

COVERAGE CONSIDERATIONS AND OUTCOME ANALYSIS OF RECONSTRUCTION OF POST TRAUMATIC SOFT TISSUE DEFECTS AROUND THE ELBOW

Plastic Surgery

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ABSTRACT

Introduction: Major crush injury of elbow joint following trauma with extensive injury to skin & soft tissue, bone, tendon, nerves and vessels remains a challenge to the reconstructive surgeon. Purpose of this study is to find out whether the size of the defect, type of flap used and the location of the soft tissue defect influence the outcome of soft tissue reconstruction.

Material and methods: A prospective study was performed in all patients with soft tissue defects around the elbow in need of flap cover at Ganga Medical Centre Coimbatore, Tamilnadu India from April 2014 to December 2015. Patients demographics, defect size, location, type of flap used, complications and long – term outcomes analysed. Patients Mayo elbow performance score and Likert scale score were recorded for analysis of functional and aesthetic outcome respectively. The Kruskal wallis test was used for statistical comparison.

Results: Forty three flaps were performed primarily for coverage in forty patients. Three patients required two primary flaps for reconstruction. The flaps used in our study included 14 local fasciocutaneous flaps (32.5%); 20 pedicled flaps both locoregional and distant (46.5%) and 9 Anterolateral thigh free flaps (20.9%) The average defect size was 151 cm². For local fasciocutaneous flap the average defect size was 44.7cm², (range, 4-120 cm²), distant pedicled flap was 181 cm² (range 24- 600 cm²) and for the ALT free flap was 252.2 cm² (range 80-450 cm²).

Conclusion: The defect size is the main determinant of the type of flap used and their outcomes.

KEYWORDS

Trauma, Elbow defects, Pedicled flaps, local fasciocutaneous flaps, ALT free flap.

INTRODUCTION:

Road traffic accidents are very common in the developing world and in India 13 road traffic accidents occur every hour¹. They predominantly affect young people and hence form a great burden to the society in terms of cost of care and the economical loss due to the time away from work and the disability caused by the injury. In spite of the advances that have taken place in trauma care, major crush injury of elbow joint following trauma with extensive injury to skin & soft tissue, bone, tendon, nerves and vessels which endanger the vitality of the whole upper limb can be difficult to treat and remain a challenge to the reconstructive surgeon. The posterior aspect of the elbow is particularly prone to skin coverage problems due to the subcutaneous nature of the olecranon, the lack of muscle and adipose tissue in this region, and the tension placed on the skin during elbow flexion. So this area requires thin and pliable, yet durable tissue to withstand constant motion, shear and external pressure. The choice of coverage depends on a variety of factors including the size and location of the defect, exposure of the vital structures, donor site morbidity, and the general condition of the patient. Previously many treatment options have been proposed for elbow coverage including primary closure, skin graft, local flaps, pedicle flaps and free flaps; these are usually attempted in a step ladder fashion with the simplest procedure being performed first². There is a paucity of expendable large muscles in the upper limb which dictates the requirement of locoregional or distant flaps³. For any moderate to extensive defect of upper extremity with exposed vessels, nerves and bone, distant flap in the form of pedicled or free flap is a suitable option⁴.

MATERIALS AND METHODS:

A prospective study was performed in all patients with soft tissue defects around the elbow in need of flap cover at Ganga Medical Centre Coimbatore Tamilnadu India from April 2014 to December 2015. All patients with soft tissue defects around the elbow were debrided well and then the fractured bones were stabilised either with internal or external fixators. Complete history, examination and photographic documentation were done for each patient. Blood investigations and X-rays were performed. Evaluation of the defect considered the extent of tissue loss and depth of the defect. Vascular repair, nerve repair and repair of musculotendinous units along with soft tissue coverage was done either primarily or later in stages. Post debridement wound size was measured with sterile scale in terms of square centimetres (cm²/sq cms). Flaps were placed into three major

groups which included local flaps, pedicled flaps and free flaps. Complications and functional outcomes were recorded.

Major complication means total or partial loss of flap needing secondary additional flap for stable wound cover or amputation of reconstructed limb. Elbow range of motion was determined with goniometer readings.

The range of motion was defined as the arc in degrees from full extension to full flexion. **Patients Mayo elbow performance score and Likert scale score were recorded for analysis of functional and aesthetic outcome respectively.** The Kruskal wallis test was used for statistical comparison.

RESULTS:

Forty patients with posttraumatic soft tissue defects around the elbow were treated in our hospital from April 2014 to December 2015. The mean age was 31 years (range 8 to 70 years). There were 28 males and 12 females (Table 1). Most of the defects were due to road traffic accidents [n=31(77.5%)]. Eight (20%) were due to industrial accidents and one (2.5%) was due to fall in well. Eighteen (45%) patients had isolated elbow injuries while the remaining twenty two (55%) patients had wounds extending over arm, forearm or both.

