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Role of Denervated Latissimus Dorsi Island Flap in Reconstruction of Complex Elbow Injuries

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ABSTRACT

Introduction: Severe elbow injuries are considered a source of significant disability. Appropriate soft tissue coverage is often requires a vascularized flap to protect the neurovascular and exposed bone and joint.

Aim of the Work: To evaluate the role of island denervated latissimus dorsi flap in complex elbow injury.

Patients and Methods: Island denervated latissimus dorsi flaps were used for soft tissue coverage in ten patients with complex elbow injuries.

Conclusion: The results were satisfactory and this flap could be considered the flap of choice for such defect.

INTRODUCTION

Major complicated injuries of the upper limb that were previously considered an indication for amputation are now successfully salvageable. Hand Surgeons are frequently challenged to salvage a limb or at least restore its function to the least needed in daily activities after receiving a mutilating trauma. But still they have to keep strict to the objectives of managing those patients as RTA (Road Traffic Accidents) patients according to the guidelines for ATLS (Advanced Trauma Life Support). They have to assign the priorities as patient's life first followed by limb survival and later limb function [1].

Reconstruction of complex elbow wounds and defects following trauma is highly challenging and technically demanding. It is determined by several factors like; patient demographics, defect criteria and specifications, available reconstruction options and its related morbidity and casualty center facilities [2].

Use of local flaps in elbow reconstruction is faced with a lot of limitations. Being near to the zone of trauma, limited size of the available flaps in comparison to the size of the defect in some cases and limited arc of rotation are all considered as challenging limitations to the reconstructive surgeon [3,4].

Microsurgical free tissue transfer is also not without limitations. It needs expert and skilled surgeons, anesthesia, nursing staff, special equipments and instruments and fit patient for a long surgery [5-11].

The latissimus dorsi muscle (LDM) is the largest muscle in the body and it has been widely used in reconstruction of large soft tissue defects in different parts of the body. Despite its large size, no practical functional motor deficit results from its transposition. The nerve supply of LDM is via the thoracodorsal nerve, a branch of the posterior cord of the brachial plexus. Blood reaches the muscle via the subscapular artery, a branch of the axillary artery. The subscapular sends off a circumflex scapular branch posteriorly, and then distributes a serratus branch before it enters the substance of the muscle on its undersurface as the thoracodorsal artery. A 5-10cm pedicle can be obtained off the subscapular system. A single venae comitant typically accompanies the artery. It could be used as myo-cutaneous, osseo-myo-cutaneous or isolated muscle flap [12-15].

PATIENTS AND METHODS

This study was carried out in Casualty Unit, Zagazig University Hospitals from May 2009 till July 2010. Ten patients with complex elbow trauma were included in this study. Patients admitted to the causality department as victims of RTA or machinery industrial injury. All of them had extensive soft tissue loss of the upper limb with exposure of important structures. Types of trauma, associated body injuries and demographic data of all patients are listed in Table (1).

Table (2) shows the nature of upper limb injury and associated local injuries. There were 6 suffered total loss of the skin and subcutaneous tissues of

Table (1): Types of trauma, associated body injuries and demographic data of patients.

Item	No.	%
Age:		
15-30 yrs	6	60
31-50 yrs	3	30
>50 yrs	1	10
Sex:		
♂	8	80
♀	2	20
Type of trauma:		
RTA	7	70
Machinary	3	30
Associated body injuries:		
Torso Trauma	4	40
Head Injury	3	30

the arm and elbow with exposure of the neurovascular bundle at the antero-medial aspect of the arm. Four patients had incomplete loss of the arm skin but with exposure of important vital structures that necessitated flap coverage. Various types of humeral fractures & elbow affection were found in 8 cases. They were dealt with by the orthopedic surgeons in the standard ways in the same setting at which coverage was done. Vascular & nerve injuries were present in 8 cases and it was dealt with immediately by the vascular surgeon (in 6 patients the brachial artery was grafted using a long saphenous graft and primary repair was done in two cases). Associated nerve injuries (7 median and I combined median & ulnar nerves) were dealt with immediately at time of coverage either by immediate primary repair (6 cases) or immediate cable nerve grafting obtained from the sural nerve (2 cases).

