

ELBOW ARTHODESIS WITH AO EXTERNAL FIXATOR IN WAR INJURIES

Nisar Ahmed, Syed Tauqeer Ahmed Rizvi*, Muhammad Khalid Sadique*

Combined Military Hospital Kharian/National University of Medical Sciences (NUMS) Pakistan, *Combined Military Hospital Lahore/
National University of Medical Sciences (NUMS) Pakistan

ABSTRACT

Objective: To analyze the surgical technique of Elbow arthodesis in term of its indications and functional outcome in war injured elbow joints.

Study Design: Descriptive study.

Place and Duration of Study: This study was carried out at Combined Military Hospital (CMH) Peshawar and CMH Quetta, from Apr 2007 to Sep 2013.

Material and Methods: Twenty patients all young males who had complex high velocity elbow joint injuries were selected for the study. Plan X-Rays were done for assessment and planning. Surgical technique for arthodesis involved use of AO external fixator 4mm alone in 15 cases and combination of external fixator with minimal internal fixation using K wires in 5 cases.

Results: Average duration of bony alkalosis and complete elbow arthodesis was achieved in 8 months (range 7 to almost 10 months). Almost 90% of the patients had pain free and stable elbow joint with satisfactory level of daily life activities and personal care hygiene.

Conclusion: Elbow joint is a commonly involved body part in the battle field resulting in extensive bone and soft tissue damage along with heavy contamination. In these extensive injuries no surgical reconstruction is possible, therefore, early wound debridement and elbow arthodesis at an appropriate angle with external fixation and vascularized soft tissue coverage whenever required is an effective method of treating such injuries.

Keywords: Blast injuries, Bone graft, Elbow arthodesis, External fixator, Non-union, Osteomyelitis, Reconstruction of elbow.

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INTRODUCTION

The elbow joint is the most susceptible joint of upper limb to war injuries¹. High velocity trauma of the war may result in complex injuries around elbow which includes extensive bone and soft tissue damage with concomitant vascular or nerve injuries and heavy wound contamination². The treatment of these complex injuries is difficult and differs from simple fractures because of high rate of complications³. Surgery in these patients often requires a multi disciplinary approach i.e. orthopedic surgeons, vascular surgeon and plastic surgeon⁴. In these destructive injuries around elbow joint no satisfactory surgical reconstruction is possible. Therefore, elbow arthodesis, which is a limb salvage

procedure, is the procedure of choice⁵. It not only provides bony fusion and ankylosis but also provides stability and freedom from pain. Ever since the start of military operations against terrorism we have been dealing with different war injuries. Among them the elbow joint has been a commonly involved joint of upper limb because of its obvious exposure and inadequate protection. The high velocity weapons used by enemy and fragments of exploding devices inflicted devastating damage to bone and soft tissue around elbow joint in our patients. In these patients stable osteosynthesis was not possible therefore elbow arthodesis with external fixator in functional position was selected as salvage procedure.

The purpose of this study is to share the experience of surgical technique involved in elbow arthodesis, its indications and functional outcome in war injured patients.

Correspondence: Dr Nisar Ahmed, Consultant Orthopedic Surgeon CMH Kharian Pakistan (Email: nisarr2005@yahoo.com)
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PATIENTS AND METHODS

This descriptive study was conducted at Combined Military Hospital (CMH) Peshawar and CMH Quetta from Apr 2007 to Sep 2013. Approval from the institutional ethical committee was obtained and informed consent was taken from the participants.

The inclusion criteria were all patients of military operations against terrorism in Waziristan and Baluchistan who got complex, contaminated and comminuted fractures of elbow resulting from gunshot and blast injuries, with intact or reconstructable soft tissue damage including skin, nerves and vessels so that the salvage limb should be optimally functional. Twenty male patients who fulfilled the above mentioned criteria were included in the study by non-probability purposive sampling. This sample size is substantial due to rarity of this trauma.

Surgical Technique for Arthodesis

Our technique of elbow arthodesis has been simple and time saving. We used tourniquet in majority of cases for thorough wound debridement, removal of dirt and foreign material and performed copious wound cleansing with isotonic saline. At this stage denuding of exposed cartilage was also done along with approximation and k-wire fixation of major fragments in seven cases.

In thirteen cases external fixator was alone used to achieve arthodesis. We used AO external fixator 4mm with two tubular rods, four Schanz screws and eight clamps. Two Schanz screws were drilled in anterolateral surface of humerus and two in the radius by keeping hand in neutral position. These are then connected by two tubular rods which are fixed through clamps at desired elbow angle for arthodesis. The elbow angle was kept at median 90° elbow flexion (range 80 to 100) on dominant side and median 70° flexion (range 60 to 90) on non-dominant side. After completion of fixation wounds were left opened and repeated dressings were done. In fifteen cases wounds were closed by delayed primary closure while remaining five required

early plastic reconstruction. Postoperatively early rehabilitation was started with hand and shoulder exercises. K-wires were removed in all cases after six weeks. For patient satisfaction Likert scale from 1-3 was used 1 = very satisfied, 2 = satisfied and 3 = unsatisfied.