The defect size ranged from 4cm² to 600cm². The average defect size was 151 cm². The choice of flap used was based on the defect size. For local fasciocutaneous flap the average defect size was 44.7cm², (range, 4-120 cm²). Distant pedicled flap was done for average defect size of 181 cm² (range 24- 600 cm²). The free flap used in our series was only anterolateral thigh free flap. The average defect size for the ALT free flap was 252.2 cm² (range 80-450 cm²) (Table no.2)

DEFECT SIZE VS MEP SCORE: Influence of defect size and outcome as per the MEP score was assessed by the Kruskal - Wallis test. For defects less than 120 cm², p value of 0.036 was obtained. Hence, statistically significant differences were seen between defects size less than 120 cm², 121 - 450 cm² and 450 cm² - 600 cm². Pairwise chi square analysis of the various defect groups as well each group versus all the rest was also performed. However no statistically significant difference was found.

DEFECT SIZE Vs LIKERT SCALE: Effect of defect size and on

aesthetic outcome as per the Likert scale was assessed by the **Kruskal - Wallis test**. A Kruskal - wallis test for aesthetic result for defects less than 120 cm² statistically significant difference was found with p = 0.024.)

Forty three flaps were performed primarily for coverage in forty patient's. Three patients required two primary flaps for reconstruction. The flaps used in our study included 14 local fasciocutaneous flaps (32.5%), 20 pedicled flaps both regional and distant (46.5%) and 9 Anterolateral thigh free flaps (20.9%).

FLAPS PERFORMED Vs MEPScore:

Outcome of local, pedicled and free flaps were analysed by **Kruskal - Wallis test**. No statistically significant difference was found between the groups, with p = 0.218. The aesthetic result of the various types showed no statistically significant difference with p = 0.221.

The average follow up period was 16 months. The average Mayo elbow performance score was 76 (range 20-100). Larger and more complicated defects had poorer outcomes. Ten patients (25%) with defects smaller than 120 cm² & 3 patients (7.5%) with defect size more than 120 cm² had excellent MEP score. Six patients (42.8%) with local fasciocutaneous flap, five patients (25%) with pedicled flap & two patients (22.2%) with anterolateral thigh free flap had excellent MEP score. Six patients (42.8%) with fasciocutaneous flap, five patients (25%) with pedicled flap & three patients (33.3%) with anterolateral thigh free flap were fully satisfied as evaluated by Likert scale. Six patients (15%) encountered postoperative complications out of which one patient (2.5%) had undergone total flap loss as the patient was elderly, diabetic and hypertensive and had a defect size of 150 cm². Local fasciocutaneous flap was done initially and then a trunk flap was done as a salvage flap. Five patients (12.5%) developed minor complications. Three patients (33.3%) with anterolateral thigh free flap developed minor complications. Secondary procedures like free functioning muscle transfer was done in two patients, Elbow arthrodesis was done in two patients. Tendon transfer procedures were done in two patients for radial nerve palsy. Their outcome would improve with physiotherapy.

Table no.1: Patients demographics

	Entire group	Local fasciocutaneous flap	Pedicled flap (locoregional & distant)	Free flaps (ALT)
No.of Patients	40	14	20	09
Mean age in years	31.03	32.23	29.5	33
Age (Range in years)	8-70	8-70	12-55	22-56
M:F Ratio	28:12	9:4	11:7	8:1
Comorbidity (DM/HTN)	3	1	1	1

Table no. 2: Relation between wound dimensions, Mayo elbow performance (MEP score) and Likert scale

Defect size	Local Fasciocutaneous Flap	Pedicled Flap Regional /Distant	Free Flaps (ALT Only)	Mayo Elbow Performance Score				Likert Scale				
				Excellent	Good	Fair	Poor	1	2	3	4	5
4-120 cm ²	13	8	0	10	6	5	1	1	6	5	0	0
121-450 cm ²	0	9	8	3	5	3	4	5	5	5	0	0
451-600 cm ²	1(Additional flap)	3	1	0	1	1	1	0	2	1	0	0

Table no. 3: Relation between type of flap MEP score and LIKERT scale.

