The Use of Dorsal Ulnar Artery Perforator Based Flap with Adipofascial Pedicle for Coverage of Wrist and Hand Defects

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ABSTRACT

Background: Hand is frequently subjected to trauma of various causes resulting in skin and soft tissue defects with exposure of underlying important osseotendinous and neurovascular structures. Immediate or early flap coverage is of vital importance to protect deeper structures and preserve hand function, this paper describes the Dorsal Ulnar Artery (DUA) perforator based flap with adipofascial pedicle that was used to reconstruct complicated skin defects of hands.

Methods: Ten patients with cutaneous hand and wrist defects, 6 males (60%) and four females (40%), the average age of patients was 36.7 years (range from 6 to 70 years) they underwent DUA pedicled flap coverage, in the Plastic Surgery Unit of the Department of Surgery, Zagazig University Hospital during the period from January, 2015 to July, 2016.

Results: The flap survival success was 80%, the main finding of the study is that the DUA flap with adipofascial pedicle has a wide arc of rotation; reaches far distally to distal third of hand, the main drawbacks were the venous congestion and flap size.

Conclusion: This flap is a quick local flap, easy to manage, preserves the vascular axis of the hand, it is recommended to cover from small to medium sized defects of the wrist and hand with good aesthetic result and minimal donor site morbidity.

Key Words: Dorsal ulnar artery – Perforator flap – Hand reconstruction – Adipofascial pedicled flap.

INTRODUCTION

Complex hand injuries are common and incur significant skin and soft tissue loss, associated with exposure of injured vital structure located just beneath the enveloping soft tissue layer [1-3], these skin defects are not amenable to simple closure or skin grafting alone [4], such defects arouse the need for flap coverage To preserve hand functions and to protect its vital structures [1,5].

Various types of flaps can be used to cover these defects either by local flap, distant flap or free flaps [1,5,6]. Soft tissue coverage goals include optimal color and contour match, with minimal donor site morbidity and maximum functional outcome [3], these goals are the fundamental principals in the management of soft tissue defects of hands [6].

Becker and Gilbert [7] were the first to describe a local flap includes skin or fascia from the ulnar border of the distal dorsal forearm perfused by the ascending branch of (DUA) of the ulnar artery with preservation of the ulnar artery [8]. This flap could be raised as a hinge (peninsular), or as a true island flap [6,9,10]. Then Karacalar and ozcan [11] had modified the standard technique by raising the flap with a subcutaneous pedicle centered on the ascending branch of the (DUA) of the ulnar artery.

The purpose of this study was to evaluate the application of fascial or fasciocutaneous flap with adipofascial pedicle based on the (DUA) of the ulnar artery used for reconstruction of soft tissue defects of hand and wrist, and to report any complications with the flap or the donor side.

Surgical anatomy: The DUA originated from the ulnar artery at a mean distance of 4.1cm (range: 3.2-5.5cm) proximal to the pisiform bone. It ran in an oblique fashion dorsally and distally under the flexor carpi ulnaris muscle at a mean of 1.2cm (range: 0.5-2cm), and it was divided into ascending and descending branches [12,13].

PATIENTS AND METHODS

This prospective case series study was conducted in ten patients, who were undergone, and this procedure for coverage of wrist and hand defects at Plastic Surgery Unit in General Surgery Department, Zagazig University Hospitals between January 2015 and July 2016. All participating patients were consented and informed about the steps of the surgery and possible complications, after approval of the Ethical Committee in Zagazig Uni-
versity. The study included 6 males (60%) and four females (40%), age range from 6 to 70 years with mean (36.7). Trauma was in 6 cases (60%), one case of infection (10%), one case with gunshot (10%), and one case after post burn contracture release (10%). Associated injuries (either fractures or tendon laceration) were found in 50% of cases. (Table 1) summarizes patients’ data.

Exclusion criteria: Patients with crushed forearm and/or vascular pedicle injury of the flap were excluded from the study.

Operative technique:

Operation was done under general anesthesia with tourniquet control and loupe magnification. The included patients were presented with Soft tissue defect of hand either after scar excision in case of post-burn contracture or wound debridement in traumatic cases at time of acute trauma, and flap was designed accordingly.

A line was drawn between the medial epicondyle of the humerus and the pisiform bone, and the flap was centered on this line. The DUA was identified by the help of Doppler. The pivot point was 3.5cm proximal to pisiform bone. Then the length of the pedicle is measured from the pivot point to the edge of defect area, then the anticipated skin paddle was centered on the previous drawn line after adding the length of the pedicle, a skin incision was done in the skin over the anticipated fascia Fig. (1) or along the border of skin territory down to deep fascia Fig. (2) except at the pedicle with taking a stitches between the deep fascia and skin island to prevent their separation, flap was elevated from beneath the deep fascia in a proximal to distal direction.

The skin over the adipofascial pedicle is incised and dissected sub-dermally 2.5cm bilaterally, the pedicle is dissected subfascially down to the origin of DUA, care was taken to preserve the dorsal branch of the ulnar nerve, then flap is rotated and the intervening skin bridge is incised to accommodate the flap, flap inset into the distant defect is done, the donor site is either primary closed or skin graft according to the flap size. Associated fractures were fixed at time of operation using kirschner wires Fig. (3), and extensor tendon was primary repaired if no laceration was present. Hand is immobilized by splint. All patients were followed-up for three months after the surgery.

