

# Surgical Techniques Used for Correction of Post Burn Contractures and Deformities of the Foot

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Scarring and foot and ankle joint contractures after burn are the result of deep partial and full thickness burns that affect foot motion, impair the lower extremity function, and often benefit from surgical reconstruction. One hundred twenty one cases and total number of 154 burn scar contractures and deformities of the foot were treated at the Inter Regional Burn Center and Burn Department of RCSUMA Samarkand, Uzbekistan.

Long term outcomes of operations performed suggest that the burned patient benefits from close observation to detect developing scar benefiting from intervention or slow growth of the injured extremity and the development of secondary changes of bones and joints. From our experience operations should be considered before development of severe scars to prevent secondary changes. In the case of severe contracture the procedure should be considered as soon as possible after detection.

The results of this report suggest that outcomes of operative interventions of the burn induced foot and ankle deformities depend on: (1) localization of scar contractures; (2) depth of injury; (3) presence of local uninjured skin for reconstruction, and (4) presence of osseous injury or osseous changes secondary to chronic scar contracture. Observations of location of foot and ankle joint contractures after burn, surgical procedure performed and results in our series are presented in this manuscript.

Foot and Ankle; Joint contractures; Burn scar contractures

## Keywords

Foot and ankle joint contractures after severe burn are the result of deep partial and full thickness burns that affect foot motion, impair lower extremity function, and benefit from surgical reconstruction [1,2].

initial burn deformities in the foot. Reasons lie in the regularity of growth, which is lacking in scars. Scars not obvious upon wound closure and having no effect on the foot ankle joints in the nearest 2-3 years may change to limiting scars in 5-6 years and more, and as a result can become the cause of formation of serious secondary deformities, development of dysfunction and bone dislocation. The joint is slow in growth; the bones become deformed causing damage of and dysfunction of extremities.

It should be noted that 70 percent of patients, who had suffered from foot burns, benefit from rehabilitation and many eventually undergo operative treatment [13,14]. Investigators routinely consider these deformities to separate locations as completed processes isolated from the general burn disease process. The significant number of patients undergoing operative reconstruction after burns suggests that the conservative methods of therapy currently in use are not always effective. There are studies on different aspects of reconstruction of extremity scars after burn [15-17]. According to our experience, the main cause of such limited progress in scar contractures treatment with local tissues in the insufficient study of the following aspects: contracture cause (scar surface deficit), and anatomical classification of burn scar contractures and deformities of the foot.

## Oavgtkanu apf Ogvgjqu

121 and a total of 154 burn scar contractures and deformities of the foot were treated at the Inter Regional Burn Center and Burn Department of the Centre of Emergency Medical Care (RCSUMA) Samarkand, Uzbekistan. The cases of the burn were Sandal burns 84 (70%), flame 11 (9%), scald 9 (7%), hot ash 8 (7%) and other 9 (7%). All treatments used in this study were approved by Research Ethics Board for the Samarkand State Medical Institute.

Among the patients, 79 were contractures from distant burns persisting for one to five years, 21 were contractures six to ten years and 21 were contractures over ten years old. Among the cases, 69 patients (57%) were under 14 years of age and 52 were over 14 years old.

Secondary bone and joint changes associated with burn scar contractures were found in 33 patients; 20 had changes due to insufficient bone growth, 8 had changes in the area of the ankle joint with valgus or varus deformities, and 5 in the area of the metatarsophalangeal joints. These patients basically were children came back very late to the hospital for a new surgery because of loss of ability of normal movement of extremities.

We found contractures of I, II and III degrees in 31 cases, III degree in 67 cases, and IV degree in 23 cases. Most surgeons assess scar related joint contracture using a scale proposed in 1946 which reflects the severity of joint dysfunction (Parin B.V. 1953), contractures are classified into four different degrees in reference to the neutral position of the foot. The amplitude of ankle joint movements is taken into consideration as a basis, normally equal to 65°-80°, i.e. 40°-50° of plantiflexion and 20°-30° of dorsiflexion. The extent of the contracture is determined in relation to the limitation of movement expressed in degrees. If the scars extended to a distal third of the dorsum of the foot, we found a significant limitation in digit flexion as well as dorsal subluxation and dislocation (13 cases). 53 deformities developed after skin grafting, when limited growth of skin graft scars and as a result plantar flexion contractures of the toes developed (Figure 1).



