



## ANTEROLATERAL THIGH FLAP IN BILATERAL POST BURN CONTRACTURE OF THE HANDS

### Plastic Surgery

**R V Koteswara Rao** Dept. of Plastic and Reconstructive Surgery, Nizams Institute of Medical Sciences, Hyderabad- 500082 Telanagana, INDIA. - Corresponding Author:

**T Sidharth** Dept. of Plastic and Reconstructive Surgery, Nizams Institute of Medical Sciences, Hyderabad- 500082 Telanagana, INDIA

**D Mukunda reddy** Dept. of Plastic and Reconstructive Surgery, Nizams Institute of Medical Sciences, Hyderabad- 500082 Telanagana, INDIA

### ABSTRACT

Severe post burn contractures of the hand cause hyperextension of the metacarpophalangeal joints and clawing of the interphalangeal joints with first web adduction contracture; this deformity makes the hand nonfunctional, more so if the contractures are bilateral. Coverage by the free anterolateral thigh flap ensures intraoperative radical release; permitting better hand positioning that allows quick rehabilitation to get the hand to do the activities of daily living.

We present our experience of free anterolateral thigh flap coverage in 3 patients with bilateral post burn dorsal contractures of the hand over the past 8 years. Simultaneous reconstruction was done in one patient and sequential reconstruction was done in two patients.

### KEYWORDS:

Antero lateral thigh flap, post burn contracture hand, Meta carpophalangeal joints, PIP joints: proximal inter phalangeal joints.

#### Introduction:

90% of all major burns affect one or both hands.<sup>1</sup> Post burn contractures of the hand are debilitating; often hands non-functional. According to workmen's compensation act, functional loss of a single hand constitutes 57% loss of function in the individual as a whole.<sup>2,10</sup> Loss of function in both hands could imply a 100% disability.

The most common sequelae of deep burns of the hand are dorsal hand contracture with hyperextension of Metacarpophalangeal joint (MCPJ) and variable flexion contractures of interphalangeal joints (IPJ). If it is associated with adduction contracture of the first web, patient may find it impossible to attain any of the basic positions of the hand. Hence the hand becomes nonfunctional. The disability is worse, if the presentation is bilateral.

So the goal of treatment in these patients should be converting the nonfunctional hands into functional hands by the quickest method possible that decreases the rehabilitation period.<sup>3</sup>

#### Literature survey:

Traditionally, the standard method of treatment in post burn contractures of the hand is either incisional or excisional release of scar followed by split thickness or full thickness graft.<sup>7</sup>

The advent of perforator based skin flaps has increased the use of free flaps in burn contractures of the hand. Complete excision of scar, tendon lengthening and dorsal capsulotomy permits achievement of better functional position of the hand; coverage by a flap permits a more thorough scar excision without the fear of creating a raw area that cannot accept a split skin graft.

Here we are discussing our experience of functional outcome in a group of patients, with bilateral hand burns, who had undergone release of severe dorsal hand contractures and reconstruction with free anterolateral thigh (ALT) fasciocutaneous flaps.

#### Methodology and approach:

From 2005 to 2012, 13 patients had undergone reconstruction with free ALT flap cover for severe post burn deformities in the hand. Patients with isolated first web space contractures were excluded in this group.

Three of these patients had severe contractures, (image 1) involving both the hands. All the six hands were nonfunctional and the patients unable to attend the activities of daily living on presentation. All were male patients, aged between 30 to 40 years.

The aims and objectives of the procedure opted are as follows,

1. To obtain maximal release of contracture in single stage operation,

which meant

- a. At least 70° of MCPJ flexion
  - b. At least 50% correction of PIPJ flexion contractures
  - c. Minimum 30° abduction of thumb with extension of IPJ
2. Immobilize for the shortest period possible
  3. To start early rehabilitation to get return of function ( activities of daily living) in both the hands.



**Image 1: pre-operative photograph of post burn contractures involving bilateral hands**

#### Procedure :

All the patients were preoperatively planned for resurfacing with free ALT flap. Two team approach, with simultaneous harvest of free ALT flap was followed.

All patients were operated under general anaesthesia with endotracheal intubation. Under pneumatic tourniquet control, excisional release of dorsal contracture was done in a sequential manner to get the MPJ of the fingers into functional position. If excision of scar did not give adequate MPJ flexion, then, lengthening of finger extensors, and finally, MPJ dorsal capsulotomy was done (Image 2)

First web space was released, starting from skin and going up to the adductor fascia; retaining the adductors of the thumb. Wherever a minimum 30° degree release was not possible, a distractor was placed across the first web space.

