. Such a graft needs compressive dressings and immobilization for a period of 20 days. Sometimes segments of the epithelial layer:



Fig. 6.



Fig. 7.

Fig. 6. The fingers are operated on at a second stage. Fibrosis involves only the skin and part of the subcutaneous tissue. — Fig. 7. Full-thickness skin graft taken in excess covers the wound. Numerous perforations of the graft are made as suggested by Chien, Saito and Morotomi.



Fig. 8. The hand on the 20th postoperative day.

peel off in the form of crusts, beneath which a normal epithelium is found. With a view to increasing the osmotic-nourishing surface, as suggested by Chien, Saito and Morotomi, numerous perforations of the graft are performed with a syringe needle (Fig. 7). Grafting with a skin transplant wider than the defect is in

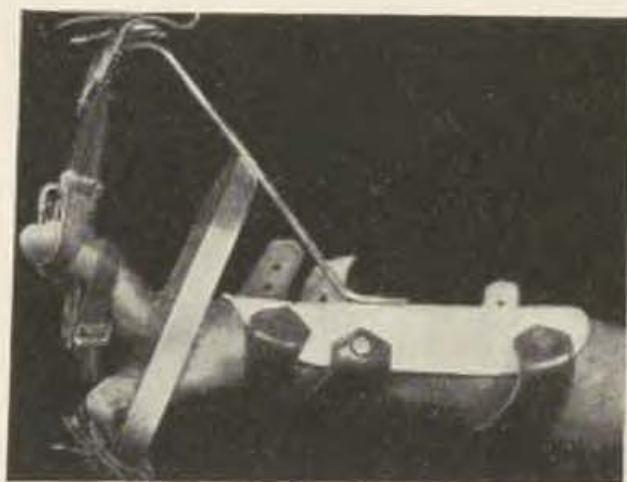


Fig. 9. Elastic splinting of the fingers is applied during the daytime.

accordance with the usual conception that the growth of free skin graft lags behind that of the remaining skin and the body of the child.

On the basis of a series of preliminary experimental investigations carried out jointly with Tzanev during the last two years on guinea pigs, using the quality and quantity of nuclear mitoses and changes in the graft and the body, sizes as basic indicators, we have obtained data that full thickness skin grafts grow equally with the remaining skin and body of guinea pigs. It is only the operation scar, its size and type, which gives the discrepancy in this simultaneous growth. It is too early to draw final conclusions and that is why we adhere to the generally accepted opinion.

The behaviour to the borderline between the dorsal and volar skin (the so-called neutral lines of the palm and fingers) is of major importance in the operative treatment of the disorder in children. When the scars are excised we cross the neutral lines dorsally (Fig. 10), though at the expense of narrow strips of normal skin. Secondary graft contraction displaces the operation scars to the neutral lines, thus preventing keloid formation and recurrence of the contractures for the next 3—4 years, the longest follow-up period in our small patients.

The second problem which must be solved in the operative treatment of the contracted hand in children is to maintain the correction achieved.

Provided fibrosis is radically excised, the skin graft taken with a sufficient size (in excess) and the neutral lines are crossed dorsally, during the first post-operative year physiotherapy must overcome two pathologically acting forces: the tendency for the recurrence of muscle-tendon-joint contractures and the normal retraction of the newly-forming connective tissue. Among the numerous procedures employed the most effective and satisfactory prove to be: 1. Elastic

splinting of the fingers, so as to allow active movements, for several hours in the daytime (Fig. 9) and firm splinting for the night. 2. Remedial exercises of the hand, submerged in water at a temperature of 37°C . 3. The slight massage of the grafts.

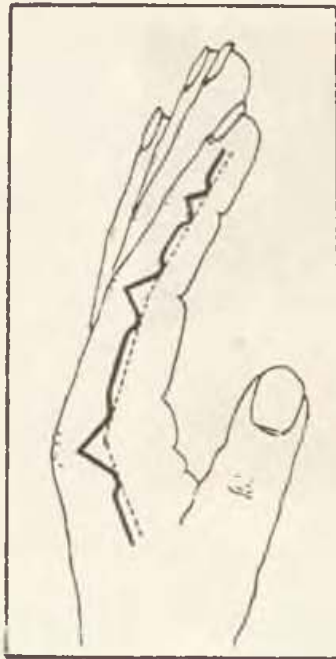


Fig. 10.

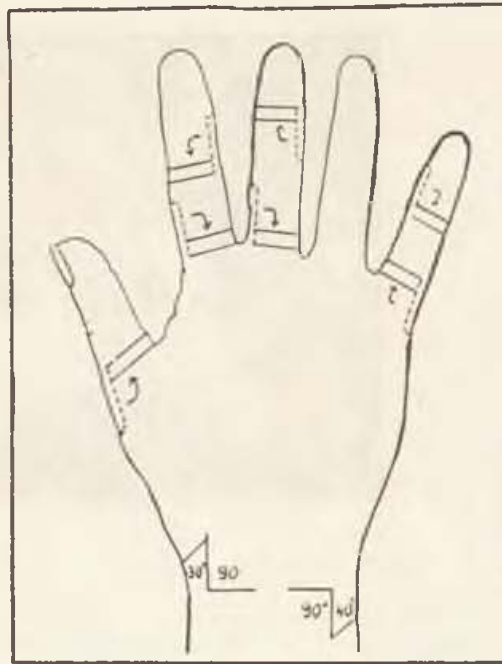


Fig. 11.

Fig. 10. When fibrosis is excised, neutral lines of the fingers and palm must be crossed dorsally at the expense of narrow strips of normal skin, as shown on the diagram. — Fig. 11. Lateral flaps for the fingers and exchange of triangular opposing flaps for the wrist region are used for correction when operative scars displace volarly. Donor areas (for finger flaps) are usually closed by direct suture.

If there is later a certain tendency towards flexing of the fingers, physiotherapy and splinting only during the night must be continued, tenaciously and patiently for a long time. In this respect mothers are the best collaborators.

If the operation scars become displaced volarly they turn into keloids causing a recurrence of the contractures. In these cases an additional operative correction should be performed using local flaps. On the wrist, excision of the keloids is followed by the exchange of opposite triangular flaps (Limberg) at best at an angle of $30-40^{\circ}$ for the surrounding skin and 90° for the graft. Lateral pedicle flaps are used for the fingers, from local skin. The grafts are cut transversely exactly along the natural volar creases of the fingers and the contractures are corrected. Then lateral flaps are rotated at about 90° and placed on the defects created (Fig. 11).

Up to now three children have undergone reoperation. Two of them were not treated radically at the first operation — neutral lines were not crossed dorsally and a split skin graft was used. In the case of the third child only an exchange of triangular flaps was carried out as the old operative scars were displaced volarly.

Local plastic procedures in some fingers aimed at the correction of slight flexion contractures needs to be carried out in another three cases in the near future (Fig. 12—14).

All the remaining children are in an excellent condition (Fig. 1 and 2).



Fig. 12.

Fig. 13.

Fig. 14.

Fig. 12. G. V. I., aged one year. Hot stove burn occurred 6 months previously. — Fig. 13. 3½ years after the surgical treatment; neutral lines were not passed dorsally at the operation and a local plasty of the fingers and palm aiming at correction of slight flexion contractures should be performed in the near future. — Fig. 14. The functional recovery of the hand is complete.

We carry out a continual follow-up on our treated children. Many years of observations are undoubtedly necessary. The future will show whether our reasoning and technique are correct and will throw more light on the difficult problem of the treatment of severe burn flexion contractures of the hand in small children.

SUMMARY

The highest incidence of burns involving the volar surface of the hand occurs in Bulgaria among children under 3—4. The manifested turgor and joint hypermobility of the child's hand account for the complete flexion contracture of the fingers even after slight and superficial burns. It is characteristic that conditions which seem hopeless at first sight, such as fingers completely adherent to the palm, high syndactyly and the absence of distal phalanges, prove to be merely fibrosis of the skin and subcutis.

The child's hand en cuirasse is inhibited in its normal rate of growth. The possibilities of anatomical and functional recovery by means of surgery decrease in ratio to the lapse of time. Despite the early age of children, operative treatment must be undertaken during the third month after the burn at latest, before skin

retraction is complicated by the muscle-tendon-joint contracture. The most suitable age for the operation of the burn-flexed suckling's hand is the second year of life.

Provided fibrosis is radically excised in width and depth, the neutral lines of the palm and fingers are crossed dorsally at the expense of narrow strips of normal skin, and full-thickness (or $\frac{3}{4}$ thickness) skin grafts slightly larger ($\frac{1}{5}$ — $\frac{1}{6}$) than the defect are used; a recurrence of the contractures during the next four years is not observed.

Rehabilitation must be carried out for a long time: 6—12 months, and in some cases more than one year after the operation.

Local plasty must be performed for the correction of operation scars displaced to the volar surface of the palm and digits.

The author's experience is based on 120 patients operated upon at various ages, and in particular on 20 children (23 hands) aged 1—4 with severe flexion-contractures resulting from burns. The follow-up period for the childrens is four years.

ВЫВОДЫ

Тяжелые сгибательные контрактуры кисти руки после ожога в раннем детстве («бронированная рука»)

Иван Матев

Ожоги ладонной поверхности кисти руки в Болгарии чаще всего встречаются у детей в возрасте 3—4 лет. Хороший тургор ткани и чрезвычайная подвижность суставов кисти руки у ребенка являются причиной полной сгибательной контрактуры всех пальцев даже после легких и поверхностных ожогов. Характерным является то обстоятельство, что состояния, которые на первый взгляд кажутся безнадежными, как например, прочно приросшие к ладони пальцы, высокие сращения пальцев (синдактилия) и отсутствие ногтевых фаланг, бывают вызваны лишь фиброзом кожи и подкожной клетчатки.

Нормальный рост пораженной контрактурами («бронированной») кисти руки ребенка бывает замедлен. Возможность анатомического и функционального восстановления при помощи хирургического вмешательства уменьшается с удлинением периода, протекшего со времени увечья.

Несмотря на ранний возраст ребенка, операцию необходимо произвести не позже трех месяцев после травматизации, т. е. до того, пока сморщивание кожи не осложнится контрактурами мышц, сухожилий и суставов. Самым пригодным временем для операции сведенной контрактурами кисти руки после ожога у ползунка является второй год жизни.

За предпосылки, что фиброзы были радикально иссечены в ширину и в глубину, далее, что разрез был произведен за границу тыльной и ладонной поверхностей ладони и пальцев в направлении к тыльной стороне, даже за счет потери узких полосок здоровой кожи и что были применены лоскуты во всю толщу кожи (или $\frac{3}{4}$ толщины кожи) и размеров немного больших (на $\frac{1}{5}$ — $\frac{1}{6}$), чем был дефект, не наблюдалось нового образования контрактур в течение четырех лет после операции.

Восстановительная терапия должна производиться в течение долгого времени, т. е. 6—12 месяцев, а в некоторых случаях даже более года после операции.

Местную пластику нужно произвести для коррекции операционных рубцов, которые были перетянуты в ладонную сторону ладони и пальцев.

Опыт автора основывается на 120 случаях, оперированных в разном возрасте, но, главным образом, на 20 детях (23 руки) в возрасте от одного до 4 лет с тяжелыми сгибательными контрактурами после ожога. Эти дети находились под наблюдением в течение четырех лет.

R É S U M É

Graves rétractions cicatricielles des mains brûlées chez les tout petits enfants — „La main infantine en cuirasse“

I. M a t e v

En Bulgarie les brûlures palmaires des mains se rencontrent le plus souvent chez les enfants jusqu'à l'âge de 3 ou 4 ans. La turgescence des tissus et la motilité exceptionnelle des jointures des mains infantiles causent des contractures en flexion complètes de doigts aussi après des brûlures superficielles. Il est caractéristique pour ces situations à première vue désespérantes — doigts en poing serré, doigts soudés (en syndactylie) et des phalanges manquantes — qu'elles sont souvent causées par des fibroses cicatricielles de la peau et du tissu sous-cutané.

Une main infantile „en cuirasse“ avec des cicatrices pareilles est bien retardée dans son évolution. La possibilité d'une réparation anatomique et fonctionnelle à l'aide d'une intervention chirurgicale diminue autant que l'on retarde l'opération.

Sans tenir compte à l'âge des enfants, il est nécessaire d'opérer au plus tard trois mois après la brûlure. C'est-à-dire, avant qu'il se produise une contraction durable des muscles des tendons et des joints comme complication des rétractions cicatricielles de la peau. En supposant que toutes les fibroses ont été radicalement enlevées en profondeur et en largeur et que les lignes neutres de la peau des doigts et de la paume ont été dépassées vers le dos (aussi au détriment d'une perte des bandes étroites de substance de peau intacte) et qu'on a placé des greffes épaisses (peau totale ou en $\frac{3}{4}$) avec les dimensions surpassantes de $\frac{1}{5}$ — $\frac{1}{6}$ la plaie, on n'a observé aucun renouvellement des contractures pendant 4 années après l'opération. La réhabilitation doit se faire pendant un long temps, c'est-à-dire de six jusqu'à douze mois, et en certains cas aussi plus qu'une année.

Il est nécessaire de performer des plasties locales pour corriger ces cicatrices opératoires qui étaient titrées vers la face palmaire de doigts et de la paume.

L'expérience de l'auteur et basée sur 120 cas opérés d'âge divers mais principalement sur 20 enfants (23 mains) de 1 à 4 ans avec des graves rétractions cicatricielles par brûlures. Ces enfants ont été surveillés pendant 4 années.

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

Schwere beugende Handkontrakturen nach Verbrennungen im frühen Kindesalter — („Panzerhand“)

I. M a t e v

Verbrennungen der volaren Handfläche kommen in Bulgarien am häufigsten bei Kinder unter 3—4 Jahren vor. Der gute Gewebsturgor und die übermäßige Gelenkbeweglichkeit der Kindeshand verursachen eine vollkommene Flexionskontraktur der Finger auch nach leichten und oberflächlichen Verbrennungen. Es ist charakteristisch, dass Zustände, die auf den ersten Blick als hoffnungslos angesehen werden, wie z. B. fest zur Handfläche adhärierende Finger, hohe Fingerverwachsungen (Syndaktilien), fehlende Fingerendglieder sind nur durch Haut- und subkutane Gewebsfibrose verursacht.

