

## RECONSTRUCTION OF POSTBURN CONTRACTURE OF FIRST WEB SPACE OF THE HAND

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### ABSTRACT

**Background:** Soft tissue reconstruction of the first web space remained a challenge for plastic and reconstructive surgeons. First web space adduction contractures are a common consequence of hand burns. Many reconstructive techniques are used and investigation for more effective methods continues.

**Objective:** assess the range of movement as regard opposition, palmar abduction and thumb extension. Also assessed the depth of web space after reconstruction of post burn contracted first web space to assess the method of covering the defect after release..

**Materials and Methods:** 35 patients' ages ranged from 12 to 59 years (with mean 31.7), years; 23 males and 12 females admitted to our Hospital during the period from June 2008 to May 2012. All patients were suffering from post-burn first web contractures. The patients underwent a variety of surgical procedures. The follow-up period ranged from one to three years.

**Results:** Full range of motion achieved in most patients, but not those with joint affections.

**Conclusions:** In our experience, surgical correction of first web space contractures- in the form of flaps good results followed by skin grafts- results in meaningful functional enhancement. The outcomes depend primarily on the severity of contracture. Functionally limiting recontracture is rare in our experience and its best prevented by appropriate therapy

**Keywords:** Contracture; Burns; First web space reconstruction.

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### INTRODUCTION

**F**irst web contracture after deep hand burns is still a common, in spite of the better treatment now available, the early initiation of physiotherapy procedures, and the early surgical treatment of deep burns<sup>[1]</sup>. Scars and contractures were common sequelae of severe burns around joints and they led to a limitation of movement<sup>[2]</sup>. Adduction contracture was the result of skin and soft tissue damage because of deep thermal burns. It resulted either from burn contracture of the web space or due to prolonged positioning of thumb in adducted and extended position leading to shortening adductor pollicis<sup>[3]</sup>

Reconstructive procedures were often necessary to release the contractures and reestablish the complete range of motion<sup>[2]</sup>.

Many techniques were described to manage web space local flaps including Z-

plasty, Y-V plasty and their variants, four-flap and five-flap technique; first dorsal metacarpal flap, posterior interosseous forearm flap, reversed flow radial forearm flaps or reversed ulnar forearm flap, microsurgical anterolateral thigh flap and skeletal traction were employed<sup>[4]</sup>.

To date, there have been no studies evaluated what components of thumb movement were most important for a successful contracture release in terms of clinical outcomes<sup>[5]</sup>.

So we measure thumb extension angle, palmar abduction and depth of first web space to assess the success of method of covering the defect

### PATIENTS AND METHODS

This study includes 35 patients'. Their ages ranged from 12 to 59 years (with mean 31.7), years; 23 males (65.7%) and 12 females (34.3%) were admitted to our Hospital during the period from June 2008 to

May 2012, suffering from post-burn contracture of first web space. 60% of those patients were operated on release of contracture at another institution. The contracture of the first web in our patients included 30 cases of unilateral hand (85.7%) and 5 cases of bilateral hands (14.3%) so the number of total cases was 40 (as in table 4). The procedures for bilateral problems were not carried out simultaneously).

History of smoking, diabetes mellitus and vascular disease was recorded, X-ray study of the underlying bony framework.

Preoperative evaluation: inclusion criterias: the deformity was analyzed as anatomically, underlying structures and condition of neighboring tissues. Assessment of the range of movement as regard opposition, palmar abduction and thumb extension. Also assessed the depth of web space.

thumb extension <sup>[6]</sup>: photograph of the hands with the palm up, fingers extended and the thumb fully extended and radially abducted parallel to the palmar plane were evaluated. A line was drawn parallel to the radial border of the thumb metacarpal (M1) and a line drawn parallel to the radial border of the index proximal phalanx (P2). The thumb extension angle was angle formed by the intersection of the two lines (M1P2)

Palmer abduction <sup>[6]</sup>: on lateral photograph of the radial aspect of the hand and forearm with the fingers fully extended and the thumb abducted 90° to the palm of the hand, a line was drawn parallel to the border M1. Lines were drawn parallel to the dorsal border M2 and parallel to the volar aspect of P2. The angles between the first metacarpal M1 and the index metacarpal M2 (M1M2) angle and between the first metacarpal M1 and the proximal phalanx of the index finger P2 (M1P2 angle) were measured.

The Thumb web width measured, is the distance from the ulnar point of thumb interphalangeal joint transverse striation to the radial point of index finger metacarpophalangeal joint transverse striation when the thumb is in the maximal abduction position <sup>[7]</sup>.

