



Early and Mid-term Results Following Surgery of Elbow Fractures with the Terrible Triad

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Abstract

Objective: This study aimed to evaluate the mid-term results of patients with dislocated fractures around the elbow with the terrible triad who were treated with an elbow external fixator together with internal fixation and ligament repair.

Methods: The study included patients who underwent surgery for a diagnosis of a terrible triad between January 2009 and January 2015. A total of 14 patients were diagnosed with terrible triad and were operated with an elbow external fixator additional to internal fixation and ligament repair.

Results: The mean follow-up period was 27 months (range, 22-38 months). According to the Mayo elbow performance score, 10 patients were evaluated as excellent, 2 as good and 2 as poor. The flexion ROM were mean 118° (range, 115°-122°), and extension ROM was mean 26° (range, 20°-32°). Flexion contracture was determined of mean 15° (range, 10°-20°) and extension contracture of mean 7.5° (range, 5°-10°). Full bone union was observed radiographically in all patients.

Conclusion: In fractures around the elbow diagnosed with terrible triad, the combination of internal fixation with elbow external fixator provided the possibility of starting elbow joint movements in the early period and the mid-term results obtained were pleasing.

Keywords: Elbow, fracture, external fixator, terrible triad

INTRODUCTION

Bone fractures and ligamentous structure injuries accompanying complex elbow dislocations are significant causes of elbow instability. These are injuries that can cause problems at the treatment stage when accompanied by various clinical problems (1,2).

The aim of treatment for complicated elbow dislocations is to be able to obtain a stable joint that provides good functional status following early surgical reconstruction (3,4).

This study aimed to evaluate the functional results of patients with dislocated fractures around the elbow with the terrible triad who were treated with an elbow external fixator together with internal fixation and ligament repair.

METHODS

Approval for this retrospective study was granted by the University of Health Sciences Turkey, Okmeydani Training and Research Hospital Local Ethics Committee (no: 48670771-514,10). The study included patients who underwent surgery for a diagnosis of a terrible triad. Between January 2009 and January 2015.

A total of 14 patients were diagnosed with terrible triad and were operated with an elbow external fixator additional to internal fixation and ligament repair (Table 1). The patients had non-comminuted radial head fractures that involve <40% articular surface and type I-II coronoid fractures. Patients were excluded from the study if they had a stable elbow fracture, neurovascular injuries, or elbow fracture following a congenital disease.



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On postoperative day 3rd, elbow joint movements were started in all patients as tolerated. For each of the 14 patients included in the study, a record was made of age, gender, mechanism of injury, concomitant injuries, early and late postoperative radiographs and computed tomography images, the total follow-up period, time from trauma to surgery, early and late postoperative complications and time to union (Figure 1).

Table 1. Demographic features and clinical measurements of the patients

Gender (M/F)	14/0
Mean age (years)	34 (24-48)
Mean follow-up period (months)	27 (22-38)
Mean time from trauma to surgery (hours)	36 (24-48)
Mean follow-up period with external fixator (weeks)	5 (4-6)
Mean VAS score	8 (7-9)
Mean elbow flexion angle (degrees)	118.60°+2.3 (range, 115°-122°)
Mean elbow flexion contracture angle (degrees)	15°+3.5 (range, 10°-20°)
Mean elbow extension angle (degrees)	7.5°+1.4 (range, 5°-10°)
M: Male, F: Female, VAS: Visual analog scale	

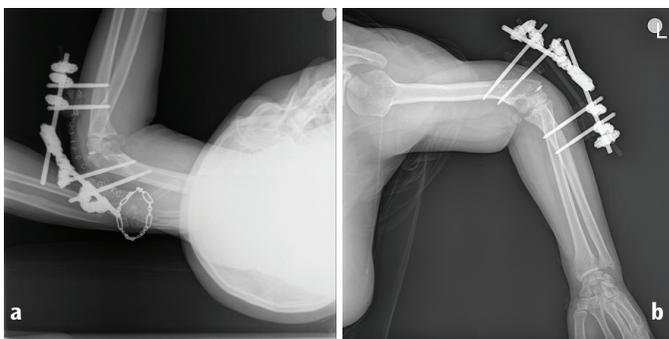


Figure 1. a, b) Postoperative X-rays of one of our patients

Statistical Analysis

Descriptive statistical methods such as mean, standard deviation, median, frequency and ratio were applied while evaluating the study data.