Table (2): The nature of upper limb injury and associated local injuries.

Item	Skin loss		Bone & Joint Injury	Vascular & Nerve Injury
	Complete	Incomplete		
No	6	4	8	8
%	60	40	80	80
Total			8	8

The Latissimus dorsi muscle (7 cases) or myocutaneous (3 cases) flaps were harvested in the classical way on their thoracodorsal pedicle and all the muscle attachments were divided. Additionally, the thoracodorsal nerve was divided and the pedicle was further elongated by dissection up to sub-scapular vessels to obtain the longest arc of rotation.

Coverage of the flap and fasciotomy wounds with split thickness skin graft (STSG) was done in another stage (7-14 days later) after being sure that the flap healed and the general health of the patient can support graft take.

Formal consent was obtained from the nearest legalized relative of the patient after discussing full details of surgery with them. They were informed about the nature of the procedure and the possibility of needing more than one stage to complete the work.

In assessment of the outcome of the procedure, assessment of the outcome of peripheral nerve repairs was not considered in this study. This was to reduce the period of follow-up as most of these repairs need at least a period of 2 years for follow-up.

RESULTS

In this study we had harvested 10 LD flaps (7 as muscle flaps and 3 as myocutaneous flaps). None of these flaps was lost. Nine flaps (90%) survived completely and reached to a point 10cm up to 15cm distal to olecranon without significant stretch on the pedicles. One case (10%) developed marginal flap necrosis about 3cm. All of the ten flaps reached to the upper 1/3 of the forearm covering all the exposed structures in the cubital fossa and medial aspect of the arm. All flaps survived nicely apart from one flap that showed loss of the distal 3cm of the flap that was debrided and later on was grafted. In another case, the skin paddle was lost while the muscle was still a life (mostly due to excessive shearing). Again, it was debrided and grafted.

No mortalities were reported in this series. Table (3) summarizes the morbidities in patients included in this series. We needed partial skin regrafting in only 2 patients (those mentioned above). Donor-site morbidity was in the form of seroma collection (2 cases), superficial wound infection (2 cases) and partial wound dehiscence (only one patient). None of these donor-site complications needed surgical intervention. They were all managed conservatively. Unfortunately, one patient (10%) had 2ry hemorrhage from vascular grafts after 20 days of our repair, that necessitated above elbow amputation and the flap was utilized to cover the stump. Other patient (10%) developed a persistent discharging sinus for 7 months that necessitated expoloration and removal of the infected proline sutures which were used for repair of biceps tendon. These last two complications were not a flap complication.

Table (3): Overall morbidity and mortality in the study.

Item	No.	%
Mortality	0	0
Flap morbidity:		
Total necrosis	0	0
Partial necrosis	2	20
Donor-site morbidity:		
Seroma	2	20
Infection	2	20
Dehiscence	1	10
Complications were not flap-related:		
2ry hemorrhage	1	10
Persistant sinus	1	10

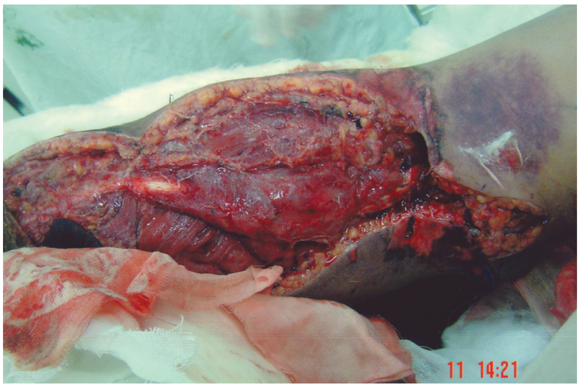

Fig. (1): Elbow and forearm injury with skin approximation over saphenous graft conduit.

