Section: Burns and Plastic Surgery

Original Research Article

RETROSPECTIVE STUDY OF EVALUATING THE VARIOUS SURGICAL MODALITIES AND FORMULATING AN ALGORITHM IN MANAGING POST BURN ELBOW CONTRACTURE

S. Suja[1], Sutha S Sellamoni[2], K. Prasanna[3], K. Murali[4]

[1]Assistant Professor Department of Burns and Plastic Surgery, Government Kilpauk Medical College Hospital, Chennai, Tamil Nadu, India.
[2]Associate Professor Department of Burns and Plastic Surgery, Government Kilpauk Medical College Hospital, Chennai, Tamil Nadu, India.
[3-4]Assistant Professor Department of Burns and Plastic Surgery, Government Kilpauk Medical College Hospital, Chennai, Tamil Nadu, India.

Received : 19/12/2023
Received in revised form : 05/02/2024
Accepted : 21/02/2024

Keywords:
Elbow Contracture, Burn Contracture, Trapeze flap3, Algorithm, PBSC Elbow, Scar based flap

Corresponding Author:
Dr. S. Suja
Email: sujachezhian05@gmail.com

DOI: 10.47009/jamp.2024.6.1.390

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 1966-1973

Abstract

Background: The mortality from burns has diminished tremendously in the last 6 – 7 decades due to improvement in acute burn care resulting in survival of major burn victims. Post burn scaring is unavoidable as healing depends upon depth of burns. Post burn scar contractures and deformities cause loss of function apart from aesthetic considerations. Post burn scarring and contracture affecting function remains the most frustrating late complication of a burn injury. Many burn survivors with contractures do not seek corrective management due to various social & financial reasons and hence the actual incidence of contracture is not known. Involvement of upper limbs is very common in a major burn and scar contracture of elbow is a common problem seen in a burn survivor. **Aim:** The aim of this study is to analyze the outcome of various modalities of management provided to a victim with post burn elbow contracture and suggest an algorithm[1] for management of Post Burn Scar Contracture of Elbow. **Material and Methods:** The study was conducted by analyzing the case sheets of 33 patients, who were managed for the post burn scar contracture of elbow in the department of Burns and Plastic Surgery, Government Kilpauk medical college hospital, Chennai. The study period taken for analysis is for 2 years from January 2022 to December 2023. **Results:** Among the 33 patients, 22 were female and 11 were male. 28 mature scar patients were surgically managed, by SSG in 14 cases, Y-V and Z-plasty in 6 cases, Cubital island or scar based flap in 4 cases, Trapeze and Byar's flap each 2 cases. Immature scar contracture patients were managed conservatively by Serial stretching (casting) **Conclusion:** Even though both surgical and nonsurgical options are available in managing post burn scar contracture of elbow, majority of the patients needed surgery due to the thick unyielding nature of the matured scar. Elbow contracture can be managed by skin grafting after release of contracture, or be resurfaced with local flaps [Z-plasty, Y-V plasty, Trapeze flap, Cubital skin flap or scar based flap] and non-surgically.

INTRODUCTION

Trauma is the 6th most common cause of death. Burns trauma has come as significant cause of death in developing and under developed countries. After primary fluid resuscitation and stabilization of the burn patient, PRIMARY EXCISION AND GRAFTING of deep second degree and third degree burns has become the standard of care in many developed countries. It decreased the morbidity and mortality of acute burn injury. It reduces the hospital stay also.

Early excision and grafting also decreases the frequency and severity of hypertrophic scarring and contractures. Burn patients who were treated "expectantly" with late grafting, encounter disastrous results.

Burn reconstruction is about the release of contractures. We should plan to use the scar by just to relief of tension, with time, Nature will try to camouflage. We should not focus on the excision of burn scars as there is already a shortage of skin.

Burn reconstruction is done in 3 phases.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

1. Acute – eyelid reconstruction, flap cover when vitals got exposed esp. in electrical burns
2. Intermediate – pressure garments, silicone gel, silicone sheet and massage, tension relief by Z-plasty
3. Late – scars more than 1year - release of scar and reconstruction with SSG and flap cover.

