Reconstruction of hand contracture by reverse ulnar perforator flap

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ABSTRACT
Hand burn scar contractures affect patients in aesthetic and functional aspects. After releasing these scars, the defects should be repaired. The reconstruction methods include primary suturation, Z plasty, skin grafting, local or free flaps, etc. All methods have their own advantages and disadvantages. One of the most useful flaps is the reverse ulnar perforator flap. We performed a two-staged procedure for repairing a post-burn contracture release defect in a 40-year-old male. In the first stage we applied reverse ulnar perforator flap for the hand defect, and ulnar artery and vein repair in the second stage. In conclusion, this two-staged procedure is a non-primary but useful option for hand and finger defects and prevents major vascular structure damage of the forearm.

Key words: Burned hand, contracture, reverse ulnar perforator flap

Introduction
Contractures resulting from burn scars may cause serious aesthetic and functional problems. One of the most encountered post-burn scar problems is the decreased hand function. These contractures may complicate the reconstructive procedures. Such reconstruction should be preferred depending on the defect size and its localization [1].

Many methods, from primary suturation to free flaps, have been described for the hand and finger defects [2,3]. In the last few years, the use of perforator flaps for skin-soft tissue reconstruction has been increasing. However, although skin grafting is an easy procedure, the flap reconstructions have more satisfactory long-term results than skin grafting. The reverse forearm flaps are useful choices for hand and wrist reconstructions [4]. Overall, there are multiple flap options with their own advantages and disadvantages in hand reconstruction.

In this study, we present a hand reconstruction by reverse ulnar artery perforator flap (RUPF) and ulnar vascular system repair by a secondary operation. This two-staged procedure is an option for hand defects and prevents major vascular structure sacrifice of the forearm.

Case Report
A 40-year-old male patient admitted to our outpatient clinic for hand contracture due to untreated flame burn while he was a child. Physical examination revealed a serious flexion contracture from distal fingers to proximal palmar crease on his left 4th and 5th fingers (Figure 1). Each joint was mobile but the patient was...
unable to extend them due to contracture. Two-staged reconstruction was planned for the case. The Allen’s test was performed for the patient preoperatively and the dominant vascular system was defined as radial artery.

1st stage: After axillary block without using tourniquets, patients ulnar perforators were identified by using a 8 Mhz hand Doppler. The most audible one which was determined and marked 14 cm proximal to wrist crease on the axial line of ulnar artery. The marked point thought that the future flap’s center. The 4th and 5th finger flexion contractures released through “H” incision and 6x4 cm sized skin-soft tissue defect appeared. A 6x4 cm sized ulnar perforator flap was harvested around the marked perforator (Figure 2). After reaching the main vessel system, the ulnar artery and vein clamped at immediately proximal to harvested flap’s perforator. After, hand flap nutrition checked via hand doppler, clamped ulnar artery and vein ligated by microclips. The reverse side of the ulnar vascular system was followed and harvested to wrist crease including the flap (Figure 3). A skin incision was performed from wrist crease to the medial palm until reaching the defect. The flap turned over by reverse ulnar system to the defect. Incisions and flap sutured primarily (Figure 4).

We observed mild congestion in the skin island immediately after flap transfer and marginal stitches were removed and we performed medical leech for one day. The congestion resolved stepwise in three days.

2nd stage: After 3 weeks of the first stage, the previously performed flap was left in place. The distal part of reverse ulnar vascular system was obliterated and cut. The pedicle incisions that were performed on 1st stage were re-incised and distal reverse ulnar stump turned
to its original position. At this time we identified no certain contracture or gap in ulnar artery but a serious contracture in the ulnar vein. The ulnar proximal stump was identified by following the microclips. Ulnar artery stumps were anastomosed by end-to-end fashion with a 9/0 nylon suture material. The reverse stump of ulnar vein was anastomosed to a superficial vein by end-to-end fashion with a 9/0 nylon suture material (Figure 5). The skin incisions were sutured (Figure 6A, B). After second stage no complication was observed.

Eighteen months after the second stage, patient had sensation on performed flap, finger movements were in normal range, skin island was mild darker than the palm.

Discussion

Contractures after the burned hand can cause serious loss of hand functions. There are many methods for the reconstruction of contracture related defects. Such methods start with secondary healing and extend to free flap surgery. Primary suturation or Z plasties may be insufficient for large hand and finger defects. The hypertrophic scars or contractures may recur when using skin grafting or during secondary healing. Reconstruction with flaps prevents contractures and restricted scars. Some useful flaps for the hand reconstruction include: abdominal flap, cross-arm flap, groin flap, reverse radial or ulnar forearm flap, reverse posterior interosseous artery flap, the anterolateral thigh free flap, etc [5]. All these flaps have their own advantages and disadvantages.

One of the most useful regional flaps for hand reconstruction is RUPF. The RUPF was used for the first time by Li et al [6]. Details of ulnar perforator mapping have been described in the literature [2,7]. The ulnar artery lies between Flexor Carpi Ulnaris and 4th and 5th Flexor Digitorum Superficialis tendons. Ulnar cutaneous perforators extend between the flexor digitorum superficialis and the flexor carpi ulnaris tendons, which are located 4.57±0.59 cm proximal to the pisiform bone and 7.73±1.14 cm distal to the medial epicondyle [8]. The RUPF can be performed over the abovementioned perforators. One of the most favored hypothesis of venous drainage of reverse flaps is venous insufficiency due to excessive increased venous pressure [9]. The RPUF can also be used as neurocutaneous flap or free flap.

In our study, the ulnar perforator was detected 7.5 cm distal to the medial humeral epicondyle by hand Doppler as described by Sun and Shen et al [8,10]. The major disadvantage of RPUF is major vascular sacrifice of the hand. We planned a two-staged operation for preventing hand circulation. By performing the presented procedure, the hand defect was repaired and we avoided vascular insufficiency symptoms such as cold intolerance. Additionally, the pedicle of the RPUF has a wide arch of rotation and can be used for all distal forearm and hand defects. It is thin and suitable for volar or dorsal defects. The donor area of the flap can be repaired by primary approximation. It has a long pedicle and can be used for distal hand defects. It is hairless and can be preferred for palmar defects. It can be used in large hand defects by including more than one perforator to the skin island.

We observed a transient venous insufficiency in the flap’s skin island. We used medical leeches for postoperative one day and the venous insufficiency healed. Furthermore, we observed a contraction in ulnar vein at the beginning of 2nd stage. In this situation we did not prefer to use a venous graft for repairing the ulnar vein. Thus, we anastomosed the distal ulnar vein stump to a superficial forearm vein.

There are a few better flap options for the same region such as reverse dorsal ulnar flap based on descending dorsal branch of the ulnar artery. This flap does not
require the sacrifice of the main vascular structures but it has a hairy surface, particularly in males.

The limitations of this study were two-staged procedure, and it may thought that presented flap dimensions is not enough for requiring the ulnar sacrifice. Also potential problems of microsurgical anastomosis are possible for this case. The reason for choosing a two-staged procedure is the releasing of the contracted tendons and soft-tissues by stretching them in the period between the two procedures. We believe that digital nerve sprouting will provide a sensate flap in the long term, and we prefered reverse ulnar flap for a non-hair bearing skin on palm.

In conclusion, this two-staged procedure is a non-primary but useful option for hand and finger defects and prevents major vascular structure damage of the forearm.

Conflict of interest statement
The authors have no conflicts of interest to declare.

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