

## The Distally Based Adipofascial Radial Forearm Flap Versus the Radial Forearm Flap for Soft Tissue Defects of the Dorsum of the Hand: A Case-Based Study

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### ABSTRACT

The distally based radial forearm (Chinese) flap is considered the workhorse of defects of the dorsum of the hand. The adipofascial modification of the flap offers the same reliability with less donor site morbidity yet still not preferred by many surgeons due to graft loss over the flap and presumed lengthier operative time. In this study fourteen patients presenting with soft tissue defects over the dorsum of the hand with no tendons or bone involvement were included and randomly divided into two groups: The first receiving the adipofascial radial forearm flap the second group received the Chinese flap. We compared the adipofascial radial forearm flap to that of Chinese flap regarding operative time, hospital stay, complications, functional outcome, aesthetic reconstruction of the defect and donor site cosmesis. Results showed that the two flaps were equal in every aspect except aesthetic outcome as the adipofascial flap showed better results in both reconstructive and donor sites.

**Key Words:** Radial forearm flap – Soft tissue defects – Dorsum of the hand.

### INTRODUCTION

The dorsal skin of the hand is thin, pliable and weakly anchored to the deep investing fascia by loose areolar tissue [1]. This area is frequently prone to different types of injuries (crush, degloving, hot press, friction, and so forth) that result in exposed tendon and bone [2]. The treatment of cutaneous defects may be achieved with regional flaps, distant flaps, or free flaps [3-8]. The distally based radial forearm (Chinese) flap in its fasciocutaneous form is considered by most authorities the workhorse flap for covering such defects [9,10]. The main disadvantage of this flap is donor site morbidity [11,12]. The sacrifice of a major artery is still debatable and studies have shown that significant problem are unusual [13-17]. Other modifications of this flap is the adipofascial flap and adipofascial perforator flap in an attempt to decrease donor site morbidity as well as preservation of the radial artery [18,19]. However, the adipofascial flap still did not gain wide acceptance

as many surgeons find it easier to raise the flap in block rather than dissecting the skin from the scanty subcutaneous fat. Also monitoring the skin flap is straightforward while the adipofascial flap necessitates a split thickness graft which interferes with early flap follow-up and usually suffers some loss [20]. In this study, the authors compared the distally based classic Chinese flap versus the adipofascial version regarding operative time, functional outcome, the donor site morbidity as well as the aesthetic reconstruction of the defect.

### PATIENTS AND METHODS

From May 2014 till October 2015, fourteen patients were included in the study. Twelve patients were male and two females. The mean age was 24.3 (ranging from 4 years to 55 years). All patients suffered from defects on the dorsum of the hand with extensor tendons exposure and no bony involvement. Patients with extensor tendons laceration or segment loss were excluded from the study. Trauma was the cause of the defect in all cases. Allen test was performed preoperatively in all patients to establish patency in both radial and ulnar arteries. All 14 patients were randomized according to the sequence of their hospital admission into two equal groups: First group underwent the adipofascial distal radial forearm flap while the second group were operated with the classic Chinese flap (Table 1). Follow-up ranged from 3 to 5 months.

#### *Surgical technique:*

After sterilization and toweling the wound was debrided adequately and cleaned from any debris. Using a template, the defect was drawn on the volar aspect of the wrist taking in consideration that the pivot point of the flap is at the radial styloid process. In all cases, exsanguination with tourniquet application was performed.

Table (1): Characteristics and complications of the studied cases.

Case	Age	Sex	Type of flap	*Size of the defect in cm	Complications
1	29	M	Adipofascial	4x6	—
2	32	M	Adipofascial	7x7	Partial graft loss
3	4	F	Adipofascial	8x7	Partial graft loss
4	7	M	Adipofascial	5x3	—
5	24	M	Adipofascial	8x5	Partial graft loss
6	33	M	Adipofascial	7x5	Partial graft loss
7	20	M	Adipofascial	6x6	Partial graft loss
8	24	M	Fasciocutaneous	5x6	—
9	12	M	Fasciocutaneous	8x7	—
10	35	M	Fasciocutaneous	11x6	—
11	37	M	Fasciocutaneous	7x8	Partial donor site graft loss
12	55	M	Fasciocutaneous	11x8	—
13	18	F	Fasciocutaneous	5x5	—
14	11	M	Fasciocutaneous	4x4	—

\* Size of the defect after debridement.

