Original Article

A Comparative Study of Conservative Functional Treatment versus Acute Ligamentous Repair in Simple Dislocation of the Elbow in Adults

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Abstract

Background: Elbow dislocation is the second most frequent type of large joint dislocations in adults. Standard treatment of simple elbow dislocation (SED) without manifestation of instability includes closed reduction, short-term immobilization of the elbow followed by functional aftercare. This study evaluates SED treatment, comparing outcomes of conservative functional treatment and surgical therapy. **Materials and Methods:** 54 adult patients with SED without manifest instability treated in tertiary hospital between January 2008 and June 2015 were analyzed in this retrospective study. 28 patients were treated conservatively. Closed elbow reduction was followed by short-term plaster splint and active rehabilitation. Twenty six patients underwent closed elbow reduction and subsequent reconstruction of torn collateral ligaments. Postoperatively, plaster splint was applied followed by rehabilitation. **Results:** Patients who were treated conservatively reached statistically significant better scores in Quick Disability Arm Shoulder Hand, Oxford Elbow Score, and Mayo Elbow Performance Score. Functional conservative treatment resulted in a higher range of motion. The complication rate was higher in the group of surgically treated patients. **Conclusions:** Careful examination of elbow stability after closed reduction of SED is crucial for further therapy. Patients with stable SED should be treated with functional conservative therapy. Surgical collateral ligaments revision and reconstruction are indicated only for patients with manifestation of elbow instability.

Keywords: *Collateral ligaments reconstruction, elbow instability, functional treatment, simple elbow dislocation*

MeSH terms: *Elbow joint, dislocations, ligaments articular, joint instability*

Introduction

The elbow is a very stable joint due to its bony alignment and the support provided by the collateral ligaments and muscles. Elbow dislocation is the second most frequent type of large joint dislocations in adults with an incidence of 5–6 per 100,000 person-years.[1,2] Most of these dislocations arise due to sports related injuries.[3] Simple elbow dislocation (SED) involves only ligamentous and soft tissue injuries, and treatment results are more favorable compared to complex elbow dislocations that include bony injuries.[4] Standard treatment of SED without manifest instability should involve closed reduction, short-term immobilization of the elbow followed by functional aftercare. This recommendation is supported by many authors, who have reported favorable results after nonsurgical treatment of simple dislocation of the elbow.[5,6] In recent years, the development of advanced arthroscopic techniques and new surgical materials, the surgical therapy of SED without manifest instability is again a topic open to discussion.[7,8] In a randomized study dating from 1987, comparisons are drawn from the results of 30 patients with SED who were treated either conservatively or by surgical therapy. No statistically significant difference between these two approaches was found.[9] The aim of this retrospective study is to evaluate the results of acute ligamentous repair of the elbow compared to the functional treatment of patients with SED without manifest instability (MI).

Materials and Methods

Seventy-nine adult patients with SED treated in tertiary hospital between January 2008 and June 2015 were enrolled in this retrospective study. We analyzed the medical records and imaging (X-ray) documentation of a consecutive series of adult patients with SED [Figure 1] treated in our hospital. According to our treatment protocol of SED in period from 2008 to 2011 all patients with SED regardless of

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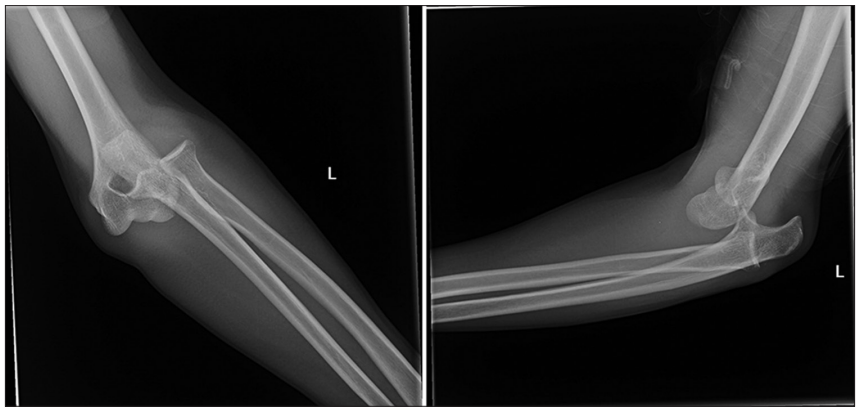

