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A CLINICAL STUDY ON MANAGEMENT OF CONTRACTURES OF UPPER LIMB FOLLOWING BURN

Plastic Surgery

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ABSTRACT

Introduction - Post burn contracture is a common sequele occurring after burn as a result of which thousands of victims of burn are handicapped every year. Upper limb contractures are also occurring more commonly because it is most mobile part of body and likely to be involved in burn.
Aim of the study: To study various operative strategies for management of patients presenting with post burn contractures of upper limb i.e axilla, elbow and hand.
Methods : 80 patients presenting with post burn contracture were treated in our hospital.
Observation & Results : In our study , the youngest member was a 2yr old girl, and the oldest was a 70yr old man .Max no. of pts 22(27.5%) were in the age group of 21-30 yrs. In our study out of 80 patients of postburn contracture, axillary contracture was present in 20 patients(25%), elbow contracture in 10patients(12.5%), wrist contracture in 8patients(10%),finger contracture in 38patients(47.5%), while complicated contracture was present in 4patients(5%). Operative procedure constituted of mainly Release with single or multiple Z-plasty in 15patients(18.75%) Release with K-wire fixation/skin grafting in 56 patients (70%),Local flap (Cross finger) in 02 patients, Abdominal/ Groin flap in 07 patients (8.75%). In our study of 80 pts, 2 pts(20%) had flap tip necrosis, 06 pt(60%) had a graft failure, 02 pts(20%) developed re-contracture while 87.5% of pts had no complications. There was no mortality in our study.
Conclusion : In the present study of 80 cases of management of post burn contractures of upper limb it is reasonable to conclude that prevention of contracture is of utmost importance. The results were satisfactory in our study in most cases with regards to quality to coverage, & range of motion.

KEYWORDS

Burn, Post burn contracture, Skin grafting, Z-plasty, Groin flap, Cross Finger flap

INTRODUCTION

A burn is a wound in which there is coagulative necrosis of the tissue. From the time immemorial burns have attracted the attention of scientist in respect of their causation, prevention and management including restoration of figure and function.

Over 1 lakh people are affected by burn every year in India and 20 thousands of them die per year.[1] A survey of past few years indicated a mortality rate of between 25-49% for adult and between 6-20% for children.[2] 10% of all accidental death and 7% of all suicide in India is caused by fire. Burn trauma is still rising in India and is second largest killer after road traffic accident. Thousands of victims of burn are mutilated and handicapped every year.[3]

A patient who receives the best of modern burn treatment is expected to heal without any contracture. However, contractures, like bed sores, do form even in the best of facilities.[1] This is because contraction is a strong natural force and difficult to counter. Moreover, life threatening complications in acute stage may compromise on problems which can be tackled later. Unfortunately, the incidence of post burn contractures is extremely high in our country. Quite often, they are not only multiple in a given patient but also very severe and diffuse. This is because the majority of the millions of burn victims in our country are treated by general practioners and not by trained burn specialist or plastic surgeons. Management of these contractures account for up to 50% of the general plastic surgeon's workload.[4,5]

Post burn contracture is a common sequele occurring after burn. Upper limb contracture like axilla is also occurring more commonly because it is most mobile part of body and likely to involve in burn. Post burn contracture of upper limb involving either axilla/elbow or hand or in combination leads to functional deficit and near total paralysis.

Once scar contracture is established surgical correction must be performed to prevent further involvement of the underlying structures. The goal of surgical correction of axillary scar contractures is to provide maximum correction with minimum or no local anatomic distortion.

Timing of Surgery in Post burn Contractures:
As a general "rule", surgical intervention for post-burn contractures should not be undertaken during the active phase of healing and scarring, i.e., as long as the scar is immature and highly vascular. This usually takes 1 year or so. One must allow the scar to become mature, soft and supple and "avascular" before undertaking surgery for contractures. This is because a highly vascular scar bleeds more during operation, with difficulties in achieving perfect haemostasis resulting in poor graft "take" leading to healing by further contraction. Secondly, operation on an active, highly vascular scar with wound bed still in active phase of contraction, adds insult to already traumatised tissues with vigorous local response in the form of further contraction. All these lead to a less than perfect result. Moreover, an immature scar is amenable to physical therapy measures resulting in significant improvement even non-surgically. With the passage of time, some mild contractures may improve with a better final result than if they had been surgically managed.