### *The distally based adipofascial radial forearm flap:*

In case of adipofascial version the skin incision was centered along the drawing as a straight line or lazy S. The skin was incised and the skin flaps

on either side of the incision are elevated up to the limit of the flap with care to leave some subcutaneous tissues over the fascia. The fascia was sharply incised in the shape of the template and elevated directly off the underlying muscles first from the ulnar side until the osseocutaneous septum between the flexor carpi radialis and the brachioradialis is reached. Care is taken to preserve the septocutaneous perforators emerging from the intermuscular septum. The dissection from the radial side then followed. First the superficial radial nerve was identified and separated. The fascia lateral to the brachioradialis muscle was incised and elevated until the radial artery and its venae comitantes were reached. The vessels were then ligated proximally to the flap and divided and the dissection of the pedicle from the septum was continued from proximal to distal until reaching the wrist joint. The adipofascial flap was then transposed to the defect through a subcutaneous tunnel along the inferior border of the radius. The flap is skin grafted after inseting and the donor site is closed directly. (Figs. 1,2).

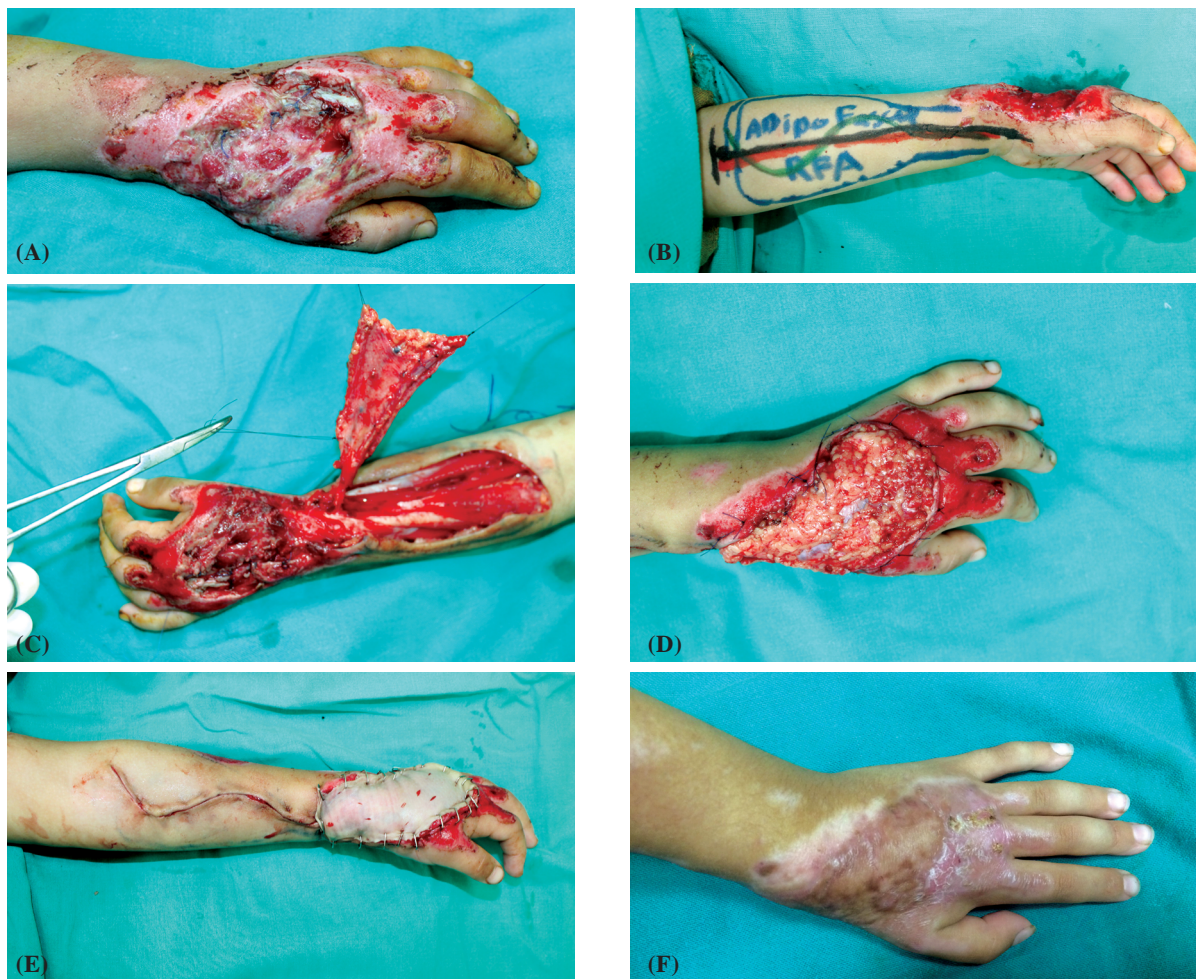


Fig. (1): (Case 3) (A) 4-year-old girl with soft tissue defect on dorsal aspect of left hand after a run over accident. (B) The design of adipofascial radial forearm flap. (C) The wound debrided and the flap elevated. (D) Flap rotated into the defect. (E) Split thickness skin graft applied over the flap in same session. (F) Two-month post-operative.