RESULTS

We performed ten flaps in this series, 7 (70%) fasciocutaneous and 3 (30%) fascial flaps, the complications were mainly with fasciocutaneous flaps; two fasciocutaneous flaps (20%) were failed due to venous congestion and an alternative flaps were used to cover those defects, and two fasciocutaneous flaps (20%) showed partial flap necrosis (less than 20% of its surface area) which healed by secondary intention without further intervention, no complications were reported from donor site. Physiotherapy was recommended for all patients to achieve satisfactory results.

<table>
<thead>
<tr>
<th>Case no.</th>
<th>Age</th>
<th>Sex</th>
<th>Cause</th>
<th>Flap size cm X cm</th>
<th>Flap type</th>
<th>Associated injuries</th>
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<tbody>
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<td>F</td>
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<td>Fascial</td>
<td>No</td>
<td>Survived</td>
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<td>18</td>
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<td>Trauma</td>
<td>8.5 X 6.5</td>
<td>F.C.</td>
<td>Metacarpal fractures and lacerated extensor tendons</td>
<td>Failed</td>
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<tr>
<td>3</td>
<td>55</td>
<td>M</td>
<td>Trauma</td>
<td>6.5 X 5.5</td>
<td>F.C.</td>
<td>Amputated thumb 5th Metacarpal fracture</td>
<td>Failed</td>
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<td>No</td>
<td>Failed</td>
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<tr>
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<td>6</td>
<td>F</td>
<td>Post burn contracture release</td>
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<td></td>
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<td>70</td>
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<td>6.5 X 4.4</td>
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<td>Metacarpal fractures and lacerated extensor tendons</td>
<td>Partial flap necrosis</td>
</tr>
<tr>
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<tr>
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<td>M</td>
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<td>Fascial</td>
<td>Extensor tendon injury</td>
<td>Survived</td>
</tr>
</tbody>
</table>

Fig. (1): Steps of DUA fascial flap with adipofascial pedicle. (A): Post infective gangrene dorsal skin defect. (B): DUA perforator fascial flap was raised with adipofascial pedicle. (C): Flap insetting and simple closure of donor site. (D): Photo of late postoperative result.

Fig. (2): Steps of DUA fasciocutaneous flap with adipofascial pedicle. (A): Preoperative dorsal wrist post burn scaring and flap design. (B): Flap was raised as fasciocutaneous flap with adipofascial pedicle. (C): Flap insetting and donor site closure. (D): Final results with complete flap survival after 8 weeks.
DISCUSSION

The soft tissue reconstruction of hand defects seems to be a challenging problem as it necessitates an acceptable aesthetic appearance besides restoring hand function. Reconstruction can be achieved by free flaps but they require microsurgical facilities, and distant flaps demand prolonged immobilization and multiple staged operations, so reconstruction by local pedicled flap option has the priority if the forearm is spared of injury [1,2,5].

The DUA based flap suits the requirement of soft tissue reconstruction as it provides a thin and elastic fascia when purely fascial and thin and pliable skin when raised as a fasciocutaneous flap. The main advantage of this flap is that it does not require the sacrifice of a major artery [12], so the blood supply of the hand is not compromised. Also several literatures reported nearly constant vascular anatomy without anatomical variation [13].

An important disadvantage of the stranded Becker flap, that was the DUA is short, which limits the flap rotation arc and prevents it to go far distally in the hand. In addition, peninsular designcauses contour abnormalities at the base of the flap which would later require adjustment [11,12,14], while designing the DUA flap on adipofascial pedicle could provide a greater rotation arc, eliminating contour irregularity and improves the aesthetic result [1,11].

Flap venous congestion was the main cause of flap failure in early two causes of the present study, at the first we were leaving a superficial vein that was dissected with pedicle as described by Kara-calar and ozcan [11] in their study which was conducted in only one case, but this maneuver seemed not to prevent venous congestion in the present series, on the other hand Liu et al., [1] recommended to overcome this problem by ligation of that superficial vein at the base of the facial pedicle and made the width of the pedicle 3cm with a wide tunnel to the defect area, we agreed with Liu et al., [1], but we increased the width of adipofascial pedicle to 5cm also we opened the tunnel to release any compression on the flap pedicle. These modifications reduced greatly the venous congestion in later cases.

As regard flap size, partial flap necrosis was another encountered complication reported in two cases in this series, we agreed with Antonopoulos et al., [15] and Choupina et al., [16]; they had issued that DUA flap cannot exceed 15cm in length and 5 to 9cm in width, due to the risk of venous congestion and partial flap necrosis occurring with larger flaps. In the same context, Gomez & Casal [17] had reported to boost the venous drainage; a termino-terminal anastomosis was performed between one of the largest subcutaneous veins of the flap and one of the subcutaneous veins on the dorsum of the hand to prevent venous insufficiency.

Conclusion:
The dorsal ulnar artery flap is a very good local flap available for the soft tissue coverage of small to medium sized defects of the hand and wrist region as long as the forearm is spared out of trauma, it preserves major vascular axis of the hand. It is convenient, reliable, with good arc of rotation; it is single-stage technique. It decreases donor side morbidity and allows for early rehabilitation.

REFERENCES