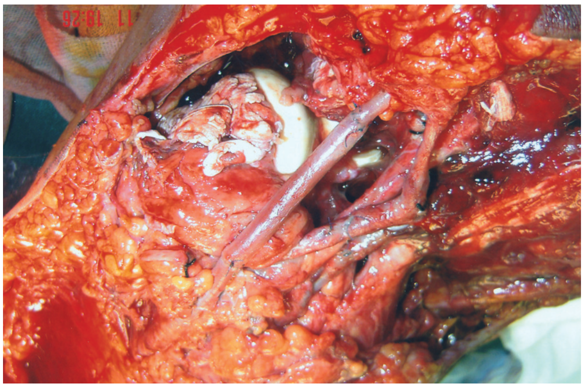

Fig. (2): Removal of sutures and debridement revealed exposed vital organs.

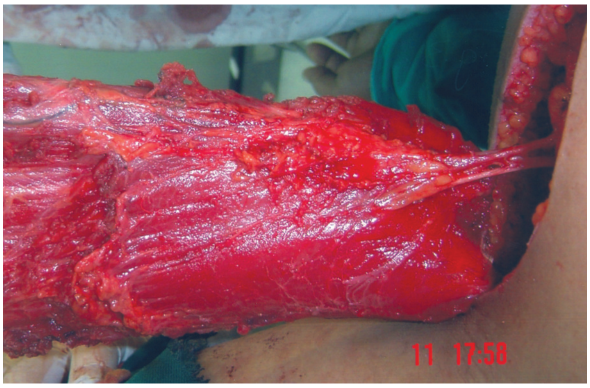

Fig. (3): LD muscle flap.

Fig. (4): Early post-operative.

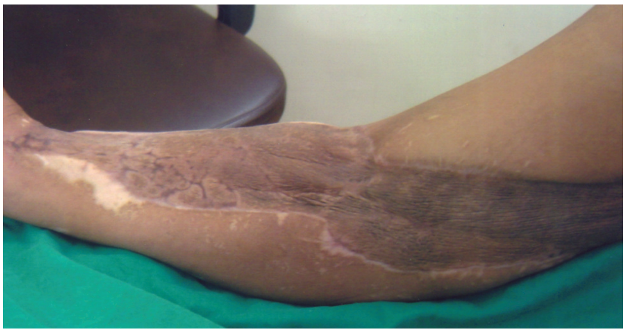

Fig. (5): Late post-operative.

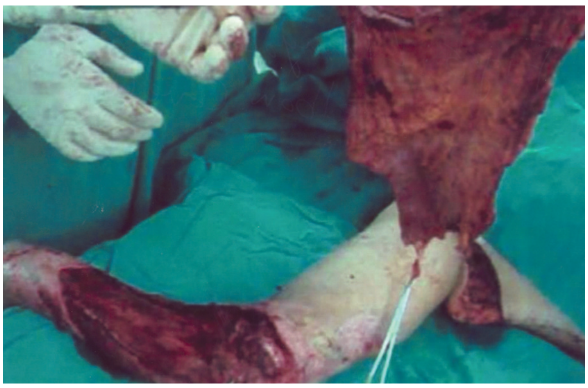

Fig. (6): LD myocutaneous flap for elbow coverage.

Fig. (7): LD myocutaneous flap for elbow coverage.

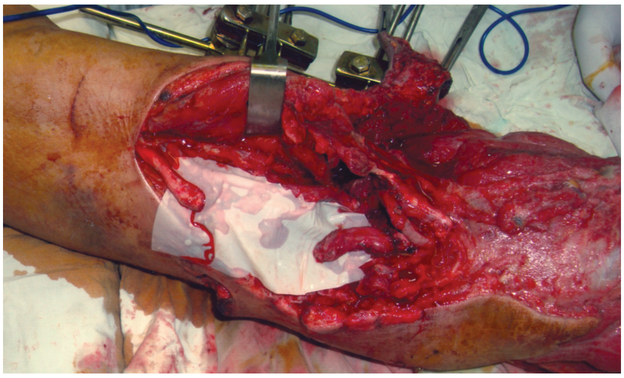

Fig. (8): Complex elbow injury.