Flexion contracture release of PIPJ of fingers was done where indicated and the volar defects were split skin grafted. IPJs were kept in the released position with Kirschner wire fixation. Arthrodesis of IPJs in functional position was done, wherever there was severe volar subluxation of PIPJ.

Kirschner wire fixation of MCPJ was done at 90°. At least 50 % of the degree of flexion contracture of the PIPJ was released and held with K wires .The defect pattern was taken and was transferred onto the thigh

and the flap harvested

Perforator for ALT flap was marked with hand held Doppler. Septocutaneous or musculocutaneous perforator was dissected after giving anterior incision (Fig intraop 9,10). In one case, it was harvested based on TFL perforator (proximal ALT perforator).. Recipient vessels were radial artery, vena comitantes and cephalic vein.

Flap was transferred on to the defect and the vessels anastomosed to the recipients. Two veins were anastomosed end to end, one to cephalic vein and another to venae comitantes of radial artery. Flap inset was completed(Image 3). Post-operative immobilization of the limb was given with above elbow POP support. Flap was monitored for venous congestion and ischemia for 72 hours.

Wherever distractor was applied, distraction was started at 7<sup>th</sup> day postoperatively and continued till 30<sup>th</sup> of spacing of the first web space was achieved. Patients were discharged on 10<sup>th</sup> postoperative day.

Post operatively Kirschner wire fixation was removed at the end of 4 weeks; distractor, when used, was also removed at 4 weeks. Rehabilitation started with active and passive range of movements, keeping the limb in a customized splint in functional position for another 4 weeks. Night splintage was continued from 8 to 12 weeks.

Scar massage and compression garments were continued for 6 months. All patients underwent secondary procedures like flap thinning and release of scar band at web spaces between 4 to 6 months postoperatively.



Image 2: Intra operative photographs of ALT flaps for bilateral hand post burn contractures



Image 3: post operative photograph of ALT flap in bilateral post burn hand contractures

Case details are described below in the following tables,

Clinical findings (table no.1)

TABLE 1

Clinical findings	Case 1		Case 2		Case 3	
	Right	Left	Right	Left	Right	Left
Duration since accident	6 years		5 years		2 years	
Previous surgeries for hand	Split skin grafting in both hands		No		No	
Wrist	Flexion	Neutral	Extension	Extension	Neutral	Flexion
Meatcarpo phalangeal joint	Hyperextended at 400 in all fingers	Hyperextended at 100in IF, MF,RF; 200in LF	Hyperextended at around 500	Hyperextended at 600 in IF,MF; 400 in RF,IF	Hyperextended at 200	Hyperextended at 200 in IF,MF; 300 in RF,LF

Proximal interphalangeal joint	Hyperextended at 400 in IF, LF; 300 in MF,RF	Hyperextended at 100in IF, MF,RF; 200in LF	Flexed at around 700	Fixed flexion at 800	Flexed at 600in IF,MF,RF; 700 in LF	Flexed at 900
Distal interphalangeal joint	Flexed at 400in IF, MF,RF; ulnar dislocation in LF	Flexed at 300 in IF, MF,RF; 400in LF	Flexed at around 400	Flexed at 500 in IF,MF,RF; Hyperextended at 300in LF	Neutral	Neutral
First web space and thumb	Contracture with obliteration of web space	Contracture with obliteration of web space: MPJ of thumb dislocated	Contracture with obliteration of web space	Contracture with obliteration of web space	Contracture with obliteration of web space	Contracture with obliteration of web space

Operative details (table no.2)

TABLE 2

Operative details	Case 1 Right hand Left hand		Case 2 Right hand Left hand		Case 3 Right hand Left hand	
	Right hand	Left hand	Right hand	Left hand	Right hand	Left hand
Release (Sequential / Simultaneous)	Sequential with 8 month interval		Sequential with 10 month interval		Simultaneous	
Tendon lengthening / Metacarpophalangeal joint dorsal capsulotomy	z-lengthening of extensors + capsulotomy	z-lengthening of extensors + capsulotomy	Lengthening of extensors with tendon grafts + capsulotomy	Lengthening of extensors with tendon grafts + capsulotomy	Metacarpophalangeal joint dorsal capsulotomy	Metacarpophalangeal joint dorsal capsulotomy
First webspace release / Distraction	Release + Thumb MCPJ arthodesed	Release + spacing with K-wire	Release	Distraction	Release + spacing with K-wire	Release + spacing with K-wire
Flap dimensions	21 x 14 cm	23 x 15 cm	21 x 15 cm	20 x 14 cm	28 x 17 cm	25 x 16 cm
Others	Wrist flexion -Incisional release , FCR, PL cut + SSG			All PIPJ arthodesed + SSG for volar defects of Middle finger and thumb		Elbow contracture release + split skin graft

Results and discussion

There were no re-explorations in the post-operative period; all the flaps survived completely. All the donor sites were grafted and healed in 2 weeks; there were no infections at the recipient or donor sites. Kirschner wires were removed at 4 weeks and the pin track sepsis, if present, was managed with cleaning and local antibiotic ointment.