AIM OF THE STUDY :

To study various operative strategies for management of patients presenting with post burn contractures of upper limb i.e axilla,elbow and hand.

MATERIALS & METHODS

MATERIALS : Present study comprise of 80 cases who presented as post burn contractures of upper limb admitted from October 2012 to July 2014 in General Surgery and Plastic Surgery Unit in CSSH SUBHARTI Hospital Meerut.

METHODS: For patients who presented with PBC of upper limb following surgical procedures were employed :-
a) Single or Multiple Z-Plasty.
b) Y-V Advancement.
c) Five- Flap plasty.
d) STSG/FTSG
e) Local flap (cross finger / groin flap).

Inclusion Criteria: All patients who presented with PBC of upper limb in the surgical OPD.

Exclusion Criteria:
1) Patients who went LAMA or were lost during follow up.
2) Contractures due to Electric burn.
3) Recurrence of Contracture.

OBSERVATION & RESULTS

Table No 1 : Age Wise Distribution:

AGE (YRS)	NO OF PATIENTS	PERCENTAGE
1-10	06	7.5
11-20	18	22.5
21-30	22	27.5
31-40	16	20.0
41-50	12	15.0
51 -60	04	5.0
61 -70	02	2.5
TOTAL	80	100

In our study , the youngest member was a 2yr old girl, and the oldest was a 70yr old man .Max no. of pts 22(27.5%) were in the age group of 21-30 yrs.

Table No 2 : Distribution According To The Type Of Contracture:

Type of Contracture	No of patients	Percentage (%)
Axillary contracture	20	25
Flexion contracture of Elbow	10	12.5
Flexion contracture of wrist	03	2.5
Extension contracture of wrist	05	7.5
Flexion contracture of fingers	32	40.0
Extension contracture of fingers	06	7.5
Complicated contracture (involving either two or three of them)	04	5.0
Total	80	100

In our study out of 80 patients of post burn contracture, axillary contracture was present in 20 patients(25%), elbow contracture in 10patients(12.5%), wrist contracture in 8 patients(10%),finger contracture in 38patients(47.5%), while complicated contracture was present in 4patients(5%).

Table No 3 : Grade Wise Distribution of Axillary Contracture

Grade	No of patients	Perentage (%)
Grade I	05	25
Grade II	05	25
Grade III	01	05
Grade IV	09	45
Total	20	100

In our study of 20patients of post burn axillary contracture 05patients had Grade I(25%),Grade II 05(25%), Grade III 01(5%), Grade IV 09(45%) contractures.

Table no 4 : Procedure wise distribution for Axillary contracture:

Procedure	No of patients	Percentage(%)
Z-plasty	08	40
Release with skin grafting	10	50
Local flap	02	10
Total	20	100%

In our study of 20 patients of postburn axillary contracture Z-plasty was done in 8patients(40%), Release with skin grafting 10patients(50%), and local flap done in 2patients(10%).

Table No 5: Grade wise distribution for Elbow contracture:

Grade	No of patients	Percentage(%)
I (Mild)	03	30
II(Moderate)	07	70
III(Severe)	None	-
Total	10	100

In our study out of 10patients of elbow contracture, Grade I (mild) contracture was present in 03 patients(30%), Grade II contracture was present in 07 patients(70%).

Table No 6 : Procedure wise distribution for elbow contracture :

Procedure	No of patients	Percentage(%)
Release with Z-plasty	03	30
Release with skin grafting	07	70
Total	10	100

In our study out of 10patients of elbow contracture, Release with Z-plasty was done in 03 patients(30%), while Release with skin grafting was done in 07patients(70%).

