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Klinik Çalışma

Treatment of post-burn upper extremity, neck and facial contractures: report of 77 cases

Üst ekstremite, boyun ve yüz yanık kontraktürlerinin tedavisi; 77 olgunun sunumu

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BACKGROUND

Post-burn contractures severely deteriorate life quality. We aimed to present our treatment protocols for post-burn sequelae and the contractures that cause functional limitations.

METHODS

Seventy-seven cases with post-burn contracture were treated in our clinic. Post-burn contractures occurring after a burn injury affected the upper extremity, face and neck in 60, 17 and 6 cases, respectively. Skin grafts, local flaps such as advancement flaps, Z-plasties, K-plasties, regional flaps such as posterior interosseous flap, tissue expanded flaps, and free flaps were used according to the severity of the contractures.

RESULTS

In one patient with type II axillary contraction, recurrence was seen. Full range of motion was achieved in the 3.6-year follow-up period in elbow contractures. Eight of 71 phalangeal joint contractures recurred. Two patients underwent reoperation for neck contracture recurrences.

CONCLUSION

Excellent results were seen with prefabricated flaps, which were used for the facial reconstruction.

Key Words: Burn; contracture; face; neck; upper extremity.

AMAÇ

Yanık sonrası kontraktürleri hayat kalitesini ciddi olarak kötüleştirir. Bu çalışmada, yanık sonrası sekel ve kontraktürlerin fonksiyonel sınırlama nedeninde tedavi protokollerimizi sunmayı amaçlıyoruz.

GEREÇ VE YÖNTEM

Kliniğimizde yanık sonrası kontraktürlü 77 olgu tedavi edildi. Üst ekstremite, yüz ve boynu etkileyen yanığa bağlı kontraktür olguları sayısı sırası ile 60, 17 ve 6 idi. Deri grefti, ilerletme flepleri, Z plasti, K plasti gibi lokal flepler, posterior interosseöz flep gibi rejyonel flepler, genişletilmiş doku flepleri ve serbest flepler kontraktürlerin ciddiyetine göre kullanıldı.

BULGULAR

Tip II aksiller kontraktürlü bir olguda nüks gözlendi. Dirsek kontraktürlerinde tam hareket kapasitesine 3,6 yılda ulaşıldı. Yetmiş bir falanks kontraktürünün sekizinde nüks gözlendi. Boyun kontraktürü nüks olgularının ikisi yeniden ameliyat edildi.

SONUÇ

Yüz rekonstrüksiyonu için mükemmel sonuç prefabrike flep kullanılan olgularda gözlenmiştir.

Anahtar Sözcükler: Yanık; kontraktür; yüz; boyun; üst ekstremite.

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Post-burn sequelae can severely disrupt quality of life and cause physical and psychological deformities such as joint contractures and hypertrophic scars. The best treatment for the sequelae is to avoid the burn accident. Fast and effective first aid and appropriate initial management are essential parts of the burn therapy. Patients must be evaluated carefully and a treatment protocol must be planned wisely.[1-11]

We report herein our treatment protocols and the results of post-burn upper extremity and facial contractures in 77 patients.

Opening (releasing) severe contractures is still a controversial issue in the literature, and there is no consensus among the surgeons regarding the treatment. The extremities and neck region contain vast neurovascular structures; thus, opening the contracture at these sites requires reconstruction with appropriate flaps. In the facial region, any flaps used for the contractures need to be similar in color and quality because it affects an individual's personal and social life.

In this study, we aimed to present our treatment protocols for post-burn sequelae and the contractures that cause functional limitations. We also discuss the indications and the treatment results for severe contractures.