All the patients were assessed for hand function and resting position at the end of 12 weeks; since none of the patients had functional hands and assessment of active and passive range of movements of individual joints ( TAM-total active motion ) was not feasible preoperatively; activities of daily living was used to assess basic functional hand position(Fig postop 13-20). Quantitative power assessment was not done.

Resting position of the MPJ of the fingers, IPJ of the fingers and the first web space were noted. Preoperative and postoperative attitude of

the joints are tabulated ( tables 3, 4, 5)

TABLE 3

	Case 1 R	Case 1 L	Case 2 R	Case 2 L	Case 3 R	Case 3 L
Preop MPJ	-30°	-10°	-50°	-40°	-10°	-20°
Postop MPJ	60°	60°	20°	30°	60°	50°

TABLE 4

	Case 1 R	Case 1 L	Case 2 R	Case 2 L	Case 3 R	Case 3 L
Preop PIPJ	-30°	-20°	90°	80°	70°	90°
Postop PIPJ	30°	20°	Neutral	Neutral	10°	10°

TABLE 5

	Case 1 R	Case 1 L	Case 2 R	Case 2 L	Case 3 R	Case 3 L
Preop First web	20°	20°	0°	0°	20°	0°
Postop First web	70°	60°	30°	30°	60°	40°

Basic positions of the hand, pulp pinch, key pinch, chuck were achieved in all the six hands. Span grasp was possible in four hands. ( table no.6)

TABLE 6

Hand position	Case 1 right	Case 1 Left	Case 2 right	Case 2 Left	Case 3 right	Case 3 Left
Key pinch	yes	Yes	Yes	yes	yes	Yes
Pulp pinch	yes	Yes	Yes	yes	yes	Yes
Chuck grip	yes	Yes	Yes	yes	yes	Yes
Span grasp	Yes	Yes	No	No	Yes	Yes

All the patients were able to write with their dominant hand, to feed themselves, to drink water with a glass, to do common house hold works like turning a tap, locking or unlocking the door.

Flap thinning and release of dorsal contracture bands at the web spaces was performed for all the six hands 6 months after the initial surgery without any complications.

Typical flexion and extension deformities occur in dorsal hand contracture with hyperextension of MCPJ, variable flexion contractures of IPJs.<sup>4</sup> MPJs are often dislocated in severe deformities. If this deformity presents along with adduction contracture of thumb, patients are unable to attain any basic position of the hand and cannot perform activities of daily living.

Unfortunately, there is no standardized method to calculate this complete dysfunction. This situation is worse when the presentation is bilateral.

Contractures are the most frustrating sequel of the thermal injuries and can be classified<sup>5</sup> as

- Grade I - Symptomatic tightness but no limitation in range of motion
- Grade II - Mild decreases in range of motion,
- Grade III - Functional deficit noted
- Grade IV – Loss of hand function.

Grade III and IV are sub classified as (a) Flexion contractures, (b)Extension contractures and (c)Combination of Flexion and Extension contractures.

Sheridan et. al.<sup>6</sup> categorizes the outcome of burn injury in hands as

- A Normal function
- B Abnormal function but able to perform activities of daily living
- C Hand can't perform activities of daily living

They noted majority of patients with deep burns can't perform activities of daily living.

These deformities require major cicatricial release of all structures, followed by resurfacing, which is preferably single stage with minimum splintage period that permits early mobilization.

The simple incisional release of scar on dorsum may not permit to get the joints into functional position, there by the need of extensor lengthening and joint capsulotomy arises.

Skin grafts are the gold standard in treating hand burn contractures as this is the simplest method to resurface skin that was lost due to the thermal burn; in the majority of situations, it gives predictable results and return of function in the simplest manner possible. Full thickness skin grafts theoretically decrease the chances of recontracture but the indications are restricted, on account of limitations of donor sites.<sup>7</sup> Full thickness grafts would receive preference in cosmetically critical burn areas rather than the hand.

Local flaps in the form of distally based perforator flaps from the forearm would be indicated in select situations like isolated adduction contracture or isolated dorsal contracture of the MPJ of fingers. Regional flaps from the lower abdomen<sup>8</sup> in the form of the groin flap or the superficial inferior epigastric flap are again limited in size (on account of necessity of achieving primary donor site closure) and the fact that they can address the problem of extension contracture of the fingers or adduction contracture of the first web but not the both. The dependent position of the hand following the operation increases edema, which is likely to increase the duration of rehabilitation.

