

## The Outcome of Local and Distant Fasciocutaneous Flaps for Soft Tissue Reconstruction of Complex Hand Defects

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### ABSTRACT

This study included 14 patients presenting by post traumatic hand defects, 11 males and 3 females, their ages ranged from 4 to 53 years. A reversed radial forearm flap used in 4 cases, distant pedicle groin flap was in 7 cases and free anterolateral thigh flap in 3 cases. Pre-operative evaluation of the patients included plain X-ray, Allen test and Doppler examination done for all cases. All patients were followed for a period ranging from 6-18 month. All flaps survived well with some complications in the form of partial skin loss in one case of the reversed radial forearm flaps, partial flap necrosis of the two groin flap cases and re-exploration with revision of the arterial anastomosis due to thrombus formation in one case of the free anterolateral thigh flap cases.

### INTRODUCTION

Hand injuries are common, they frequently present to accident and emergency departments, the injuries may attack part or all the structures of the hand [1].

The surgical management of complex and extensive soft tissue defects arising from trauma is a challenging problem, reconstruction requires regional, distant pedicle or free flaps [3,5].

Fixation of fractures and repair of other structures injured are important before coverage to allow early mobilization and restoration of function [2].

The concept of the axial pedicle flaps and its application created the possibility of reliable immediate coverage for extensive wounds in which appropriate coverage needed. Treatment of hand injuries is based on the assessment of the injury and the selection of the proper reconstructive method [4,6].

Different methods of reconstruction are available for the treatment of hand defects; pedicled groin flaps, distal pedicle reversed radial forearm

fasciocutaneous flaps, posterior interosseous flaps and free flaps [10,11].

Our work presents the use of three types of fasciocutaneous flaps for coverage of complex soft tissue defects in 14 hand injuries. These flaps are the reversed radial forearm flap, the distant pedicle groin flap and the free anterolateral thigh flap.

### PATIENTS AND METHODS

This study included 14 patients, 11 males and 3 females, their ages ranged from 4 to 53 years.

They presented by post-traumatic hand defects, reversed radial forearm flap used in 4 cases, distant pedicle groin flap in 7 cases and free antero-lateral thigh flap in 3 cases.

The aetiology, site and size of the defect are summarized in Table (1).

In all cases the soft tissue defects accompanied by varied amounts of tendon, nerve, vascular damage with fractures or digit amputation which managed in the same procedures.

Pre-operative evaluation of the patients included plain X-ray, Allen test and Doppler examination for all cases.

Follow up of the cases was done for periods ranging from 6-18 months. Both the functional and aesthetic results of different flaps were evaluated.

#### *Operative technique:*

Proper estimation of the defect size before designing our flap to match the dimensions of the flap needed to cover the defect. The magnifying loop used in the flap harvesting.

In reversed radial forearm cases the flap harvested under tourniquet control, the rotation point

of the flap is at the proximal wrist crease and sufficient vascular pedicle must be included in the design to permit rotation into the injury site, the flap component are skin, subcutaneous and volar forearm fascia, ligation of the radial artery at the proximal forearm, the flap circulation depends on the reversed flow distally. The donor site of the flap in the forearm covered by split-thickness skin graft.

In the pedicle groin flap, the flap based on the superficial circumflex iliac vessels. Careful consideration is given to the approach of the flap to the recipient defect of the hand.

The length and orientation of the pedicle should be designed to allow proximal tension-free insitting of the flap avoidance of pedicle kinking, freedom of joint motion and positioning of the patient for comfort, the flap size must be larger than the defect size to facilitate the insitting of the flap without tension. The distal part of the flap was harvested in the superficial plane until the lateral border of the sartorius reached, then the plane become deeper to preserve the pedicle.

The donor site closed primarily and the flap separated after 3 weeks in all cases. In anterolateral thigh free flap cases we followed the same surgical technique as described by Wei et al. [7].

In brief a template is made of the defect to be reconstructed along with an estimation of the length of the pedicle needed. After marking the perforators with hand-held Doppler the dissection is begun medially. The flap should be centered around the perforators with the long axis of the flap running parallel with the long axis of the thigh. Perforators are followed to the intermuscular septum between the rectus femoris and the vastus lateralis muscles. Once the septum is reached the dissection then is completed from the lateral surface of the flap until only the septal perforator is connecting the flap to the patient.