Der normale Wachstum einer durch Narben kontrahierten („gepanzerten“) Kinderhand ist verlangsamt. Die Möglichkeit einer anatomischen und funktionellen Wiederherstellung durch einen chirurgischen Eingriff ist von dem verfloßenen Zeit abhängig.

Trotz des frühen Kindesalters ist es notwendig die Operation spätestens bis zu 3 Monaten nach dem Unfall durchzuführen, d. i. bevor die Hautschrumpfung durch Muskel-, Sehnen- und Gelenkskontraktionen kompliziert wird.

Die zweckmässigste Zeit zur Operation der kontrahierten Hand nach Verbrennungen beim Säuglingen ist das zweite Lebensjahr. Wenn die Fibrose radikal breit und tief exziiert wird, die Neutrallinien der Hand und Finger in Richtung zum Handrücken überschritten werden und Hauttransplantate in voller Dicke (oder $\frac{3}{4}$ Dicke) mit etwas grösseren Ausmassen ($\frac{1}{5}$ — $\frac{1}{6}$) als der Defekt verwendet werden, haben wir im Verlaufe von 4 Jahren nach der Operation keine Recidiven beobachtet. Die Rehabilitation muss im Verlaufe einer langen Zeitdauer d. i. 6—12 Monate und in bestimmten Fällen mehr als 1 Jahr durchgeführt werden.

Notwendigerweise muss eine Lokalplastik zur Korrektur der Operationsnarben durchgeführt werden, wenn die Narben auf die Volarseite der Handfläche und Fingern verzogen sind.

Die Erfahrungen des Autors stützen sich auf ein Krankengut von 120 Fällen, die in verschiedenem Alter operiert wurden, besonders auf 20 Kinder (23 Hände) im Alter von 1—4 Jahren mit schweren Flexionskontrakturen nach Verbrennungen. Die Kinder wurden im Verlaufe von 4 Jahren verfolgt.

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EXPERIMENTAL AND CLINICAL TRANSPLANTATION OF HEMI-JOINTS

A. S. IMAMALIYEV

The problem of the transplantation of joints has, for a long time, claimed the attention of experimental investigators and surgeons all over the world. This interest is understandable in view of the importance of joint transplantation not only from a biological point of view but also for its immense practical aspects.

In 1893 Prof. Pensky of Kharkov University performed auto- and homo-transplantation of joints in sheep and dogs for the first time in the history of experimental surgery, with good results. Unfortunately, the period of observation of the animals was not sufficiently long.

In 1901, the French surgeon Tuffer performed the first clinical autotransplantation of hemi-joints in a patient by replacing the distal end of the radial bone with the proximal phalanx of the thumb.

Buchman (1907) performed a clinical autotransplantation of an entire joint by replacing the elbow with the first metatarsophalangeal joint.

The German surgeon Lexer devoted a considerable part of his time to bone plastic operations and transplantation of joints. He carried out the first homo-transplantation of an entire joint which was removed from a cadavar. He later performed a total of 23 such operations, 12 of which with good results.

Transplantation of whole and hemi-joints has been performed by other surgeons as well: Judet (1906), Axhausen (1912), Heinz (1911), Kütter (1910), Pavlov-Silyvansky (1914) and Meyer (1929).

In spite of the number of studies on the transplantation of joints, there still remain many unsolved problems. On the suggestion of Prof. Nikolai Nikolayevich Priorov, member of the USSR Academy of Sciences, we have begun to study some of them.

The suggestion made to us was to study the possibility of transplanting parts of joints (distal articulating end of the femoral bone) from one animal to another, the possibility of preserving grafts at low temperature (-70° to -60° C), implantation at various time intervals and observing the changes in the tissues.

Soon after transplantation (in 7, 14, 21 and 28 days) it is possible to follow the process of vascularization and the complete renewal of vascular supply may be seen even later (more than a year).

The use of antibiotics prevents suppuration of the wounds (penicillin and streptomycin) which increases the chances of a successful take.

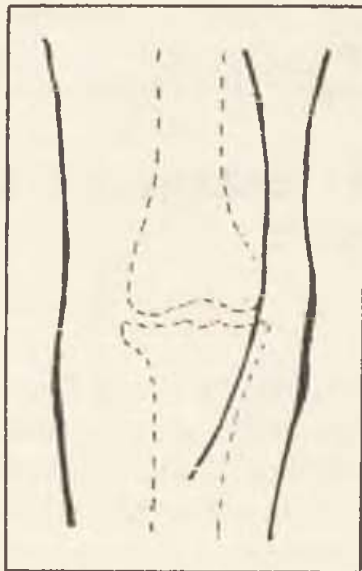


Fig. 1.

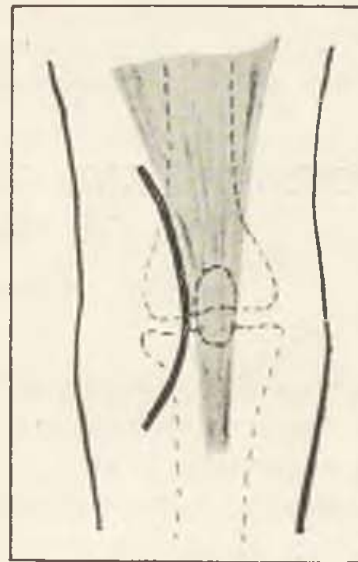


Fig. 2.

Special attention was paid to the devising of a suitable surgical technique as one of the most important problems.

Up to the present there has not been any universally accepted technique of joint transplantation. Various technical errors occur in the course of surgery.

From the point of view of healing and the ultimate fate of the graft, transplantation of hemi-joints is the most acceptable because the condition of the articulating surface is the closest to normal.

We have performed experiments with transplantation of the distal end of the femur. The principle is the grafting of the hemi-joint from one dog to another. The grafting is done either immediately on the operating table or subsequently after preservation of the graft at a temperature of -70° to -60° C for several days.

The skin around the knee joint is incised by means of a longitudinal incision along the upper edge of the outer surface of the limb (Fig. 1). The knee joint capsule is then opened only along the inner edge of the *ligamentum patellae* and the patella itself (Fig. 2). This approach prevents the overlapping of the skin and the capsular stitches, and the area of the open wound is reduced, thus lowering the danger of infection of the deeper layers. By means of a spatula inserted into the wound the patella together with the *ligamentum patellae* is brought out (Fig. 3) and the lateral ligaments are cut at their point of insertion into the knee bone. The *ligamentum cruciatum* is cut with a scalpel. All of these manipulations are done with great care in order not to damage the meniscus. The

muscles inserted into the posterior surface of the lower third of the femoral bone are bluntly dissected. The implanted graft is fixed to the bed with two stainless-steel pins. The stumps of the lateral ligaments are attached to their original points of insertion with silk stitches (Fig. 4). The muscles on the posterior surface of the femoral bone are firmly fixed with catgut to the graft.

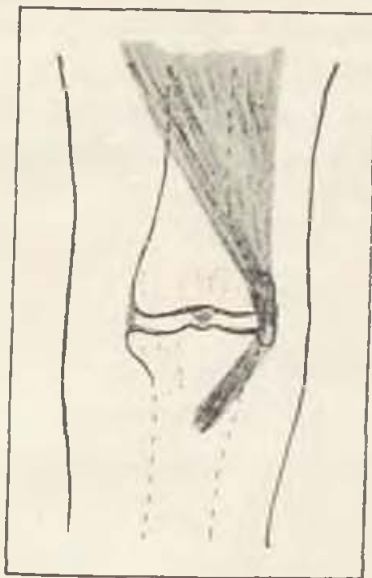


Fig. 3.

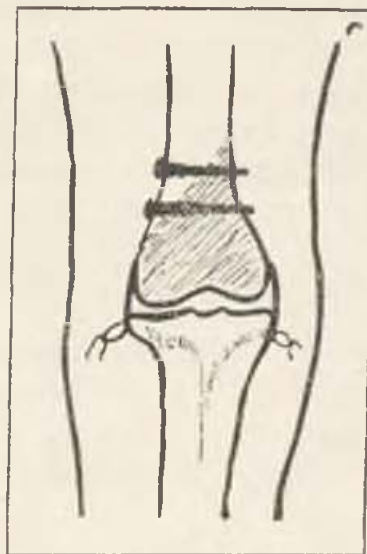


Fig. 4.

The patella and the *ligamentum patellae* are replaced to their original position. The capsule and the skin are sutured with catgut. Penicillin (200,000 — 500,000 units) is injected into the wound. The knee is immobilized in a plaster cast with the joint flexed at an angle of $100-110^{\circ}$ so that the flexor muscles are approximated to their points of insertion. Subsequently, the dog receives antibiotics and glucose solution every other or every two days as well as more liberal amounts of food.

With this method it has been possible for us to fix grafts firmly to the bed with two pins without injuring the different parts of the bone (periosteum, endosteum and marrow), and to preserve the patellar and lateral ligaments which are sutured together during the operation. The graft consists of the joint cartilage, the epiphyseal cartilage and part of the metaphysis. Freeze preservation makes it possible to use the graft in clinical practice.

The transplantation technique which was worked out has been shown to be satisfactory and given good experimental results.

The experiments were divided into groups depending on the duration of the freeze-preservation of the grafts. Before use, the graft was placed for an hour in a solution of penicillin (400,000 units). The manner of freezing and preservation was of the utmost importance for the ultimate fate of the grafted joint. Quick freezing does not cause the formation of ice crystals in the tissues and thereby the possible danger of mechanical damage to the cellular microstructure is reduced to the minimum (Schmidt 1935). It is known that a graft preserved at

a low temperature loses its antigenic properties and such a graft upon transplantation evokes a weaker immune reaction. In our opinion preservation of the graft at a temperature corresponding to -60°C to 70°C played a major role in the ultimate success or failure of the transplantation experiments.

On the basis of the experiments it appears that the most favourable period of preservation is three to four weeks. Grafts preserved for less than three weeks are resorbed soon after transplantation. Preservation for one to two months produces a high percentage of postoperative complications.

Thus, in the group of experiments in which grafts preserved for periods up to 25 days were used, there were eight cases of postoperative wound suppuration out of a total of 68 operated dogs, while for grafts preserved for 31 to 60 days the figure was six out of ten.

Table 1.

Number	Group	Period of Preservation	Number of Experiments	Number of Suppuration
1.	I	1— 5 days	15	2
2.	II	6— 8 days	15	2
3.	III	11—15 days	12	1
4.	IV	16—21 days	12	2
5.	V	21—25 days	14	1
6.	VI	26—30 days	10	3
7.	VII	31—60 days	10	6
8.	VIII	Control	16	3
Total			104	20

Wound suppuration is of the utmost importance in the transplantation of joints. Suppuration of the soft tissues is very easily carried over into the graft itself. According to reports by various workers (Savin 1903, Michelson 1943, Vinogradov 1944 and others) and also our own results, it appears beyond doubt that suppuration acts destructively on the joint cartilage and disrupts its integrity and thereby its function. If the inflammation subsides, then the whole process at best terminates in ankylosis.

With regard to the age of donors, we selected three to six-year-old dogs for the experiments. We consider this age group to be the most suitable for transplantation.

If the age of the donor was such that skeletal ossification was not complete and if the epiphyseal zone was not ossified, the graft was quickly resorbed along the growth zone of the epiphysis.

The early resorption of grafts (obtained from puppies) is due to the fact that the growth zone is not yet ossified but is still in the cartilaginous stage. In

this period the epiphyseal zone easily succumbs to resorption and collateral vessels do not appear. This is in agreement with studies of Prives (1938), who excludes the possibility of growth of collateral vessels in the epiphyseal cartilage prior to its ossification. The process of resorption is therefore not replaced by bone production because of the lack of vascular supply in this zone.

In studying the changes accompanying the transplantation of unpreserved joints, the violent periosteal reaction around the graft is interesting. According to several workers (Golovina 1956 and others), fresh unpreserved bone grafts are easily resorbed. But as a result of active periosteal proliferation there occurs a simultaneous replacement of the graft with newly formed bone. This bone, in the presence of the graft undergoing resorption, causes deformation of the joint.

Our experiments also showed that in the transplantation of unfrozen joints rapid resorption of the graft takes place and that functional strain leads to deformation of the joint. We had the opportunity to study this in the experiment with dog No. 34 in whom, in the first few months after grafting, impairment of the integrity of the graft could be seen in the X-rays. Subsequently, there was a violent periosteal reaction which caused a change in the shape of the bone (Fig. 5).

For purposes of comparison the results of transplantation experiments with frozen joints (dog 36) are presented. In this case there was resorption of the graft without replacement by newly formed bone. The shape was not deformed and the periosteal reaction was slight. Three years after operation the graft, on the X-rays, has a normal configuration typical for the joint. The joint space is intact and the grafted bone does not in anyway differ in structure from the bed (Fig. 6—7).

Satisfactory results obtained in the experimental transplantation of joints made it possible for us to introduce the operation into clinical practice.

Transplantation of joints was performed in patients with bone tumours. In those cases where it was impossible to preserve the articulating surface of the bone because of the tumour, resection was carried out. In replacing the resected joint with homotransplant, anatomical relations were restored and attempts were made to preserve function. In three cases we were successful in restoring function (follow-up for one year) after transplantation of the metacarpal bones.

Short summaries of the cases are presented as examples of transplantation of large joints.

1. Tul... The patient, a 48-year-old man, ill from 1953, was admitted on Jan. 31, 1959 to the Central Institute of Traumatology and Orthopaedic Surgery with a diagnosis of osteoblastoma of the distal end of the left femoral bone (Fig. 7). Pathological fracture in the lower third of the bone was noted in the case history. The patient received X-ray therapy, but the disease progressed. There was complete ankylosis.