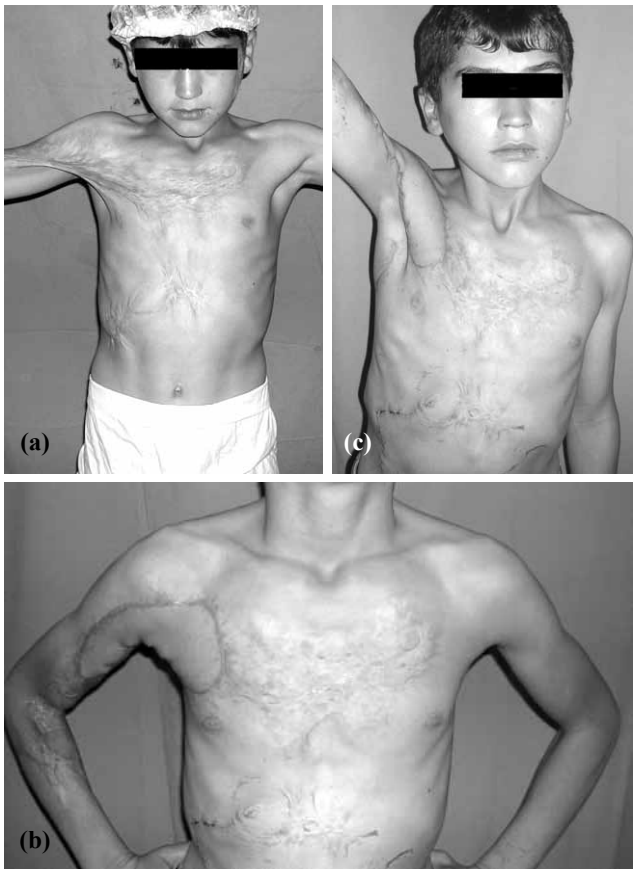

Fig. 1. **(a)** Pre-operative view of a case with axillary contracture. **(b, c)** Late postoperative views of case after the contracture release and treatment with thoracodorsal perforator flap.

MATERIALS AND METHODS

To date in our clinic, 60 patients have been operated for upper extremity contractures: 17 patients for facial contractures, which included lower lip contracture, ectropion, and hypertrophic scars that distorted the anatomic location, and 6 patients for cervical contractures. Only primary cases are included in this article. Every region was evaluated individually.

Axillary Contractures: Axillary contractures are classified into three types as type I: the contracture of the anterior or posterior axillary web, type II: the contracture of both webs but sparing the cupola, and type III: contracture as obliteration of axilla. Five patients had type I, 10 patients type II and four patients type III contracture. Nineteen patients were operated because of axillary contractures. Local flaps (advancement flaps, Z-plasties and K plasties) were used in 14 patients with combined skin grafting. In one patient, thoracodorsal perforator flap was performed (Fig. 1). Tissue expander was used in four cases, especially in contractures that distorted the nipple areola complex, so immediate reconstruction of the breast was completed. Postoperative splinting of the arm at 90 degree abduction and starting passive range of motion exercises immediately are important parts of the therapy.

Elbow Contractures: The classification of elbow contractures depends on the loss of extension. Less than 10 degrees of extension loss is negligible, 11-49 degrees of extension loss is mild, 50-89 degrees of extension loss is moderate, and greater than 90 degrees of extension loss is severe. Three patients were operated with moderate contractures. Multiple Z-plasties with combined skin grafting were used to release the contracture. Lateral arm fasciocutaneous flap was used for a patient whose contracture was severe and three weeks splinting was applied.

Hand Contractures: Thirty-eight cases with wrist, metacarpophalangeal (MCP), phalangeal, and thumb contraction were operated. Nine patients had MCP joint contracture, four had severe (>30 degrees) extension contracture and five had flexion contracture. After releasing flexion contractures in MCP, local advancement flap and skin grafting were used. Groin flap was used in all of the patients who had MCP extension contracture. Seventy-one phalangeal finger contractions in 24 cases were operated. Local advancement flaps with combination of skin grafting was adequate, but in eight patients, flexor tenotomy or volar plate release was needed to release the contracture. Five patients had first web adduction contracture, and groin flap and posterior interosseous flaps were performed, and the Kirschner wire was pinned for stabilization.

Serial casting and aggressive physical therapy was begun after the removal of Kirschner wire.

Neck and Facial Contractures: Cervical contractures were released in six patients. Z-plasties with combined free skin grafting were performed in four patients; in one patient, tissue expansion was needed; and in the last patient, after releasing the neck contracture, a free flap was used to reconstruct the defect (Fig. 2) and cervical collar was applied postoperatively (Table 1).