After preparation of the recipient vessels in hand and debridement of the defect, the flap separated from the thigh. Anastomosis of the lateral circumflex femoral vessels of the flap to the radial a., cephalic v. in the anatomical snuff box by the use of operative microscope the flap insitted over the defect without tension and the donor site of the flap in the thigh closed primarily. Monitor of the flap continued for 7 days.

## RESULTS

All flaps survived well, there was partial loss of the skin graft in one of the cases of the reversed

radial forearm flaps which healed conservatively by dressing and hypertrophic scarring in the edge of the healed graft wound in two cases.

There were partial flap necrosis in the distal part of 2 groin flaps managed conservatively in one case and excision with advancement of the flap surgically in the other case and infection of the donor wound in 2 cases which managed by frequent cleaning and dressing and antibiotics.

In the anterolateral thigh free flap cases, re-exploration of the anastomotic site done in one case due to ischaemia of the flap in the 2<sup>nd</sup> post-operative day, a thrombus detected in the artery which removed with revision of the anastomosis and the flap salvaged. A haematoma detected 48 hours after surgery in one donor site of the thigh due to blockage of the suction drain which evacuated and delayed wound closure after that.

Case reports:

*Case I (Fig. 1):*

A 25 years old man with old skin graft scar on the dorsum of the left hand managed previously after explosion injury leads to damage of the dorsal skin and long extensor tendons of the index, middle and ring fingers (Fig. 1a,b).

Excision of the dorsal scars with reconstruction of the three extensor tendons with tendon grafts (Fig. 1c).

A reversed radial forearm flap was used for immediate coverage of the defect with skin graft applied over the donor site (Fig. 1d,e).

The late follow up of the patient after one year with full extension, flexion of the finger with improved aesthetic appearance of the hand (Fig. 1f,g,h).

*Case II (Fig. 2):*

A 4 year old female child with severe run-over crush injury of the right hand with major soft tissue defect of the dorsum of the hand, wrist, lacerations of the volar aspect and comminuted fractures of the volar aspect and comminuted fractures of the all metacarpals (Fig. 2a,b,c).

Immediate debridement, fixation of all fractures with k-wires and coverage of the dorsal defect with a pedicled groin flap (Fig. 2,d,e,f), the late follow up of the patient after 6 months after union of the fractures with accepted functional outcome (Fig. 2g,h).

**Case III (Fig. 3):**

A 52 years old man with degloving injury of the dorsum of the hand with multiple fractures and exposed extensor tendons of the ring and little fingers (Fig. 3a,b). ALTF flap from the right thigh

used for reconstruction of the defect after fixation of the fractures.

The late follow up of the patient is 14 months after surgery (Fig. 3c,d,e).



(A)



(B)

Fig. (1-A,B): A 25 years old man with old skin graft on the dorsum of the left hand managed previously after explosion injury with loss of a major segments from the long extensors of the middle three fingers.

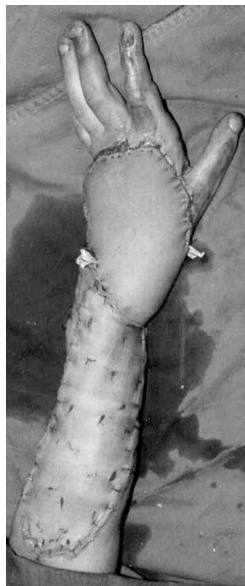


(C)

Fig. (1-C): Excision of all the dorsal scars with reconstruction of the three tendons with tendon grafts.



(D)



(E)

Fig. (1-D,E): The immediate post-operative picture after coverage of the defect with a reversed radial forearm flap.



(F)



(G)



(H)

Fig. (1-F,G,H): The late follow up of the patient after one year with full extension, flexion of the fingers and improved aesthetic appearance of the hand.

