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Original Research

Comparison of a single approach versus double approaches for the treatment of terrible traid of elbow—A retrospective study

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ABSTRACT

Introduction: Dislocation of the elbow associated with radial head and coronoid fracture, the so-called "terrible triad" of the elbow, is challenging to treat and has a history of complicated outcomes. This study is to compare the clinical outcome of a single lateral approach—the extensile splitting extensor digitorum communis (EDC) approach and combined lateral and medial (CML) approaches for the treatment of terrible traid of the elbow (TTE).

Material and methods: After appropriate exclusion, 60 TTE patients (28 patients in the EDC group, 32 patients in the CML group) from 2009 January to 2015 August were reviewed in this study. All included patients underwent open reduction, lateral collateral ligament complex repair, and postoperative function exercise. Surgical time, intraoperative blood loss, postoperative pain, elbow motion, MEPS score and complication rate were recorded and compared.

Result: There were significant differences in surgery time ($P < 0.05$) and ulnar nerve lesion symptom, no patient suffered ulnar nerve lesion symptom in EDC group, but 5 patients in CML group suffered it. No differences were found in intraoperative blood loss, postoperative pain and heterotopic ossification ($P > 0.05$). Mean follow-up was 26.1 months (from 24 to 30 months), at the final follow-up, 2 patients in EDC group and 4 patients in CML group required elbow release operation, mean flexion and extension (124.1 ± 14.6°and 8.3 ± 5.3°), pronation and supination (73.4 ± 5.3° and 74.4 ± 6.0°) in EDC group were higher than CML group (114.2 ± 15.0° and 17.6 ± 8.0°, 69.2 ± 6.9° and 70.4 ± 7.5°, $P < 0.05$). Besides, MEPS score in the former group was also higher than the latter group (91.8 ± 4.5 to 84.4 ± 5.2, $P < 0.01$).

Conclusion: The single lateral approach achieved better function recovery than combined lateral and medial approach, decreasing the risk of ulnar nerve lesion and surgery time for the treatment of TTE.

1. Introduction

The terrible traid of elbow (TTE) is posterior or posterolateral dislocation of the ulnohumeral joint with fractures of the radial head and coronoid process [1]This injury is complex with rupture of elements of the different components of the elbow's stability: the anterior column by fracture of the coronoid process of the ulna and the medial and lateral columns by disruption of ligaments. In addition, the presence of radial head fracture affects the lateral column. As a consequence, the terrible traid is an injury which damages the primary and secondary stabilizers of the elbow [2,3]. TTE is characterized by great potential for joint instability and has a relative poor prognosis [4]. Nowadays, surgical protocols for it include fixation of the coronoid fracture, repair or replacement the radial head, and repair of the lateral collateral ligament complex (LCLC), some doctors also advise medial collateral ligament (MCL) repair or application of hinged external fixation for patients with residual instability if possible. Approach for treatment of TTE included a single lateral approach, lateral combined medical approach, anterior approach, posterior medial approach etc [5–7]. Many orthopedics doctors were used to selecting posterior medial approach,

Abbreviation: TTE, terrible traid elbow; EDC approach, extensile splitting extensor digitorum communis approach; CML approach, combined lateral and anteromedial approach; LCLC, lateral collateral ligament complex; MCL, Medial collateral ligament

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although this approach can provide wide exposure for internal and external structures of elbow joint, there may be disadvantages of subcutaneous of hematoma, heterotopic ossification, and even flap necrosis. Besides, it is not beneficial to expose anterior structure of elbow, such as coronoid process fracture. Currently, a single lateral approach—the extensile splitting extensor digitorum communis (EDC) approach and combined lateral and medial (CML) approach are the most popular approaches, but there is few report about comparisons of the two different approaches at present. Some surgeons prefer to selecting CML approach for its wide coronoid process fracture exposure [5–8], however, it also associated with complications like heterotopic ossification, elbow joint stiffness, ulnar nerve lesion. In an attempt to better function recovery and lower the complication rate and shorter surgery time, the EDC approach gains popularity in recent years. To our knowledge, no article about the comparison of function recovery and complication rate of the single lateral approach and combined lateral and medial approaches for the treatment of terrible traid of the elbow (TTE) has been reported before. The purpose of the study was to compare the elbow functional recovery and complications of two different approaches for the treatment of TTE. We hypothesized the EDC approach achieved better clinical result in treatment of TTE.