In seven patients, whose hypertrophic scar invaded half of the face, prefabricated radial forearm flap was used (Fig. 3). Ectropion was fixed with full thickness skin grafting in four patients. Alopecia in 10 patients, ectropion in four patients, and hypertrophic scars distorting the anatomic location in seven patients were the main reasons for the operation. Alopecia involved at least 50% of the scalp. Tissue expander was the choice of reconstruction for the alopecia due to burn scar. Two crescentic tissue expanders in the scalp were used for alopecia for each patient. We inserted two crescentic tissue expanders in the subgaleal plane, adjacent to the scar, in all cases. Stage reconstruction was required in five patients.

RESULTS

Axillary Contractures: Local skin flaps such as advancement flaps, Z-plasties and K-plasties provided adequate tissue to cover post-release defects in patients with type I contracture. There was no necrosis or infections. In patients with type II contracture, both of the web spaces were scarred and blood supply of local flaps was diminished, so we used advancement flap with combined skin grafting. Because of severe contracture at the anterior web, thoracodorsal perforator flap was performed in one patient. In patients with type III contracture, the author evaluated not only the severity of contractures, but also the distortion of the breast. In the literature, the authors used tissue expanders for tissue expansion. However, with tissue expansion, a large amount of healthy tissue will be replaced with scarred tissue. Postoperative splinting of the arm at 90 degree abduction was applied and early passive range of motion exercises were started. Recurrence was seen only in one patient who had type II contraction.

Table 1. Indications for operation in head and neck

Reasons	Number
Alopecia in scalp	10
Hypertrophic scar	7
Ectropion	5
Cervical contracture	6

Elbow Contractures: Z-plasties with combination of free skin grafting were used to reconstruct the defect following the release of elbow contractures. Full range of motion was achieved in the 3.6-year follow-up period.

Hand Contractures: Partial necrosis was observed in one patient with posterior interosseous flap. Despite the combination of surgical and conventional therapies, none of the patients achieved full range of motion. Sixty-three of 71 phalangeal joint contractures were released by using local advancement flap or free skin grafting and no recurrence was seen. In eight of 71 contractures, recurrence was seen. Volar plate releasing, flexor tenotomy and flexor tendon lengthening were performed to obtain adequate range of motion in these contractures. Six cross-finger flaps and two dorsal metacarpal artery flaps were used to cover exposed tendons in the latter group, and Kirschner wire was used for stabilization. Three of the patients in the latter

Fig. 2. **(a)** Pre-operative view of a case with neck contracture. **(b, c)** Late postoperative views of the case after the contracture release and treatment with free anterolateral thigh flap.

group were operated for recurrences. Groin flaps and posterior interosseous flaps were used to cover the defect after releasing the first web adduction contracture. Adequate web space was provided and no recurrence was seen.

Neck and Facial Contractures: An average 110 degree cervicomental angle was obtained after the operation. Two patients were reoperated for neck contracture recurrences. Multiple Z-plasties were used to eliminate the recurrences.

Z-plasties with combined free skin grafting in four patients, tissue expansion in one patient and free anterolateral thigh adipofascial flap for one patient were used to reconstruct the defects after neck contracture release and cervical collar was applied. An average 110 degree cervicomental angle was obtained after the operation. Two patients were reoperated for recurrences. Tissue expander was the choice of reconstruction of alopecia due to burn scar. The author inserted two crescentic tissue expanders in the subgaleal plane adjacent to the scar in all cases. Stage reconstruction was required in five patients. Prefabricated flaps were used for the reconstruction of facial features, and hypertrophic scars were replaced with healthy tissues so patient satisfaction was good; however, facial expression was not acquired completely. Full thickness skin grafting was used following ectropion release. Lacrimation decreased and conjunctivitis resolved.