Functional outcome in everyday activities was graded as follows, no restriction, mild restriction, severe restriction or incapable. (No restriction or mild restriction = good, severe restriction = satisfactory and incapable for day to day activity = poor). Pain was evaluated using visual analog scale (0-10); 0 no pain and 10 worst pain ever.

Data was analyzed using SPSS version 20.0. Descriptive statistics were used to find out mean and standard deviation. Frequency and percentages were calculated and data was presented as tables and pie charts.

RESULTS

Twenty patients were operated upon for elbow arthodesis. Mean age of the patients was 25 years (range 18 to 36 years). Side of injury (right/left) is given in fig-1. Sixteen patients



Figure-1: Side of injury.

(80%) had sustained injuries with bullets and 4 (20%) with fragments of explosive devices. Table-I shows nature of injury (isolated vs poly trauma) Associated nerve injuries were present in 5 patients and vascular injury in one patient which were repaired. Plastic reconstruction was required in 5 patients who had extensive soft tissue loss.

Plain x-rays were taken in all patients pre-operatively for assessment and planning. Post-operatively, patients were regularly evaluated for bony fusion with serial radiographs, patient satisfaction and their functional outcome for daily activities and personal care hygiene.

All patients were evacuated (by road and helicopter) to their respective hospitals with mean time period of 10 hours (range 6 to 18 hours) of injury.

The mean time elapsed between definitive surgery and sustaining injury in battle field was therefore 10 hrs (range 6 to 18 hrs). Follow up period in these patients is between 6 months to 4 years.

Median elbow angle was kept at 90° flexion

settled with conservative treatment and after removal of external fixator. Three patients had persistent nerve palsy for which they were having continuous physiotherapy. One patient developed non-union for which he had revision surgery with compression plating and bone grafting.

DISCUSSION

Ever since the start of military operations against militants in Swat, Waziristan and Baluchistan our soldiers fighting war on terror have sustained different injuries. Elbow joint was second most commonly injured joint of the body in a series of 358 war injured joints⁸.

These injuries were inflicted by modern day high velocity weapons and fragments of different

Table-I: Nature of injuries.

Isolated elbow injury	Poly trauma
12	8

Table-II: Patient satisfaction.

Very satisfied	Satisfied	Un-satisfied
15 (75%)	4 (20%)	1 (5%)

Table-III: Functional outcome.

No restriction	Mild restriction	Severe restriction/ incapable
13 (65%)	5 (25%)	2 (10%)

(range 80 to 100) on dominant side and 70° flexion (range 60 to 90°) on non dominant side. The average time taken by bony ankylosis and complete arthrodesis was 8 months (range 7 to 10 months).

External fixator was kept in situ for an average period of 7 months (range 6 to 9 months). While k wires were removed after 7 weeks (6 to 8 weeks). Redo arthrodesis was done in 2 patients by internal fixation and bone grafting. Post treatment patient level of satisfaction is given in table-II and Patients' functional outcome is given in table-III.

One patient (5%) was unsatisfied with this surgery due to painful infected non-union while the other patient (5%) had poor result due to severe restriction of daily life activities. Our patients had only minor complications. Four patients developed pin tract infection which

explosive devices. This high velocity trauma often results in complex injuries of elbow joint², which include extensive comminution of bones with or without elbow dislocation, severe soft tissue damage, concomitant nerve or vessel injury and massive wound contamination. Their management is different from simple fractures implying that standardized concepts usually can not be applied and it can be a complex surgical challenge to manage them⁹. These injuries presented alone in majority of our patients and in rest were part of poly trauma in which life threatening injuries were treated on priority basis followed by elbow joint management.

These firearm injuries of upper limb pose serious problem in both medical and economic terms¹⁰. They need multiple surgical support, repeated surgical procedures and prolonged hospitalization. The general basis of treatment of

these injuries involves aggressive debridement of soft tissue, copious irrigation, antibiotics and open fracture protocol. When exploration is indicated decompression and excision of necrotic tissue is the rule with colour, consistency, contractility and capacity to bleed providing valuable information regarding muscle viability. Their treatment also needs a proactive surgical strategy^{11,12}.