TYPE OF FLAP	MEP SCORE				LIKERT SCALE				
	EXCEL LENT	GOOD	FAIR	POOR	1	2	3	4	5
Local fasciocutaneous flap (LFF)	6	4	3	0	6	4	3	0	0
Flexor carpi ulnaris flap	1	0	0	0	0	0	1	0	0
Lateral arm flap	0	0	1	0	0	1	0	0	0
Trunk flap	2	3	2	3	3	5	2	0	0

Abdominal flap	2	1	0	0	2	1	0	0	0
Para umbilical flap	0	1	0	0	0	1	0	0	0
Hypo gastric flap	0	0	1	0	0	1	0	0	0
Latissimus dorsi flap(LD flap)	0	0	1	0	0	1	0	0	0
Anterolateral thigh flap (ALT)	2	3	1	3	3	4	2	0	0

Table NO.4: Distribution of the type of complication, initial defect size and management

Type of complications	No. of complications	Primary flap	Management of complication	Defect size
Total flap loss	1	LFF	Trunk flap	150 cm ²
Partial flap loss	1	Free ALT	VAC Dressing and skin graft	350 cm ²
	1	Trunk	Secondary intention healing	600 cm ²
Haematoma	1	Free ALT	Evacuated	450 cm ²
Infection	2	Free ALT	Conservative	200 and 350 cm ²
	1	Trunk	Conservative	600 cm ²



Case 1: figure no.1.1: Pre operative photograph (Major crush injury around elbow joint following RTA)



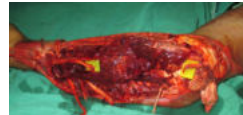
Figure No. 1.2: Post debridement and bony fixation defect around elbow joint.



FigureNo.1.3: Trunk flap cover around right elbow joint.



FigureNo.1.4: Functional outcome.



Case 2: Figure No.2.1: Pre operative photograph (Major crush injury of right elbow along with forearm)



Figure No.2.2: Intraoperative photograph depicting post debridement bony fixation defect over right elbow along with forearm and harvested free ALT Flap



Figure No.2.3: Coverage of the defect with ALT free flap.



FigureNo. 2.4: Functional outcome

DISCUSSION

Plastic and reconstructive surgeons have long been involved in the management of injuries of the upper limb. With the advent of an increase in road traffic accidents and the setting up of major industries, upper limb injuries have become common. Devastating defects around the elbow region are those defects with exposure of vital structures, including bones, joints, major vessels and nerves which endanger the vitality of the whole limb². Salvaging the accompanying vascular injury becomes critical both in terms of demands, infrastructure and the skills of the operating team. Participation of Plastic and reconstructive surgeons from the very beginning of management is the way towards success.

Our study consisted of 40 patients with defects over the elbow, out of which 28 were male and 12 were female, which is supportive of other studies suggesting males are most commonly associated with RTA¹, the age group ranged from 8 - 70 years with 52.5% patients in the middle age group. Seventy seven percent (31) of our sample sustained injury following RTA, 20% were following industrial accidents, which included conveyor belt injury, machine crush injury, carding machine injury, steam roller machine injury. Wound defects over the elbow were classified on anatomical basis. Post debridement defect size ranged from 2x2 cm² to 40x12 cm² with average being 151 cm², smallest defect was over the posterior aspect. Choudary and colleagues in their retrospective study of 90 defects around the elbow found an average size of defect measuring 98 cm², ranging from 1.5 cm² to 840 sqcm². In our study only those defects which were necessitating soft tissue cover were included. At present no prospective outcome studies compare different flap types for elbow coverage. The ultimate choice of flap coverage depends on several variables including size and complexity of the wound, exposure of vital structures, co morbid status of the patient, potential donor site morbidity, and overall outcome potential of the joint. Choudary and colleagues in their study chose the flap for coverage based on defect size, our selection was based on consideration of all the above mentioned factors. Our study required 43 flaps which consisted of three double flaps. Out of the 40 patients 18 had isolated elbow injuries while the remaining 22 had wounds extending over arm, forearm, or both. The flaps used in our study included 14 local fasciocutaneous flaps (32.5%); 20 pedicled flaps both regional and distant (46.5%) and 9 Anterolateral thigh free flaps (20.9%). In our series the complication rate was 15%, while Choudary and colleagues had 33% complications. In our study average follow up was 16 months (range 5 to 26 months) with an average MEP score was 75.75 suggestive of good elbow function. Ten patients had excellent MEP score who had defects smaller than 120 cm². Three patients who had excellent MEP score had a defect size of more than 120 cm². Giannicola et al did a study on 45 patients with elbow defect, treated based on the pathoanatomic changes found intra operatively and the results of their study shows an average MEP score of 94.⁶

CONCLUSION

Post traumatic soft tissue defects around the elbow require team management with meticulous planning, good debridement and staged reconstructions.

The defect size is the main determinant of the type of flap used and their outcomes.

The correct solution is the simplest one that minimizes the patient's morbidity, provides predictable return to function, and takes into consideration the defect size, site, status of the surrounding tissue, patient factors and needs for secondary reconstruction.

The choice of soft tissue cover around the elbow is a clinically based decision that is largely determined by the experience of the surgeon and is individualized according to the patient's need.

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