



Optimizing Different Resurfacing Options After Release of Post Burn Elbow Contracture : A Single Institution Experience

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ABSTRACT

Background: post burn elbow contracture is one of the most common joint involved among burn patients. Release and resurfacing is required to keep hand in optimal functional position. We are presenting here, our experience with different resurfacing procedures and preferred option according to the type of contracture.

This study is aimed to evaluate different surgical options for resurfacing after release of post burn elbow contracture in terms of functional and aesthetic outcomes.

Methods: This non-randomized prospective study was done on 38 patients operated in 2 years time period. the patients with various types of elbow contractures were operated and resurfacing procedure selected according to the type of contracture. Among different described procedures in the literature author uses skin grafts, Z plasty, local advancement flap, propeller flap, reverse medial arm flap and forearm fasciocutaneous flap.

Results : Conclusion: Skin grafting is a simple procedure, although requires long term postoperative splinting, has fewer complications and gives satisfactory functional and aesthetic results. Multiple Z plasty are suited for mild single band contractures. Local advancement flaps gives best functional and aesthetic results with single band contractures, however, it may have to be supplement with skin graft in case of moderate contracture. Propeller flap have advantage of giving suitable coverage over joint area along with STSG above and/or below it so that there is least chance of recurrence. Fasciocutaneous flaps like Reverse medial arm flap and forearm fasciocutaneous flaps, if possible give good functional and aesthetic results with early postoperative full range of motion exercises.

KEYWORDS : post burn elbow contracture, skin grafting, Z plasty, propeller flaps, reverse medial arm flap.

Introduction:

In burn care, during the past decades survival of patients with severe burns has improved significantly. Since more patients survive with a large percentage of total body surface area burned, many more patients now have to deal with the sequel of scarring; burn scars frequently remain with a poor functional outcome. Functional problems related to burn scarring are often caused by scar contractures.

Full hand motion is useless if elbow contracture prevents the hand to keep in optimal functional position.¹ Elbow contractures commonly result from deep burn especially when adequate rehabilitation such as active and passive exercises, use of pressure garments and immediate splinting in extension and forearm supination are not given to the patient. Contractures also form in cases of full thickness skin burns when primary grafting is not done. After release of these contractures the resulting raw areas need a suitable covering. The methods for resurfacing range from split-thickness skin graft, Z-plasties, local and regional flaps up to the most complicated repair with free microvascular flaps. Each technique has its unique advantages and drawbacks.

In this article we present a prospective study of 38 patients in order to evaluate the efficacy of different procedures for resurfacing defects after release of post burn elbow contractures with reference to functional recovery and aesthetic improvement.

Material and Methods:

A non-randomized prospective study was conducted on 38 patients operated in 2 years time period from January 2012 to December 2013 at Kolkata Medical college, Kolkata. Patients with non-burn elbow contracture and those having elbow joint pathology (e.g. heterotopic ossification, osteoarthritis) were excluded from study.

In this study, out of 38 patients 22 were male and 16 were female, between 4 years and 60 years of age. Maximum number of patients (47%) belonged to the age group of 1 to 10 years.

Preoperative assessment of elbow extension loss: The contractures were classified into mild, moderate and severe categories according to the severity of elbow extension loss.²

Mild contracture: 11° – 49° extension loss

Moderate contracture: 50° – 89° extension loss

Severe contracture: > 90° extension loss

According to above classification majority (76%) of the patients in the present study had mild to moderate contractures.

Anatomical types of contracture: The patients were also classified according to the anatomical type of contracture into (1) *longitudinal band contracture* (medial, lateral or central) with normal healthy pliable skin on either side, and (2) *diffuse contracture* that extends across the entire antecubital region to opt for a suitable resurfacing method. Both the anatomical type had almost similar incidence.

Operative techniques:

Informed consent was taken from all the patients before operation in their respective native language. All the operations were done under general anaesthesia. The options of surgical treatment were chosen according to the contracture type, with individualization (**Table: 1**).

Patients with longitudinal band contracture of elbow were resurfaced with multiple Z-plasty, local advancement flaps, or propeller flaps with STSG according to the condition of the scar and , the release procedure was tailored accordingly with preoperative marking. Thin band contractures were successfully treated with multiple Z-plasty, whereas thick hypertrophic bands were covered with advancement of the uninvolved cubital fossa skin to fill the raw area created after release procedure. If the band contracture was of moderate severity, then these procedures were supplemented with STSG to cover the remaining area after flap inset, or the propeller flap was used along with STSG above and/or below the joint area.