Figure 1: X-ray Anteroposterior and lateral views showing posterolateral elbow dislocation

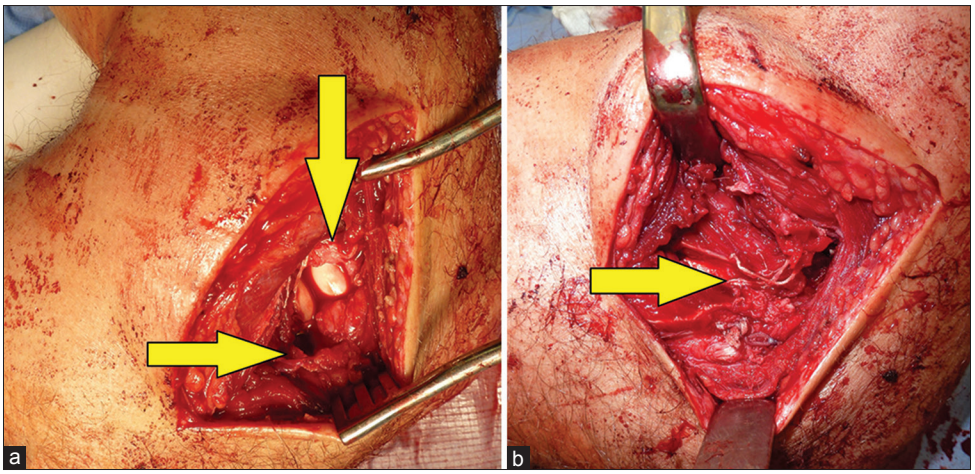

Figure 2: Peroperative clinical photograph showing (a) lateral collateral ligament rupture, ends of ruptured ligament are marked (b) its reconstruction using suture anchor (right side photography)

elbow stability after reduction underwent reconstruction of collateral ligaments [Figure 2]. During the period from 2012 to 2015 our treatment protocol was changed. All patients with stable SED were treated conservatively, only those patients who met criteria described by O'Driscoll *et al*. (subluxation or noncongruent elbow joint on the radiographs following closed reduction, SED requiring an extension block splint over 45° to maintain reduction)[10] were indicated for surgery.

The following were inclusion criteria to our study: an adult patient, closed reduction of elbow dislocation, elbow after reduction was without instability in stable arc of motion, functional treatment or acute ligamentous reconstruction after SED.

Exclusion criteria were following: previous elbow fracture or dislocation on the same side, unstable SED, open reduction of elbow dislocation, followup time <1 year after injury, associated vascular lesions, patient with multiple trauma.

Fifty-four patients met inclusion criteria. These patients were invited for clinical assessment in 2012 (surgically treated patients with SED without MI) and in 2016 (conservatively treated patients with SED without MI).

Patients were divided into two groups. Control group (CG) – patients with SED without MI who received standard X-ray examination with the exclusion of associated elbow fractures. Closed reduction of elbow was done within 2 h from injury and elbow was examined for instability in stable arc of motion (45-120°), following with elbow fixation in plaster splint with elbow flexion at 90° for maximum of 14 days after injury. Active physiotherapy in stable arc of motion started immediately after the period of elbow fixation with plaster of Paris. Three weeks after injury, physiotherapy continued till full range of motion (ROM). The criterion for discharge from physiotherapy was a 120° arc of motion of the affected elbow or period of physiotherapy longer than 6 months after injury. Study group (SG) – patients with SED without MI who received standard X-ray examination with the exclusion of associated elbow fractures. Closed reduction of elbow was done within 2 h from injury and elbow was examined for instability in the stable arc of motion.