Table No 7 : Procedure wise distribution for wrist contracture :

Type of contracture	No of patients	Procedure	Percentage (%)
Flexion contracture of wrist	03	Release with grafting	37.5
Extension contracture of wrist	05	Release with abdominal flap	62.5
Total	08		100

In our study out of 8patients of wrist contracture, Release with skin grafting was done in 3patients (37.5%), while Release with abdominal flap was done in 5patients (62.5%).

Table No 8 : Grade and Procedure wise distribution for hand contracture :

Type of contracture	No of patients	Grade	Procedure	Percentage (%)
Flexion contracture of finger	32	IIIa	Release with skin grafting/cross finger flap	84.2
Extension contracture of finger	06	IIIb	Release with skin grafting	15.8
Total	38			100

In our study out of 32patients of post burn flexion contracture of finger, Release with skin grafting/cross finger flap was done in 32patients (84.2%), while Release with skin grafting was done in all 6patients(15.8%) having extension contracture of fingers.

Table No 9: Grade and Procedure wise distribution for Complicated contractures :

Type of contracture	No of patients	Grade	Procedure	Percentage (%)
Axilla+ Flexion contracture of elbow	01	Ia(A) + II(E)	Release with Z-plasty(A) +Release with skin grafting(E)	25
Axilla + Flexion contracture of elbow	01	Ia(A)+ I(mild)	Release with Z-plasty	25
Elbow+ Extension contracture of wrist	01	II (moderate)	Release with grafting (E)+Release with abdominal flap(W)	25
Neck+ Contracture dorsum of hand with flexion contracture of fingers	01	IV (H)	Release with SSG(N)+Release with dorsum contracture of hand with abdominal flap(H)	25
Total	04			100

Table No 10 : Overall Procedure Wise Distribution:

Procedure	No of pts	Percentage
Release with single or multiple Z-plasty	15	18.75
Release with K- wire fixation/ skin grafting(STSG/FTSG)	56	70.00
Local flap (Cross finger)	02	02.50
Abdominal/Groin flap	07	08.75
	80	100

Table No 11: Distribution according to the mean range of motion achieved after Surgery:

Normal Range of motion	Site of PBC	Mean Pre-operative angle	Mean maximum degree of range of motion 1month after surgery	Mean maximum degree of range of motion 3 months after surgery	Mean % Improvement
200-1800	Axilla	700	1200 (900-1500)	1340	58

00-1500	Elbow	1100	1400 (1350-1450)	1440	78
00-750	Wrist	400	700(600-720)	720	57
00-1000	Hand	700	900 (800-960)	920	76

In our study of 80cases of post burn contractures of upper limb the mean degree of range of motion achieved after release of contracture was 1200 (axilla), 1400(elbow), 700(wrist) and 900 (hand) respectively.

Table No 12: Complications:

Complication	No of pts.	Percentage (%)
Graft failure	06	60
Re-contracture	02	20
Flap tip Necrosis	02	20
Total	10	100

In our study of 80 pts, 2 pts(20%) had flap tip necrosis, 06 pt(60%) had a graft failure, 02 pts(20%) developed re-contracture while 87.5% of pts had no complications.

DISCUSSION

Present study comprise of 80 cases who presented as "post burn contracture of upper limb i.e axilla ,elbow & hand or a combination of them. In our study of 80cases of post burn contractures, 48(60%) were females and 32(40%) were males. The reason for the high percentage of female patients in comparison to male is that they are commonly involved in the kitchen work and most of the burn injuries occurs at home especially in the kitchen. Various possible risk factors are floor level cooking, substandard kerosene pressure stove, loosely worn garments (sarees and dupatta) , low level electric plug points, table cloth over which hot food or beverages are kept, carelessly kept match boxes within reach of children, substandard pressure cookers, etc. In our study, high percentage of cases with post burn contracture are between 11-30 years of age group, because burn sustained in children, preventive measures even if given, these are not fully effective because of noncooperation of children for preventive measures like splintage/pressure garments.

