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Original Research Article

A Hospital-Based Assessment of the Management of Posttraumatic Posterior Elbow Defects by Non-Microsurgical Reconstruction

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Abstract

Aim: In this article, we studied management of Posttraumatic Posterior Elbow Defects by Non-microsurgical Reconstruction.

Methods: A retrospective analysis was conducted at Department of Burn & Plastic Surgery ESIC Medical college, Bihta, Patna, Bihar, India for 12 months by including all patients with posttraumatic posterior elbow defects reconstructed with non-microsurgical flaps. Patients having anterior elbow defects and defects covered with free flaps were excluded from the study. Patients with injuries of and around the elbow were managed primarily by orthopaedic surgeons. Coverage of defects was performed secondarily after bony stabilization by plastic surgical unit. Data was collected from electronic medical records, departmental operative registers, and photographic records.

Results: There were 40 males and 10 females in the study. Road traffic accidents were the most common presentation (n=40) followed by industrial accidents (n=8) and domestic accidents (n=2). The age of the patients varied from 8 to 72 years with mean age being 38 years. The defect size varied from as small as 2 x 2cm to as large as 14 x12cm. 28 patients were small defects (A) and 22 were large complex defects (B).

Conclusion: Posterior elbow defects are a difficult problem to tackle. To achieve optimal results, all patients with elbow trauma should be attended and managed by orthopaedic and plastic surgeons in collaboration for optimal results. We believe that most of these defects can be resurfaced by nonmicrosurgical reconstruction with proper planning and execution and their utility cannot be understated.

Keywords: Posterior Elbow Defects, Non-Microsurgical Reconstruction, Management Of Posterior Elbow Defects.

Introduction

Upper extremity soft tissue reconstruction is an extensive topic as a multitude of options exist for diverse soft tissue defects involving shoulder, arm, elbow, forearm, wrist, and hand. Many of the times flap cover is necessary for resurfacing exposed critical structures like tendons, neurovascular structures, bone and to provide supple tissue over joints. The options include local, regional, distant and free flaps. It is well established that free flap option is a versatile single stage procedure facilitating simultaneous reconstruction of other critical structures. It also allows postoperative mobilization

and early discharge and return to work. [1] On the other hand, it requires additional resources, workforce, prolonged operating time and carries a risk of total loss of flap.

Pedicled flaps have been the workhorse flaps for reconstruction of the upper limb in many centers across the world. Though the procedure includes multiple surgery, prolonged immobilization, and joint stiffness, refinements in the execution of flap can prevent many of the disadvantages. [2] In some aspects, the outcome is better than free flap reconstruction. [3] Few of the pedicled flaps are well known for both soft tissue coverage and functional reconstruction. [4] Pedicled flaps are the lifeboats when there is a dearth of recipient vessels or in the event of free flap failure. The reconstructive algorithms exist for specific regions of upper limb [5,6] or general management of upper limb trauma. [7,8] A general algorithm encompassing the whole of upper limb reconstruction with pedicle flaps is helpful in day to day practice.

The reconstructive goal of posterior elbow defects is to provide a durable skin cover that will facilitate full active and passive range of motion. In this era of microsurgery, free tissue transfer is feasible for almost any defect.

In this article, we studied management of Posttraumatic Posterior Elbow Defects by Non-microsurgical Reconstruction.

Materials and Methods

A retrospective analysis was conducted at Department of Burn & Plastic Surgery ESIC Medical college, Bihta, Patna, Bihar, India for 12 months by including all patients with posttraumatic posterior elbow defects reconstructed with nonmicrosurgical flaps. Patients having anterior elbow defects and defects covered with free flaps were excluded from the study. Patients with injuries of and around the elbow were managed primarily by orthopaedic surgeons. Coverage of defects was performed secondarily after bony stabilization by plastic surgical unit. Data was collected from electronic medical records, departmental operative registers, and photographic records.

Defect Assessment and Evaluation

The spectrum of injury varied from compound fractures and dislocations of proximal radius, ulna, and distal humerus to extensive open and comminuted fractures with defects involving exposed joint, vital structures, or implants with or without loss of skin and/or bone. Adequate bone alignment and stabilization were achieved by the orthopaedic surgeons either with internal or external fixation and then the patients were referred to plastic surgery unit for soft tissue coverage. Almost all patients were reconstructed secondarily after a delay of 2 to 3 weeks due to multiple reasons. Most of the patients had some degree of joint stiffness, edema, and an external fixator in situ. Coverage with a durable skin cover and achieving complete wound healing was the primary reconstructive goal. Patients were followed up for 3 months postoperatively; however, some were lost to follow-up. Patients were assessed for wound healing and status of flap. The range of movements of the elbow was not assessed. Patients were then assessed by orthopaedic surgeons after healing of flaps for the management of orthopaedic hardware, need of any secondary procedures, and physiotherapy.