On March 24, 1959 operation was performed (Imamaliyev): resection of the distal end of the femur and removal of the tumour (Fig. 8), the defect was filled in with frozen-joint graft which was fixed with two pins to the bed. The

lateral ligaments, ligamentum patellae and the capsule were restored. Passive movements were attempted seven months after operation.

2. V... The patient, a 35-year-old man, was admitted to the Institute on March 1, 1959 with a diagnosis of fibrous dysplasia of the distal end of the radial bone (distal two-thirds), with deformation of the hand (manus vara). Movement at the radiocarpal joint was limited to a considerable extent (Fig. 9).

Operation was performed on March 15, 1959 (Imamaliyev): resection of the diseased part of the radial bone, resection and shortening of the ulna for correct positioning. The defect in the radial bone was replaced with a frozen homotransplant. The radial bone was fixed with intra- and extramedullary bone wedges, and the ulna with Bogdanov metal spikes nailed through the olecranon (Fig. 10). Passive movements were started seven months after operation.

3. A..., 25 years old. The patient was referred to the Institute for a defect of the upper third of the right femoral bone caused by fibrous dysplasia (Fig. 11).

Operation was performed on Sept. 8, 1959: removal of the diseased bone and replacement with homotransplant frozen at low temperature (Fig. 12).

The short period of observation (half a year at the longest) of our clinical cases (16) does not permit us to make any definitive conclusions. Nonetheless, it is absolutely clear that the good experimental results and the clinical observations make it possible to extend the usage of hemi-joint grafting in clinical practice.

SUMMARY

1. The best results in experimental transplantation of hemi-joints were obtained with grafts preserved for 20—30 days at a temperature of -60° to -70° C.

Transplants should be taken from animal donors after the completed ossification.

2. The method of transplantation of frozen hemi-joints provided us with good results, enabling us to apply and widely use the method in clinical practice.

ВЫВОДЫ

Пересадка полусустава в эксперименте и в клинике

А. С. Имамалиев

1. Наилучший исход при экспериментальных пересадках полусуставов нами получен при использовании трансплантатов, консервированных при температуре минус 60° — минус 70° C, в течение 20—30 дней.

Трансплантаты полусуставов должны браться у животных доноров с законченным периодом окостенения.

2. Методика пересадок замороженных полусуставов дала нам удовлетворительный результат в эксперименте, что дало нам возможность применить и шире использовать применяемую нами методику в клинике.

RÉSUMÉ

La transplantation des semiarticulations expérimentale et clinique

A. S. Imamaliyev

1. Au cours de la transplantation des semiarticulations les meilleurs résultats obtenus par l'auteur représentaient les greffes conservés à la température de -60 degrés C. à -70 degrés C. à la durée de 20—30 jours.

2. Les greffes des semiarticulations doivent être relevés des animaux-donneurs au stade de l'ossification terminée.

3. La méthode aux greffes des semiarticulations congelées nous a donné d'excellents résultats dans l'expérience, ce qui a facilité l'emploi et la large utilisation de cette méthode en clinique.

ZUSAMMENFASSUNG

Experimentelle und klinische Transplantation von Halbgelenken

A. S. Imamaliyev

1. Bei der experimentellen Transplantation von Halbgelenken erhielten wir die besten Ergebnisse mit der Verwendung von Transplantaten, die im Verlaufe von 20—30 Tagen bei einer Temperatur von -60 bis -70° C konserviert wurden.

2. Halbgelenks-Transplantate sollen von Tierspendern mit abgeschlossener Ossifikationsperiode abgenommen werden.

3. Die Transplantationsmethodik der gefrorenen Halbgelenke zeigte gute experimentelle Ergebnisse, die eine Verwendung und breitere Ausnützung dieser Methodik in der Praxis ermöglichten.

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ON THE DYNAMIC EQUILIBRIUM OF THE FORKED FOREARM STUMP

G. D. SHUSHKOV

In 1953 the author elaborated and performed an operation for the sparing forking of a long forearm stump. Contrary to the usual methods a fork was obtained with short branches (12 to 14 cm.) separating only little (5 cm.) but gripping with great power (19.5 kg.). The author considered such a fork to be useful in an unilateral amputation where the patient is able to perform every complicated manipulation and the grasping of large objects with his sound hand and use the forked stump for fixing the object for a considerable time.

The operation is performed as follows:

The skin incision is made so that the volar flap, which is to cover the radial branch of the fork, is 1 cm. wider than the dorsal destined for the ulnar branch (Fig. 1). The marking of the skin prior to incision guarantees the exact performance of this part of the operation. On the volar aspect of the stump all flexors are then resected as far as the proximal end of the skin incision, and on the dorsal aspect the tendons of extensor digitorum communis and extensor carpi ulnaris. *The tendons of flexor pollicis longus and brevis, abductor pollicis longus and extensor indicis proprius are not resected since they are usually adherent to the end of the radius stump* (Fig. 2). The interosseal membrane is divided in the distal portion of the stump under visual control, in the proximal portion with a narrow osteotome. Then the radius is pulled away from the ulna to a distance of 7 cm. After this the radial branch of the stump is covered with the volar and the ulnar branch with the dorsal skin flap.

The results of this operation are somewhat unusual:

1. On the eighth day, i. e. before the removal of the stitches, the capacity for gripping (adduction of the radial branch of the fork towards the ulnar branch in a plane lying between pronation and supination) becomes evident and rapidly improves. As is well known in other methods this requires about one to two months.

2. The power of gripping steadily increases until, on discharge of the patient, it reaches 19.5 kg. (which is 2.5 times more than the greatest power of gripping measured in a forked stump of the usual type).

The following observations confirmed that this was no accidental result, but that it was the merit of the new surgical procedure.

Case 1: A male patient P-v V. L. aged 21. The function of the left hand is undamaged. The right forearm has been amputated at the level of the junction of the middle and proximal third. The stump, 21. cm. long, is in good condition with a terminal and linear scar. Pronation and supination are not restricted. Prior to operation the skin of the stump was systematically stretched every day.

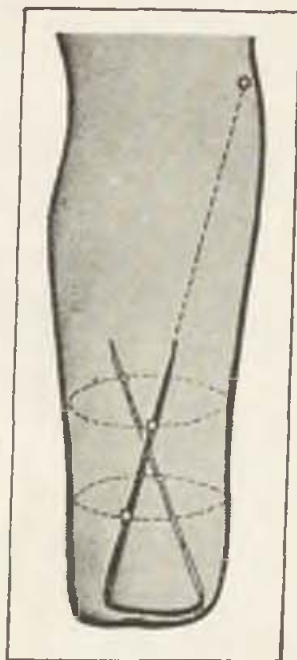


Fig. 1. Diagram of skin incision in the careful forking operation of a forearm stump. The uninterrupted line marks the incision on the flexor side of the stump.

Operation, performed on August 5, 1955: Ether-oxygen anaesthesia; tourniquet on the arm. First the skin was marked as shown on fig. 1. Then an incision was made through the skin and the subcutaneous tissue coming up to about 10 cm. distance from the proximal end of the stump. On the volar aspect the fascia was incised along the ulnar border of the palmaris longus tendon to a length of 10 cm. Within the extent of the operation wound the following structures were resected: on the volar aspect the flexor profundus and sublimis, the flexor pollicis longus and — after injecting novocaine — also the median nerve; on the dorsal aspect the extensor digitorum communis, the remnants of the extensor indicis proprius and the extensor pollicis longus and brevis. *The origin of the abductor pollicis longus on the ulna and its insertion into the end of the radius stump were left intact* (Fig. 3). The distal portion of the interosseal membrane was divided near the radius under visual control, the proximal portion was separated from the bone for its entire length by a narrow osteotome. Then the radius was pulled away from the ulna to a distance of 10 cm. Bleeding was controlled. The skin suture on the radial branch of the fork was performed without tension; on the ulnar branch incisions had to be made to loosen the tension. Healing proceeded by first intension (Fig. 4). Active capacity for gripping appeared already on the sixth day after operation and on the tenth day, when the sutures were removed,

it was quite evident, the range of movement being about 3 cm. The power of gripping increased rapidly. Condition on discharge: depth of fork — 11 cm., separation of branches — 3.5 cm., power of grip — 30 kg. (Fig. 5).

Case 2: A male patient (M-v), aged 27, blind. There was a stump of the left hand after amputation of all fingers at the level of the carpo-metacarpal joints

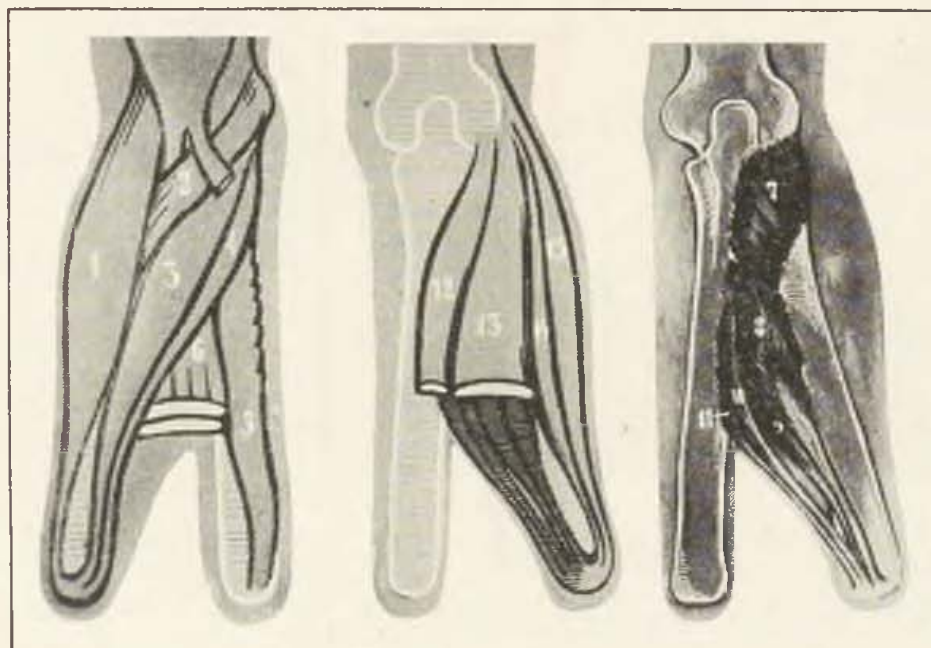


Fig. 2. Diagram of muscle plasty in the careful forking operation. 1 — m. brachioradialis, 2 — m. pronator teres, 3 — m. flexor carpi radialis, 4 — m. palmaris longus, 5 — m. flexor carpi ulnaris, 6 — flexors of fingers, 7 — m. supinator, 8 — m. abductor pollicis longus, 9 — m. extensor pollicis brevis, 10 — m. extensor pollicis longus, 11 — m. extensor indicis proprius, 12 — m. extensor carpi ulnaris, 13 — extensor digitorum communis, 14 — m. extensor carpi radialis brevis, 15 — m. extensor carpi radialis longus.

and the thumb at the level of the proximal phalanx; the stump of the thumb was fully mobile in all preserved joints. The movements of the radio-carpal joint were not limited. The right upper extremity was amputated at the level of the metaphysis of both bones of the forearm, the length of the dorsal aspect of the stump being 26.5 cm. The scar was terminal and linear. The musculature was little developed. The psychic condition of the patient was defective; psychopathia of a considerable degree with frequent decompensation supervened. Disregarding the expected difficulties the author decided to carry out a reconstructive operation in the hope that the patient would use the forked stump in moments of clearer consciousness. Special preoperative treatment of the stump appeared unnecessary. The patient was frightened of the operation, and several times previously pre-operative treatment, carried out in other hospitals, caused a violent recurrence of the psychic disorder.

On August 25, 1955 10 ml. of 10% Hexenal instead of glucose was administered intravenously to the patient in the dressing room. Anaesthesia was then

continued in the operating theatre with a mixture of ether and oxygen. The incision was calculated so that the skin of the stump could be divided evenly between the radial and ulnar branch of the fork, and reached a level of about 15 cm. from the proximal end of the stump. Within the range of the operation wound all flexors, the extensor digitorum communis and the median nerve

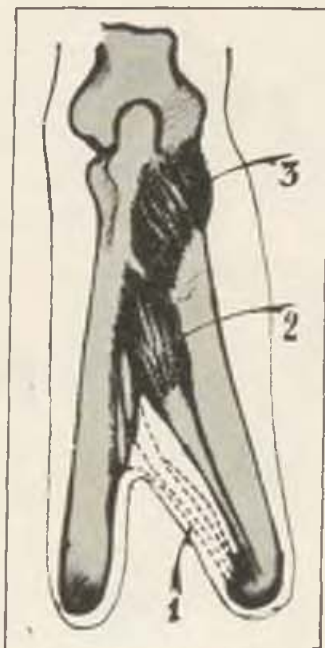


Fig. 3. Diagram of the operation on patient P-v. 1 — resection of m. extensor pollicis brevis, m. extensor pollicis longus, m. extensor indicis proprius; 2 — m. abductor pollicis longus; 3 — m. supinator.

were resected. *The dorsal muscle group of the thumb was preserved* (the tendons of these muscles were adherent to the end of the radius stump). The interosseal membrane was divided along its entire length and the branches of the fork pulled apart to a distance of 9 to 10 cm. The ulnar branch was covered by skin without tension. On the radial branch incisions had to be made on the skin to loosen the tension. Healing proceeded without complications (Fig. 6). On the 15th day the radial branch was adducted to the ulnar branch with power as in true gripping. The elaboration of function was retarded because the patient did not comprehend what he was supposed to do in order to abduct the radial branch of the fork. Only after one month was he able to abduct satisfactorily. — Condition on discharge: length of fork branches — 9 cm., separation of branches — 3.5 cm., power — 20 kg. (Fig. 7).

The question arises of why these patients develop the capacity of active gripping so speedily. The answer lies obviously in the special arrangement of muscles acting on the radial branch of the fork. The careful division of a forearm stump differs from other methods in the fact that it preserves the dorsal muscle group of the thumb which from the anatomical point of view forms a solid block with a common source of blood supply and innervation. The action of these

muscles on gripping is realized by their particularly advantageous grouping within the fork (all muscles, except the extensor brevis of the thumb, have their origin on the proximal and middle third of the ulna and their insertion after amputation on the end of the radius stump). The entire group constitutes a powerful synergist to the supinator; the insertion of these muscles onto the fork always



Fig. 4. Patient P-v after operation.