Regarding post burn contracture of axilla out of 20 patients 5 patients (25%) belong to Grade 1, 5 patients (25%) belong to Grade II, 1 patient (5%) belong to Grade III, and 9 patients (45%) belong to Grade IV. 9 patients (45%) belong to Grade IV.

Similar study was done at **Mansoura University Hospitals**,(October 1994 till October 1997). In this study out of 35 patients type I contracture constitute 10 patients (28.5%), type II contracture constitute 20 patient (57%), type III and IV contracture constitute 5 patient (14.25%). In this study most of the patient belong to type II (57%). This figure is not compatible with our study. Reason for this may be high incidence of females in our study who are mostly involved in kitchen work and also that most of the cases which are reported as accidental burns in females are actually suicidal and homicidal burns. Chest is usually involved in suicidal burn.

Similar study was done in burn unit in **National Orthopaedic Hospital**, **Enugu(2000-2004)** out of 37 patient, grade I include 31 patient, grade II 4 patient, grade III and IV include 2 patient. Again this study was not compatible with our study, due to change in the trend as described above.

In our study of axillary contracture out of 20 patients, Z-plasty was done in 8patients(40%), release and skin grafting done in 10 patients(50%), local flap done in 2 patients (10%). So in our study release and skin grafting was the commonly used procedure.

Study similar to ours was done in burn unit **National Orthopaedic Hospital, Enugu (2000-2004).** In this study out of 37 patient Z-plasty done in 12 patient, release and skin grafting done in 6 patient, local flap done in 23 patient. The reason for this change in trend is mainly because in our study patients of axillary contracture presented with extensive axillary burn along with chest wall involvement, leaving it not suitable for Z-plasty or local flap.

Study done in **Department of Burn, Cairo University** in the period between May 2002 & June 2006. Out of 20 patient multiple Z-plasty was done in 5 patient(25%), local flap in 11 patient(55%), release and skin grafting done in 4 patient(20%). This study was again not compatible with our study due to change in trend as mention above.

In our study the surgical procedures performed were Release of contracture with Single or Multiple Z-plasty in 15 patients (18.75%), STSG/FTSG in 56 patients(70%), Local flap in 2patients(2.50%) and Groin/Abdominal flap in 7 patients(8.75%).

Evaluation of functional results after 3- 6months of follow up showed that in patients of contractures around joints not having tendon and capsular involvement (i.e vital structures are not exposed) and release of contracture with SSG and postoperative physiotherapy 80-90% functional results were found in all cases.

In our study majority of the patients 70patients (87.5%) had a fair graft uptake with no postopervative complications, 6patients(7.5%) had a graft failure, 2patients(2.5%) had flap tip necrosis(as these flaps were raised from scared areas) and 2patients(2.5%) developed re-contracture.

In the study done in **Pakistan Institute of Medical Science(PIMS) Islamabad**,(2007-2011) 174patients(91.09%) of the patients had a fair graft uptake, 17patients(8.9%) had a poor graft uptake. All flaps survived. 8patients(3.7%) developed early recurrence in three 3months. Functional improvement was quiet satisfactory in all patients. The result of this study is quiet compatible with our present study.

Burn scars of the **elbow** are best resurfaced with a thick STSG as long as there is no exposed bone, cartilage, nerve, or vessel. When vascularized tissue is required, a fasciocutaneous flap such as a reverse radial forearm or reverse ulnar flap is indicated so long as adequate perfusion to the distal extremity is assured.

Yang[71] reports satisfactory results in 11 of 12 patients using a reverse medial arm flap, although all but one of these contractures were less than 50°. Overall, results with elbow releases have a lower success rate than other joints.

Stern et al[72] using a variety of techniques, report full extension restoration in 82% in contractures less than 50° and in only 50% in contractures greater than 50°.

In a study done at **KATH Hospital Ghana from January 2004 to December 2008** on 51 patients presenting with postburn contractures of upper limb, 31 (40.79%) involved the hands, nine (11.89%) involved the elbow, nine (11.89%) involved the axilla, and two (2.63%) involved the wrist. Out of these 9 cases of post burn contracture of elbow in 6cases Release with STSG was done and in 3 cases square flap was done to repair the cubital fossa defect.