For ease of description, elbow defects were assigned an α- numerical value as described later. Cubital crease was used as a reference. Two parallel lines were drawn at the point where the crease starts to fade medially and laterally. The part of the elbow in between these lines was anterior elbow and rest was considered as posterior elbow region. Posterior elbow was further divided in to medial, central, and lateral compartments. The part of the elbow between the lateral border of the olecranon and the lateral end of cubital crease was

the lateral compartment. The part of the elbow between the medial border of the olecranon process and the medial end of elbow crease was the medial compartment. The elbow between two borders of the olecranon process was the central compartment.

Defects with exposed vital structures were again subclassified according to size as small (A) (<5cm or <30cm2) and large (B) (>5cm or >30cm2). Small defects (A) were thus classified and labeled according to location as:

1. Medial (A1)
2. Central (A2)
3. Lateral (A3)

Large defects (B) involving multiple subunits were labeled as:

1. Mediocentral (B1)
2. Laterocentral (B2)
3. Medio-latero-central (B3)
4. Defects of posterior elbow extending proximally on to the arm (B4)
5. Defects of posterior elbow extending distally on to the forearm (B5)

Flap Planning and Execution

The defects were assessed and resurfaced with a locoregional or pedicled flap as deemed appropriate taking into consideration the various factors like size, location, extent, need for secondary procedures, methods of fixation, neurovascular injury, exposed vital structures, and positioning required for flap harvest. Only defects with exposed bones, hardware, joint, and vital structures were managed with a flap cover and the rest were skin grafted. The perforators around the elbow joint were assessed and marked preoperatively in all patients with 8Hz handheld Doppler. All flaps were marked with the elbow in 90 degrees of flexion and shoulder in abduction.

1. Size: Small defects were managed with local transposition flaps preferably based on the perforator adjacent to the defect. Proximally based local flaps were preferred where feasible based on the musculocutaneous perforators of the radial recurrent artery (RRA) along the axis of the brachioradialis muscle. Brachioradialis with its overlying skin paddle is usually spared from complex traumatic elbow injuries and also rarely the site for pins of external fixator. Thus, it was a safe and reliable flap for moderate sized defects for lateral, central and medio-central defects. The brachioradialis muscle flap was preferred for small central and lateral defects. For small and large sized defects of either compartment, distally based local fasciocutaneous (LFC) flaps were harvested preferably including a perforator at its base. A propeller flap based on RRA perforator was used for small lateral and central defects.

2. Location: Central defects were technically easier to resurface with flaps from the lateral side due to proximity of the ulnar nerve and medial cutaneous nerve of forearm encountered medially. Reverse lateral arm (RLA) flap was our flap of choice for central and medio-central defects. Distally based posterior ulnar recurrent artery (PURA) flap was considered in defects with extensive trauma to the lateral aspect of the arm with external fixator in situ precluding a laterally based flap. However, position required for the harvest was shoulder in external rotation and abduction in presence of a fixator.

3. Extent of the defect: For moderate-to-large defects extending distal to the elbow with exposed ulna/radius with or without a fracture required a large flap. The radial artery originates deep just distal to cubital fossa and often escapes trauma. The pedicled radial forearm flap (RFF) was our flap of choice for such defects. For similar and large medio-latero-central defects associated with brachial artery injury, supracondylar humerus fractures, an elbow spanning external fixator or doubtful Allen's test, we preferred an inferiorly based abdominal flap or a lateral thoracic

flap based on multiple perforators along the midaxillary line. With moderate-to-large defects involving the posterior elbow and extending proximally with an external fixator in situ, a pedicled musculocutaneous latissimus dorsi (LD) flap harvested in lateral position was utilized to resurface the defect.

4. Concomitant ulnar nerve injury: Elbow defects with acute ulnar nerve injury needing repair were managed simultaneously with primary nerve coaptation and anterior transposition followed by flap cover depending on the location. Defects associated with a crush component resulting in a concomitant ulnar nerve defect more than 5 cm necessitating a cable graft were managed with tagging of ulnar nerve ends and defect closure with a flap and secondary reconstruction of nerve with sural nerve cable graft after 3 months.

Results

Table 1: Patient characteristics

Variables	N%
Gender	
Male	40 (80)
Female	10 (20)
Cause of injury	
RTA	40
Industrial Accidents	8
Domestic Accidents	2
Flaps	
Locoregional or pedicled flap cover	44
Transposed anteriorly and then covered with flap	6
Defects	
Small defects A	28
Large complex B	22

There were 40 males and 10 females in the study. Road traffic accidents were the most common presentation (n=40) followed by industrial accidents (n=8) and domestic accidents (n=2). The age of the patients varied from 8 to 72 years with mean age being 38 years. The defect size varied from as small as 2 x 2cm to as large as 14 x12cm. 28 patients were small defects (A) and 22 were large complex defects (B).

