

PLANNING AND TECHNICAL DETAILS WHEN TREATING A POST-BURN HAND CONTRACTURE

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SUMMARY. Hand contractures are still a problem in everyday plastic surgery practice. We decided to review the hand contractures we had treated over a 5-yr period (2000-2004) and to present some guidelines for their prevention. In the 5-yr period we operated on 206 patients with hand contractures. The number of patients demonstrates that not infrequently our plastic surgeons still have to treat this condition. The age group most liable to this form of burns sequelae is that of children up to five years old, because of the deeper burns they suffer in the hands. The surgical approach to post-burn contractures of the hand is discussed from three aspects: the skin aspect, the osteotendinous aspect, and the wound closure procedure. The discussion puts special stress on the risk of impairing blood supply to the distal phalanges, which is related not only to the involvement of the arteries in the scar tissue but also to spasms or accidental damage in the digital arteries. Special attention must be paid when the fifth finger is interested.

Introduction

In view of the broad range of surgical procedures applied at the Service of Burns and Plastic Surgery in the Mother Teresa University Hospital Centre Teresa, Tirana, Albania, we considered it worthwhile to review post-burn contractures of the hand, which are among the most frequent diseases we treat.¹ This has been an object of observation also in the past, and we will demonstrate that there has been a consistent downward trend in the number of patients presenting such burns sequelae, a finding that has a sound explanation.

The aims of this paper are:

- to demonstrate the continuing high incidence of hand contractures in the framework of burns sequelae in our country;
- to comment on the surgical techniques used to correct these contractures, with special emphasis on the importance of respecting and preserving blood supply to the fingers.

First of all we would point out that this disease can be prevented by better treatment of the burned hand, better timing of coverage of the granulated burn wound, and better rehabilitation during convalescence.²

We have noticed that numerous hand contractures were treated with poor results in our country's regional hospitals. Bad functioning and a recurrence of the contracture were nearly always present. As such operations encompass aspects of both orthopaedic and plastic surgery, we would strongly recommend that they should be performed exclusively by appropriately qualified personnel.

Table I - Annual distribution of hand contractures

Year	2000	2001	2002	2003	2004	Total
No. of cases	54	61	44	30	17	206
Females	24	31	21	18	10	104
Males	30	30	23	12	7	102

Table II - Distribution of cases in relation to age

Age groups	0-5 yr	6-10 yr	11-15 yrs	16-20 yr	> 20 yr
No. of cases	67	34	36	30	39

Clinical material

The material consists of the 206 patients we treated for a hand contracture in the 5-yr period 2000-04.

Table I shows the distribution of cases in relation to the successive years and the patients' sex.

Table II shows the distribution of cases in relation to the patients' age.

Most of the cases, as can be seen, belonged to the age group 0-10 yr (101 cases, i.e. almost half of the cases). The high incidence of this particular sequela at paediatric age shows the elevated probability of a child getting burned, the greater probability of such a burn being deeper, and the failure of preventive efforts. Sixty-nine of our patients were over 16 years old. The majority had sustained their burns in childhood; 82% came from towns other than Tirana. The sex distribution was 101 males and 105 females.

Table III - Surgical techniques for correction of hand burn contractures

Technique	Full-thickness graft	Full-thickness graft + Z-plasty	Z-plasty	Flaps	Phalangeal amputations
No. of cases	144	33	21	3	5

Only six of our patients had also the other hand burned. Of the 206 hands, 115 were right hands and 91 left hands.

The routine anaesthesia used in our clinic is intravenous anaesthesia with Ketalar, applied in 161 cases. Other types of anaesthesia (endotracheal, local, plexus, inhalation) were less common (number of cases, respectively, 29, 12, 3, and 1).

The mean hospital stay was six days. After discharge patients were seen on a weekly basis until complete healing of wounds had occurred. Eleven patients (5.7%) patients were operated on more than once, either because they had more than one hand involved or because there was a recurrence after the first operation. This second circumstance occurred in only five patients.

The surgical techniques used are shown in *Table III* and *Fig. 1*.