Patients with diffuse elbow contracture, the contracture was released up to the subcutaneous tissue with fish tailing at the apices to gain full or maximum possible extension of the elbow joint preoperatively, covered either with split thickness skin grafts or with any one of the two fasciocutaneous flaps, namely forearm fasciocutaneous flap or reverse medial arm flap, depending on the condition of the surrounding skin and whether vital structures were exposed or not.

Post operative course: In case of skin grafts the dressing was opened on the 5th postoperative day. All the patients in whom skin grafting alone was used were advised to continue elbow splintage in extension for at least 3-6 months, along with range of motion exercises. In cases where one of the flaps had been used for resurfacing, early post operative range of motion exercises were started and elbow splintage was not used.

Functional assessment was done at 6 months post operatively by measuring the angle of elbow extension with a goniometer. Aesthetic appearance was also assessed at the same time in terms of color, texture and, contour match with the surrounding skin and rated them as excellent, good, fair and poor.

Results:

Functional outcomes: The median post-operative gain of elbow extension at 6 months in the mild, moderate and severe contracture groups were 35° (range 20°- 45°), 55° (range 45°- 65°) and 90° (range 75°- 90°) respectively (**Table 2**). Achievement of full elbow joint extension was possible in 78% (11 out of 14) cases of mild contracture, 86% (13 out of 15) cases of moderate contracture, and 55% (5 out of 9) cases of severe contracture. The recovery of range of elbow joint extension in all the three groups (i.e., mild, moderate and severe contracture) varied slightly across the different surgical procedures and the differences were not statistically significant ($p > 0.5$). Overall, full elbow extension was achieved in 76% cases (29 out of the total 38 cases) in the study.

Recurrence of contracture: At 6 months follow up after surgery, the contracture recurrence rate was 44% (4 out of 9 cases) in the split thickness skin graft (STSG) group in spite of advising prolonged use of elbow extension splint. However, the severity of elbow extension loss in the cases with post-operative contracture recurrence was much less severe as compared to the preoperative elbow deformity in all the cases. In this study, there was no recurrence after multiple Z-plasty, local advancement flap, propeller flap, forearm fasciocutaneous flap and reverse medial arm flap. **Recipient site complications:** There was minor flap tip necrosis in two cases of multiple Z-plasty both of which healed secondarily. Also, there was partial flap necrosis of reverse medial arm flap in a single case, which was managed by debridement and skin grafting.

Donor site morbidity: There was mild infection at the donor site in one case of split thickness skin graft, which resolved with antibiotic treatment and local dressing. There was hypertrophic scar formation at the STSG donor site in five cases, which was managed by local application of steroid ointment and pressure garment.

Aesthetic outcomes: The aesthetic outcome was acceptable in terms of color, texture, contour match and subjective analysis for overall appearance in all the cases except in three patients. The patient acceptance of the aesthetic outcome of surgery was 77% in the STSG group versus 100% in the other procedures.

Discussion:

Upper extremity burn contractures are a major challenge to the re-

constructive surgeon. Elbow contracture commonly result from deep burn especially due to inadequate primary burn management and rehabilitation. Flexion contracture of the elbow is a common consequence of severe burn. According to Schneider et al, elbow is the second most common joint involved among four major joints (shoulder, elbow, hip and knee).³

After release of post burn elbow contractures the resulting raw area needs a suitable covering. The various methods used for this purpose range from split-thickness skin graft,^{4,5} Z-plastie,⁶ local and regional flaps,⁷ up to the most complicated repair with a free microvascular flaps.⁸

The choice of reconstructive procedure, however, depends on the type of contracture (longitudinal band contracture or diffuse contracture), the severity of contracture, condition of adjacent skin, and exposure of vital structures. When the cause of the contracture is a longitudinal hypertrophic scar band with pliable skin on either side, local tissue rearrangement with the Z-plasty or any of its modifications will usually suffice, whereas diffuse contracture that extends across the entire antecubital region will require a transverse incision across the axis of the scar extending into unscarred tissue and breaking into a Y (fishtail) at both ends to enhance complete release. Resurfacing is done with a sheet of thick split-thickness skin graft or full-thickness skin graft.⁹

In our study, mild band contractures were resurfaced with multiple Z-plasty, local advancement flap or propeller flap with acceptable functional results with full gain in angle of extension in almost 80% cases. Aesthetically all the patients were satisfied with the postoperative results.