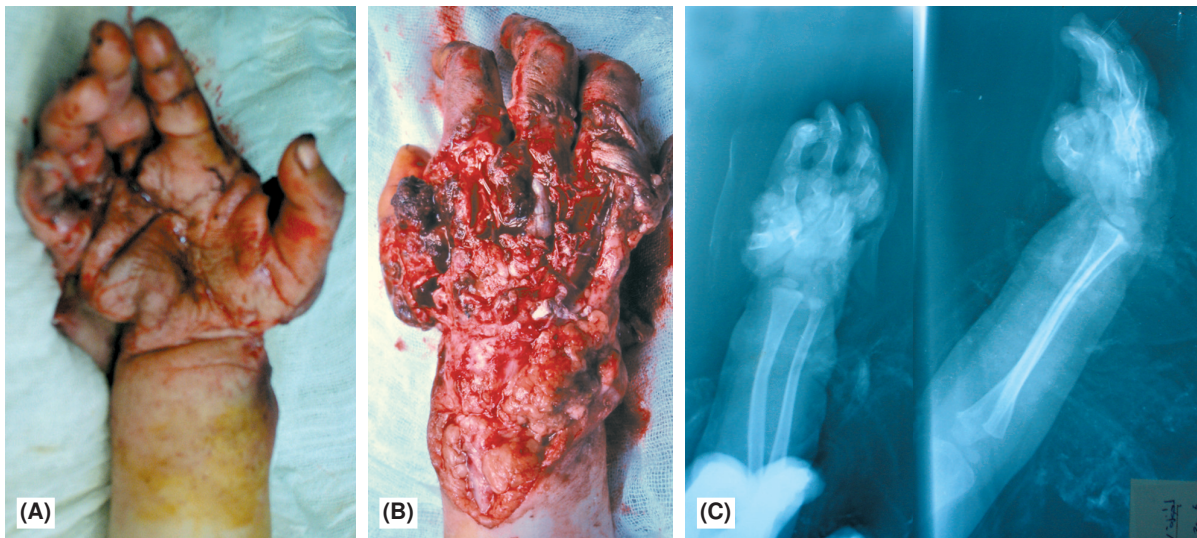


Fig. (2-A,B,C): A 4 years old female child with severe run-over crush injury of the right hand, major soft tissue defect of the dorsum, volar aspect lacerations and open fractures of all metacarpals.



Fig. (2-D,E,F): Immediate debridement, fixation of all fractures with k-wires and coverage of the dorsal defect with a pedicled groin flap.

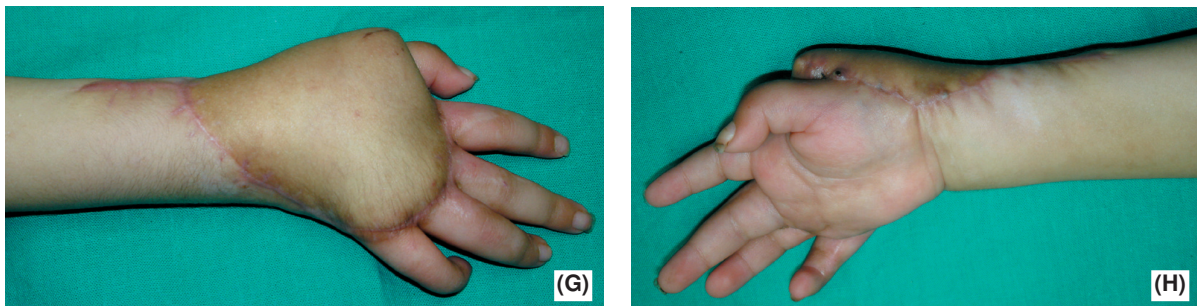


Fig. (2-G,H): The late follow up of the patient after 6 months.



**(A)**

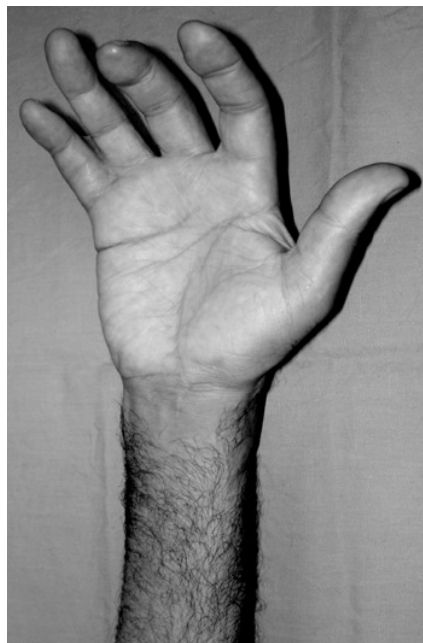


**(B)**

Fig. (3-A,B): A 52 years old man with degloving injury of the hand with multiple fractures and exposed extensor tendons of the ring and little fingers.