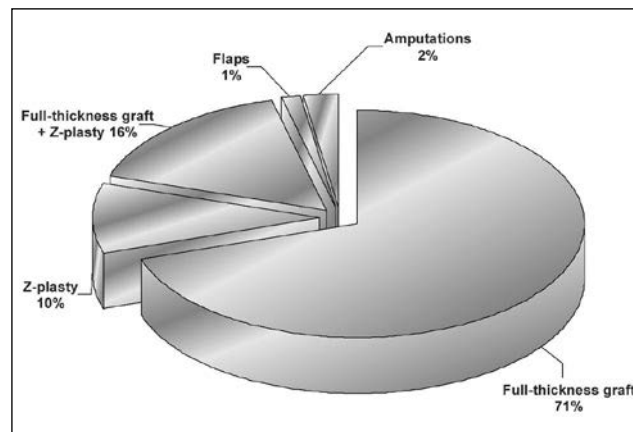
Discussion

Hand contracture after deep hand burns is still a common event in our practice, in spite of the better treatment now available, the early initiation of physiotherapy procedures, and the early surgical treatment of deep burns. The improvement of all these aspects has resulted in fewer contracted hands, also in our country. In a previous review we made, covering the years 1996-1998, we found a total number of 212 operations performed for hand contractures, respectively 88, 52, and 72 each year.³ In other words, we operated on 70 approximately hand contractures per year, while this more recent review, taking into account the years 2000-2004, shows that we now operate on an average number of 42 hand contractures per year.

Operative technique

After careful planning and the necessary lab exams, the operation was generally performed under general anaesthesia, usually applied intravenously. The incision was irregular, depending on the contracting scar, saving as much as we could of the unburned tissues, which are considered irreplaceable by any kind of graft.^{4,5} All the scarred tissues responsible for the contracture were removed. Full release of the contracture was achieved by means of peripheral incisions, respecting anatomical flexion creases.

When necessary, complete and physiological opening of contracted fingers was performed by elongation of short-

**Fig. 1** - Surgical procedures used.

ened flexor tendons and by total tendolysis from the fibrotic adherences with adjacent tissues.^{6,7} Gradual manual freeing of the joints was then carried out until the full range of finger extension was reached. At this stage the manoeuvre was performed delicately in order to avoid displacement of the interphalangeal joints. K-wires were then applied to secure immobility of the fingers, as this was necessary for graft take.^{8,9}

Correction of web space contractures was obtained using "alphabet surgery" (Z-plasty, A-plasty, M-plasty, V-Y), whenever possible.^{10,11}

Final closure of the remaining wounds was achieved by use of full-thickness grafts, usually harvested from the groin or the hypogastric area, which offer a considerable amount of skin even for large defects.¹²⁻¹⁴ For small grafts we generally used the skin of the radiocarpal crease. Donor sites were always closed primarily. Grafts were freely sutured and tie-over dressings were applied over them.¹⁵

Final dressings were applied taking care to leave the fingertips exposed so that regular assessment of the blood supply was easy to perform in the post-operative period. Elevation of the limb was maintained throughout this period in order to prevent post-operative oedema. We used a combination of antibiotics intra-operatively and in the first days post-op.

The grafts were initially assessed on the fourth or fifth day after the operation if - until then - the patient had been free of pain and other signs of infection. In other cases, the first assessment of the graft was performed earlier. Thereafter, dressing changes were carried out every two or three days. K-wires were not removed for at least two weeks.

We paid special attention to the preservation of the distal blood supply to the fingers. The compromise of fingertip blood supply is caused by abrupt and aggressive finger extension, as well as by undue application of K-wires. Clinically, this is demonstrated by pallor of the fingertips,

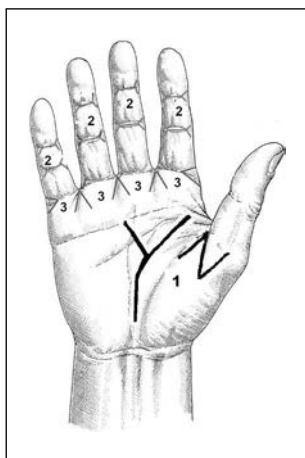


Fig. 2 - Timing of different steps in correction of hand contracture.
 1. Palmar and thumb area.
 2. Finger contractures.
 3. Web spaces.

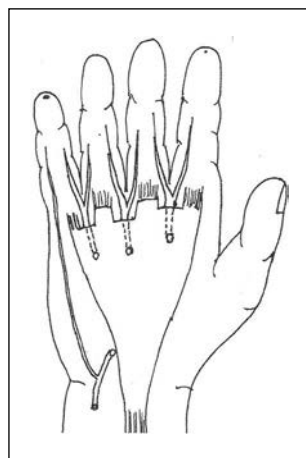


Fig. 3 - Scheme of blood supply to 5th finger.
 1. Digital arteries originating from palmar arch and running under the palmar aponeurosis.
 2. Lateral digital artery to 5th finger with extra-aponeurotic course.

absence of capillary refill, and absence of blood after puncturing of the fingertip with a needle. These signs are followed by cyanosis, which can extend to the whole distal phalanx or even further. Failure to spot this condition within two to three hours of the operation may lead to necrosis of the finger.