SCAR REHABILITATION IS A BETTER ALTERNATIVE THAN SCAR EXCISION.

MATERIALS AND METHODS

A total of 33 patients who underwent management of post burn scar contracture of elbow were included in our study. The patients were treated in Government Kilpauk Medical College Hospital in Burns, Plastic and Reconstructive Surgery. There were contractures involving neck, lip, axilla, elbow, hand, groin, popliteal fossa and toes. This study is to formulate the treatment algorithm for elbow contracture only. If the patient had contracture of neck it was addressed first to aid in ease of anaesthesia management. Other contractures were released subsequently

This is a retrospective study of the contractures of elbow, where reconstruction was done applying the basic principles of Burn Reconstruction which are the following

1. As there is already shortage of skin, there is no role of scar excision. Incisional release is preferred.
2. Scar tension release is to be done.
3. Contracture release should be restricted to the scar tissue, which is usually present in skin and sub cutaneous level to prevent iatrogenic contour deformity.
4. Inter-positioning of a flap[8] with Z-Plasty or transposition or interpolation or cubital fossa skin island flap is a good option.
5. When there is tension in the area after release and local adjustment of tissues then a portion of the scar released has to be skin grafted.
6. Split Skin Graft (SSG) is preferred over Full Thickness Skin Graft (FTSG) in elbow contracture reconstruction as the need of skin graft is more.
7. Local flaps are more useful
8. There is a limited role for free flaps.
9. Immature scar is not addressed surgically, instead Serial Stretching is to be done.
10. [5]The correction achieved at the time of surgery will be the maximum that will be achieved.
11. [5]It is the extent of the release, more than the type of cover matters.
12. [5]Timing of surgery is crucial for better outcome.

RESULTS

On analyzing the case sheets of 33 patients operated for post burn scar contracture of elbow in, Kilpauk Medical College Hospital for 2 years from January 2022 to December 2023, the following results were obtained.

AGE

SEX

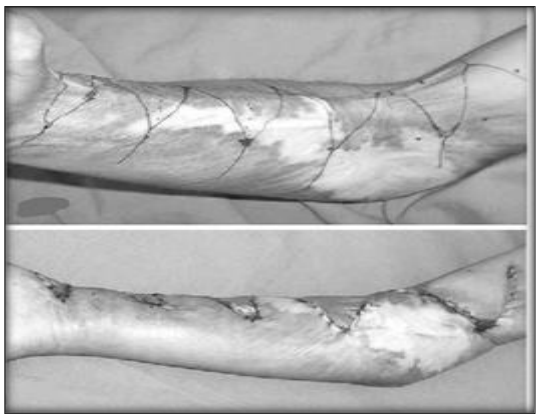
Female patients were commoner than male.

FEMALE – 22; MALE – 11; TOTAL – 33.

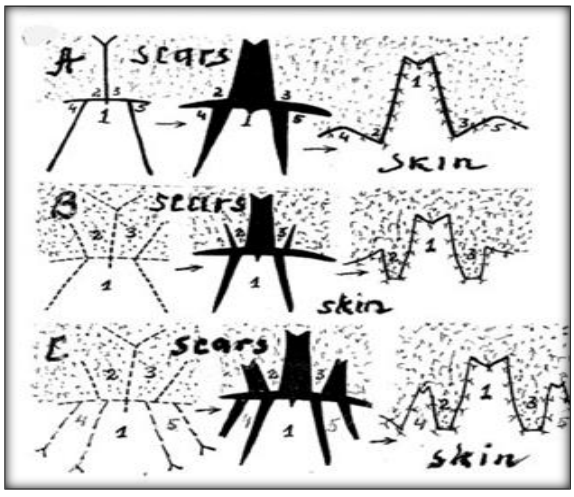
Among the non-surgical procedures, Serial Stretching (serial casting) of the Immature Scar was done in 5 patients.

As LASER is not available LASER resurfacing of burn scar was not done.

But CO^2 LASER,[14,15] is effectively used in management of elbow scar contracture.