In these high velocity injuries there is great concern focused on soft tissue management. The soft tissue defects can be addressed by early splint thickness grafts to cover granulating surfaces, later full thickness flaps may be substituted to replace scar tissue and permit reconstructive surgery. Major complicated injuries of upper limb that once led to amputation are now successfully managed. Complicated major trauma can be treated by musculocutaneous latissimus dorsi flap with skeletonized and denervated pedicle¹³. In majority of our patients elbow wounds were dealt with primary or delayed primary closure. Patients with larger defects were treated by local or distal flaps by using latissimus dorsi and partial thickness skin graft in collaboration with plastic surgeon.

War related elbow injuries because of their complexities represent great challenge to both the patient and surgeon and demand fast and definitive treatment¹⁴. For these injuries with extensive bone and soft tissue defects no surgical reconstruction is feasible and elbow arthodesis is the method of choice. Elbow arthodesis is a salvage procedure that results in joint fusion and bony ankylosis. It is a reliable treatment for destructive war injuries that defy reconstruction of useful joint⁶. It is technically difficult with high rate of complications. The functional limitations to activities of daily living and personal care are significant¹⁵.

Historically, tuberculosis was the most common indication for elbow arthodesis and various methods have been described for it¹⁴. Before doing elbow arthodesis one must take into account medical and occupational indication, age

and condition of nearby joints which partially share the function of elbow. Elbow joint is a complex joint, loss of its function can severely affect activities of daily life. Its arthodesis results in greater functional disability than arthodesis of other large joints¹⁶. There is no optimal position for elbow arthodesis. Most of authors suggest 90° flexion on dominant side with normal movements at shoulder, wrist and cervical spine. It is the best position for daily activities like eating, writing and personal hygiene. It also gives maximum arm strength at this elbow angle. Radioulnar arthodesis may also be performed when proximal ulna is completely absent^{1,17,18}. On the non dominant side arthodesis is done at 50-70 degree flexion which is a better

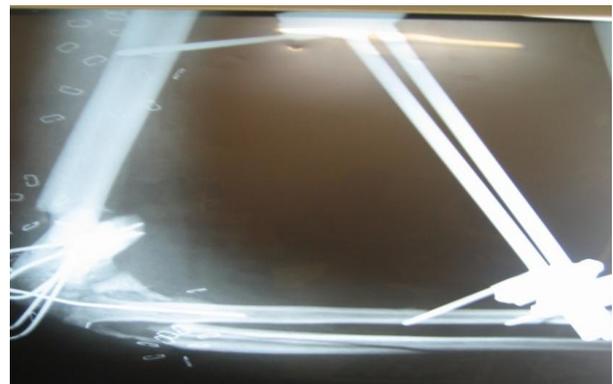


Figure-2: External fixator with multiple k-wire fixators.

position for some professions and also gives better cosmetic appearance. The position of forearm is usually kept neutral with slight pronation to write and use computer¹⁹. Majority of our patients performed their activities satisfactorily on dominant and non dominant sides after adequate rehabilitation and regular training.

Complications of elbow arthodesis include neurovascular injury, wound infection, delayed union, nonunion, and malunion. Painful prominent hardware and skin breakdown can occur over the posterior aspect of the elbow where subcutaneous tissue is minimal⁶. In combat related and blast induced heterotrophic ossification is common and often clinically

problematic⁷. However in our study patients experienced minor complications as mentioned in results.

Rehabilitation plays an important role in functional outcome of elbow arthodesis. Gentle exercises of fingers, wrists and shoulder are started early in post operative period. Serial X-rays are taken to assess the satisfactory bony fusion after which strengthening exercises are started. They give added stability to elbow joint. Therapist helps the patient to keep the pain under control, improve strength and learn how to adjust daily activities without putting strain on elbow.

Although elbow arthodesis is an uncommon procedure, different techniques have been described in literature for elbow arthodesis in destructive injuries. Earlier reports were mainly concerned with tuberculous arthritis, and methods included the ingenious use of local and distant bone grafts. Nowadays it includes use of tubular external fixator in combination with k wire and cancellous screw fixation and bone grafting¹. Moghaddam et al used compression plating in their surgical technique of elbow arthodesis⁵. Ilizrov's external fixator has also been used successfully to achieve elbow arthodesis with moderate restriction of daily activities²⁰. Our technique involved use of tubular AO external fixator either alone or in combination with multiple k-wire fixations (fig-2). We used this technique as primary arthodesis procedure after aggressive wound debridement and irrigation. We achieved satisfactory bony fusion and consolidation on account of multiple bony pieces of cancellous bone providing excellent bone graft.

CONCLUSION

Elbow arthodesis is a definitive treatment for complex, comminuted and contaminated open intraraticular fractures of elbow joint where no surgical reconstruction is feasible. Our results revealed that early wound debridement, denuding of exposed cartilage, approximation

and fixation of bony pieces with k wires and external fixation at an appropriate elbow angle is an effective method of achieving elbow arthodesis in war injuries.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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