What is the main mechanism responsible for this event, which if left untreated may necessitate amputation? It is the spasm of both digital arteries, which may cause ischaemia even if they are anatomically intact. The secret is therefore not only to avoid mechanical damage to the arteries but also not to cause spasms. Two steps should be strictly followed to achieve these two purposes: first, careful dissection of the digital arteries and, second, gradual stretching of the contracted fingers, without the exertion on them of excess tension. The observation of signs of vascular compromise of the fingers should prompt interruption of this second manoeuvre. In other words, if full extension of the finger entails the risk of vascular compromise, it is better not to do it at all and to leave it for a second procedure.

We consider it very important to maintain not only the arterial component of the blood supply but also venous drainage of the fingers. The problem may be evident in cases where the fingers are contracted and both the adjacent web spaces also need release. In such a situation the incisions, apart from in the flexor area, may have to be extended towards the extensor part of the fingers. This may create problems for the venous-lymphatic drainage of the finger, even when the arteries are intact. For this reason, at the moment of the first consultation we make an ap-

propriate very detailed plan, preferring to treat web space contractures separately, or one at a time.

For proper planning aimed at achieving good final results, we perform the full release of contracted burned hands according to a three-step strategy.^{16,17}

The first step is the release of the palmar or dorsal area, and probably the thumb, in order to provide a better blood supply to the other fingers. The second step is the release of the remaining contracted fingers, and the third is the opening of the web spaces.

It is important to emphasize that the second and third steps can be inverted (*Fig. 2*).

Signs of slight vascular compromise can be reverted simply by removing the K-wires, removing unnecessary stitches, and leaving the finger in a more physiological position. In clinical settings, we found that after these manoeuvres the colour of the fingertip very soon returned to normal.

Our experience is that the fifth finger is the one most exposed to the danger of vascular compromise. In two of our cases, in spite of emergency measures, including the use of spasmolytic agents, there was a necrosis of the tissues in the lateral area of the finger. After consulting the anatomical literature, we found the explanation for this phenomenon. The lateral artery to the fifth finger takes its origin only from the superficial palmar arch and it also runs over the palmar aponeurosis. The scarring process thus very easily causes it to atrophy, making it non-existent, and leaving blood supply to the fifth finger almost exclusively to the medial digital artery (*Fig. 3*).

For successful treatment of a contracture involving the fifth finger, we would recommend:

- Z-shaped incision away from the course of the lateral digital artery;
- careful dissection, if possible under magnification, of the two digital arteries, especially of the medial artery, taking into account the possibility that the lateral artery may be atrophied or have only partial function because of the frequent damage due to the scarring process;
- delicate stretching of the finger, immobilization in a slightly flexed position, and application of a soft bandage;
- non-insertion of K-wires because of the possibility of unintentional damage to the arteries.

Conclusions

1. Hand contractures are better prevented than treated. This means careful treatment of the burned hand, especially in deep second- or third-degree burns. Early surgical treatment of deep wounds, immobilization, and application of early escharectomy with immediate skin grafting are advocated.

2. If already established, a post-burn hand contracture must be treated as soon as possible. This will yield better results. Early treatment of established contractures prevents tissue fibrosis, tendon shortening, and joint stiffness.
3. The preservation of finger blood supply is of extreme importance. A patient would rather have a

finger that is not fully stretched than one that is amputated. Maximum care must be taken during dissection of the digital arteries, especially those to the fifth finger.

4. Careful planning and timing of the different stages of treating a contracted burned hand are very important for better final results.

RÉSUMÉ. Les contractures de la main continuent à être un problème dans la chirurgie chirurgicale quotidienne, et conséquemment les Auteurs ont voulu passer en revue les contractures de la main qu'ils ont traitées pendant une période de 5 ans (2000-2004) et présenter quelques indications pour les prévenir. Pendant cette période ils ont opéré 206 patients atteints de contracture de la main. Ce numéro de patients démontre que les chirurgiens plastiques doivent encore traiter cette condition avec une certaine fréquence. L'âge des enfants les plus exposés à cette forme des séquelles des brûlures est celui jusqu'à 5 ans à cause de la profondeur des brûlures qu'ils subissent aux mains. Les Auteurs discutent de trois points de vue l'approche chirurgicale aux contractures post-brûlure des mains: l'aspect de la peau, l'aspect ostéotendineux et la procédure de la fermeture de la lésion. La discussion souligne le risque particulier de compromettre l'apport de sang aux phalanges distales, qui est corrélé non seulement à la compromission des artères dans le tissu cicatriciel mais aussi aux spasmes ou aux dégâts accidentels aux artères digitales. Il faut prêter une attention particulière dans les cas où le 5ème doigt est intéressé.

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