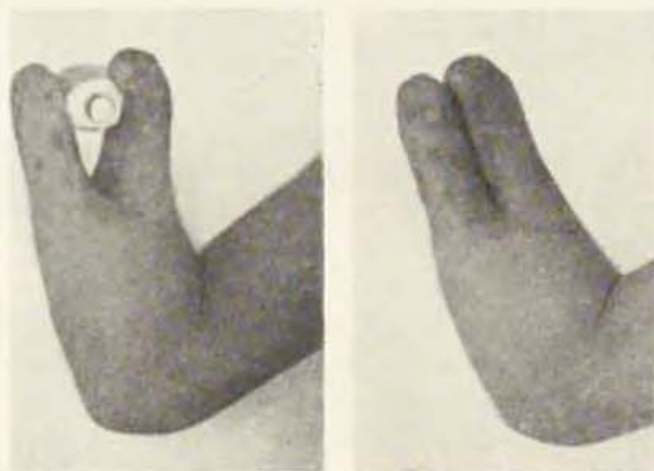


Fig. 5. Abduction and adduction of radial branch of fork in patient P-v on discharge from hospital.

counter-balances the more powerful muscle group acting in the direction of pronation. *The fork is dynamically balanced and thus the necessary conditions for the realization of active gripping are created.*

In the methods of Krukenberg, Albrecht, Povolocky and others the group of muscles effecting pronation of the radial branch is always more powerful than the group of supinators, and the abducting muscles are more powerful than the adductors. Active gripping by a dynamically unbalanced fork is possible only

by mobilising mechanisms of physiological compensation and for this considerable effort on the part of the patient as well as time are needed. The dynamic equilibrium of the fork which is the advantage of the careful division of the forearm amputation stump, may be affected by an alteration of the muscle supply systems to the radial branch, as is shown in the following case.

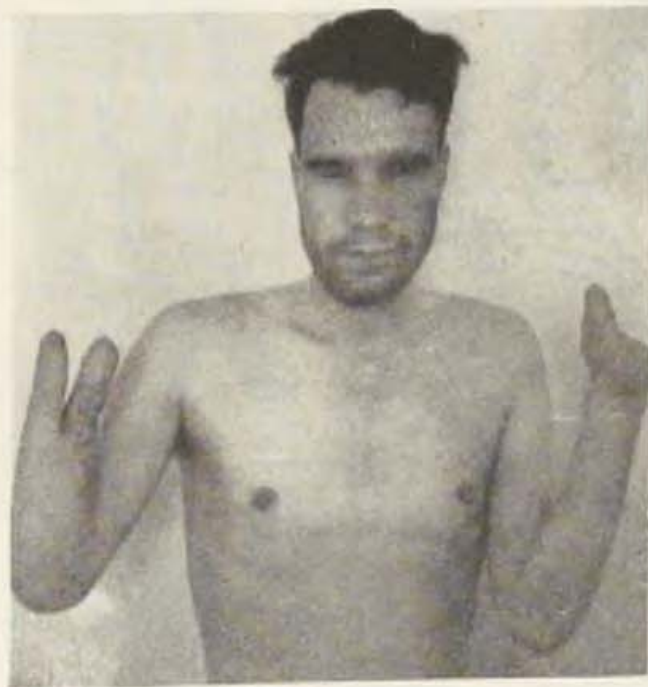


Fig. 6. Patient M-v after operation.



Fig. 7. Function of fork in patient M-v.

A male patient (M-v), 24 years old: The left hand was undamaged. The stump of the right forearm was 25 cm. long on the extensor side and in good condition. After the usual pre-operative treatment of the skin and special exer-

cises, operation was performed on November 1, 1955 under combined inhalation anaesthesia. A tourniquet was applied to the arm. The incision was made through the skin and the fascia so that two flaps of 14 cm. length were formed, the one for the radial branch was 1 cm. broader than the one for the ulnar branch. Then mobilisation of the flaps was effected. The flexor sublimis of the fingers was

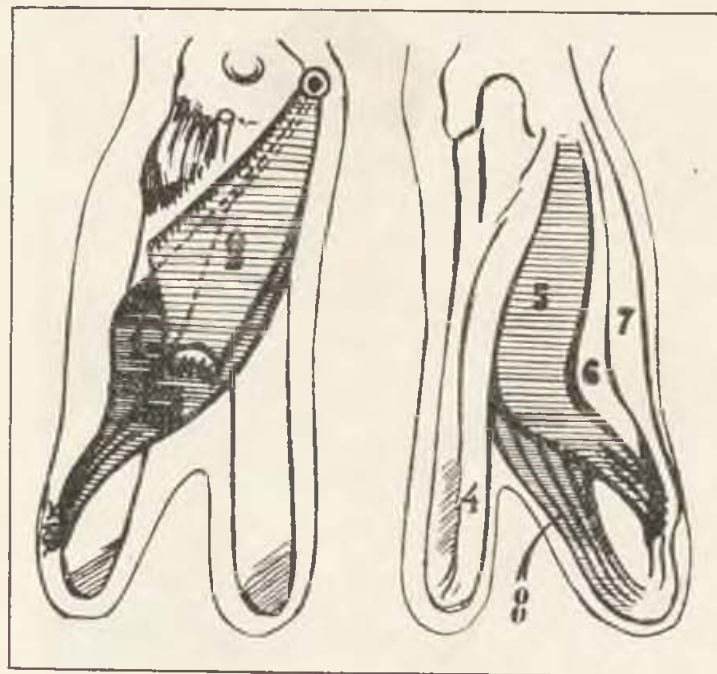


Fig. 8. Deviation from usual muscle plasty in operation on patient M-v G. 1 — m. flexor pollicis longus, 2 — m. flexor digitorum sublimis, 3 — m. flexor digitorum profundus, 4 — m. extensor carpi ulnaris, 5 — m. extensor digitorum communis, 6 — m. extensor carpi radialis brevis, 7 — m. extensor carpi radialis longus, 8 — dorsal muscle group for thumb.

resected at the level of the proximal corner of the wound and the rest sutured to the flexor digitorum profundus. The median nerve was resected with the utmost care. The interosseal membrane was divided down its entire length, the radius then abducted to a distance of 7 cm. At the level of the proximal corner of the wound a tunnel between the radius, the brachial muscle and the radial extensor of the hand was formed in a volardorsal direction. The tendons of flexor digitorum profundus and pollicis longus were separated and led through the tunnel onto the dorsal side of the forearm and sutured to the tendons of the extensor digitorum communis above the radius. The dorsal muscle group of the thumb was not resected, only their origins on the ulna were partly separated and shifted proximally by 1.5 cm. (Fig. 8). After controlling the bleeding the skin-fascia flaps were wrapped around both branches of the fork and incisions made to loosen the tension.

Healing proceeded without complications. In this case the entire musculature of the stump with the exception of the ulnar flexors and extensors of the hand was used for ensuring the gripping capacity of the fork. Rapid appearance of

active gripping and a maximum power were, therefore, expected. The result, however, did not come up to expectation. The patient was incapable of performing abduction of the radial branch after three weeks and the training of active gripping, which first appeared after one and a half months, required great patience, effort and time on the part of the rehabilitation workers. On discharge



Fig. 9. Patient M-v G. after operation.

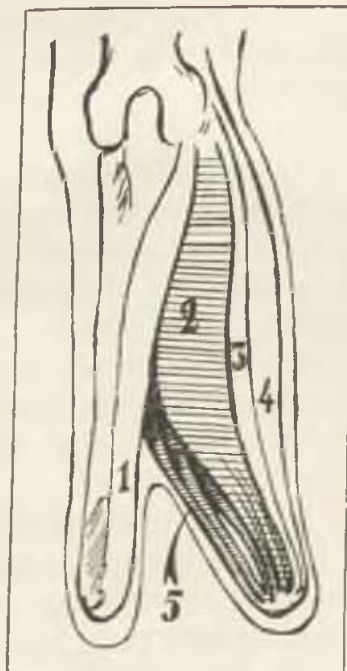


Fig. 10. Diagram of the operation on the right forearm fork in patient Z-k. 1 — m. extensor carpi ulnaris, 2 — m. extensor digitorum communis, 3 — m. extensor carpi radialis brevis, 4 — m. extensor carpi radialis longus, 5 — dorsal muscle group for thumb.

the separation of the fork branches reached 5 to 6 cm. and the power was 30 kg. (Fig. 9).

The peculiar development of the gripping capacity in this case undoubtedly depended on the alteration of the principle of dynamic equilibrium: 1. it became evident that the muscle group acting in the direction of adduction was more

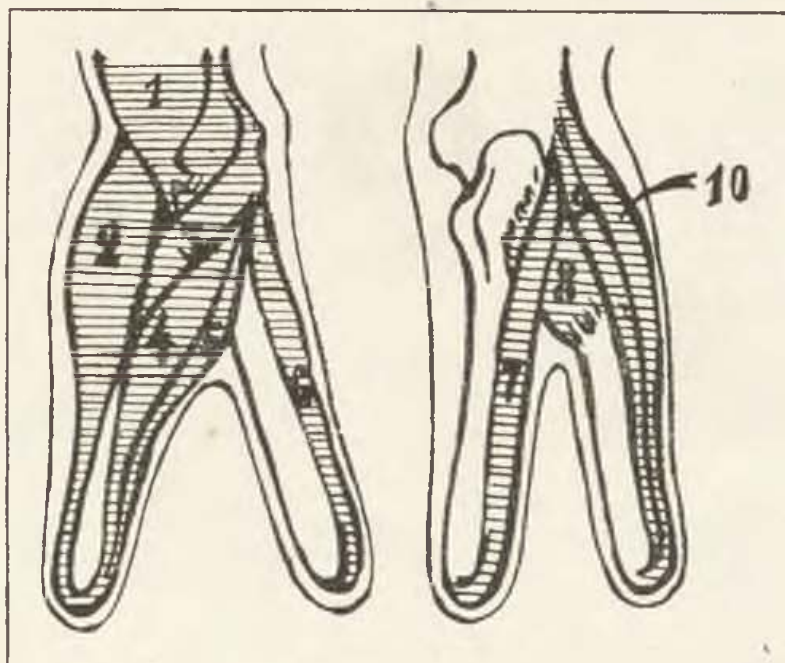


Fig. 11. General diagram of Russian method of forking a forearm stump. 1 — m. biceps brachii, 2 — m. brachioradialis, 3 — m. pronator teres, 4 — m. flexor carpi radialis, 5 — palmaris longus, 6 — m. flexor carpi ulnaris, 7 — m. extensor carpi ulnaris, 8 — m. supinator, 9 — m. extensor carpi radialis brevis, 10 — m. extensor carpi radialis longus.

powerful than that effecting abduction (abduction of the radial fork branch did not appear for a long time); 2. the flexors of the thumb after transposition became pronators so that the pronators predominated over the supinators. Despite the concentration of muscles for the function of adducting the radial branch, the power of gripping was not greater in this case than in case No. 1 (P-v), where the sparing type of operation was performed. This proves that the assumption that the power of gripping is also dependent on the dynamic equilibrium of the fork, was correct. In other words: where the dynamic equilibrium has been preserved the power of gripping is greater.

In his monograph on "Reconstructive Operations on Upper Extremity Stumps" (1956) the author expressed his idea about the development of the gripping capacity of the fork. Under normal circumstances this function is alien to man and, therefore, without the genetic foundation of the respective reflex mechanism., It requires the creation of new conditioned reflex associations, i. e. of a new dynamic stereotype. The described cases, however, show that the capacity for active gripping can be developed without any training on the basis of *the old dynamic stereotype*.

Particularly instructive in this respect is the following case.

A male patient (Z. L. G.), 30 years old, with bilateral amputation of the forearm: on the right in the distal third, on the left between the distal and middle third, after frost-bite of all four extremities eight months previously. September 1, 1958 operation for the careful forking on the right forearm stump to a depth of 12 cm. was performed. On the volar aspect all flexors of the fingers were resected to the limit of the operation wound. On the dorsal side all muscles were preserved and the abductors of the thumb and the index finger together with the tendons of the extensor digitorum communis were left with the muscle group of the radial fork branch (Fig. 10). The ulnar branch was covered with the skin of the stump. To cover the radial branch with skin it was necessary to make incisions to loosen the tension. The thus created defect of 3×6 cm. was covered by an autotransplant. Healing proceeded without complications. On the eleventh day active gripping function was evident which rapidly improved. Much time was needed for the treatment of a trophic ulcer on the right foot.

November 17, 1958 operation was performed on the left forearm. During dissection it was seen that dorsal group of muscles had been already partly resected in the first amputation and had partly undergone scarring, so that it was impossible to use it for the fork. The remnants of the muscles for the thumb and of extensor digitorum communis were removed. On the volar aspect the flexors of the fingers were resected (Fig. 11). The fork became dynamically unbalanced with an evident predominance of the flexors and pronators. Healing proceeded by first intension. With the exercises usually practised at the Clinic, active capacity for gripping of this stump developed very slowly and it took two months before the patient mastered the movement.

In this patient, therefore, the function of active gripping developed in the right, dynamically balanced fork eleven days, and in the left, dynamically unbalanced fork not until two months after the operation.

S U M M A R Y

The author's observations prove that the principle of the dynamic equilibrium of the fork is by no means an abstract conception. It must not be neglected when planning an operation for forking a forearm stump. Without considering this principle no results of this reconstruction can be properly analyzed. The dynamic equilibrium of the fork means the optimum physiological proportion both between adductors and abductors, and between pronators and supinators of the radial fork branch. This proportion can be changed not only by the transposition of muscles by operation, but also by special exercises of individual muscle groups prior to operation. In practice it is important to achieve harmony among all participating muscle groups so that the function of the fork would not require the bringing in of additional, compensatory mechanisms which is always connected with loss of time and further effort. The results of the careful forking of a forearm stump show the practical way of applying the principle of the dynamic equilibrium of the stump in the reconstructive surgery of the forearm.