In our study of 10 patients(12.5%) of postburn elbow contracture Release with Z-plasty was done in 3 patients(30%) and Release with SSG in 07 patients(70%) to reconstruct the defect following the release of elbow contracture. Flaps were not done in our study, as in our study in none of the cases of elbow contracture vital structures like tendons and bone were exposed.

In a study published in **Turkish journal of trauma in 2008** on 60 cases of post burn contracture of upper extremity it was observed that in mild and moderate elbow contractions, multiple Z-plasties with combined full thickness skin grafting are successful for releasing the contractures. After releasing the severe contracture, larger defects may be created and fasciocutaneous flap may be required. Reverse lateral forearm flap can be used safely and provides good results.

In our study for mild elbow contracture (like a band), Release with Z-plasty was done and in moderate elbow contracture, Release with STSG was done successfully to release the contracture.

From a functional point of view, burns of the **hand** are devastating. It is far easier to prevent than to treat burn contractures of the hand. Aggressive and early tangential excision of the burned hand, combined with splinting and mobilization therapy, leads to improved long term results.[73]

In hand contracture better results may be achieved with the release of MCP joint flexion contractures rather than extension contractures. Local flaps or full-thickness skin grafting is usually sufficient to

release flexion contractures.[74] Release of extension contractures is difficult because of tightening of the collateral ligament in the MCP in extension posture. Most of the contractures in phalangeal joints may be released with local flaps or skin grafting.[75] When tendons are exposed, distant flap like cross-finger or dorsal metacarpal artery flap may be used.

In the study published in **Turkish journal of trauma in 2008** Sixty-three of 71 phalangeal joint contractures were released by using local advancement flap or free skin grafting and no recurrence was seen. In eight of 71 contractures, recurrence was seen. Volar plate releasing, flexor tenotomy and flexor tendon lengthening were performed to obtain adequate range of motion in these contractures. Six cross-finger flaps and two dorsal metacarpal artery flaps were used to cover exposed tendons in the latter group, and Kirschner wire was used for stabilization. None of the patients in this study achieved full range of motion. The results of this study is also quiet similar with our study.

In our study out of 32 patients of post burn flexion contracture of fingers in 30 patients(79%) Release with skin grafting was done and in 2 patients during release of contracture the tendons were exposed so cross finger flap was taken. In all 6 patients(15.8%) of extension contracture of fingers, Release with skin grafting was done successfully and in 1 case of complicated contracture abdominal/groin flap was done.

In a study done by **Muhammad et al** from January 2006 to December 2008 on management of post burn digital flexion contracture of **hand** in 31 patients it was observed that majority of the patients had involvement of right hand (53.6%) and 66.1% of the patients had single digit involvement whereas 33.9% had two or more digits involvement. Among the operative modalities done were Z-plasty in 4patients(12.5%), Release with skin graft in 21patients(67.9%) and Release with local flap in 6patients(6.1%).In this study the recurrence rate of contracture was 3.6% after one year.

In our study we operated on 32patients having post burn digital flexion contracture of hand we found that release with skin grafting was the most commonly done procedure in 30 patients(79%) and in 2patients crossfinger flap was done and in 1patient groin flap was done. In our study the recurrence rate of contracture was 2.6%. The reason for recurrence in our study was mostly found that these patients did not follow the proper advice that was given to them during discharge. The result of this study is compatible with our study.

In a study carried out by **Ullah et al**. in 2005 the in postburn flexion contractures, the planter/palmer split-thickness skin graft was used in 50patients.

In a study done at **KATH Hospital Ghana from January 2004 to December 2008 on** 31 patients on post burn digital contracture of hand 23 (31.51%) of the contractures were repaired with full thickness skin grafts. Four (5.48%) cases involving the digits were repaired with partial thickness skin grafts after Kirchner (K)-wire fixation of the released digits. In six (8.22%) of the cases partial thickness skin grafts were used to repair the defects but the limbs were splintered with plaster of Paris (POP) for a minimum of three months to prevent recurrence of the contractures. The result of this study is also quiet similar with **our study**.