The surgical procedure was carried out in an operating theater under general anesthesia. Indication for revision of medial, lateral, or both ligamentous complexes depended on the presence of varus/valgus instability. Torn collateral

ligament complex, common extensor tendon, and joint capsule tear were repaired with metal anchor screws (Arthrex, Naples, USA; Medin, Nové Město na Moravě, Czech Republic), postoperative X-ray is presented in Figure 3. To protect the repaired soft tissue structure, the elbow was placed in a postoperative plaster splint with elbow flexion at 90° for maximum of 14 days after injury. Active physiotherapy in the stable arc of motion started immediately after the period of elbow fixation. Three weeks after injury, physiotherapy continued in full ROM. The criterion for discharge from physiotherapy was a 120° arc of motion of the affected elbow or period of physiotherapy longer than 6 months after injury.

Clinical outcomes were evaluated in terms of ROM compared to uninjured side, joint stability, and elbow function using the Mayo Elbow Performance Score (MEPS),[11] Oxford Elbow Score (OES),[12] Quick Disability Arm Shoulder Hand Score (QuickDASH),[13] and presence of complications such as paresthesia in innervation zone of ulnaris nerve. The stability of the elbow was evaluated with valgus and varus stress test and presence of lateral pivot shift phenomenon. Radiographic outcomes including posttraumatic changes as well as heterotopic ossification were evaluated on the most recent followup images.

Variables are described by absolute and relative frequencies and differences between control and tested group and tested using Fisher's exact test for binary variables and using Mann–Whitney U-test for continuous data. The results were considered statistically significant at the level of alpha <0.05 in all applied analyses. Analyses were performed using IBM SPSS Statistics 23.0.0 (IBM Corporation, Armonk, New York, 2013).

Results

Seventy-nine patients were enrolled into this study, 54 patients met inclusion criteria. Twenty-eight patients were enrolled in the CG, whereas 26 patients were enrolled in the SG. Nineteen females and 9 males were entered

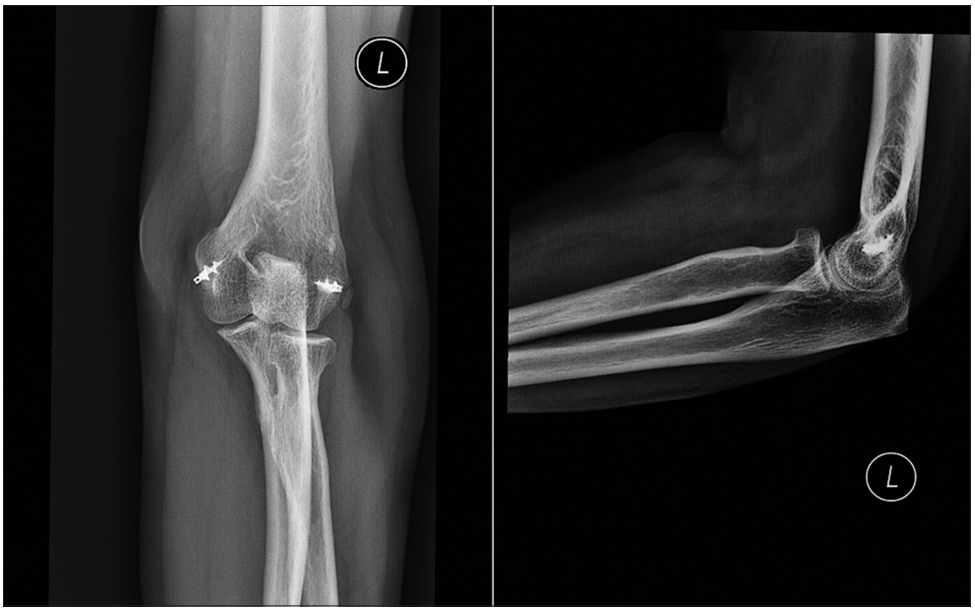

Figure 3: Postoperative X-ray anteroposterior and lateral views of elbow showing medial and lateral collateral ligament repair was performed using suture anchors on both sides