ВЫВОДЫ

«О динамическом равновесии расщепленной культи предплечья»

Г. Д. Шушков

Клиническая проверка нового способа экономного расщепления культи предплечья, разработанного автором в 1953 году, показала, что сохранение в составе лучевой branши клешни тыльной группы мышц большого пальца резко изменяет динамику клешни: прямой плоскостной схват, на разработку которого обычно необходимо 1—2 месяца, осуществляется больными сразу же после снятия швов. Это зависит от усиления группы разгибателей лучевой branши и динамического уравнивания силы разгибателей и сгибателей клешни.

«Динамическое равновесие клешни», которое понимается нами как оптимальное физиологическое соотношение между приводящей и отводящей мускулатурой, между пронаторами и супинаторами лучевой branши клешни, можно изменять путем перемещения и иссечения мышц во время операции, а также целенаправленной тренировкой определенных мышц культи предплечья до операции.

Принцип динамического равновесия должен стать основой любой операции расщепления культи предплечья; при соблюдении его схват клешни формируется очень быстро, без значительных усилий со стороны больного.

Знание упомянутого принципа помогает рациональному планированию операции и позволяет анализировать результаты её.

RÉSUMÉ

L'équilibre dynamique du moignon dédoublé de l'avant-bras

G. D. Shoushkoff

Les expériences cliniques avec la nouvelle méthode physiologique du dédoublement du moignon de l'avant-bras, élaborée par l'auteur en 1953, nous montrent que la conservation du groupe dorsale des muscles du pouce destiné pour la branche médiale de la fourchette est capable de changer la dynamique de la fourchette. La prise directe en plan, dont l'acquisition n'est guère possible en une période de moins d'un à deux mois, devient réalisable les piqûres une fois prises, ce qui dépend de la force aggrandie du groupe des fléchisseurs de la branche radiale de même que d'équilibre dynamique de la force des fléchisseurs et des extenseurs de la fourchette.

L'équilibre dynamique de la fourchette, c'est-à-dire le rapport physiologique entre les muscles adducteurs et abducteurs entre les pronateurs et les supinateurs de la branche radiale de la fourchette, peut être changé à l'aide de la transposition et de la résection des muscles au cours de l'opération, mais de même à l'aide des exercices envisagées des muscles eux-mêmes du moignon de l'avant-bras au temps préopératoire. Le principe de l'équilibre dynamique devrait constituer la base de chaque opération du dédoublement du moignon de l'avant-bras, en le conservant, la possibilité de la prise de la fourchette se forme bien vite, sans effort considérable pour le blessé. La connaissance du principe cité ci-dessus nous aide à rendre le bilan de l'opération rationnel le plus que possible et nous permet de juger raisonnablement les résultats obtenus.

ZUSAMMENFASSUNG

Über das dynamische Gleichgewicht des gespaltenen Oberarm-Stumpfes

G. D. Schuschko ff

Die klinische Überprüfung einer vom Autor im Jahre 1953 ausgearbeiteten neuen Art von schonender Spaltung des Oberarm-Stumpfes ergab, dass die Erhaltung der dorsalen

Muskelgruppe des Daumens auf den radialen Gabelschenkel die Gabelndynamik wesentlich ändert: Eine direkte Ergreifung mit der Handfläche, zu deren Ausarbeitung man gewöhnlich 1—2 Monate benötigt, kann der Kranke sofort nach Entfernung der Nähte durchführen. Dies hängt von der Verstärkung der Flexorengruppe des radialen Schenkels und von dem dynamischen Gleichgewicht der Flexoren- und Extensorenstärke der Gabel ab.

Das „dynamische Gleichgewicht“ der Gabel, was wir als optimales physiologisches Verhältnis zwischen Adduktoren und Abduktoren und zwischen Pronatoren und Supinaren des radialen Gabelschenkels verstehen, kann sich durch Versetzung und Muskelresection im Verlaufe der Operation, sowie durch zielbewusste Übung der einzelnen Muskeln des Oberarm-Stumpfes vor der Operation ändern.

Das Prinzip des dynamischen Gleichgewichtes soll die Grundlage für jede Operation des gespaltenen Oberarm-Stumpfes bilden; unter Beibehaltung dieses Prinzips bildet sich die Fähigkeit der Gabelergreifung sehr rasch aus, ohne den Patienten wesentlich anzustringen. Die Kenntnis des angeführten Prinzips verhilft zu einer rationellen Operationsplanung und gestattet eine richtige Beurteilung der Operationsergebnisse.

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„DIVIDED NAEVUS“ OF THE EYELIDS (With an analysis of 14 operated cases)

CHU HUNG-YIN, WANG TA-MEI, KUNG FAN-HU, HAO CHU-JEN

“Divided naevus” of the eyelids is a pigmented mole of congenital origin, situated partly on the upper and partly on the lower eyelid. Fuchs, in 1919, first described this disease, and called it “divided naevus” because the naevus is divided by the parpebral fissure into two halves. The lids are closed by epithelium during the early part of foetal life and open at the end of the 5th month of gestation. Presumably such a naevus is formed before the lids are separated.

“Divided naevus” of the eyelids is a rare disease. Following A. Fuchs’ report, Collenza (1937, 2 cases), Sugar (1944, 1 case), Callahan (1946, 1 case), and Fuchs (1948, 3 cases) made similar reports. In China, Lo reported three cases in 1951



Fig. 1.



Fig. 2.

and in his report he mentioned that Chan had also seen two other cases. Among the previous communications, except for those of Collenza, Sugar, and Callahan, there are merely clinical reports of a rare case without treatment.

Since 1952 we have operated on 14 such cases (see table) 11 being in men and three in women. The naevus was located on the left lids in seven cases, and on the right eyelids in seven cases. The naevus invariably involved the skin and the conjunctiva of the lid. It may be located on the nasal side, the middle portion, or the temporal side of the lids. Among these 14 cases, in four cases it was

located on the nasal side (Fig. 1, 2), in four cases in the middle portion (Fig. 3), and five cases near the temporal side (Fig. 4, 5) of the eyelids. In one case the whole lids were involved.

The naevi of these 14 cases can be roughly divided into two clinical types. In type 1 (8 cases), the naevus was black in colour, elevated from the normal



Fig. 3.



Fig. 4.



Fig. 5.

skin, having a rough warty surface and also coarse hair (see Fig. 1). The naevus was usually large in size, consequently, it interfered with vision and caused irritation to the conjunctiva and cornea. The configuration of the eyelashes was disturbed, resulting in trichiasis. According to location, naevi in type I can be further divided into two groups. In one group the naevus involves the skin and conjunctiva of the eyelids, while in the other group it involves chiefly the lid margin (Fig. 6).

In type 2, the naevus was brownish-black in colour, flat or slightly elevated from the normal skin, and having a smooth surface with or without thick hair (5 cases, see Fig. 2). Although a naevus belonging to this type does not produce any functional disturbances, it affects the patient psychologically.

Table. Summary of

Case No.	Name	Sex	Age	Location of naevus	Type
1	Lin T. C.	F.	16	Right, nasal	I
2	Li D. C.	M.	21	Right, nasal	Mixed
3	Chang C. C.	M.	20	Left, central	II
4	Kao P.	M.	31	Right, temporal	I
5	Ch'ang Y. C.	M.	26	Right, nasal	I
6	Hou S. C.	F.	19	Right	I
7	Li S. M.	M.	28	Right, central	I
8	Chin T. C.	M.	24	Left, central	II
9	Li M. H.	M.	27	Left, nasal	I
10	Liu W. Y.	M.	21	Left, temporal	I
11	Tang C. H.	M.	20	Left, temporal	II
12	Sha P. Y.	M.	30	Left, temporal	II
13	Tiao T. K.	M.	24	Right, temporal	II
14	Kao H. J.	F.	23	Left, central	I

Case Histories.


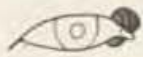












Condition of conjunctiva, cornea	Functional disturbances	Pathological examination	Diagrammatic drawing
Congestion of conjunctiva, scar of cornea	Interference of vision. Irritation from trichiasis	Junctional naevus	
Congestion of conjunctiva	Interference of vision, chiefly on the nasal side. Itching sensation	Dermal naevus	
Congestion of conjunctiva	No	Dermal naevus	
Congestion of conjunctiva	Interference of vision of the temporal side	(Not done)	
Scar of cornea. Congestion of conjunctiva	Difficulty in opening eye. Interference of vision	Dermal naevus	
Cornea claudy, congestion of conjunctiva	Difficulty in opening eye. Vision blurred	(Not done)	
Normal	Interference of vision when looking down ward	(Not done)	
Normal	No	Dermal naevus	
Normal	Interference of vision on the nasal side	(Not done)	
Congestion of conjunctiva	Itching sensation. Interference of vision on the femoral side	(Not done)	
Normal	No	(Not done)	
Normal	No	(Not done)	
Normal	No	Dermal naevus	
Scar of cornea	Interference with vision	(Not done)	



Fig. 6.



Fig. 7.

In most cases, the naevus on the upper and lower eyelid belonged to the same type. There was only one case (Fig. 7) in which the naevus on the upper eyelid belonged to type I and that on the lower eyelid to type 2.

Following the advancement of technique in plastic surgery, this disease can be satisfactorily remedied by surgical means. The chief problem involved in the treatment lies in the repair of the defect resulting from excision of the tumour. From the surgical point of view, the lid is considered to be composed of two layers. The part in front of the tarsus belongs to the outer layer, and that behind and including the tarsus constitutes the inner layer. "Divided naevus" largely occupies the outer layer, and in part the inner layer. Thus, after the removal of the tumour the outer layer loses more tissue than the inner layer. We use a sliding tarsoconjunctival flap to repair the inner layer, and a split-

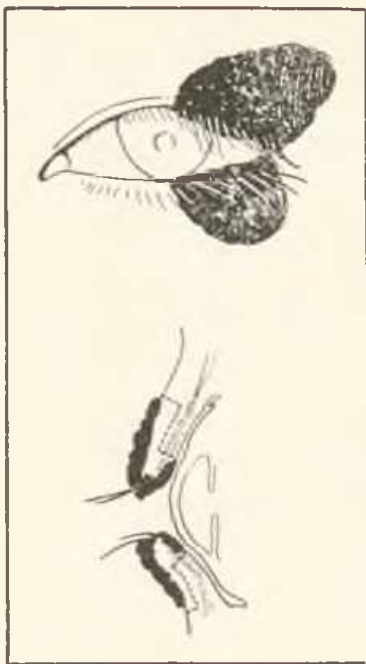


Fig. 8 a.

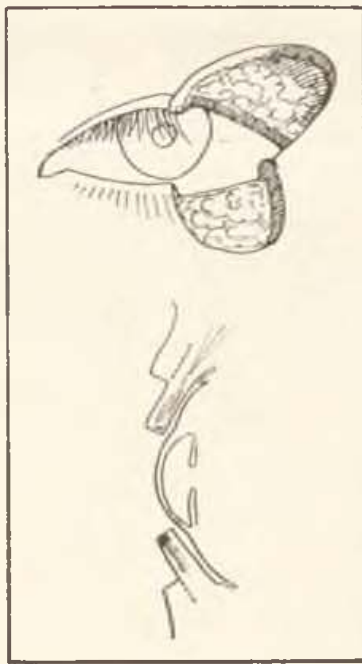


Fig. 8 b.

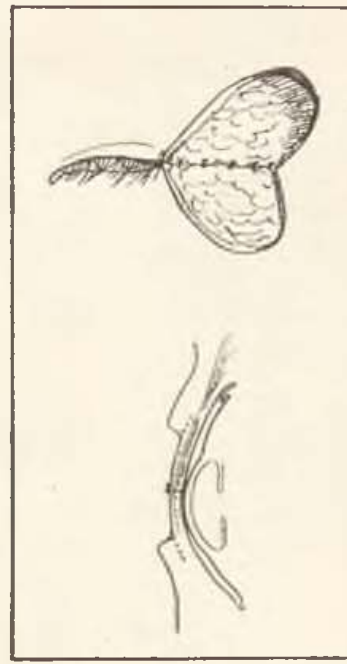


Fig. 8 c.

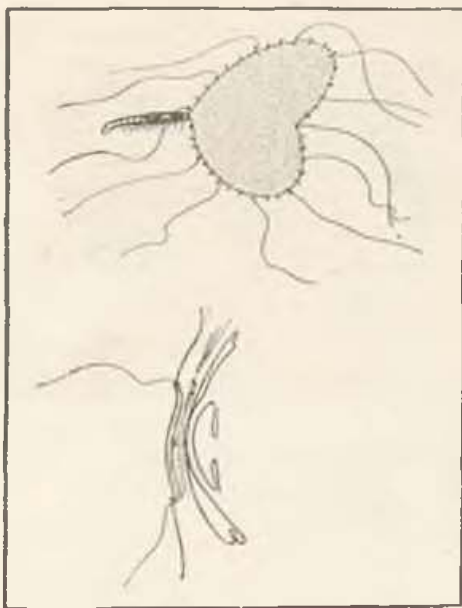


Fig. 8 d.



Fig. 8 e.



Fig. 8 f.



Fig. 9 a.



Fig. 9 b.



Fig. 9 c.

Fig. 9. Case 1. a, b, Preoperative. Fig. 9 c. One month after the treatment was completed.



Fig. 9 d.



Fig. 9 e.

Fig. 9 d, e. 7 years later.



Fig. 10a.



Fig. 10b.

Fig. 10 a, b. Preoperative.



Fig. 10 c. After the second stage of operation is completed, showing the condition of hair-bearing graft taken from the eyebrow.



Fig. 10d.



Fig. 10e.

Fig. 10 d, e. End result.



Fig. 11.