**(C)**



**(D)**



**(E)**

Fig. (3-C,D,E): The late follow up of the patient 14 months after surgery.

Table (1): Details of the patients treated with a fasciocutaneous flaps for complex hand injuries.

Case	Age	Site	Cause of injury	Size of the defect	The flap used
1	22	Right hand first web space	Industrial crush injury	10 x 7	R.R.F.F
2	53	Right hand dorsal ulnar defect	RTA degloving injury	14 x 8cm	ALT.F. F.
3	43	Right hand palmar defect	Crush amputation injury	10 x 5cm	R.R.F.F
4	39	Left exposed ulnar 5 <sup>th</sup> ray	Crush amputation injury	Not recorded	Groin flap
5	25	Right dorsal hand	Firework explosion injury	13 x 7cm	R.R.F.F
6	4	Right hand dorsal defect	Run-over crush injury	14 x 8cm	Groin flap
7	9	Left transmetacarpal 5 <sup>th</sup> ray amputation	Run-over crush injury	9 x 9cm	Groin flap
8	37	Left ulnar defect	Run-over crush injury	10 x 5cm	Groin flap
9	32	Right hand central dorsal defect	Crush avulsion injury	12 x 8cm	ALT.F. F.
10	39	Left ring finger degloving	Crush avulsion injury	Not identified	Groin flap
11	11	Left hypothenar and wrist	Deep electric burn injury	10 x 6cm	Groin flap
12	33	Right hand thenar and first web space	Deep electric burn injury	Not recorded	Groin flap
13	29	Right hand base of the thumb dorsally	Deep electric burn injury	7 x 4cm	R.R.F.F.
14	18	Left proximal palm and wrist	Hot press injury	11 x 9cm	ALT.F. F.

R.R.F.F. = Reversed radial forearm flap. ALT.F.F. = Antero-lateral thigh free flap.

## DISCUSSION

In this article three different flaps used for reconstruction of complex hand defects were evaluated in 14 patients, the reversed radial forearm flap used in 4 cases, the groin flap used in 7 cases and free ALT free flap used in 3 cases.

Their results proved that these flaps are reliable for management of the hand defects.

The requirements for a relatively thin and pliable skin flap and has minimal donor site morbidity determined the choice of these three flaps.

Careful pre-operative planning is essential for matching the size of the flap to the defect.

For reconstruction of the hand, the ideal flap should have the following features: Like tissue for replacing like area, thin and pliable flap for molding the hand contour, minimal donor-site morbidity [8,9].

In the reversed radial forearm cases the flap dissection is smooth, the vessels are large and the skin quality is appropriate for hand applications, the criticism of the flap is the sacrifice of a major artery to the hand and the poor donor site result in the forearm [12].

The great advantages of the flap is that you can reconstruct the hand in one stage with a pliable tissue, it facilitates the elevation, mobilization and early starting of the physiotherapy regimen.

The pedicle groin flap is a basic standard technique, we used this flap in our cases due to its versatility, its ability to cover soft tissue defect in different hand regions, easy harvesting in a short time with the ability to intraoperative debulking.

The disadvantages of the groin flap is that it is a two stage procedure, the hand becomes in dependent position, delay the mobilization of the hand plus the incidence of marginal necrosis, donor site wound infection with broad ugly scar in the abdomen [5].

The use of the anterolateral thigh free flap in our work is due to its versatility in hand reconstruction. Any defect in the hand which has exposed critical structures that cannot be covered by a local flap is an indication for free tissue transfer [13]. this flap is widely applicable nowadays for different reconstructive procedures, we found that the great advantage of this flap is the easy insitting over the complex curved surfaces of the hand.

The donor site in the thigh was closed directly except in one case with large dimentions which needed skin graft.

Re-exploration of the microanastomoses site was done in one case due to arterial thrombosis with salvage of the flap and post-operative haematoma in the thigh detected in one case, but no serious complications happened.

In conclusion, the reversed radial forearm and the free anterolateral thigh flaps has a superiority

in selection for reconstruction of complex hand defects over the pedicle groin flap due to the availability of one stage reconstruction, ability for hand elevation and early starting of the physiotherapy with less incidence of wound infection.

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