Table 1: Type and side of elbow dislocation

Specification of elbow dislocation	Total (*n*=54), *n* (%)	Group		*P*
		CG (*n*=28), *n* (%)	SG (*n*=26), *n* (%)	
Type of elbow dislocation				
Posterior	28 (51.8)	15 (53.6)	13 (50.0)	0.942
Posterolateral	24 (44.4)	12 (42.8)	12 (46.2)	
Posteromedial	1 (1.9)	0	1 (3.8)	
Lateral	1 (1.9)	1 (3.6)	0	
Side of elbow dislocation				
Left side	28 (51.8)	14 (50.0)	14 (53.8)	0.793
Right side	26 (48.2)	14 (50.0)	12 (46.2)	

CG=Control group, SG=Study group

Table 2: Elbow motion deficit, data from affected elbow were compared to healthy one

Mean values	Group		*P*
	CG (*n*=28)	SG (*n*=26)	
Extension deficit (°)	4.6 (0-15)	15.9 (0-40)	<0.001
Flexion deficit (°)	5.2 (0-10)	11.7 (0-45)	0.125
Supination deficit (°)	2 (0-15)	5 (0-15)	0.001
Pronation (°)	1 (0-5)	1 (0-5)	0.175
Range of motion (°)	132 (120-145)	117 (60-145)	<0.001

CG=Control group, SG=Study group

Table 3: Clinical outcomes by the Mayo Elbow Performance Score

Result of MEPS	Total (*n*=54), *n* (%)	Group		*P*
		CG (*n*=28), *n* (%)	SG (*n*=26), *n* (%)	
Excellent	34 (62.9)	24 (85.7)	10 (38.5)	0.001
Good	17 (31.5)	4 (14.3)	13 (50.0)	
Fair	3 (5.6)	0	3 (11.5)	
Poor	0	0	0	

MEPS=Mayo Elbow Performance Score, CG=Control group, SG=Study group

into the CG and 14 females and 12 males into the SG. Patients ranged between 18 and 72 years of age with a mean of 50 years in SG and 48 years in CG. There were no statistically significant differences between CG and SG with respect to age ($P = 0.403$) and sex ($P = 0.698$). Mean followup was 26 months (range 12–44 months) in SG and 32 months (range 12–48 months) in CG with no statistical significant difference between both groups ($P = 0.523$). Thirty-one elbow dislocations resulted from sports injuries, 23 from low-energy falls related to daily living activities. SED presented more frequently on the left side in both groups. Posterior type of elbow dislocation was the most frequent pattern; incidence of other types [Table 1]. In SG, three patients had associated distal radius fracture on ipsilateral side and in CG only one of all patients had this type of injury on the ipsilateral side. All values mentioned above in both groups were not statistically different, at least not in any significant way.

All patients in both groups underwent closed reduction of SED. Following closed reduction, a plaster splint and hinged brace were used on all patients. In the CG, the mean time of elbow fixation in plaster splint was 5 days (range 3–14 days) following with fixation in hinge brace for a mean time of 21 days (range 14–28 days). Progressive active and passive motions of the elbow were started immediately after plaster splint removal. In the SG, the mean time of elbow fixation in plaster splint was 7 days (range 5–14 days) following with fixation in hinge brace for mean time of 21 days (range 14–28 days). Progressive active and passive motions of the elbow were also started immediately after plaster splint removal. In the SG, all patients underwent acute ligamentous repair of the elbow, 16 of them had medial collateral ligament (MCL) repair, 5 of them had lateral collateral ligament (LCL) repair, and 5 of them had repair of both MCL and LCL.