8 out of 50 flaps developed some complication out of which 6 flaps hadminor complications of marginal necrosis. These were managed conservatively till eschar formation and then allowed to heal by auto separation of eschar followed by secondary healing. However, three flaps developed major complications of more than 50% flap necrosis out of which one was managed with a secondary flap for coverage and two needed secondary grafting.

Discussion

The concept of reconstructive elevator propagates the usage of more complex techniques for the best possible outcomes. [9] For a complex functional unit like upper limb, this concept is very well accepted. However, the choice apparently depends up on the available resources, infrastructure, knowledge, ability of the team, and multiple patient-related factors.

In a reconstructive algorithm for soft tissue coverage of the elbow, Jensen and Moran found pedicled LD flap, anconeus flap, pedicled RFF, and free anterolateral thigh flap to be most useful and reliable for

coverage of most elbow defects. [10] Sherman often used free scapular, parascapular, rectus, and gracilis muscle flaps as free flap options for coverage of the elbow. [11] RLA flap was the workhorse flap for most central, medial, and complex defects in our series due to its advantages of reliable skin paddle and ease of harvest with the forearm rested on the patient's abdomen, not sacrificing any major vessels of the limb, and without need of microsurgical anastomosis. Also, it is associated with minimal donor site morbidity and skin graft at a location that can be easily covered with clothing. An elbow spanning fixator poses technical difficulty in the harvest. Patel and Higgins [12] highlighted the versatility and reliability of RLA flap for posterior elbow wounds. Their study also included RFF, brachioradialis, pedicled LD, and local perforator flaps as coverage options for posterior elbow that correlates with our case series. The RLA flap can also be based anterior to the lateral epicondyle to include perforators of RRA in the flap base, which minimizes the kink and prevents venous congestion as suggested by Devale et al. [13]

RFF is a versatile flap and can be used for most defects around the elbow. [14] Various reconstructive algorithms for elbow defects put forth by Choudry et al, [15] Bishop, [16] and Jensen and Moran [10] describe RFF as the workhorse flap in their respective series. However, patients with extensive trauma often have an elbow blocking external fixator on the lateral aspect and it becomes technically challenging to harvest RFF in a flexed elbow and externally rotated shoulder and should be considered only in defects without external fixator or where positioning is suitable. We opted for inferiorly based abdominal flap and the lateral thoracic flap for complex defects in extensive trauma with external fixator. It is a safe alternative than sacrificing an important vessel in such extensive trauma.

The unstable elbow is usually stabilized with an external fixator in 90 degrees flexed position with pins on the lateral aspect of the humerus and radius with two elbow spanning rods. This arrangement allows proper positioning of the upper limb on the abdomen for an inferiorly based abdomen flap. Large abdominal flaps are prone for developing venous congestion, marginal necrosis and can be too bulky in women and obese individuals. We suggest considering alternate flaps in such patients as the limb positioning can be cumbersome.

The PURA flap provides a large skin paddle extending proximally up to midarm and comprising almost the entire medial circumference of the arm enabling coverage of complex moderate to large laterally located defects. However, it involves tedious dissection of ulnar and medial cutaneous nerve of forearm. The RLA flap and PURA flaps included in our series are reliable axial pattern [17] flaps that can cover complex medial and lateral defects, respectively, with ease. The pedicled LD MC was our flap of choice in extensive trauma with elbow defects extending proximally on to the arm, inadequate local flap options, and extensive zone of trauma with poor recipient vessels. [18] The flap provides adequate bulk with acceptable donor site morbidity. [19]

A major limitation of locoregional flaps is the unaesthetic donor sites. However, in units like ours catering mainly to low-income group of patients consisting of daily wage earners and manual workers, early return to work and rehabilitation has to be given a priority with available infrastructure and constraints. Besides, the typical Indian clothing consisting of full sleeve shirts conceals all the possible donor sites.

Conclusion

Posterior elbow defects are a difficult problem to tackle. To achieve optimal

results, all patients with elbow trauma should be attended and managed by orthopaedic and plastic surgeons in collaboration with bony stabilization and soft tissue cover achieved simultaneously as early as possible. We believe that most of these defects can be resurfaced by non-microsurgical locoregional flaps with proper planning and execution and their utility cannot be understated. They can be considered as the first choice in selected patients owing to their reliability, durability, ease of harvest, and minimal donor site morbidity. They prove to be very useful in centers that lack a dedicated plastic surgical unit or are not very well equipped with microsurgical infrastructure and expertise.

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