Fig. (2): (Case 4) (A) 7-year-old male with a defect over the dorsum of the left hand after a run over accident. (B) Design of the adipofascial flap. (C) The flap rotated into the defect after wound debridement. (D) Immediate grafting of the flap. (E,F) 40 days postoperative, the patient regained full range of motion.

*The distally based fasciocutaneous radial forearm flap:*

The skin was incised along the borders of the flap up to the deep fascia which was included in the flap. Dissection proceeded in the same fashion as the adipofascial flap except that the cephalic vein was preserved its proximal end is ligated and cut to include the vessel in the flap which is necessary for the skin drainage. Once the dissection

was completed the flap was turned into the defect after making a small incision along the skin covering the inferior border of the radius with care not to injure the superficial radial nerve. A suction drain was left under the flap for the first 48 hours. The donor site was closed with a split thickness skin graft (Fig. 3). At the end of the operation a volar slab was applied maintaining the wrist in a neutral position, the MP joints in 45 degrees and IP joints in a straight position.





Fig. (3): (Case 12) (A) 55 year-old diabetic male with post inflammatory soft tissue defect on the dorsal aspect of left hand (after wound debridement). (B) Design of the Chinese flap. (C) flap elevated with preservation of cephalic vein. (D) flap inset and the suction drain inserted. (E) Results 2 weeks postoperative.

## RESULTS

All flaps from the two groups survived. The volar slab was removed at day 10 and not used anymore. The first dressing on the grafted fasciocutaneous flap was at day five during which skin graft take and healing of the donor site in the forearm were assessed. For the classic Chinese flap the first dressing was performed on the third postoperative day while the tie-over on the grafted donor site was left for a week. The operative time was similar for the two flaps with no statistical difference ranging from 75 minutes  $\pm$  10 minutes. Hospital stay was equal in both groups and ranged from 3-5 days. The follow-up of the classic distally based Chinese flap was straightforward while that of the adipofascial flap mainly depended on the intraoperative bleeding from the fat and the pulsa-

tion of the radial artery within the flap. Graft take over the adipofascial flap was successful in 2 cases while in the other 5 cases there were some areas of superficial desquamation or graft loss. They were managed with further dressing and healed within 2 weeks. The donor site showed a partial graft loss in one case of fasciocutaneous flap (14.2%) while viable wound edges and straightforward wound healing were observed in the adipofascial version.

All patients were advised to start flexing and extending the interphalangeal as well as the metacarpophalangeal joints from day 12 after being sure of stable wound coverage and adequate graft adherence in case of adipofascial flap. From the second week postoperative the patients in the study were followed on weekly basis for range of motion.



The interphalangeal joints range of motion returned completely within 5 weeks while the metacarpophalangeal joint took a further one to two weeks. None of the patients in the study required the intervention of a physiotherapist and all returned to their normal physical activity after a maximum of 45 days postoperatively. There were no significant differences regarding functional outcome nor time to reach full range of motion in both groups. Regard-

ing patients' satisfaction, all patients in both groups were satisfied of their reconstruction process. Concerning the cosmetic appearance, the adipofascial flap although slightly more glistening, it was better levelled with the normal skin when compared with the Chinese flap. As for donor site morbidity the linear scar was well accepted from the patients when compared to the grafted defect of the Chinese flap (Fig. 4).



(A)



(B)

Fig. (4): Donor site morbidity: (A) Adipofascial radial forearm flap. (B) Chinese flap.

## DISCUSSION

Industrial and vehicular hand trauma to the dorsum of the hand is a common problem facing the plastic surgeon. In literature, there are many solutions for soft tissue coverage of such defects. In the past distant flap as groin and abdominal flap were the workhorse of such defects. However, the cumbersome position, the need of second stage procedure and the edema and stiffness of the joints of the hand apart from the possibility of infection and donor site wound dehiscence were all major drawbacks of these flaps [21]. Moreover, the bulky reconstruction was not appreciated by the patients and further operations were requested to decrease the thickness of the flap. With the introduction of the microvascular era, many of these drawbacks were omitted yet to be replaced by the lengthy operative time and the need for microsurgical experience. Many free flaps were suggested which encompassed classical axial free flaps, fascial free flaps, perforator flaps and even free muscle flaps [22-27]. In the mid- eighties many regional flaps were introduced the most important of which is the distally based radial forearm flap. Still to our day the distally based radial forearm flap is the first choice in many centers for the reconstruction of such defects. The two major drawbacks of this flap is the conspicuous donor site and the sacrifice of the radial artery. To decrease donor site morbid-