**Hkiwtg 1:** Post burn foot deformity.

The anatomic features contractures of the foot were studied before surgery and during operation, noting contractures location and severity, contracture cause, and scars spread. The criteria were used: scar location caused contracture, surface surplus and healthy region, fold location in relation to joint surfaces severity of the contracture and deformities of the foot. The specific features were categorized into distinguished several types. During operations, the contracture cause was explored (scar surface deficit) for understanding of the shape of local flaps necessary for contracture elimination.

## Rguwvu

### Iuqnavgf eqpytaevwtgu qh vjg apmng lqkp

Burn scar contractures were caused by burns on the ankle; the resulting scars were located on the lateral, medial, and anterior surface or some combination. Using anatomical principles we distinguished the following contractures of the foot and ankle joint: dorsal flexion (11 cases), lateral surface (7), plantar flexion (8) and whole ankle joint (8). The scars limited motion in the joint which in turn decreased patient. In addition, irregular positioning of the foot due to scar caused secondary deformity. These factors could be eliminated with effective reconstruction before these events. The first task was to bring the foot

more complete elimination of tightening and better functioning of the wound margins with the ends of the grafts. The grafts were displaced towards each other and sutured by touching sides. If the contracture was not eliminated completely, another pair of grafts was cut out.

**Navgtan eqpvtaevwtg:** In seven cases scars were located on the lateral surface of the ankle joint, occupying the area of the ankle and reaching the anterior median line of the joint. We found the best method was of reconstruction was single trapezoid flap plasty. Mild to moderate contracture with adjoining normal skin was addressed with one flap, prepared from the medial non scarred healthy skin from the anterior surface. Planning consisted of several line drawings: a line along the scar band, a perpendicular line on the scar edge with a Y shaped end anterior to the malleolus, and two lines depicting the borders of the flap in the ankle joint projection. With the first incision along the flap border, the sheets were separated. The following Y shaped incision was followed and lifted to the malleolus. After full ankle extension, a trapezoid wound was formed. The flap was transposed on the wound with moderate tension (Patient A)

**Phapvat hmgzkqp eqpvtaevwtg:** Plantar flexible deformations of the ankle joint are result of burn damage in the posterior surface of the leg with involvement of the Achilles tendon, leading to the development of equine varus deformity. Out of seven cases, one patient had injuries in the zone of the heel tendon and four had suffered deep burns with tissue defect in the affected zone with ulcerous scars. In these cases we used L shaped flap plasty from the lateral surface of the ankle and foot.

**Wjqng apmng lqkpvu:** Scars surrounding the ankle joint without bands can be hypertrophic or pathologic with ulceration. The scar surface deficit, responsible for contracture, is extensive; therefore, local flap technique is excluded.

Hypertrophic scars do not often develop in the ankle joint area, but they may cause severe dysfunctions and malformations. Scars tighten the joints and cause limited movements (8 cases). Such contractures are considered to be the most difficult. It is known that more severe shortening of scar bands leads to more severe deformities.

In this study, reconstruction was performed using wide scar excision with skin grafting. The scar was excised when mature, which allowed us to leave the subcutaneous fat layer *in situ* undamaged, with light bleeding. Skin grafts were fixed to each other and to the underlining tissue with U shaped sutures; a gauze bolster was tied above, creating compression on the graft. As a result, sufficient skin adhered to the underlying tissue providing a good functional and cosmetic outcome.

#### **Gzvpgfgf eqpvtaevwtgu qh vjg fqtuw o qh vjg hqqv \*fkikvu. apmng lqkpv+**

Extended contractures of the dorsum of the foot (digits, ankle joint) were the most frequent type of disturbance (59 cases) with significant anatomical variability. The following groups of this disturbance were identified: (a) isolated injury to the dorsum of the foot; (b) disturbance with extension of scars on the digits causing dorsiflexion of the metatarsal phalangeal joints with or without involvement of ankle joint, with or without digit syndactyly. In terms of surgical reconstruction, it was important to prevent the development of bony deformities.