Y-V PLASTY



TRAPEZE FLAP

ISSN (O): 2687-5365; ISSN (P): 2753-6556

SCAR BASED FLAP[18]

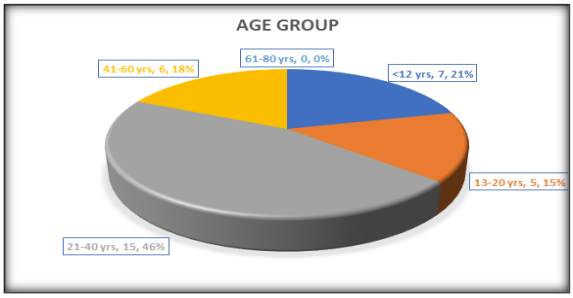


Figure 1: Age Group

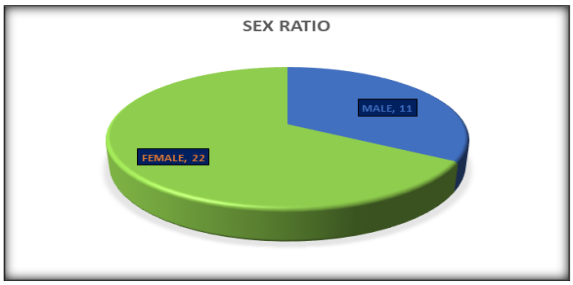


Figure 2: Sex Ratio

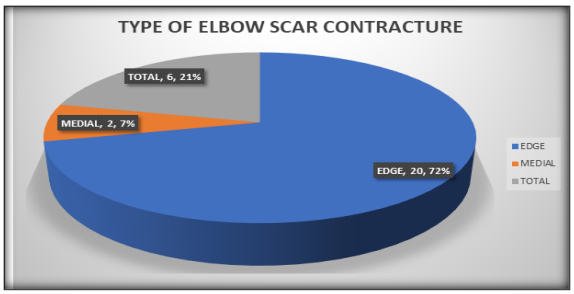


Figure 3: Type of Elbow Scar Contracture

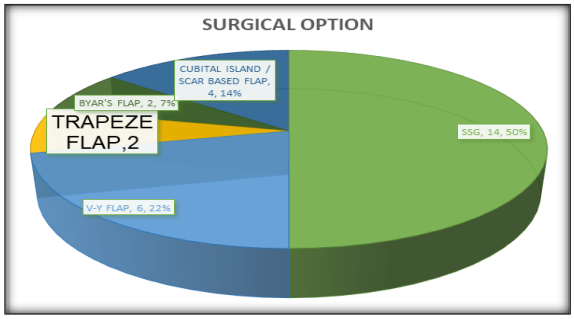


Figure 4: Surgical Option

Z-PLASTY

ISSN (O): 2687-5365; ISSN (P): 2753-6556

CUBITAL SKIN ISLAND FLAP

BOTH EDGE CONTRACTURE

CUBITAL SKIN ISLAND FLAP IN BOTH EDGE CONTACTURE

TRAPEZE FLAP

ISSN (O): 2687-5365; ISSN (P): 2753-6556

ULNAR EDGE CONTRACTURE

RELEASE AND SSG

ULNAR EDGE CONTRACTURE

Table 1: Age

Age in years	<12	13 – 20	21 – 40	41 – 60	61 – 80
No of cases	7	5	15	6	0

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 2: Treatment Options Given

SURGICAL	NON-SURGICAL
28 for mature scars	5 for immature scars

Table 3: Types of Contracture in Our Cases

Type of Elbow Contracture	Mature Scar	Immature Scar
Ulnar Edge Elbow Contracture - 31%	10	-
Radial Edge Elbow Contracture - 24%	8	-
Both Edge Elbow Contracture - 9%	2	1
Medial Elbow Contracture- 12%	2	2
Total Elbow Contracture - 24%	6	2
Total	**28**	**5**

Table 4: Surgery Done after contracture release -28 patients

Surgical Option	No. of Cases	Complications
SSG	14	2 partial loss
Y-V flap / Z-Plasty[8]	6	-
Trapeze flap[3,10]	2	One small area in triangular flap - partial necrosis
Byar's flap	2	-
Cubital island flap / scar-based island flap[9]	4	-
Total	28	

DISCUSSION

BURN WOUND HEALING AND DEVELOPMENT OF SCAR AND CONTRACTURE[2]

Healing of a burn wound is either by RESTITUITION (REGENERATION) or SUBSTITUITION (SCARRING). Restitution can happen only in burns of depth up to Papillary Dermis. Epithelization can occur from pilo-sebaceous units and sweat glands.