Opposition: the distance, in millimeters, between the first and fifth metacarpal head, as measured between the first and fifth palmar digital crease under maximal opposition. For this measurement, higher oppositional distances demonstrate poor opposition. We chose to measure opposition because it was a measurable distance in all of these patients <sup>[5]</sup>.

Laboratory investigations: complete blood picture, partial prothromp time and thrompoplastine concentration time for all patients. Patients above forty years renal functions tests, liver function tests, blood sugar level and ECG were done.

Written consent was obtained from the patients before surgery after they had been informed about the advantages and possible adverse effects of the operation.

Preoperative broad spectrum antibiotic in the form of Cefotaxime in the dose of 50-180 mg/kg in divided doses and Sulbactam/Ampicillin in the dose of 150 mg/kg in divided doses -was given IV 2 h before surgery. All operations performed under general anesthesia. The position of the patient on table was preplanned. The operation was performed under tourniquet control. All patients underwent release of the soft tissue element of the contracture, usually by incision of palmar contractures, and excision of contracted scar tissue for dorsal contractures.

The patients were classified according to the method of covering the defect after complete release of the contractures which depended on condition of skin surrounding the defect, adductor muscle contracture, fibrosis, or joint exposure after release- into

Group 1: 5 flap Z plasty flap by Stern, et al <sup>[8]</sup>. in cases just simple skin contracture (photo. 1 a-b)

Group 2: the defects covered with skin grafts (photo. 2 a-b). With or without release origin of first dorsal interosseous muscle, and origin of adductor pollicis

Group 3: the defect bridged by Pedicled groin flap (photo. 3 a-b) by Saleh, et al <sup>[9]</sup>. as in cases of severe contracture the structures must be released were, origin of first dorsal interosseous muscle, and origin of adductor pollicis. While setting the flap, it was

important to keep the web space, open by bridging K wire <sup>[3]</sup>.

Donor wound had to be covered in cases of flap.

Postoperative care: - The dressing was comfortable, well padded and not too tight, elevation of limb had to be slightly above the level of the heart in case of covering the defect with skin graft or z-plasty, monitoring of flap (color, capillary refilling, and temperature of the flap) in case of covering the defect with groin flap .

Rehabilitation: splinting and positioning, supervised motion, and use of pressure dressings and garments. All of those methods initiated by 2–3 weeks regardless of the reconstructive procedure performed following FTSG, as soon as the graft showed good take, we initiated full active motion with therapy and this is not done in case of groin flap covering the defect.

The patients were not allowed to walk before two weeks in case of covering the defect with groin flap. Bulky tissue defatting was delayed for at least six months.

Statistical analysis: collected data were tabulated and statistically analysed using statistical package for social science (SPSS) version 16 (SPSS Inc., Chicago, USA). Numerical data were presented as arithmetic mean and standard deviation (SD), while categorical data were presented as frequency and percent. For comparison between groups one-way analysis of variance was used for numerical data and for comparison between two variables at two different points of time, paired samples (t) test was used. P value < 0.05 was considered significant.

### RESULTS

Edge contracture (21 dorsal )( photo. 4-a), and 2 palmar(photo. 4-b); medial adduction contracture (4 cases) (photo. 4-c) and Total burn contracture (13 cases) (photo. 4-d)

In group one 5-flap Z- plasty or dorsal transposition flap (21 cases) represent 52.5%

from the study with tip necrosis in (three cases) healed by secondary intention, sloughing of flaps in (one case), and covered by skin graft as in (tables 1 and 4).

In group two. The defects covered by skin grafts (7 cases) represent 17.5% from the study with partial take and covered by split thickness skin graft in two cases as in (tables 2 and 4).

In-group 3 the defect was bridged by Pedicled groin flap and defatting of the flap after at least 6 months' interval (12 cases) represent 30 % from the study as in (tables 3 and 4).

Mean of palmar abduction (thumb abducted 90° to the palm of the hand) (M1M2) in the three groups was significant between preoperative and postoperative p <0.001 but in group three the mean of palmar abduction (M1M2) postoperative was the most improve ( 54.16) (tables 5 and 6 ).

Mean of palmar abduction (M1P2) in the three groups was significant between preoperative and postoperative p <0.001 but in group three the mean of palmar abduction (M1M2) postoperative was the most improve (63.75 ) (tables 5 and 6 ).