Surgical Technique

All the patients were operated on under general anesthesia by different surgeons in our hospital. For radius head fracture restoration and lateral collateral ligament (LCL) injury reconstruction, either a Kocher or Kaplan incision was used, depending on the surgical plan. In patients with a multi-

fragmented radius head, a radius head prosthesis was used. In patients with a radius head that could be restored, fixation with screws only or with plate and screws was applied. LCL repair was applied with the aid of suture anchors. Under fluoroscopic guidance, a K-wire was placed in the lateral plane to pass the midpoint of the condyles then 2x4 mm Schanz screws were placed from the lateral of the distal humerus followed by 2x4 mm Schanz screws in the lateral plane from the proximal ulna. Fixation was then provided by placing an elbow external fixator so that the K-wire was at the hinge point of the humerus condyles. After checking the stability and bleeding, the layers were closed appropriately. No early postoperative complications were observed in any patient.

RESULTS

The 14 cases included in the study were male with a mean age of 35.7+8.9 years (range, 24-48 years). The mean time from trauma to surgery was 36+6.6 h (range, 24-48 hours) and the mean follow-up period was 27.6+4.7 months (range, 22-38 months). The mechanism of trauma was a workplace accident in 3 cases (21.4%) and a fall from height in 11 cases (78.6%). Head trauma was determined in 1 patient (9%), and sub trochanteric femur fracture in 2 patients (18%) who fell from height. The patient suffered from a workplace accident and had no additional injuries.

The follow-up time with external fixator was mean 5 weeks +0.8 (range, 4-6 weeks). After the removal of the external fixator, the mean visual analog scale (VAS) score was 8+0.78 (range, 7-9). According to the Mayo elbow performance score, 10 patients were evaluated as excellent, 2 as good and 2 as poor (Table 2). The elbow flexion angle was mean 118.60°+2.3 (range, 115°-122°). Flexion contracture was determined to mean 15°+3.5 (range, 10°-20°) and extension contracture of mean 7.5°+1.4 (range, 5°-10°). Full bone union was observed radiographically in all patients (Figure 2). Infection in 2 of the patients with an open fracture was eradicated with antibiotherapy without the need for removal of the implant. In 2 patients (5%) with an open fracture who did not respond to antibiotherapy, the radius head prosthesis was removed at 6 months postoperatively because

Table 2. Mayo elbow score

	n	%	Mayo Elbow Score
Excellent	10	71.4	
Good	2	14.3	
Poor	2	14.3	
Total	14	100	

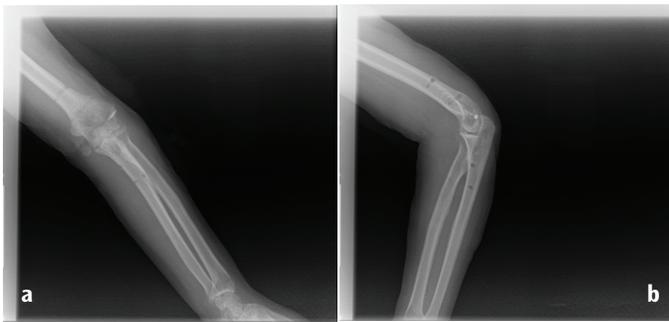


Figure 2. a, b) Full bone union was observed radiographically in all the patients

of infection. Apart from these 2 patients where the radius head prosthesis was removed, no postoperative instability was observed. No postoperative complications of neurovascular deficit or heterotrophic ossification developed. The superficial pin tract infection was seen in the pins placed in the humerus in 4 patients and this responded to oral antibiotic treatment in all cases.

DISCUSSION

The aim of the treatment of complicated elbow injuries should be to obtain stable joint restoration by providing full joint range of motion (3,5,6). It is usually difficult to achieve this as different procedures must be used for the restoration of the bones and when a wide surgical dissection is necessary, more invasive surgical methods are required. The use of minimally invasive methods is recommended, which will provide mobilization and stability for treating complicated elbow fractured dislocations (3,6,7).

With the consideration of a minimally invasive approach, elbow external fixator treatment was combined with ligament repair and internal fixation for the patients in this study. No difference was observed between the early postoperative and mid-term results.