The average ROM in the CG was 132°, the average extension deficit compared to uninjured side was 4.6° and the average flexion deficit compared to uninjured side was 5.2°. In the SG average ROM was significantly lower (117°), as well as average extension (15.9°) and average flexion (11.7°) deficits were significantly worse compared to the CG ($P < 0.001$). The prono-supination motion of forearm in both groups was not greatly affected [Table 2]. The mean MEPS in the CG was 97 (range 75–100) and excellent results were reached in 24 cases, in comparison with the SG, where the mean MEPS was 87.7 (range 60–100) and excellent results were reached only in 10 cases. The difference was statistically significant [Table 3].

Patients from the CG also achieved better results in OES, the mean value of OES was 46.2 (range 41–48) compared to the SG where mean value was 42.5 (range 33–48), the difference between both groups was statistically significant ($P = 0.003$).

The mean QuickDASH score in the CG was 2.5 (range 0–13.6) compared to the SG, which was 8.3 (range 0–27.3) and the difference between both groups was statistically significant ($P = 0.001$).

All patients enrolled in this study were clinically examined for the presence of elbow instability. In both groups, no patients had positive varus, valgus, and lateral pivot shift tests.

Number of complications was also higher in the SG. Ten patients (38.5%) had neurological complaints that were related to the ulnar nerve. These neurological complaints included occasional numbness and tingling in the fourth and fifth finger and sensitivity over the ulnar groove. One patient (3.8%) from the SG had superficial wound infection after the surgery. In the CG only 2 patients (7.7%) complained of ulnar neurological symptomatology. The difference between both groups was statistically significant ($P = 0.009$).

The radiographic assessment revealed heterotopic ossification in 18 patients (69.2%) from the SG and in 12 patients (42.9%) from the CG.

Discussion

The elbow is a complex joint and its natural stability and protection against dislocation results primary from its bony architecture, reinforced by the medial and lateral thickening of the capsule.[3] Osseous articulation alone contributes up to half of joint stability in flexion, and extension.[14] Inherent osseus elbow stability allows for early mobilization in most simple dislocations.[5] In the literature, there is an insufficient number of well-designed randomized controlled trials suggesting that a conservative approach

is the best method of SED treatment in adults. Only one randomized controlled trial comparing results of SED treated by surgery and conservative therapy was published in 1987 by Josefsson *et al*.[9] Thirty patients with SED were enrolled to this study. Fifteen patients were treated conservatively (3 weeks of elbow immobilization) and the same number of patients were treated surgically. Both groups showed generally good results, but the differences were not statistically significant. Similarly to our study, extension deficit in the group of patients treated by surgery was higher (18°) than group treated conservatively (10°). In this study, we achieved better results of mean extension deficit in CG (4.6°) as well as in SG (15.9°). The reason for these better results should be shorter time of elbow immobilization and functional approach to conservative treatment. Objective questionnaire indicators (OES, MEPS, QiuckDash) are missing in Josefsson's study and they could not be compared.

In the literature, there are many studies separately evaluating outcomes of conservative treatment of SED.[5,15-20] Rafai *et al*. in randomized controlled trial of 50 patients with SED, concluded that remaining extension deficit was present in 4% of patients treated with early functional therapy compared to patients treated with elbow immobilization for 3 weeks, where extension deficit was present in 19% of patients.[17] In a study by Mehlhoff *et al*., they conclude that prolonged immobilization of the elbow after injury was strongly associated with an unsatisfactory result. Longer immobilization of elbow had larger flexion contracture.[5] This fact also supports our better result in ROM of elbow compared to Josefsson's study. Maripuri *et al*. in their study comparing the treatment of SED with functional treatment and immobilization with plaster of Paris confirmed that longer immobilization of the elbow is associated with less favorable outcomes.[16] Patients treated with functional therapy reached mean MEPS 96.5 that is comparable to our CG (MEPS = 97). Similarly, Ross *et al*. used an immediate motion protocol after closed reduction without any immobilization and achieved excellent results (95%) in their study.[19] Iordens *et al*. in their multicenter randomized clinical trial also compared results between patients with SED treated with functional therapy, and they reached mean QuickDASH score = 4.0 which was worse than in our CG, where it was 2.5. Similarly, in our CG, no patient had recurrent dislocation.[20] Kesmezacar and Sarikaya evaluated results of conservative treatment of SED, mean MEPS of his patients was 96.9, which is very similar to our study, but they reported higher incidence of heterotopic ossifications (66.7%) compared to our CG (42.9%) and higher number of neurological complaints (28.6%) compared to our CG (7.7%).[6]