Pandya[83] emphasizes the importance of coordinating proposed operations with the involved physiotherapist. Colditz had reported excellent results with the use of serial splinting in the stiff hand from a variety of causes. This therapy technique is quiet time intensive for both the patient and the therapist. In the post burn hand this technique would be of most value after skin release to regain range of motion from stiff joints. In our study all patients underwent serial splinting to prevent the development of contracture.

Our study presents some limitations as several of the more modern aspects of contracture management could not be addressed. For instance, we mainly employed STSGs and FTSGs for the resurfacing of released contractures; however these do not constitute the most ideal choice for resurfacing. They do not provide the best possible colour/texture match, skin elasticity, or ideal cosmesis. There is also a tendency to secondary contractures and late recurrence. Additionally, there is a need for post operative physiotherapy, splintage, pressure garments, and anti-deformity positioning for several months. When STSGs are employed in combination with dermal substitutes such as Integra and Alloderm, the quality of reconstruction is greatly enhanced, and most of the aforementioned problems are solved. **The cost of dermal substitutes is the main barrier to their availability**, and thence to their general use in our settings. Tissue expansion is also a useful addition to the armamentarium of reconstructive surgeons in the management of contractures in affluent societies; however, their cost often precludes any widespread use, particularly on poor patients in developing countries. Further well designed studies are suggested to fill the gaps in knowledge and compare skin grafts and local flaps with other sophisticated and modern techniques such as Integra, tissue expansion, and free flaps in reconstructing defects that result from release of contractures.

CONCLUSION

In the present study of 80 cases of management of post burn contractures of upper limb it is reasonable to conclude that:

1. In our study of 80 cases of post burn contracture the most common site of contracture were fingers(47.5%), followed by axilla(25%), elbow(12.5%) and wrist(10%).
2. In our study there were 4cases of complicated contracture (5%) which involved either two or three of them.
3. In our study of 80cases of post burn contracture, Grade IV contracture was most commonly seen in axilla(45%), Grade II (moderate) contracture was seen in elbow(70%),Grade IIIa (flexion contracture of fingers) was seen in hand (79%).
4. In our study of 80cases of post burn contracture, in 70% of the patients release with skin grafting was the most commonly performed procedure followed by single or multiple Z-plasty(20%).
5. In 10% of the patients flaps in the form of cross-finger/groin flap were employed wherever possible to cover the defect where vital structures like tendons or bone were exposed.
6. In our study the mean range of motion achieved after surgery was 120^0 (axilla) (N $20^0 - 180^0$), 140^0 (elbow) (N 0^0-150^0) 70^0 (wrist) (N 0^0-75^0) and 90^0 (hand) (N 0^0-100^0) respectively.
7. In our study common complications were graft failure(7.5%) flap tip necrosis(2.5%) and re-contracture(2.5%).
8. In the treatment of contractures, though split thickness skin graft appears an easy solution, it is not so. The patients discomfort and noncompliance is high. Thus is the possibility of secondary procedures required for re-contractures. Wherever possible skin flaps should be used. The choice between Z-plasty, local flaps, regional flaps and free flap should be dictated by the amount and type of skin available, the amount of skin desired and the available expertise.
9. Golden rule is to delay the reconstruction till inflammation comes down and burn scar matures for better results except in cases of ectropion of the eyelids, incapacitating contracture of the neck, severe mictostomia, crippling contractures of the hand especially dorsal contracture with metacarpophalangeal joint going in hyperextension, post burn contractures with associated adjoining chronic raw areas etc.
10. Goals of rehabilitation are to restore function, prevent contracture, return to normal activities, best aesthetic appearance and prevent deformity.
11. Rehabilitation team not only comprises of doctors and nurses but also comprises of psychologists, physiotherapist, occupational therapist, dietician and social workers.
12. In our study we did not use dermal substitutes or tissue expanders. In developed countries these newer adjuncts to surgery are routinely being employed, and yield superior results.

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