The hinged external fixator (HEF) is an effective, minimally invasive method that can be used to create a stable joint at a good level of function in terrible triad injuries and complicated elbow fracture dislocations. HEF provides good protection during the healing process in patients where ligament repair has been achieved. In this study, the VAS pain score and Mayo performance score evaluations were consistent with the literature (2,3,6).

The gold standard treatment in complicated elbow fracture dislocations is restoration, with repair made of capsular and ligament structures with internal fixation (3,4). The gold standard treatment for complex fractures around the elbow is internal

fixation and stable reconstruction. Elbow external fixators are used in several complex injuries (8). In this study, an elbow external fixator was used alone in patients diagnosed with the terrible triad and mid-term successful results were obtained.

There are difficulties in the combination of multiple surgical procedures and the treatment of fractures around the elbow joint (9). In this study, despite several difficulties in the application of the elbow external fixator, no major complications developed in any patient in the current study.

Instability is generally seen after reconstruction of bone and ligamentous structures in complicated elbow fracture dislocations, which leads to terrible triad injury dislocations. The treatment results of these injuries do often not please, with post-traumatic instability, joint stiffness and early joint arthrosis often seen (5,10). In patients with elbow dislocation diagnosed with a terrible triad, it has been reported that the use of plaster cast for immobilization could prevent early mobilization and increases the risk of joint contracture and stiffness (11-15). It has been reported in the literature that patients with terrible triad diagnosis experience pain and restricted joint movement (16-18). In the present study, restricted movement was determined in only 2 patients.

Unstable elbows are often treated with the application of a plaster cast following primary ligament and bone repair. Ligament repair may not provide sufficient stabilization for early active movement. As plaster cast immobilization does not permit early movement, there is an increased risk of joint stiffness forming leading to joint contracture (9,11-13). Therefore, the HEF is an effective treatment method for complicated elbow dislocations. Successful early results have been reported in the literature from the use of an elbow fixator for early movement (17). Consistent with the data in the literature, the early and mid-term results of the current study patients were successful.

During rehabilitation of an elbow fixed with an elbow external fixator, the elbow is stabilized against the varus stress formed associated with the weight of the forearm when the shoulder is in abduction. As this stabilization was provided in this series, open surgical approaches, which lead to fibrosis and heterotrophic calcification, could be avoided. The HEF, when applied centralized to provide medial collateral ligament and LCL isometry, reduce scar formation by allowing early mobilization (18). No scar formation was observed in the current study patients, which was consistent with the literature.

The most important complications of the surgical treatment of patients with terrible triad of symptoms are heterotrophic ossification, joint stiffness, nerve injury and recurrent subluxation or dislocation (18).

Previous studies have shown that excessive dissection and a late start to movement lead to heterotrophic ossification and elbow stiffness. In this study, as movements were started early and minimally invasive surgical dissection was performed, no heterotrophic ossification was observed.

There are inherent difficulties in the application of an elbow external fixator to fractures around the elbow. However, it has been shown that when the HEF technique is applied appropriately, taking the anatomical regions into consideration, no complications develop (19). As the fixator was applied to the patients in the current study taking the technical properties into consideration, no associated complications were observed. A superficial infection encountered in 2 patients was successfully treated with antibiotherapy.

In many studies, while the elbow flexion and extension degree of movement after removal of the fixator in most cases are good in the early period (18,20), the mid-term results of the current study were also seen to be good.

Study Limitations

The limitations of the current study are that the number of patients was low and there was no long-term follow-up.

CONCLUSION

In fractures around the elbow diagnosed with terrible triad, the combination of internal fixation with elbow external fixator provided the possibility of starting elbow joint movements in the early period and the mid-term results obtained were pleasing. Therefore, this can be considered a good option during the initial treatment.

Ethics

Ethics Committee Approval: Approval for this retrospective study was granted by the University of Health Sciences Turkey, Okmeydani Training and Research Hospital Local Ethics Committee (no: 48670771-514,10).

Informed Consent: All the patients participating in the study were informed about the study and informed consent was obtained.

Peer-review: Externally and internally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: A.Ç.T., E.Te., Concept: A.Ç.T., Design: B.K., Data Collection or Processing: B.K., Analysis or Interpretation: H.G., Writing: E.T., B.K.

Conflict of Interest: No conflict of interest was declared by the authors.

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