On the other hand, there is a growing number of studies describing surgical therapy of SED.[7,21-23] In 2008, our department started with surgical therapy (acute ligamentous repair) of all patients with SED without instability in the stable arc of motion. Indication for MCL or LCL repair was positive valgus stress test (MCL) and varus stress test or lateral pivot shift test (LCL). In case all the above tests were positive, revision of both MCL and LCL was indicated. Evaluation of patient's data who were treated with acute ligamentous repair compared to conservative therapy (patients treated conservatively before 2008 and literature data) showed worse results in ROM, higher extension, and flexion deficit as well as worse results of MEPS, OES, and QuickDASH score. The number of ulnar nerve complaints was related to patients with MCL repair, in all these patients, visualization of the ulnar nerve was carried out. Manipulation of the nerve structure, formation of scar tissue or heterotopic ossifications on the side of revision could result in neurological complaints. These outcomes lead to cessation of this therapeutic approach in 2011. If our results of SG are compared to recent studies, we will find following results. Jeon *et al*. described this approach in unstable SED in 13 patients who underwent reconstruction of elbow collateral ligaments, and they reached mean MEPS 93.5 and 3 of them (23%) had mild ulnar nerve symptoms after the operation.[23] These results are more favorable compared to our SG with MEPS 87.7 and ulnar nerve symptoms (paresthesia) in 38.5% of patients. Kim *et al*. in their study of acute repair of ulnar collateral ligament disruptions in 19 patients achieved similar results compared to our SG mean elbow extension was 13°, flexion 120°, mean MEPS was 86.9 points (65–100 points).[7] Micic *et al*. in their study of surgical management of unstable SED found injury of MCL in 55% and LCL in 80% of patients. They reached mean MEPS 93.2 and average extension loss was 14.3°, which is comparable to our results.[24] The use of arthroscopy in elbow surgery is growing. In 2014, O'Brien *et al*. published results of acute repair of the radial ulnohumeral ligament after SED in high demand patients. They achieved the following results in 14 operated patients who were young active patients. The mean MEPS was 99.6 and all returned to their preinjury level of function with no restrictions or instability. Final ROM averaged −3° of full extension to >130° of flexion. These results are more favorable than our SG, the difference could be contributed to their selection of young, active and motivated patients.[8] Arthroscopic technique is also well and safely used for the treatment of posttraumatic changes after SED.[25] In 2015, Hackl *et al*. published results of their meta-analysis of conservative and surgical therapy of SED and they concluded that early functional therapy can be recommended as standard treatment for SED without higher-grade instability.[26] Our results also support the results of this study. Functional scoring systems (MEPS, OES, and QuickDASH score) as well as ROM reached statistically superior results compared to patients treated surgically. With respect to our results as compared to the mentioned studies, we conclude that functional therapy should be the gold standard of treatment of SED without manifest instability.

Limitations of our study were as follows. First, this study was retrospective and nonrandomized. Second, the sample size is small. Third, the stability of elbow was evaluated only by a physical examination and objective examination such as stress X-rays was not performed.

Conclusions

All patients, who suffered SED should be carefully examined for the presence of instability after the reduction of the elbow. All patients with the absence of a higher grade of instability should be treated with functional conservative therapy. Surgical therapy should be reserved for patients who had manifested as high grade elbow instability.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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