Mean of thumb extension (M1P2) in the three groups was significant between preoperative and postoperative p <0.001 but in group one the mean of palmar abduction (M1M2) postoperative was the most improve (45.47 ) (tables 5 and 6 ).

Mean of web space angle ) in the three groups was significant between preoperative and postoperative p <0.001 but in group three the mean of palmar abduction (M1M2) postoperative was the most improve (71.25 ) (tables 5 and 6 ).

The outcome measuring the depth of web was increased. Range of movement in palmar abduction (photo.5a) and thumb extension abduction(photo.5b) was improvement in the majority of cases. Range of opposition(photo..5c) was improved as well in most cases.



A



B

PHOTO 1; (A) dorsal view of right hand showing linear scar of first web postburn  
(B) Corrected by 5 Z-plasty



A



B



C

photo..2 ::(A) preoperative dorsal view of both hands showing total contracture post burn.  
(B) intraoperative dorsal view of right hand showing defect extend to the web  
:(C postoperative view of both hands showing reconstruction with groin flaps of both hands



A



B

Photo3: (A) preoperative view showing total left hand post burn contracture .  
(B) postoperative view showing release of contracture and skin graft covering the defect



Photo4.: (A) palmar view of right hand showing dorsal contracture post burn of first web  
 (B) palmar view of left hand showing palmar contracture post burn of first web  
 : (C) palmar view of right hand showing medial adduction of thumb  
 : (D) view of right hand showing total contracture post burn of the first web space

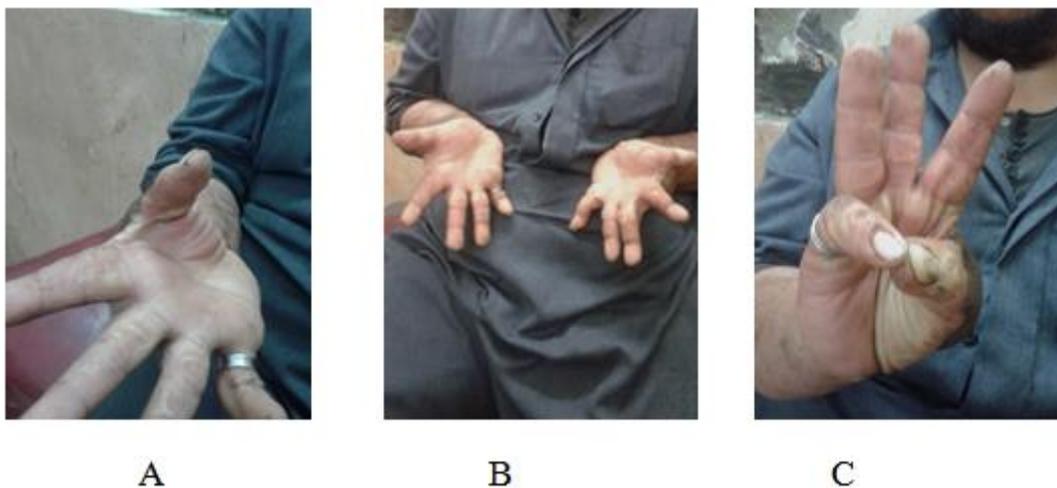


photo.5:(A)postoperative palmar I view of right hand showing good palmar abduction .  
 :(B) postoperative palmar I view of both hands showing good thumb extension  
 :(C) postoperative dorsal view of right hand showing good opposition.

**Table –1** Clinical series of group 1:5 flap Z plasty flap

No.	sex	Age	Etiology	Anatomical position of scar	Method of reconstruction	2'nd Ancillary Procedures	Complications
1	male	12	Thermal burn	Right edge dorsal	5 Z- plasty		none
2	male	32	Thermal burn	Right edge dorsal	5 z-plasty		none
3	male	43	Flame burn	Right edge dorsal	5 Z- plasty		none
4	male	41	Thermal burn	Left edge palmar	5 z-plasty		none
5	female	16	Thermal burn	Right edge dorsal	z-plasty		none
6	female	16	Flame burn	Right edge dorsal	z-plasty		non
7	male	33	Thermal burn	Right edge dorsal	z-plasty		Tip necrosis
8	female	55	Thermal burn	Right edge dorsal	z-plasty		none
9	male	17	Thermal burn	Right edge dorsal	z-plasty		none
10	male	19	Thermal burn	Left edge dorsal	z-plasty		none
11	male	25	Thermal burn	Right edge dorsal	z-plasty		none
12	male	30	Thermal burn	Left edge dorsal	z-plasty		none
13	male	31	Thermal burn	Right edgedorsal	z-plasty		none
14	female	35	Thermal burn	Right edge burn	z-plasty		none
15	male	19	Thermal burn	Right edge dorsal	5 z-plasty		none
16	female	31	Thermal burn	Left edge dorsal	5 z-plasty		none
17	male	17	Flame burn	Right edge dorsal	z-plasty	g	Tip necrosis
18	male	19	Thermal burn	Left edge dorsal	5 z-plasty		none
19	female	59	Thermal burn	Right edge dorsal	5 z-plasty	Full thickness graft	Sloughing of flaps
20	male	59	Thermal burn	Right edge dorsal	5 z-plasty		none
21	female	17	Thermal burn	Right edge dorsal	5 z-plasty		none