If skin is affected up to the depth of Reticular Dermis, the defect is covered by substitution by formation of scars with connective tissue. Wound closure is assisted by wound contraction and epithelization from the margins resulting in a contracture.

In case of flexural region like elbow, axilla and wrist, flexed position gives an advantage for bringing the wound margin closure causing undesirable flexural contracture.

It is an active biological process of healing wherein the area of skin loss in open burn wound is decreased due to concentric reduction in the size of the wound. This reduction causes lesser degree of connective tissue deposition needed for epithelization. This wound contraction involves an interaction of FIBROBLASTS, MYOFIBROBLASTS and COLLAGEN DEPOSITION. It is an advantage in non-critical areas, where loose skin is available and the tissue loss is minimal.

Treatment options available for contractures are,

1. Surgical Contracture release and reconstruction with local flaps,[4] SSG (Split Skin Graft) or
2. Non-surgical options - Serial stretching with POP or LASER resurfacing.

Free Flaps are rarely required. Other flap options like Lateral Arm Flap,[4,11] Abdominal Flap, Abdomino Thoracic Flap,[11] and Radial Forearm flap[4] can be used. These flaps may be needed to cover large defects of the elbow with exposed vessels or bone and local tissue is not being enough to resurface the raw area.

At the time of burns, the elbow joint is usually kept in flexion as a protective reflex. Hence in reasonable number of patients, the cubical skin remains healthy causing edge contracture of the elbow on either ulnar or radial side.

Description about flaps

Y-V plasty: Single or multiple Y incisions made along the linear contracture band and closure done in V fashion.

TRAPEZE FLAP[3]

Edge elbow contracture has crescent shaped scar fold. Typically, it has one lateral sheet which is scarred, medial sheet and adjacent cubital fossa which is healthy skin. The contracted scars extend from fold's crest to the joint rotation axis. The scar sheet surface deficiency is the cause for contracture. But there is surface surplus in width.

First, it is necessary to separate the healthy medial sheet skin from lateral scarred skin by incising the crest of fold. Then perpendicular cross cut incision made in lateral sheet to elbow joint rotation axis, the end is made Y shaped enclosing the epicondyle. One trapezoidal flap from medial sheet and cubital skin is raised, two trapezoidal flaps are raised from lateral sheet. [Medial and lateral sheets are in relation to the cubital fossa].

The flaps are interposed and according to the length of the contracture band, multiple flaps are interposed.

CUBITAL SKIN ISLAND FLAP

It is done in case of both edge elbow contractures. The healthy elliptical cubital fossa skin is raised as perforator flap based on the fossa perforator and propelled 900 and inset given. There is no need to doppler the perforator.

SCAR BASED FLAP

In Medial scar contracture, like cubital island flap, the scarred cubital skin is elevated oblong longitudinally as perforator flap centering the

ISSN (O): 2687-5365; ISSN (P): 2753-6556

cubital fossa, propelled 900 and inset given horizontally covering the fossa. Here also, there is no need to doppler the perforators in the cubital fossa.

BYAR'S FLAP

It is the Horizontal Bipedicle flap at the cubital fossa flap is not raised but after the proximal and distal incisions stretched and raw areas are grafted.

VARIOUS CLASSIFICATIONS ARE GIVEN FOR ELBOW SCAR CONTRACTURE

ANATOMICAL TYPES OF ELBOW SCAR CONTRACTURE[3]

E**DGE ELBOW CONTRACTURE:** It can be an Ulnar or Radial edge contracture wherein the medial aspect of the scar is normal along with normal cubical fossa. 70 percentage of elbow scar contractures are of the edge type.

MEDIAL ELBOW CONTRACTURE: Cubical fossa is involved along with medial sheet.

TOTAL ELBOW CONTRACTURE: Scar is present all around the elbow joint.