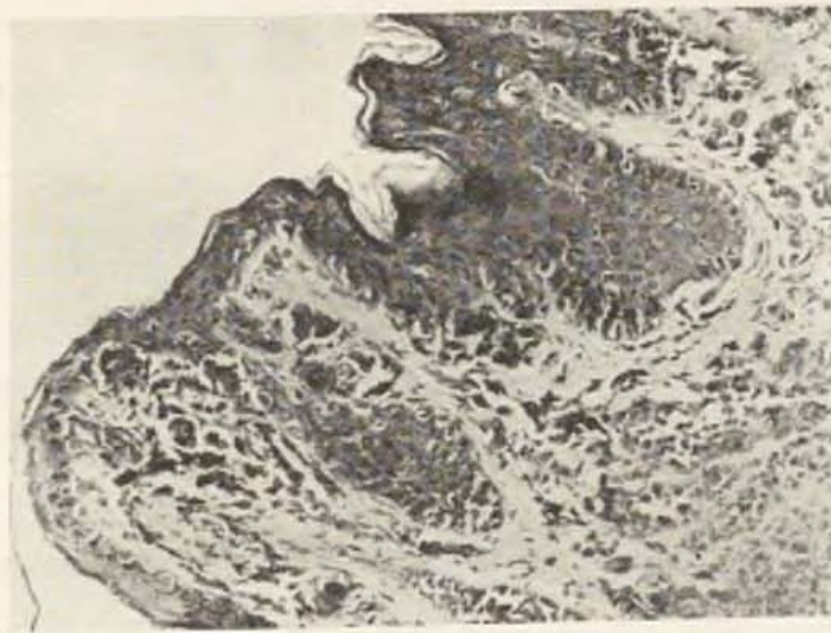


Fig. 12.

Fig. 11. Photomicrograph of the naevus removed from case 10. This section shows clusters of pigmented naevus cells in the dermis between the downgrowths of the epidermis. The surface epithelium is atrophic. (H. & E. X 180.) — Fig. 12. Photomicrograph of the naevus removed from case 1. This section shows nests of pigmental naevus cells in the epidermodermal junction. Clusters of pigmented naevus cells can be seen in the left lower corner of the photo. The surface epithelium is slightly hyperkeratotic. (H. & E. X 180.)

thickness skin graft to repair the outer layer, and finally implant a strip of hair-bearing skin graft taken from the eyebrow to construct the eyelashes.

The whole course of treatment is divided into three stages. In the first stage, after the tumour has been completely excised, the inner layer of both lids is mobilized, their free margins are approximated and sutured with interrupted subconjunctival stitches. The raw surface is covered by one piece of split-thickness skin graft taken from the inner surface of the upper arm (Fig. 8 a. b. c. d.). In the second stage, usually three to four months after the first stage, when the grafted skin becomes soft and pliable, an incision is made along the future palpebral fissure down to the tarsus. A strip of hair-bearing skin graft of suitable length and with three to four rows of hair is inserted into the narrow space, and anchored with stitches (Fig. 8, e.). Third stage: one to two months after the second stage, the eyelids are cut open in such a way that there are "eyelashes" on the margins of both eyelids (Fig. 8, f.).

In cases where the naevus chiefly occupies the lid margins, the treatment is carried out in two stages. First stage: excision of the naevus, mobilization and suturing of the inner layers of the lids, a strip of hair-bearing skin graft is used for the outer layer. Second stage: the eyelids are cut open.

We operated upon 14 cases according to this scheme. Thirteen cases have been completed, one case is now under treatment. The longest follow-up is seven years (Fig. 9). A recently finished case is shown in Fig. 10. The results of the cases treated were satisfactory both functionally and cosmetically. So far there is no evidence of recurrence of the naevus.

Pathological examination of the excised specimen was made in six cases. Five were (case 2, 3, 5, 8, 13) naevi of dermal type (Fig. 11), the remaining one (case I) junctional naevus (Fig. 12).

SUMMARY

In reconstruction of full-thickness loss of the eyelid with the eyeball intact, the Peking Medical College Hospital treated 14 cases of divided naevus of the eyelids. The naevus was excised en block, the remnants of the conjunctivae and tarsi of the upper and lower lids were sutured together after thorough mobilization, and the defect in the skin was replaced by one piece of split thickness skin graft. Two to three months afterwards a narrow strip of composite graft of skin and subcutaneous tissue with 3—4 rows of hair was cut from the eyebrow of hair line to make eyelashes. One month later the reconstructed lid was cut open. The result was satisfactory both functionally and cosmetically.

ВЫВоды

Разделенное родимое пятно век

Чу Хумг-ин, Ванг Та-мей, Кумг Фан-ху, Хао Чу-джен

В факультетской больнице в Пекине подвергалось лечению 14 больных с разделенным родимым пятном век, причем реконструкция дефекта век, захватывающего все слои, производилась таким образом, чтобы глазное яблоко осталось незатронутым. Родимое пятно было иссечено целиком. Далее была произведена обширная мобилизация остающейся

конъюнктивы и хряща верхнего и нижнего века, после чего они были сшиты и дефект кожи перекрыт одним трансплантатом по Тиршу. Через 2—3 месяца была иссечена узкая полоска кожи с подкожной клетчаткой из бровей или из границы волос, на которой были оставлены 3—4 ряда волос для реконструкции ресниц. Через дальнейший месяц восстановленные таким образом веки были разделены поперечным размером. Результаты оказались удовлетворительными как с функциональной, так и с косметической точек зрения.

R É S U M É

Le naevus doublé des palpèbres

Chu Hung-yin, Wang Ta-mei, Kung Fan-hu, Hou Chu-jen

14 cas du naevus doublé des palpèbres ont été soignés en Hôtel-Dieu de la Faculté de Médecine de Peking. La reconstruction fut pratiquée à la manière de rétablir toutes les couches laissant le bulba indemne. Le naevus fut totalement extirpé, les restes de la conjonctive et du tarsus de la palpèbre inférieure aussi bien que supérieure ont été largement mobilisés, cousus après, et le défaut de la peau couvert par la greffe de Tiersch. En suite de 2—3 mois une partie mince de la peau et du tissu sous-cutané, comprenant 3—4 rangs des cheveux et servant à la reconstruction des cils, fut excidé des sourcils ou de la partie chevelue de la tête. Un autre mois passé, les palpèbres reconstruites de cette manière furent divisées par une incision en largeur. Les résultats ont été favorables quant à la fonction de même qu'à l'égard esthétique.

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

Geteilter Augenlider-Naevus

Chu Hung-yin, Wang Ta-mei, Kung Fan-hu, Hou Chu-jen

Im Fakultätskrankenhaus in Peking wurden 14 Fälle von geteiltem Augenlider Naevus behandelt. Der Defekt im Augenlid, der alle Schichten einschloss, wurde in der Form rekonstruiert, dass der Augenbulbus unberührt blieb. Der Naevus wurde im ganzen exzidiert, die restliche Bindehaut und Ober- und Unterlidtarsus breit mobilisiert und genäht und der Hautdefekt durch einen einzigen Thiersch-Lappen gedeckt. Nach 2—3 Monaten wurde ein schmaler Hautstreifen und subkutan Gewebe aus den Augenbrauen oder der Haargrenze ausgeschnitten, an dem 3—4 Haarreihen zwecks Rekonstruktion der Augenwimpern verblieben. Nach einem weiteren Monat wurden die auf diese Weise rekonstruierten Augenlider durch Querinzision geteilt. Die Ergebnisse waren sowohl in funktioneller, als auch kosmetischer Richtung befriedigend.

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PROBLEMS OF PRIMARY ALLOPLASTY OF SKULL DEFECTS

V. D. GOLOVANOV, M. E. TKACHEVA

Our experience with primary covering of skull defects by alloplasty is presented in this communication.

Our method of using polyethylene implants has given such satisfactory results that we considered it worth while to publish it.

It is well known that surgeons have devoted great attention for a long period to the various types of plastic repair for covering skull defects. All types of plastic operations suggested hitherto, however, are related to the period a long time after the occurrence of the defects. The operations are usually carried out at the earliest one year after trepanation of the skull for the treatment of a depressed fracture of the vault.*) Primary plasty, however, i. e. the covering of the skull defect immediately after trepanation of the skull, was hitherto used only rarely and represents one of the tasks of contemporary plastic surgery.

Before continuing with the description and justification of the method of primary alloplasty for covering of skull defects employed by us to day, we think it advisable to give a short survey of the methods of auto- and alloplasty most frequently used for late secondary operations.

Every more or less experienced surgeon knows that autoplasty comprises the use of ribs, bone from the iliac crest, cartilage and bone grafts from the right costal arch and also cadaver cartilage. For small skull defects rib chips are used which are levelled into the defect, or chips from the iliac crest, which are taken according to the size of the defect and inserted into the defect with their convexity upwards. Cadaver cartilage is used much more rarely for covering skull defects (V. S. Semenov, Yakutsk).

Autoplasty employing $\frac{3}{4}$ thickness bone and cartilage grafts from the right costal arch according to the method of N. N. Burdenko may be considered as useful for large skull defects. Such a graft can be fairly easily modelled and gives favourable results with firm covering of the defect. A. S. Melkumov in her dissertation explained the use of this method as the final stage in an operation for herniae of the cerebral ventricles due to gunshot injuries to the skull and brain.

*) B. J. Jegorov's report on the 25th Soviet Congress of Surgeons.

All the above kinds of autoplasmic covering of skull defects require special, rather complicated preliminary operations to obtain the autograft. This is certainly a negative aspect of autoplasty. It is also known that results of autoplasty are not always favourable, because the grafts are frequently absorbed and replaced by connective tissue.

During the last ten years alloplastic methods have begun to be used most frequently for the late covering of skull defects.

It is known that in the USA tantalum has been used for this purpose.

In the USSR the most frequently used alloplastic materials are plexiglass (V. A. Goykhman - Leningrad) and polymethylmeta-acrylate (N. D. Leybzon - Moscow).

The use of polymethylmeta-acrylates for skull defects after gunshot injuries was successfully described by the second author in his extensive study of experimental clinical work (dissertation) at Burdenko's Neurosurgical Institute of the Academy for Medical Science in the USSR.

Turning now to the question of primary plasty of skull defects, one cannot say, that this is completely new.

The endeavour of surgeons to cover skull defects immediately after trepanation has always been natural and taken into consideration.

It is only in recent years, however, that this question has become actual, being brought about undoubtedly by the great progress in plastic and reconstructive surgery especially the development of alloplasty.

Up to recent times only the covering of small defects was performed immediately after trepanation of the skull for injuries to its vault causing compression and then only under favourable conditions.

In depressed fractures of the cranial vault for example, where one or more fragments had not lost connection with their original site, they could be raised to the level of the cranial vault and left there to reduce or completely cover the bone defect.

Under specially favourable conditions one may even use free bone fragments for the same purpose of covering bone defects. We have cases, where fragments were laid like tiles and the results were very satisfactory. At the same time there must be no doubt with regard to the basic fact that any fragment could cause pressure on the dura mater lying underneath.

Very small skull defects formed by trepanation, can be covered by mobilising the external lamina of the skull bone in the vicinity of the defect and rotating it into the region of the defect according to the method of A. L. Polenov. Such kinds of autoplasty, however, have only a very restricted application and only the use of alloplastic implants allows the covering of skull defects of larger dimensions.

During the last three years we have been concerned with finding methods for the primary covering of skull defects by alloplasty. We chose polyethylene for this purpose because C. V. Gruzdkov, an older scientific worker, had obtained very good results with this particular plastic substance in the treatment of defects and deformities of the facial regions. She studied the use of modelled implants

of elastic plastic substances (egmass-12, polyethylene) for many years both experimentally and on a large number of cases at the Maxillary and Facial Surgical Unit of the Central Institute for Traumatology and Orthopaedics. The results were so favourable that there could be no doubt as to the suitability of employing polyethylene for the purpose of primary plasty in the covering of skull defects. E. V. Gruzdkov showed that the polyethylene implants became well encapsulated by a fine connective tissue and infection was not observed as a complication.

Our technique of employing polyethylene plates for skull defects convinces by its simplicity. A polyethylene plate of appropriate shape and size is prepared in advance according to the shape and size of the depressed fracture of the cranial vault and allowing for the probable enlargement due to trepanation. For this purpose we first take a plaster impression of the defect and then make the plaster model of the implant required. A wax model of the implant is prepared from the plaster model and according to this a plaster form (shaped under pressure) for the modelling of the prosthesis. The polyethylene plate is heated and pressed. The prepared implant is then cooled, mechanically treated and cleaned. The prosthesis is gradually bevelled out from the centre to the periphery. On the convex side of the plate a prominence is left in its central part, which, when laid on to the cranial vault is turned to the cavity of the defect. The prominence must not have sharp edges and its height should not exceed the thickness of the bone in the region of the defect; the prominence of the plate, cannot therefore, touch the dura mater. Holes are drilled into the margin of the prosthesis for the insertion of a needle, because after it has been placed over the bone defect the margins of the plate are fixed to the galea aponeurotica by several catgut stitches. The plate is laid on to the skull defect so that its thinned margins lie closely upon the borders of the defect. This greatly assists the use of the implanted plate, because it makes it unnecessary to fit it into the defect as is usually done with autografts. The basic component of polyethylene is neutral ethylene, an inert neutral product, which is processed for this purpose under high pressure (Laboratory for Plastic Substances CITO — V. A. Marsky). It is necessary to have a number of plates of different sizes and shapes in store for emergency operations which can be altered in size and shape before or during the operation. The prostheses are sterilized by simple boiling for 25—30 minutes.

In the postoperative phase the implant does not cause any inflammatory reactions of the cranial tissues. The only not infrequent complication, is a small quantity of reactive tissue transudate in the region of the wound — under the skin flap over the plate. To avoid stagnation of the transudate it may be necessary to aspirate it twice or three times with a syringe with the simultaneous injection of a small quantity of penicillin solution (50,000—100,000 units) as a prophylactic measure.

All wounds under our observation healed per primam. The fact that the margins of the plate are laid upon the borders of the bone defect does not have an unfavourable effect on the cosmetic results.