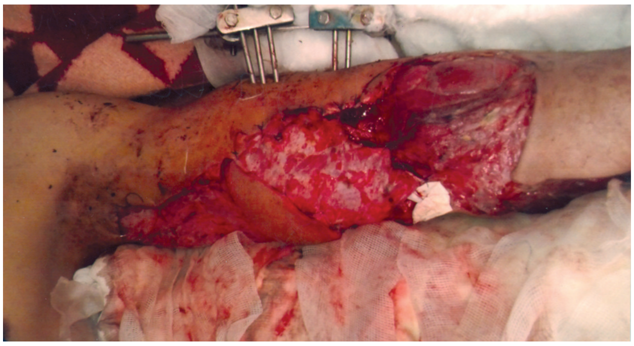

Fig. (9): Grafted LD muscle flap for the same patient.

Fig. (10): Complex elbow injury.

Fig. (11): Early post-operative photo for the same patient.

DISCUSSION

Coverage of complex elbow injuries carries many challenges to the reconstructive surgeon. Being mostly with exposed important structures, makes coverage with skin grafts (STSG) unfeasible. Locoregional flaps and even free flaps carry various limitations in its use in this difficult situation **[2]**.

The first use of the Latissimus Dorsi flap for restoration of the soft tissue of the elbow was done by Shottstaedt et al., in 1955. Further publications have shown advantages of latissimus dorsi flaps for salvage of major trauma of the elbow **[16-18]**.

Use of LD as a pedicled muscle flap with STSG provides excellent soft-tissue coverage of large upper extremity wounds. The tendinous insertion was left intact to guard against excessive traction on the pedicle when the flap was used for soft-tissue coverage only **[18]**.

In this study we had harvested ten LDM flaps. None of them was totally necrosed. This was comparable to the work presented by Rogachefsky et al., **[18]**. They reported only seven cases where they used LDM and STSG for coverage of open wounds of the shoulder, arm, or elbow with exposed vital structures (mean wound size: 15x10 cm). All of their flaps and STSG were successful. Of course their group of patients was smaller than ours (only seven cases). Also, their work included a wide age range (6-71 years) while in this study we excluded the pediatric age group from it. But this didn't affect the outcome. Balakrishnan et al., **[5]** stated that it is a very helpful muscle in upper arm reconstruction with minimal donor site morbidity. We found this is totally true in this study.

Another study by Ma et al., **[20]** adopted the use of pedicled LD flap for reconstruction of upper extremity large soft-tissue defects. The ages of their patients was ranging between 17-67 years. Their 20 flaps survived without loss. Only minor complications of flap edge necrosis and wound breakdown were found in three patients, and varying degrees of minor split-thickness skin graft loss were present in five patients. No deep infections were found in their series. Those are more or less comparable to our results mentioned in Table (3). But they didn't mention any thing about denervation of the LDM to elongate it to cover a more distal area in the forearm as done in this work.

Although Stevenson et al. **[16]** recommended that the LD flap should not be used routinely to cover defects more than eight centimeters distal to the olecranon to avoid distal necrosis pedicle length limitation and excessive flap stretching, Ismail et al. [17], Rogachefsky et al. [18] and Tarek et al. [19] reported success with LD flap coverage at distances greater than eight centimeters distal to olecranon.

In this work we adopted total skeletonization of the pedicle of LDM to attain the longest pedicle possible. This is obtained by cutting of the thoracodorsal nerve and freeing of the thoracodorsal vessels up to the sub-scapular trunk from the axillary vessels. This gave us an extra-length of about 5-7cm in the flap and made the flap to reach to up to 15cm distal to the olecranon. Meanwhile, no remarkable increase in incidence of postoperative morbidity was recorded in this study.

Conclusion:

This study revealed that the island denervated Latissimus Dorsi flap is considered as one of the most useful flaps for reconstruction of complex elbow wounds and can cover down to the proximal upper third of the forearm. It is safe, reliable, single-staged, with few complications and minimal donor morbidity.

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