Another classification system

Type Ia - Linear band midline

Type Ib- Linear scar either ulnar or radial region

Type IIa - Broad band on one side

Type IIb - Broad band both ulnar and radial region

Type III - Broad band extending to next surfaces

Type IV - Entire circumference of the elbow

In children,[7]

Type 1 - SIMPLE BAND

Type 2 - COMPLEX BAND

Type 3 - DIFFUSE SCAR

Type 4 - LIMITED SCAR

Initially the scar contracture is limited to skin, subcutaneous tissue. Long standing Elbow Scar Contracture may affect deep fascia, tendons, neurovascular structures and elbow joint contracture. It is classified depending on the loss of joint extension. It can be associated with Heterotopic Calcification.[5,8]

NEGLIGIBLE - $<10^0$ Extension loss

MILD - 11^0- 49^0

MODERATE - 50^0 - 89^0

SEVERE - > 90^0 Extension loss

PREVENTION OF ELBOW CONTRACTURE

Proper positioning of the arm and elbow

Early excision and grafting

Physiotherapy

Regular follow up

Pressure garments

Splinting,[8]

Availability Plastic Surgeon in the society providing proper care.

Treatment Algorithm,[1] for Elbow Burn Scar Contracture

Type Of Scar	Suggested Algorithm[1]
Immature scar	LASER[14,15], Serial stretching
Mature scar	
Edge elbow scar linear	Z-plasty[8], Y-V plasty[6]
Edge elbow scar broad band	Trapeze flap[3,10]
Both edge scar linear	Z-plasty
Both edge scar broad	Cubital skin island flap[17]
Medial elbow scar	Scar based flap[9,16](islanded[13] / bipedicled[12])
Total elbow scar	Release and SSG

CONCLUSION

Burn contracture reconstruction is a great challenge for plastic surgeons. Prevention is always better than a cure. So aim at prevention of Post Burn Scar Contractures, but if burn contracture is encountered the basic principles of burn reconstruction has to be followed. Formulation of an algorithm in treating the patients, makes it is easier for a surgeon to plan the management. To conclude, the algorithm of managing the post burn scar contracture is as follows. Immature scar is managed conservatively. Edge elbow scar contracture is managed by interposition flap like Z-plasty,[8] Y-V plasty,[6] or Trapeze flap.[3,10] If it is both edge broad scar, it is better to do cubital skin island flap.[17] In medial elbow scar type, scar based island flap,[13] can be done. If it is total elbow scar contracture, release and SSG is the simple option.

REFERENCES

1. Algorithms for Management of Post-Burn Contracture in Upper Extremity in Children
2. H. Terziqi, 1, 2, 3 I. Sopjani, 3 B. Gjikolli, 3, 4 G. Muqaj, 2 and M. Mustafa 3, ∗Ann Burns Fire Disasters. 2021 Jun 30; 34(2): 192–198. Published online 2021 Jun 30.
3. Post-burn scars and scar contractures Arun Goel and Prabhat Shrivastava Indian J Plast Surg. 2010 Sep; 43(Suppl): S63–S71. doi: 10.4103/0970-0358.70724
4. The post-burn elbow medial flexion scar contracture treatment with trapeze-flap plasty Viktor M. Grishkevich Burns, Volume 35, Issue 2, March 2009, Pages 280-287
5. Different surgical modalities for management of post burn flexion contracture of the elbow, Menoufia Medical Journal, Original Article Year: 2015| Volume: 28 | Issue: 4 | Page: 852-857, Shawky Shaker Gad1, Ahmed Mohamed Albarrah1, Sherif Mohamed Elkashty1, Hisham Taha Ahmed, 1 Department of Plastic Surgery, Faculty of Medicine, Menoufia University, Egypt, 2 Shebein el-kom teaching hospital, Egypt.
6. Plastic Surgery - Lower Extremity, Trunk and Burns Volume – 4, 5th Edition, ETER. C. NELIGAN, EXTREMITY BURN RECONSTRUCTION by S. Raja Sabapathy, R. Raja Shanmuga Krishnan, and Vamseedhara Muthu Kumar.
7. The multiple Y-V plasty in linear burn scar contracture release, Author links open, verlay panelM.A.C.S. Cooper FRCS (Registrar in Plastic Surgery), ichard J Schwarz , British Journal of Plastic Surgery, Volume 43, Issue 2, March 1990, Pages 145-149
8. Surgical Treatment of Elbow Contractures in Postburn Children, Stern, Peter J. M.D.; Law, Edward J. M.D.; Benedict, Frederick E. M.D.; MacMillan, Bruce G. M.D. Plastic and Reconstructive Surgery 76(3): p 441-446, September 1985 - Journal of American Society of Plastic Surgeons
9. TOTAL BURN CARE - David N. Herndon, MD, FACS Edition 5, Page; 573 - 588 Management of Contractural Deformities Involving the Shoulder Elbow, Hip, And, Knee Joints in Burned Patients by KAREL D. CAPEK, RAMON ZAPATA-SIRVENT, and TED T. HUANG.
10. A review and critical appraisal of central axis flaps in axillary and elbow contractures, Durga Karki & Rajeev B. Ahuja, Burns & Trauma volume 5, Article number: 13 (2017)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