**Table –2** Clinical series of group 2: the defects covered with skin grafts

No.	sex	Age	Etiology	Anatomical position of scar	Method of reconstruction	2'nd Ancillary Procedures	Complications
1	male	14	Thermal burn	Right medial adduction	Release of origin of transverse head of adductor-covering the defect by full thickness skin graft		none
2	male	40	Flame burn	Bilateral total burn	Full thickness grafts		Partial take
3	male	17	Thermal burn	Left medial adduction	Full thickness grafts f		none
4	male	51	Thermal burn	Left edge palmer	Release of origin of transverse head of adductor-covering the defect by full thickness skin graft		none
5	male	42	Thermal burn	Right medial adduction	Full thickness grafts		Partial take
6	male	53	Thermal burn	Right medial adduction	Release of origin of transverse head of adductor-covering the defect by full thickness skin graft		none

**Table –3Clinical series of group3: : the defect bridged by Pedicled groin flap**

No.	sex	Age	Etiology	Anatomical position of scar	Method of reconstruction	2'nd Ancillary Procedures	Complications
1	male	25	Flame burn	Bilateral total burn	Groin flaps	defattening	none
2	female	56	Flame burn	Right total burn	Groin flap	defattening	none
3	female	29	Flame burn	Right total burn	Groin flap	defattening	none
4	female	18	Flame burn	Bilateral total burn	Groin flaps	defattening	none
5	male	23	Flame burn	Bilateral total burn	Groin flaps	defattening	none
6	female	25	Thermal burn	Left total burn	Groin flap	defattening	none
7	male	45	Flame burn	Bilateral total burn	Groin flaps	defattening	none
8	male	50	Flame burn	Right edge dorsal	Groin flaps	defattening	none

**Table (4): Descriptive data of studied cases**

Variable	Statistics	
Age (years)	31.70±7.45; 12-59	
Gender (male/female) (n=35)	23 (65.7%) / 12(34.3%)	
Laterality (unilateral/Bilateral) (n=35)	30(85.7%) / 5(14.3%)	
Surgical intervention (n= 40 hand)	Group 1	21(52.5%)
	Group 2	7(17.5%)
	Group 3	12(30.0%)

**Table (5): pre and postoperative measurements in studied groups**

		G1		G2		G3		F	p
		Mean	S. D	Mean	S. D	Mean	S. D		
Preoperative	Palmar abduction M1-M2	21.66	5.55	18.57	3.77	18.75	8.29	1.127	0.33
	Palmar abduction M1- P2	20.71	5.07	17.85	2.67	18.75	3.10	1.56	0.22
	Radial Abduction M1-P2	25.23	4.32	22.85	3.93	27.08	5.82	1.75	0.18
	Web space angle	24.28	5.54	22.85	4.87	24.16	6.33	0.17	0.84
Postoperative	Palmar abduction M1-M2	42.61	7.35	33.57	3.77	54.16	5.57	24.91	<0.001*
	Palmar abduction M1- P2	54.28	9.52	36.42	4.75	63.75	7.11	24.38	<0.001*
	Thumb extension M1-P2	45.47	4.97	38.57	3.77	57.50	3.98	44.99	<0.001*
	Web space angle	57.85	8.74	42.85	4.87	71.25	6.440	31.73	<0.001*