No painful sensations are observed after the use of the plate. Finally, it can be said that the polyethylene implant is a harmless endo-obturator, which is well fixed. From our experience with 12 cases we would like to give two examples:

Patient S-kov, 31 years old, reg. No 854:

He was treated at the Central Institute for Traumatology and Orthopaedics from the 26. 4. 1957—22. 6. 1957. He was admitted with the diagnosis: depressed fracture of the right frontal and parietal bone (after gunshot injury), Jacksonian epilepsy. He was injured in 1944 by a missile fragment which penetrated into the right fronto-parietal region, causing tangential injury to the skull with compression. He became unconscious. Epileptic attacks appeared 2—3 days after the injury. Operation was not performed. Since January 1950 he had severe headaches.

Local findings: retracted skin scar in the right frontal region, 8×0.5 cm.

On the X-ray pictures of the skull a defect of 5×1 cm. was found, on the right frontal bone small spinters were evident in this region. (Fig. 1.)

CSF analysis: protein 0.165%, cytosis 4/3, positive Pandy, reaction Nonne — An. +, Takata — Ara reaction within normal limits.

Neurological findings: slow reaction of pupils to light, central paresis nerv. facialis, hemihypaesthesia on the left. Reduced abdominal reflexes on the left, memory poor.

After operation for the depressed fracture of the cranial vault, performed on May 15, 1957, a defect of the skull of 7×2.5 cm. (Fig. 2) was created, which was covered by a polyethylene plate prepared beforehand. The plate was put into position so that its thin margins overlapped the borders of the bone defect for 1—1½ cm., and was fixed by 3 catgut stitches through holes specially drilled for the needle (Fig. 3).

The post-operative course was uneventful.

One month after the operation the patient was discharged from hospital.

It is two years from the operation. The headaches have disappeared. Epileptic attacks have not recurred.

Patient D-in, 26 years old, reg. No 519. He was admitted to the Central Institute for Traumatology and Orthopaedics on the March 4, 1958 with the diagnosis of compound depressed comminuted fracture of the right parietal bone.

The accident happened at the factory on March 4, 1958 (he was crushed by ferro-concrete slab). The accident was followed by loss of consciousness, headache followed immediately, giddiness.

Local findings: contused wound in the right parietal region.

The X-ray of the skull showed a depressed fracture of the right parietal bone.

Neurological findings: retrograde amnesia. Sluggish reaction to light. Central paresis of the right n. facialis, weakness of the left hand. Patellar reflex and Achilles' tendon reflex on the left increased. Slight Babinsky reflex on the left. The eye fundus normal. CSF — normal.

On the day of the accident — 4. 3. 1958 — operation was performed: trepanation of the skull with removal of comminuted depressed bone fragments. After

the operation a defect of 4×5.5 cm. was formed. The defect was covered by a polyethylene plate, the margins of which were laid upon the borders of the defect and fixed by 4 catgut stitches. The patient was discharged from hospital after one month and 11 days in good of health. The operation was performed one year and 5 months ago. Headaches have disappeared.

Some illustrations of this case are given on the following page (4, 5, 6).

In conclusion it must be noted that our method of primary covering of skull defects by polyethylene plates does not exclude the use of other kinds of alloplastic operation. But the success of our observations allows us to recommend it as a rational method.

SUMMARY

Primary covering of skull defects is of great importance and is today being done by various methods. During the last two years we introduced the method of primary alloplastic covering of skull defects immediately after trepanation of the skull vault, performed for depressed fractures of the skull.

In choosing the alloplastic material we decided on polyethylene, which had previously been adequately tested in experiments at the CITO and proved satisfactory (E. V. Grudkov).

In 12 cases treated by us no complications were observed.

Technical possibilities of modelling the implant in our method convinces by its simplicity. The implant in this case really represents an end-obturator.

For emergency operations it is necessary to have different sizes and forms of plates in reserve.

ВЫВОДЫ

К вопросу о первичной аллопластике дефекта черепа

В. Д. Голованов, М. Е. Ткачева

Задача первичного закрытия дефекта черепа имеет большое значение, и в настоящее время осуществляется при помощи различных методик.

В течение двух последних лет нами освоена методика первичной аллопластики закрытия дефектов черепа непосредственно после операции трепанации свода черепа по поводу его импрессионного перелома.

При выборе аллопластического материала мы остановились на полиэтилене, который до этого в опыте ЦИТО был уже достаточно апробирован (Е. В. Груздкова).

В нашем опыте 12 наблюдений не отмечалось никаких осложнений.

При технической возможности изготовления имплантата наша методика подкупает своей простотой. Имплантат при этом является, по существу, эндообтуратором.

Для экстренных операций следует иметь запас имплантатов различной величины и формы.

RÉSUMÉ

Contribution à la question d'alloplastie primaire du défaut du crâne

V. D. Golovanov, M. E. Tkacheva

La couverture primaire du défaut du crâne joue un rôle important et, de nos jours, elle est pratiquée à l'aide de divers méthodes. Dans les deux années qui viennent de passer, nous avons pratiqué l'alloplastie primaire du défaut du crâne immédiatement après la trépanation du crâne nécessitée par la fracture par invagination du crâne.

Quand au matériel de l'alloplastie, nous avons choisi le polyéthylène, approuvé par de maints expériences en CITO (E. Gruzdkova).

Aux douzaines des cas soignés chez nous, il n'y avait pas de complications.

Due à la facilité technique de la fabrication de cet implant, notre méthode est celle de préférence. L'implant lui-même sert d'endo-obturateur.

Pour des cas d'une opération immédiate nécessaire il est recommandable d'avoir en réserve de divers implants quand à la forme si bien qu'à la grandeur.

ZUSAMMENFASSUNG

Zur Frage der primären Alloplastik des Schädeldefektes

V. D. Golovanov, M. E. Tkačeva

Die primäre Deckung des Schädeldefektes hat eine grosse Bedeutung und wird heute mittels verschiedener Methoden verwirklicht. Im Verlaufe der letzten 2 Jahre haben wir die Methode der primären Alloplastik der Deckung des Schädeldefektes unmittelbar nach der Trepanation der Schädelwölbung eingeführt, die infolge eines eingedrückten Schädelbruches durchgeführt wurde.

Bei der Wahl des alloplastischen Materials entschieden wir uns für Polyäthylen, das bereits vorher bei der experimentellen Prüfung im CITO (Zentralinstitut für Traumatologie und Orthopädie begutachtet wurde [E. V. Gruzdkova]).

Bei den 12 von uns behandelten Fällen wurden keine Komplikationen beobachtet.

Besteht die technische Möglichkeit zur Anfertigung des Implantates, so besticht unsere Methode durch ihre Einfachheit. Dabei ist das Präparat eigentlich ein Endo-obturator.

Bei einer unaufschiebbaren Operation ist es notwendig einen Vorrat von Implantaten verschiedener Grösse und Form zu besitzen.

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LOCAL PLASTIC METHODS OF DISCISION OF SMALL DORSAL AND VOLAR INTERDIGITAL SKIN FOLDS

A. A. LIMBERG

After burns, contracting scars develop which form prominent ridges stretched above the concave parts of the body surface, e. g. in the region of the interdigital skin webs, the antecubital fossa, the axilla, etc. At the moment of thermal injury the skin of these parts remains covered up by the surrounding skin. The contracting scars therefore develop on the anterior or posterior border of the axilla, on the dorsal or volar border of interdigital pits, etc. This fact gives sufficient reason for distinguishing between dorsal and volar interdigital scar ridges. The differentiation is the more important since some peculiarities in the structure and function of the skin of the dorsal and volar aspect of the hand make it necessary to perform the local plastic discision by different methods on the dorsal and the volar scar ridge.

The undamaged skin of the axilla, cut by a Z-plasty into symmetrical, asymmetrical or combined flaps, may be transposed to the side of the breast as well as of the back. The undamaged skin of the interdigital pit, however, can only be successfully transposed to the dorsum of the hand, i. e. it is suitable only for the discision of dorsal scar ridges. In volar scar ridges it is better to use a flap of palm skin and transpose it to the interdigital pit.

These rules arise from the endeavour to achieve the reconstruction of the normal anatomical shape of the interdigital pits (of the second, third and fourth interdigital space), the volar border of which is normally formed by a slightly raised skin fold. The fold consists of skin which, on its volar aspect, is of the same kind and the same structure as that of the palm, but on the side, facing the pit, is similar to that of the dorsum of the hand.

From the dorsum of the hand the skin slopes into the interdigital pit by an even slant. Here only transverse scar ridges develop after burns.

The interdigital webs may undergo pathological changes in shape and dimension by contracting scars of the palms and the volar aspect of the fingers. When contractures develop on the volar aspect of fingers the skin of the palm is drawn towards the interdigital web. Plastic discision of contractures on the volar aspect of fingers is aimed at permitting the skin of the palm to return to

its natural position. Sometimes, however, operation of the web itself appears indicated if the skin on the side of adjacent fingers requires lengthening in order to deepen the interdigital space.

All congenital interdigital membranes of the syndactyly type are but variations of the normal interdigital web. All interdigital webs together may

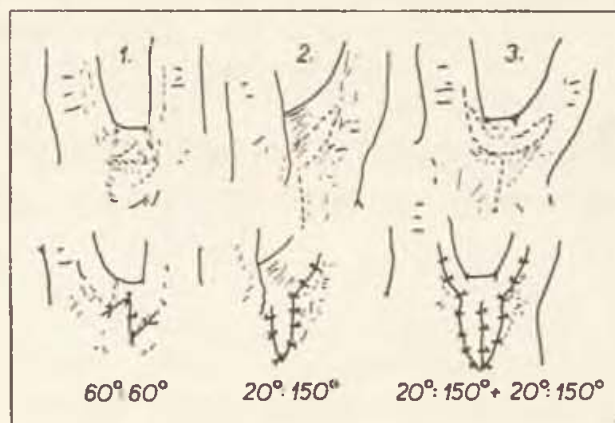


Fig. 1—3. Plastic dissection of dorsal interdigital scar ridges. — Symmetrical pattern of the Z-plasty with equal mobility of both flaps (Fig. 1); asymmetrical pattern with better mobility of the narrower flap. (Fig. 2); two asymmetrical pattern with a common incision cutting across the scar ridge (Fig. 3). Below the diagrams the approximate degrees of the angles, at which the individual section of the incision meet, are given.

form a continuous fold limiting the spreading of fingers, a function quite indispensable, e. g. for playing musical instruments (Tab. 2, Fig. 7).

DISCUSSION OF DORSAL INTERDIGITAL SCAR RIDGES

On the dorsal border of the interdigital pit contracting scar bands or bulging scar ridges may develop from scars involving the whole dorsum of the hand, which make the dorsum of the hand contract in a transverse direction and impede the spreading of the fingers. In dependence on the shape, the location and the quality of the skin of such scar ridges, located on the interdigital gradient, it is possible to attain complete or partial improvement by using one or the other of the following typical patterns of local skin plasty by the exchange of opposing triangular flaps (Fig. 1—3).

If the changes in the skin of both gradients of the scar ridge or the bands are approximately the same, a pattern of triangles with the cut sides running at angles of 60 and 60 degrees to the base respectively and of a length of about 15 mm. each, depending on the length of the crest of the scar ridge, is recommended (Fig. 1).

If the dorsal surface of the scar overhanging the interdigital pit from the dorsal side, is rough and thickened, an asymmetrical pattern with side incisions of 20 mm. length each running at angles of about 20 and 150 degrees respectively, is recommended. The middle portion of the serrate incision leads along the

crest of the ridge. A narrow and well mobile flap is thus dissected from the undamaged skin on the concave gradient of one side wall of the interdigital pit (Fig. 2). The flap is then swung by considerable rotation into the gap which has opened on the dorsum of the hand between the wound edges of the incision through the scar.

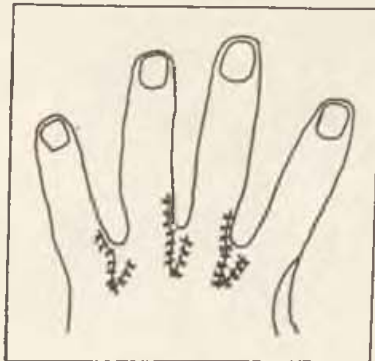


Fig. 4. Postoperative result of multiple discisions of dorsal interdigital scar ridges approximately of the same degree of contracture.

If the crest of such a coarse scar ridge is overhanging both fingers equally and the concave gradient on both opposing walls of the interdigital pit is lined with undamaged skin, it is advisable to use a pattern of two flaps with incisions at angles of about 20 and 150 degrees each, joined by the common incision cutting through the thickened scar down its dorsal gradient (Fig. 3). The two narrow and well mobile flaps are rotated so that they meet along one margin and thus fill the gap on the dorsum of the hand which has opened after the wound edges of the incision made through the scar have parted. When the two flaps, originally separated by a wide angle, are rotated, their bases are raised and take on the shape of an upright cone. In order to inverse this cone and deepen the dorsal gradient of the interdigital pit still further, the incision through the scar must be made sufficiently deep, and after the operation a pressure dressing must be applied to make the flaps adhere to the thus deepened floor.

If similar changes also exist in the region of other interdigital pits, plastic discision can be performed in the same or similar way by successive operations with appropriate alterations as to the length and angles of the side incisions (Fig. 4).

PLASTIC DISCISION OF VOLAR INTERDIGITAL WEBS

First of all the author wishes to point out that he does not intend to deal with the independent and extensive chapter of syndactyly. This report is only concerned with the new and typical method of plastic discision of the web which is particularly suitable in cases where it is naturally a little bit too prominent, or slightly lifted or contracted by a scar, but where the normal interdigital pit is preserved. Even a small, seemingly unimportant change in the shape of the interdigital web significantly impedes abduction of the fingers and thus the functional efficiency of the hand. In such cases large discision followed by

a free skin graft is not sufficiently indicated, and so it is particularly useful to be able to perform only a local plasty. Such a plasty becomes inevitable for the completion of repair after a previous large reconstructive operation.