Therefore, at the beginning of subluxation and foot deformity, we sought to perform the operation no later than 6 months after healing of

burn wounds. Through this strategy, functional disorders, and distortions were minimized using local tissues. We were able to perform most of these operations in one stage. Skin grafting and/or flap plasty was performed, depending upon scar extension, scar thickness, tissue reserve, and the degree of contracture.

In case of large scars causing severe contractures (grade III-IV) with subluxation of digits and syndactyly, oftentimes footwear was not used, though static and dynamic functions of foot were not disturbed. In these cases, pathological tissues were incised to the level of the metatarsophalangeal joints. As has been done on the hand, reconstruction webspace reconstruction was performed using trapezoid or z plasty. Simultaneously, subluxation and dislocations of digits which were gradually transferred into the position of plantar flexion at 60°-90° with retrograde Kirshner wires, particularly in grade III-IV contractures. If fixation with wires was not effective, the toes were attached through the nail phalanges by means of thick ligature to the plantar surface of the foot. The technique was effective in eliminating dislocations and subluxations of digits in all patients. Significant defects (up to 2/3 of the foot) were closed by skin grafting.

#### **Phapvat uwthaeg qh vjg hqqv**

A total of 20 patients were treated in our department for burns of the plantar surface of the foot. Depending on the location, extent and depth of tissue defects on the plantar surface of the foot, a proper method of reconstructive surgery was planned.

After elimination of the limited surface defects of the plantar surface located in the area of central loading of the foot (heel), we performed bilobed skin flaps in nine patients. The significance of bilobed skin flap plasty is the use of the most appropriate local tissues to fill the defects in the supporting foot area.

This method allows dissipating the tension of tissues when closing the donor wound in a large area remote from the center of the defect. This results in complete recovery of the skin, resistant to exertion, and without atrophy or newly formed scars.

In deep ulcers penetrating the calcaneus, the thickness of cutaneous flaps is often insufficient for formation of supportive surface. In deep defects reaching the heel bone in two patients, we performed a combined reconstruction a muscular one in combination with transfer of the skin fat flap or a free skin graft.

When reconstructing scars in the heel area and in distal part of the plantar surface directly on the bone, we used tube grafts in five cases. The Filatov and gluteal femoral tube graft method of plastic surgery by tube grafts refers to transferring tissues on the sole. During reconstruction using a flat Filatov tube graft at the first stage, the skin and subcutaneous tissue were lifted using parallel incisions with preservation of both limbs. The donor wound was sutured and the tube wound was closed by split skin. Twenty to twenty five days later the distal limbs were divided; the tubed graft was flattened by longitudinal incision under the flap maintaining a uniform thickness not less than 1 cm. With this thickness of the tube graft, the scars were excised and closed with the tubed graft after connecting the posterior surface. After 3-4 weeks, the proximal limb was divided, the remainder of the tubed graft was flattened, and the flap was inserted in the plantar surface of the foot. In these five cases a good results were achieved and no complications were noted. The grafts were viable, sensibility was preserved and no marginal necrosis was noticed (Patient B).

In heel defects reconstruction on the weight bearing side of the foot, we chose in 4 cases to perform two stage reconstructions of the heel soft tissues by medial calf flap of the opposite leg.

#### **Fluvan hqqv**

The distal part of the foot was injured in 41 cases. Syndactyly was reconstructed by means of local tissues Pi-form, trapezoid, triangular grafts transplantation (26 cases). These operations decreased flexion contractures of digits, and adequately covered the plantar surface which did not interfere with foot development and reinnervation of the skin and gradual increase of exertion.

In plantar surface scars of the first and fifth toes, combined skin plastic surgery was performed (15 cases). Full thickness skin graft of the medial surface of the hallux or lateral surface of the 5th digit was used for coverage of deficits of the respective metatarsophalangeal joints. The digit was set in the position of moderate hypercorrection. The graft was transferred to the defect to cover the wound. There was no necrosis of grafts after this procedure.

After reconstruction of the foot and ankle joint, these were fixed

The operation is easy to plan and perform. It fully uses the local tissues, yields good stable results, and prevents flap loss and contracture recurrence. Reconstruction should be considered before severe contractures and secondary bony changes ensue.

### **Aempqyngfigogpvu**

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### **Eqphnkev qh Ipvgtguv**

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