In moderate band contractures, Z-plasty seemed insufficient to cover the extensive raw area, and therefore local advancement flaps with or without skin grafting were used. The propeller flap and the forearm fasciocutaneous flap are also good options in such cases, depending on the condition of the forearm skin and perforator. Advantages of the propeller flap are easy design and rapid flap elevation that permits a single stage correction of the deformity without further sacrificing an artery or muscle.¹⁰ Using the local flaps in the moderate contracture group achieved full extension in more than 85% cases in our study.

None of the patients in our study who presented with severe contracture had band contracture. In patients with severe contractures, sequential release of deeper structures may be indicated. After such surgery, the bed may be unfavorable for grafting, and in such cases flap coverage is indicated.¹ Flap coverage is also indicated when subsequent deep reconstructive surgery, such as nerve or tendon repair, is contemplated. The reverse medial arm flap seems to be a suitable option for severe contractures of elbow when there are exposed vital structures or preoperative full extension has not been achieved.¹¹ Due to the inherent property of the flap to expand and grow there are minimal chances of recontracture especially in case of children. Additionally postoperative gradual extension splintage can be used if full extension not achieved preoperatively.¹² In our study, skin grafting was done only in those cases in which donor area was not available for flap surgery. Functional outcome was acceptable in majority of the cases.

However, diffuse contractures resurfaced by skin grafting had 44% recontracture rate in our study in spite of using extension splint in postoperative period. Other studies have observed that the recontracture rate may be more in children, due to poor compliance for postoperative regime.¹³ The split thickness skin graft take was 80% to 100% in our study, with minimal complications. However, we noted overall five cases of hypertrophic scar at donor site which was managed with pressure garments and topical use of steroid. Aesthetically, unmeshed thick sheet grafts were found to be better than meshed thin grafts in terms of color and texture match.

Conclusion

We conclude that post burn elbow contractures need categorization according to the anatomical type of contracture, involvement of surrounding skin and severity of contracture, so that adequate method of resurfacing must be planned preoperatively. Mild longitudinal

band contractures are best managed with multiple Z plasty or local flaps. Following release of moderate contractures the raw area is so extensive that Z-plasty procedure would not be sufficient to cover; therefore we recommend either V-Y advancement or propeller flap from healthy adjacent cubital fossa skin, and skin grafts may be used to cover remaining raw area.

In cases of severe contractures, obtaining full release at the first attempt is unusual. After the release, rigorous physiotherapy is needed. Therefore, flap coverage is required. However, if the raw area following the release of diffuse contracture irrespective of severity is vascular enough to take a skin graft then it would be easy quick and simple option. The risk of recontracture can be minimized with the use of postoperative use of extension splint and active full range of motion exercises. Fasciocutaneous flaps like reverse medial arm flap and forearm fasciocutaneous flaps can achieve acceptable functional and aesthetic results with early postoperative full range of motion exercises in appropriately selected cases.

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Table 1: Resurfacing methods used in the study

Anatomical type of elbow contracture	Mild contracture	Moderate contracture	Severe contracture
Diffuse (total) contracture [n = 18]	- Split thickness skin graft (STSG) [n = 5]	- STSG [n = 1] - Forearm fasciocutaneous flap [n = 2] - Reverse medial arm flap [n = 1]	- Reverse medial arm flap [n = 5] - STSG [n = 3] - Forearm fasciocutaneous flap [n = 1]
Longitudinal band contracture [n = 20]	- Multiple Z-plasty [n = 5] - Local advancement flap [n = 2] - Propeller flap [n = 2]	- Forearm fasciocutaneous flap [n = 3] - Local advancement flap+STSG [n = 3] - Propeller flap [n = 5]	-

Table 2: Functional improvement in elbow extension after surgery

Severity of elbow contracture	Gain in elbow joint extension (degrees)		
	Minimum	Maximum	Median
Mild contracture (n = 14)	20°	45°	35°
Moderate contracture (n = 15)	45°	65°	55°
Severe contracture (n = 9)	75°	90°	90°



Figure 1: seven days post-op following local advancement flap.

ment flap .



Figure 2: patient with moderate band contracture with pre-op marking of perforator with the help of hand-held doppler.



Figure 3: Seven days post-op picture following propeller flap .



Figure 4: Six days post-op picture following forearm fasciocutaneous flap.



Figure 5: Patient with Severe contracture with preoperative marking for reverse medial arm flap.



Figure 6: Per-op picture following inset of islanded reverse medial arm flap .

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