ity, the adipofascial version was introduced and later modified into adipofascial perforator based flap [18,28]. The adipofascial perforator based radial forearm flap was described by Chang et al., in 1990 and the vascular basis of the flap was later elucidated by Weinzwieg et al four years later [18,19]. The aim of this procedure is to preserve the radial artery by basing the flap on the perforators issuing from the artery in its distal part. This modification has two main drawbacks: First, the pivot point of the flap is usually based 2-5cm proximal to the radial styloid process thus limiting the reach of the flap. Second, by sacrificing the more proximal perforators the safe territory of the flap is diminished, making it no suitable for large defects or more distal defects. Weinzwieg et al., reported marginal flap necrosis in 5 out of 8 flaps and admitted that their largest flap (286cm<sup>2</sup>) suffered major loss [19]. Maamoun et al., used a groin flap in one of their series to complete the reconstruction of a defect encompassing the wrist and dorsum of the hand. They recommended limiting the proximal border of the flap at 8cm from the elbow crease [29]. Mostafa et al., in a series of 22 perforator based flaps mentioned a total flap necrosis and marginal flap loss in 2 cases [30]. They concluded that the flap width should be limited to 9cm. In our opinion, the perforator based flap is best reserved for defects over wrist, mid-dorsum or base of the proximal phalanx of the thumb. The

reach of the perforator based version is less than the classical adipofascial flap due to decrease in the length of fascia that can be incorporated and also due to the more proximal pivot point of the flap which is 3cm above the styloid process. Fourteen patients with soft tissue defects without any bone or tendon involvement were enrolled in this study. The patients were divided randomly into two groups: One group has the distally based radial forearm performed while the other was reconstructed by the adipofascial version of the same flap. In all 14 patients, the sacrifice of radial artery after a satisfactory Allen's test has not been associated with either acute or chronic hand ischemia which is consistent with many other works [30-32]. Only one case of acute ischemia after harvesting of the Chinese flap has been published [33]. Meland et al., reported in a series of 13 patients who have undergone sacrifice of the radial artery that there was a delay in rewarming of the hand for the first minute but no further difference after 5 minutes [16]. Moreover, it has been proved by Doppler studies that after sacrifice of the radial artery, the ulnar artery increases in size and shows increase in flow with a higher peak flow velocity ratio [34].

In this study the operative time and hospital stay was statistically insignificant in both groups. This is consistent with other studies suggesting that the adipofascial version is as reliable and easy to execute as the classic Chinese flap [31,32]. In our series 5 of the 7 grafted fasciocutaneous flap suffered some areas of superficial desquamation or graft loss. Graft loss over the adipofascial is not an uncommon finding and was observed by many authors [19,24,30,31,35]. In our series such complication was found insignificant and was managed by conventional dressing and complete healing was reached at 3 weeks postoperative without postponing the early mobilization. Weinzwieg suggested delaying the grafting for a week yet this would violate the single stage procedure concept and would increase the immobilization period [19]. There was one case with partial graft loss over the donor site of the radial fasciocutaneous flap. The wound was managed by further dressing and healed within 3 weeks.

Functional outcome was equal in both groups with all patients reaching full range of motion within 45 days. Other works showed some stiffness related to either original injury or problem with donor site or flap survival. This study is limited to soft tissue defects not involving tendons or bones which explains the good functional outcome once adequate coverage is performed [36]. More-

over, the reliability of the adipofascial flap and the Chinese flap with complete survival of flaps in both groups and no donor site complications was of great value in achieving such results.

The reconstructed donor site in the adipofascial group was more glistening, slightly hyperpigmented (3 cases) but well levelled with the surrounding skin. On the other hand, in Chinese flap group the reconstructed skin was hairier (in males), slightly elevated and of fairer quality than the rest of the dorsum. The slight elevation in the Chinese flap is due to the inherent lymphedema occurring in any island fasciocutaneous flap.

Our study reported significant difference in patient satisfaction regarding donor site cosmetics in the adipofascial flap compared to the Chinese flap. When asked about their opinions on the forearm scarring, all patients in the adipofascial flap appreciated the linear scar compared to the Chinese flap group who all expressed their dissatisfaction. This is consistent with many other works concluding that the main drawback of the radial forearm flap is its unsightly donor site disfigurement.

#### Conclusion:

The distally based adipofascial radial forearm flap is safe, reliable, easily executed and allows for a reconstruction of large defects along the dorsum of the hands. It offers all the benefits of the radial forearm flap with better cosmesis regarding the reconstruction and donor site. The adipofascial radial forearm flap should be the first option in the armamentarium of the plastic surgeon for such defects.

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