Free flaps have the following advantages<sup>3,9,11,12</sup> (a) large amount of skin is available for the transfer and this helps in management of contractures involving the whole hand; (b) the vascularity of all portions of the hand is assured, unlike regional flaps, where a certain random element of the flap has a chance of vascular compromise at the most critical part of the defect; (c) permits very aggressive release that includes tendon lengthening and capsulotomy, thereby achieving the best hand position intra-operatively.

The disadvantage of a free flap is the need to have adequate recipient vessels in the forearm, the increased bulk which needs a secondary flap thinning or flap liposuction procedure and development of bridge scars at the dorsal distal edge of the flap inset that needs Z-plasty and scar revisions.

**Conclusion**

We conclude that the resurfacing with a free anterolateral thigh flap following aggressive excisional release is advantageous in providing early return of function in patients with bilateral hand burns that are nonfunctional to begin with.

**Future scope**

The problem in using the microvascular flap in burnt areas is venous insufficiency. To combat this problem one may try to use various other modalities like usage of long vein grafts, usage of AV loupes. With the help of these modalities vascular access can be extended and flap reach to the distal parts can be achieved.

**References**

- 1 Kreymerman, Peter A. M.D.; Andres, Lewis A. M.D., Ph.D.; Lucas, Heather D. P.A.-C.; Silverman, Anna L.; Smith, Anthony A. M.D. Reconstruction of the Burned Hand. *Plast Reconstr Surg*:February 2011 - Volume 127 - Issue 2 - pp 752-759
- 2 Engrav L.H.I., Dutcher KA, Nakamura D.Y. Rating burn impairment. *ClinPlast Surg.* 1992 Jul;19(3):569-98.
- 3 Woo, Sang-Hyun M.D., Ph.D.; Seoul, Jung-Hyun M.D., Ph.D. Optimizing the Correction of Severe Postburn Hand Deformities by Using Aggressive Contracture Releases and Fasciocutaneous Free-Tissue Transfers. *Plast.Reconstr.Surg.* January 2001 107(1):1-8
- 4 Mc Cormack, R.M. Principles of treatment and reconstruction of the burned hand and fingers. In symposium on the hand. St.Louis :Mosby, 1971.Pp42-54
- 5 McCauley. Reconstruction of the pediatric burned hand : *Hand Clinics* 2000; 16:149-259
- 6 Sheridan, Robert L. MD; Baryza, Mary J. MS, PT, PCS; Pessina, Monica A. OTR; O'Neill, Kim M. OTR/L; Cipullo, Hilary M. MS, PT; Donelan, Matthais B. MD; Ryan, Colleen M. MD; Schulz, John T. MD, PhD; Schmitzer, Jay J. MD, PhD; Tompkins, Ronald G. MD, ScD. Acute Hand Burns in Children: Management and Long-Term Outcome Based on a 10-Year Experience With 698 Injured Hands. *Annals of Surgery*: April 1999 - Volume 229 - Issue 4 - pp 558-564
- 7 Schwanholt C1, Greenhalgh DG, Warden GD. A comparison of full-thickness versus split-thickness autografts for the coverage of deep palm burns in the very young pediatric patient. *J Burn Care Rehabil.* 1993 Jan-Feb;14(1):29-33.
- 8 Kelleher JC, Sullivan JG, Baibak GJ, Dean RK. Use of a tailored abdominal pedicle flap for surgical reconstruction of the hand. *J Bone Joint Surg Am.* 1970 Dec;52(8):1552-62.
- 9 De Lorenzi F1, van der Hulst R, Boeckx W. Free flaps in burn reconstruction. *Burns.* 2001 Sep;27(6):603-12.
- 10 American Medical Association: guides to the evaluation of permanent impairment 4thed, Chicago, American Medical Association, 1994
- 11 Adani, Roberto M.D.; Tarallo, Luigi M.D.; Marocco, Ignazio M.D.; Cipriani, Riccardo M.D.; Gelati, Chiara M.D.; Innocenti, Marco M.D. Hand Reconstruction Using the Thin Anterolateral Thigh Flap. *Plast Reconstr Surg* August 2005 - Volume 116 - Issue 2 - pp 467-473
- 12 A Reigstad, K R Hetland, K Bye, M Røkkum. Free flaps in the reconstruction of hand and distal forearm injuries. *The Journal of Hand Surgery British & European Volume* 17, Issue 2, April 1992, Pages 185-188