11. Trapeze-flap plasty: an effective technique for post burn edge elbow contracture, elimination, Viktor M. Grishkevich, Shoulder & Elbow Volume2, Issue4 October 2010, Pages 273-280 First published: 02 November 2010 https://doi.org/10.1111/j.1758- 740.2010.00077.
12. Loco-Regional Perforator Flaps for Reconstruction of Post Burn Contracted Elbow, Wael Mohamed Ayad, Moustafa Sayed Ahmed Meky and Osama Mohamed Abdel-Hafeez Abdallah*, Department of Plastic & Reconstructive Surgery, Faculty of Medicine, Al-Azhar University, The Egyptian Journal of Hospital Medicine (April 2019) Vol. 75 (4), Page 2585-2587 2585
13. Treatment of wide scar contracture of antecubital fossa with bipedicle flap from scar tissue, Seyed Esmail Hassanpour, Sadrollah Motamed, Mohammadreza Ghazisaidi Burns Volume 33, Issue 2, March 2007, Pages 236-240
14. The propeller flap for postburn elbow contractures Author links open overlay, anelGurcan Aslan, Dogan Tuncali, Bulent Cigsar, Ayse Yuksel Barutcu, Ahmet Terzioglu Burns Volume 32, Issue 1, February 2006, Pages 112-11
15. Laser Treatment of Traumatic Scars and Contractures: 2020 International Consensus Recommendations Meghan Seago MD, Peter R. Shumaker MD, Leah K. Spring DO, Murad Alam MD, Firas Al-Niaimi MSc, MRCP, EBDV, R. Rox Anderson MD, Ofir Artzi MD … See all authors First published: 09 December 2019 https://doi.org/10.1002/lsm.23201 Lasers in Surgery and Medicine
16. Lasers and ancillary treatments for scar management: personal experience over two decades and contextual review of the literature. Part I: Burn scars Rory B McGoldrick, Adam Sawyer, Christopher R Davis, Evgenia Theodorakopoulou,1 and Maxwell Murison Scars Burn Heal. 2016 Jan-Dec; 2: 2059513116642090. Published online 2016 Apr 22. doi: 10.1177/2059513116642090 PMCID: PMC5965326 PMID: 29799577
17. The propeller flap for postburn elbow contractures Gurcan Aslan 1, Dogan Tuncali, Bulent Cigsar, Ayse Yuksel Barutcu, Ahmet Terzioglu Burns. 2006 Feb;32(1):112-5. doi: 10.1016/j.burns.2005.07.007. Epub 2005 Dec 27 PMID: 16384651 DOI: 10.1016/j.burns.2005.07.007
18. "Namaste Flap": Modification of Subcutaneous Pedicle Propeller Flaps in the Reconstruction of Postburn Axillary and Elbow Contractures. Karki D, Muthukumar V, Dash S. Ann Plast Surg. 2019 Dec;83(6):636-641. doi: 10.1097/SAP.0000000000002076. PMID: 31658100

ISSN (O): 2687-5365; ISSN (P): 2753-6556