DISCUSSION

The main causes of burn contractures (especially joint contractures) are mostly the inappropriate initial burn management and inadequate physical therapy.[3] Early aggressive physical therapy and splinting are the fundamental parts of the burn management. In the literature, early physical therapy and splinting have been shown as an effective method to decrease the incidence of burn contracture releasing operation.[4] Exercises must provide full range of motion. There are well-defined splinting protocols that are used in burns in different anatomical locations.[5] Excision and grafting, in deep second-degree and third-degree burns, decrease the length of hospital stay and also the development of burn contractures.[6]

Reconstructive principles must be obeyed strictly in burn surgery. The chosen method should be the simplest method to obtain the optimal results.[7] Skin grafts, local advancement flaps (Z-plasty, K-plasty) or their combination, distant flap, and free flaps are all used to release burn contractures.[8]

Contracture in the axilla is a challenging problem for surgeons. High recurrence rates and joint stiffness are the common problems. Local advancement flaps

Fig. 3. **(a, b)** Pre-operative appearances of a case with facial contracture. **(c)** Flap prefabrication period. **(d, e)** Late postoperative views of the case after the contracture elimination and treatment with prefabricated flap.

like Z-plasties, K-plasties and V-Y plasties are the treatment choices for most surgeons, especially in type I and type II axillary contractures.[9,10]

Good results are also reported with skin grafting techniques.[11,12] In type III axillary contractures, fasciocutaneous or muscle flaps may be used.[13] We used local flaps as Z- and K-plasty and skin grafting in type I and type II axillary contractures. In one patient, thoracodorsal artery perforator flap was performed. The main follow-up period was 3.4 years and there has been no recurrence.

The breast is an important anatomic region adjacent to the axillary fold. Especially in broader contractures, an extensive scarring may develop in the breast region and distort the nipple areola complex. We used tissue expansion method for broader contractures. We operated four patients with type III axillary contractures involving breast scarring. The contracture released with better aesthetic results and expanded tissues were replaced with healthy tissues, and the donor site could be closed primarily.

In mild and moderate elbow contractions, multiple Z-plasties with combined full thickness skin grafting are successful for releasing the contractures.[14] After releasing the severe contracture, larger defects may be created and fasciocutaneous flap may be required. Reverse lateral forearm flap can be used safely and provides good results.[15] Our cases, though limited in number, are consistent with the literature.

Better results may be achieved with the release of MCP joint flexion contractures rather than extension contractures. Local flaps or full-thickness skin grafting is usually sufficient to release flexion contractures.[16] Release of extension contractures is difficult because of tightening of the collateral ligament in the MCP in extension posture. Skin release alone does not provide optimal release and additional capsulotomy may be required.[17] We operated four patients with greater than 30 degree extension contractures. Capsulotomy was performed in all patients. The defects were covered by groin flap in all patients. The loss of range of motion in flexion was observed in all of the patients.

Most of the contractures in phalangeal joints may be released with local flaps or skin grafting.[18] When tendons are exposed, distant flap like cross-finger or dorsal metacarpal artery flap may be used. We operated 27 phalangeal joint contractures. Z-plasties or full thickness skin grafting was appropriate, but we used dorsal metacarpal artery flap in seven cases. As with extension contracture of MCP, volar plate release and flexor tendon tenotomy were required to achieve adequate release of contraction. For hand function, the thumb is the most important digit, so contractures of the thumb severely deteriorate hand function. Adduction, flexion or extension contractures may develop. Z-plasties or skin grafting may be used to release the contracture in the first web. The authors' operated five first web adduction contractures. Groin flap was used in three patients and posterior dorsal artery flap in two patients. Musculus adductor release was done in addition to obtain appropriate web space. We experienced that in severe contractures, bulky fasciocutaneous flaps were useful to cover the defects and acted as a strut in the first web space.

Alopecia is the major cosmetic problem that deteriorates the social life of the patients, and a variety of solutions have been reported in the literature. The tissue expansion method is the most frequently used among reconstructive surgeons.[19] Recent studies have reported higher rates of tissue expansion complications in burn patients,[20] but we did not observe any complications in our burn patients. According to author experiences, tissue expansion is a reliable and a safe method for reconstruction of alopecia.

Neck contractures, especially of the anterior neck, cause secondary deformities. The basic goal of treatment is obtaining enough cervicomental angle to permit functional motion of the neck.[21] There are many classification systems for neck contractures,[22] which mostly depend on the degree of extension. Local advancement flaps are the best choice for treatment in the mild to moderate group.[22] Tissue expansion, free flaps and perforator flaps are used to cover the wounds, following release of mentosternal contractures. Free flaps are also good options for the reconstruction.

In conclusion, local advancement flaps, tissue expanded flaps and free flaps were used in burn patients according to the severity of the contractures.

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