1. Plastic discision of the interdigital web in order to deepen the interdigital space and thus enhance abduction of fingers in a piano player (Fig. 5,

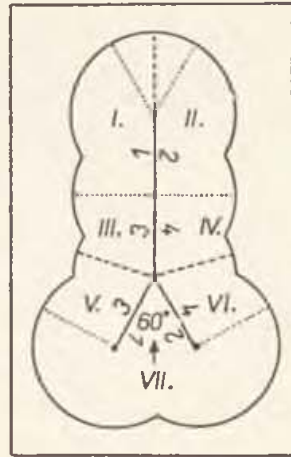


Fig. 5. Pattern of plastic discision of the interdigital web: VII palm of hand, V—VI volar gradient crest of web, III—IV gradient of interdigital web, I—II interdigital pit.

6, 7). A man of 22 complained of being unable to spread his fingers sufficiently when playing a musical instrument. Both hands looked almost normal, only the fingers were somewhat shorter and on spreading them as wide as possible an obstacle in the form of considerable tension in the skin at the border of the palm and the interdigital webs became discernible.

Plastic operations were performed on the interdigital webs for deepening the interdigital space and thus lengthening the basal phalanges, the length of the individual components of the incisions amounting to 8—10 mm. The subcutaneous tissue and partly also the transverse fascia bundles were carefully dissected by a raspator, and then a triangular volar skin flap cut to cover the wound gap in the interdigital pit. The sides of the basal phalanx of each finger were thus lengthened by the length of one component of the incision. As a result of the operation the skin no longer impeded the movements of the metacarpophalangeal joints.

A year later the patient sent the following letter: "I am studying the cello and piano at the musical school. The operation was of great advantage to me. With so small a capacity for spreading the fingers I would never have been able to play the cello, not to mention the piano. The scars have already been absorbed. I can now span more keys more easily."

2. Plastic discision by various patterns of two scar ridges on the fingers (Fig. 7). A boy, one-year-old, scalded his left hand with boiling water, and the resulting scars caused a flexion contracture of the 2nd, 3rd and 4th finger. He was operated on once in Moscow and, in 1954, four operations, in which transplan-

tation of skin to the palm of the hand was performed by the Italian method, were carried out in Leningrad.

In 1955 the patient was admitted to the Clinic at the age of 10, because of a scar effecting a flexion contracture of the index finger. In addition to this an enlarged interdigital web had developed on the edge of the graft between

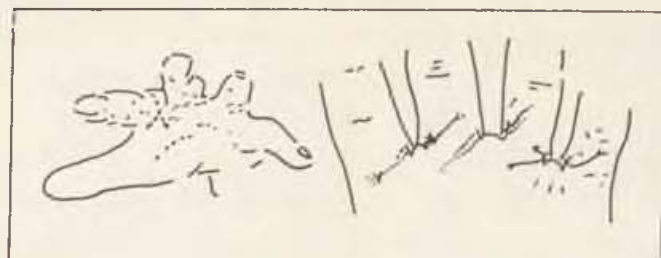


Fig. 6.

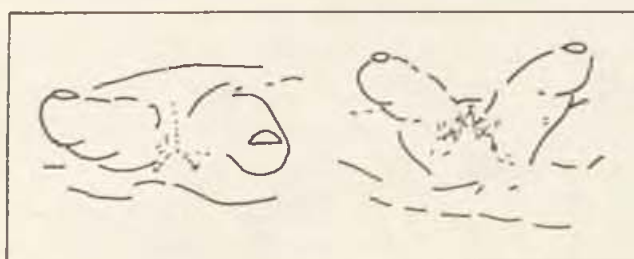


Fig. 7.

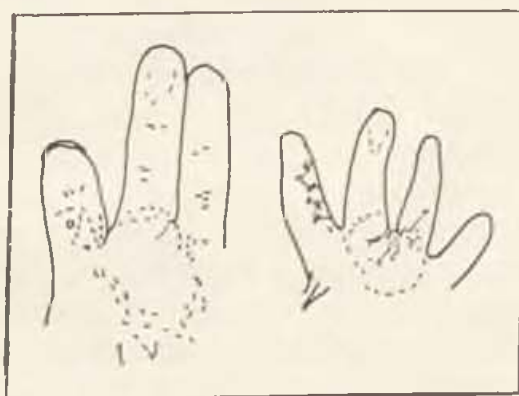


Fig. 8.

Fig. 6—8. Plastic discision of interdigital webs. Tension of the skin on the edge of the palm, manifesting itself by the lifting up of a fold, impedes abduction of fingers (Fig. 6.) Pattern of incisions in situ and the results after operation (Fig. 6 and 7). Discision of a scar-ridge on index finger in flexion contracture and discision of an interdigital web (Fig. 8).

the 3rd and 4th finger. Under local anaesthesia plastic discision of both folds was performed by the full use of all cicatrized skin.

The length of the normal index finger of the right hand was 63 mm., the length of the volar aspect of the contracted index finger of the left hand was

40 mm.; the shortening amounted, therefore, to 23 mm. The crest of the scar ridge involved the basal and middle phalanx and was 16 mm. long. On this stretch it was necessary to perform the lengthening by 23 mm., i. e. by 145% in relation to length of the crest. The side gradients of the scar ridge were quite broad, the crest ran somewhat obliquely to the axis of the finger. The shape of such a ridge requires a double pattern of opposing triangular flaps with sides running at angles of $60+60$ degrees each (see report in "Ortopediya, Travmatologiya i Protezirovaniye" 3, 1956 (Fig. 17 and 19). The index of the total increase of length is equal to 164% of the length of the central portion of the incision. The individual components of the incision were chosen at a length of 16 to 14 mm.

The interdigital scar ridge on the volar aspect was repaired by plastic discision as described above, the individual components of the incision being 10 mm.

3. Plastic discision of a contracted scar ridge for the deepening of the first interdigital space and discision of a scar band on the radial aspect of the index finger (Fig. 10 to 12). The scar developed after burns in childhood.

In 1959, the boy was admitted to the Clinic at the age of 15 and complained of limitation of movements, particularly in abduction of the thumb of the right hand. Discision of the contracting scar and deepening of the interdigital space was indicated. Plastic discision with transposition of a triangular flap, the length of the components of the incision being 10 mm., was performed. The flap was then placed into the floor of the interdigital pit and thus the sides of the adjacent digits were lengthened by 10 mm. (operation performed by A. T. Titova).

The scar band on the radial aspect of the index finger was repaired by a plasty of two opposing triangular flap pattern with the cut sides of one triangle both being 6 mm. long and running at angles of $30+90$ degrees, and those of the other 8 mm. and $60+60$ degrees respectively.

Healing proceeded by first intention, the scar bands were removed and thus abduction of the thumb was increased sufficiently.

The minor plastic operations, described above, are destined for severe functional disorders of the interdigital space which previously found little attention both in the literature and clinical practice.

The author, however, wishes to point out that the importance of the hand in the life of man places as high, a demand for functional and structural repair on the reconstructive surgery of the hand as on that of the face.

SUMMARY

Scar contractures and prominent skin folds on the dorsal surface of the interdigital pit, which develop after burns, impede the movement of fingers, particularly abduction. If there is enough skin on both sides of the prominent fold its repair may be attained by a local plasty using opposing triangular flaps with side incisions of various angles the degree of which depends on the shape of both gradients. In the region of the interdigital pit well mobile, narrow triangular flaps of healthy skin may be cut from opposing surfaces of the contracted fingers and rotated dorsally by a considerable range so as to cover the raw bed of the gaping wound left after discision of the scar. For this purpose

single or double pattern are used, the latter by exchanging two opposing triangular flaps with the two cut sides running at angles of about 20 and 150 degrees respectively.

On the volar aspect of the interdigital pit scar contractures are observed on the border of the palm forming skin folds which narrow the interdigital space and considerably tighten the interdigital web on abduction of fingers, impeding this movement, so important, e. g. when playing a musical instrument. For releasing the tension of the skin, and in this way enhancing abduction of the fingers, it is necessary to use quite a different method of plastic repair: a triangular flap is cut from the volar aspect of the web. After this discision of the dorsal gradient of the web and the interdigital pit is performed by two sectional incisions. The flap is then placed onto the floor of the interdigital pit and thus makes it wider. In this way also the interdigital space is deepened by the length of one sectional incision.

ВЫВОДЫ

Местнопластические способы рассечения небольших тыльных и ладонных межпальцевых складок кожи

А. А. Лимберг

На тыльной стороне межпальцевых впадин кисти рубцовые стяжения и выпуклые складки кожи после ожогов нависают над впадиной, значительно нарушая разведение и общую подвижность пальцев. При наличии запасов кожи в боковых скатах выпуклых складок рассечение их возможно местной пластикой встречными треугольными лоскутами с различной величиной углов боковых разрезов в зависимости от формы скатов. Хорошо подвижные узкие треугольные лоскуты здоровой кожи могут быть заимствованы из боковой поверхности стянутых пальцев в области межпальцевой впадины и повернуты на большой угол в сторону тыла кисти на зияющую раневую поверхность после рассечения рубцовой кожи. Для этого применяются одиночные или сдвоенные фигуры пластики встречным обменом двух треугольных лоскутов при углах боковых разрезов около 20 и 150°.

На ладонной стороне межпальцевых впадин наблюдаются рубцовые стяжения края ладонной кожи, закрывающие просвет входа в промежуток, и чрезмерно натянутые врожденные кожные складки при усиленном разведении пальцев, необходимом, например, при игре на музыкальных инструментах. Для устранения натяжения и увеличения разведения пальцев необходима совершенно другая фигура пластики: треугольный лоскут выкраивают из ладонного ската складки, затем рассекают двумя составными частями разреза скат складки на стороне впадины и дно впадины. Лоскут ложится на дно впадины и расширяет ее. При этом также удлиняется поверхность кожи основания пальцев на величину одной составной части разрезов.

R É S U M É

La correction chirurgicale des plis interdigitaux palmaires et dorsaux à l'aide de la méthode de la plastie en Z

Les contractures cicatricielles et les plis tendus de la peau, résultant des brûlures sur la surface dorsale des parties interdigitales de la main font obstacle à l'abduction et anéantissent les mouvements des doigts. Au cas du surplus de la peau aux côtés des plis tendus, la correction peut être faite à l'aide de la plastie en Z aux différents lambeaux cutanés dont les angles des incisions d'à côté dépendent de la forme même de ces côtés. Des minces lambeaux cutanés, capables du glissement, peuvent être coupés de la peau saine de la surface latérale des doigts en contracture, aux alentours de la partie inter-

digitale. Ils sont capables d'être glissés à l'angle grand en direction du dos de la main et de couvrir ainsi la surface sanglante résultant de la dissection de la cicatrice. Pour arriver à ce but, on se sert de figures plastiques simples ou doublées en forme de l'échange en avance de deux lambeaux triangulaires dont les angles des incisions latérales comportent à peu-près 20—150 degrés.

Au côté palmaire de la main on observe des contractures des bords de la peau de la paume, formant des plis qui amoindrissent la partie interdigitale et allongissent les plis primaires de la peau au cours de l'abduction des doigts telle que nécessaire par exemple pour jeu des instruments de la musique. Pour abolir cette tension de la peau et pour agrandir l'abduction des doigts on se sert d'une toute autre technique: le lambeau triangulaire se forme de la surface palmaire du plis, lequel se divise par une incision en deux parties intégrantes sur la surface dorsale du plis et au fond de l'espace interdigital. Le lambeau se pose au fond du plis et le prolonge de cette manière, ainsi que la surface de la base des doigts devient plus long correspondant à la grandeur d'une partie intégrante de l'incision.

ZUSAMMENFASSUNG

Die chirurgische Korrektur volarer und dorsaler interdigitaler Falten von nicht zu grossem Ausmass mit der Methode der lokalen Hautplastik

A. A. Limberg

Narbige Zusammenziehungen und Bildung von angespannten Hautfalten nach Verbrennungen an der dorsalen Seite der interdigitalen Flächen der Hand stellen ein bedeutendes Hindernis für die Abduktion der Finger dar und stören deren gesamte Bewegungsfähigkeit. Wenn an den Seitenflächen der derart gebildeten Falten Haut in genügendem Masse vorhanden ist, kann die Korrektur der Falten durch örtliche Plastik mit Hilfe einander gegenüberstehender dreieckiger Hautlappen, deren Seiten verschiedene Winkel einschliessen, die von der Form der Faltenseitenflächen abhängen, durchgeführt werden. An der seitlichen Oberfläche der in Kontrakturstellung befindlichen Finger können in der Gegend des interdigitalen Raums gut bewegliche schmale dreieckige Lappen gesunder Haut entnommen werden, die um einen bedeutenden Winkel in der Richtung zum Handrücken auf die nach Durchschneiden des narbigen Gewebes verbliebene blutige Wundfläche gedreht werden können. Zu diesem Behufe benützt man einzelne oder doppelte plastische Figuren bei jeweiligem Abwechseln zweier einander gegenüberstehender dreieckiger Lappen mit einem von dem Schnittflächen eingeschlossenen Winkel von etwa 20° und 150°.

An der palmaren Seite der interdigitalen Räume gelangen narbige Zusammenziehungen am Rande der Handflächenhaut zur Beobachtung, die zur Faltenbildung und einer Verkleinerung der Interdigitalflächen führen, ebenso wie übermässige Anspannung der angeborenen Hautfalten, die bei bedeutender Fingerabduktion, wie sie zum Beispiel beim Spielen auf Musikinstrumenten notwendig ist, in Erscheinung tritt. Zur Beseitigung der angespannten Haut und Vergrösserung der Fingerabduktion muss eine vollständig verschiedene Art der Plastik angewandt werden: Der dreieckige Lappen wird aus der palmaren Seitenfläche der Falte ausgeschnitten, hierauf wird die Oberfläche der Falte von der Seite des Interdigitalraums und die Haut in der Interdigitalfurche selbst durch zwei zusammenhängende Schnitte zerschnitten. Der Lappen wird auf den Grund der Interdigitalfurche gelegt, wodurch diese verbreitert wird. Dabei verlängert sich auch die Hautoberfläche an der Fingerbasis um die Länge eines Teilschnittes.

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