\*= significant difference

**Table (6): Comparison between pre-and post-operative values of studied parameters in each group**

		Group 1			Group 2			Group 3		
		Mean	S. D	Paired (t)	Mean	S. D	Paired (t)	Mean	S. D	Paired (t)
Palmar abduction M1-M2	Preoperative	21.66	5.55	23.60*	18.57	3.77	13.74*	18.75	8.29	15.68*
	Postoperative	42.61	7.35		33.57	3.77		54.16	5.57	
Palmar abduction M1-P1	Preoperative	20.71	5.07	16.90*	17.85	2.67	10.33*	18.75	3.10	18.87*
	Postoperative	54.28	9.52		36.42	4.75		63.75	7.11	
Thumb extension M1-P2	Preoperative	25.23	4.32	21.45*	22.85	3.93	12.52*	27.08	5.82	21.15*
	Postoperative	45.47	4.97		38.57	3.77		57.50	3.98	
Web space angle	Preoperative	24.28	5.54	17.43*	22.85	4.87	15.37*	24.16	6.33	28.01*
	Postoperative	57.85	8.74		42.85	4.87		71.25	6.44	

\*= significant difference

## DISCUSSION

Soft tissue reconstruction of the first web space remained a challenge for plastic and reconstructive surgeons. Skin defects of the first web space created after the release of post-burn contractures could be covered by skin graft, fascial Pedicled flaps, distant flaps, or free flaps, depending on the patient's general condition and the conditions of the local wound and donor site <sup>[10]</sup>.

In our study dorsal commissural contracture was (55 % of the total number); palmar, (5 %), and total contracture, (30 %) but edge contractures in the study done by Grishkevich' <sup>[11]</sup> dorsal commissural contracture was (82% of the total number); palmar, (11%), and total contracture, (7%).

Treatment of post burn contractures of the first web space implied in most of cases the use of a full thickness skin graft, especially when the contracture did not involve deeper structures but only the skin and the subcutaneous tissues. The use of a full thickness skin graft carried with it certain inconveniences such as those related to its take, secondary contracture, donor site morbidity <sup>[12]</sup>..

The use of skin grafts is not effective to improve the functional aspect and to ensure a stable result; the recurrence of contracture or chronic breakdown is often observed and a second surgical operation is necessary <sup>[13]</sup>.

It is obligatory used in certain cases Especially in pediatric patients<sup>[7]</sup>

Advantages with this relatively simple method include the ability to release multiple joints at the same sitting. But disadvantages of skin grafting hypertrophic scar , contracture of graft lead to recurrence that require re-release, partial take , the patient would require physiotherapy and splintage to maintain joint motion after release and donor site morbidity <sup>[14]</sup>..In our study, there were two cases partial take from seven cases but Rawat, et al <sup>[7]</sup>. had partial graft loss in two patients from 16 patients which were treated with split thickness skin grafts.

Several local flaps were used to reconstruct the resultant defects of the web space. However, local flaps might remain inadequate for reconstruction, when defects were extremely large or deep with exposed

bones, tendons or vessels such as electrical burns <sup>[15]</sup>.

Although more recently developed local fasciocutaneous and free flaps had overshadowed the use of Pedicled flaps, Pedicled flaps continued to have an important place in the reconstructive first web space surgery <sup>[16]</sup>.

In our study there were three cases showing tip necrosis and one case sloughed but in series of Gumus and Yilmaz <sup>(17)</sup>, there was no necrosis appeared in the z plasty flaps and all flaps had survived totally. Gumus and Yilmaz <sup>[17]</sup>.avoided any elevation of flaps for the movement so its blood supply did not compromise, making the flaps safer so avoiding tip necrosis of z plasty flaps. On the other hand, Rawat, et al <sup>[7]</sup>.elevated z- flaps tip necrosis seen in one patient, which healed secondarily with minimal scarring, and without recontracture.

The groin flap's drawbacks were that it is thick and needs prolonged immobilization until separation. Our results were consistent with those of Koshima et al., <sup>[18]</sup>.who performed a groin flap in the coverage of 65 patients with post-burn deformed dorsum of the hand.

In our study the defect covered by groin flaps was not associated with complication that agreed with work of Rawat, et al <sup>[7]</sup>.who observed that better results with flap coverage after releasing first web space. However, release and grafting along with splint age remained the time proven method. Flap coverage had the advantage of preventing recontracture, chances of which were higher in cases operated with release and split thickness skin graft.

In our study, we used groin flap to cover the dorsal defect that agreed with Neumeister, et al <sup>[19]</sup>.who used the groin flap to cover dorsal hand defect. Derek, et al <sup>[5]</sup>.noticed that the success of a contracture release was not related to achieving normal abduction angles, it might be related to achieving a change in the abduction angles from the patients' preoperative values.

## CONCLUSION

In our experience, surgical correction of first web space contractures resulted in

meaningful functional enhancement. The outcomes depended primarily on the severity of contracture. Functionally limiting recontracture was rare in our experience and its best prevented by appropriate therapy.

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