2. Material and method

We conducted a retrospective cohort study among patients with TTE injury treated in our hospital between January 1, 2009 and August 31, 2015. Data collection began before the operation and continued forward until the latest office visit after the operation. This study was approved by our hospitals' Institutional Review Board. Informed consent was obtained from all patients. All patients were confirmed to have radiological diagnosis of X-ray and computed tomography. All patients had been treated with closed reduction and cast immobilization in emergency and none of them associated with nerve lesion symptom before operation.The inclusion criteria were set as follows: (1) closed fracture without open elbow wound; (2) patients were over 18 years old and could cooperate with us for treatment and postoperative observation; (3) patients without elbow joint operation or fracture history and the elbow function was normal previously; (4) patients were operated within 2 weeks after injury; (5) patients without other fracture that may have influence on elbow motion such as distal humerus fracture, olecranon fracture and so on; (6)patients were not associated with other diseases that may have influence on elbow motion after surgery; (7) follow up more than 2 years. Regan-Morrey classification is used for ulna coronoid process fracture [8]. The classifications of radial head fracture were based on Mason-Johnston classification [9]. According to the research, the enrolled patients were classified into either EDC group or CML group, and all of them were operated by one group of experienced elbow joint surgeons. **The work had been reported in line with the STROCSS criteria.**

2.1. Operative technique and protocol

The principle of operation in this study was the restoration of all damaged structures (1) to recover the congruency of the elbow joint (2) to provide enough stability to the injured elbow for the early motion of elbow joint after surgery. The repair procedure was conducted initially with internal fixation (ulna coracoid process fracture first, radial head fracture second), followed by repairing the LCLC, then repair MCL of elbow joint if necessary.

2.2. Operative approach

(1) EDC: Incision originated from lateral condyle of humerus, extending to proximal and distal directions. Make a lateral incision about 10–16 cm long, for exposing the lateral collateral ligament complex (LCLC), origin of common extensor tendon, radial head fracture, coronoid process fracture and anterior joint capsule from superficial to deep. Splitting the extensor digitorum communis (EDC) along the lateral condyle of humerus and the midline of radial head to have better expose radial head fracture and coronoid process fracture.

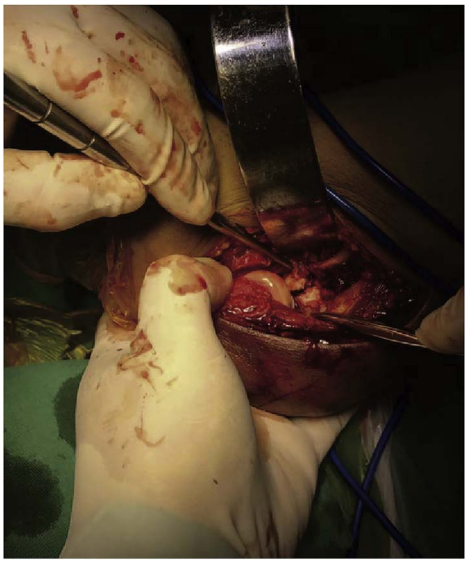

Fig. 1. Intraoperative photograph, coronoid fracture was exposed through the extensile splitting extensor digitorum communis (EDC) approach.

(2) CML approach: The radial head fracture was addressed through a lateral approach (Kocher approach), this incision originated from 8～12 cm above lateral condyle of humerus to 8–10 cm below olecranon, surgeons could open the space of the flexor carpi ulnaris and the elbow muscle to expose the LCLC and radius head fracture. Medical approach originated from medial condyle of humerus, making a 10–15 cm incision along axis of forearm midline. There were two choices for coronoid process fracture exposure: (1) open the space of flexor carpi radialis and pronation teres, which is suitable for disposing of small fracture bone; (2) separating the origin of flexor digitorum communis, which is appropriate for big fracture bone (See Fig. 1).

Coronoid process fracture fixation: To Regan-Morrey type I fracture, non-absorbable suture used to “lasso suture”, fixing at the posterior olecranon of the olecranon, sometimes Kirschner wires or suture anchor were used for fixation. To type II fracture, the“lasso suture fixation”method was used as well, and Kirschner wires were applied for internal fixation, then tighten suture and knot at the posterior of ulna. Remove Kirschner wires 2months after operation. Sometimes,1–2 titanium screws or screws combined Kirschner wires were applied for fixation.

Radius head fracture fixation: Non-absorbable screws with diameter of 2 mm and 1.2 mm Kirschner wires were used to for type I ～ II fractures. To type III fractures, reduction and internal fixation with a plate or screws, if satisfied reduction was difficult to achieve, radial head arthroplasty was selected.

LCLC and MCL repair: Suture anchors or transosseous sutures can be used to repair LCLC. Once all the reconstruction was completed, elbow stability was then evaluated with the goal being concentric stability with no observed posterior or posterolateral subluxation through a flexion–extension arc of 30–130° with the forearm in neutral rotation, no valgus or supination stress was added. If elbow instability persisted, fixation of the radial head and coronoid process were checked and augmented suturing of the lateral ligament complex was performed if needed [7,10]. Then we test again, if instability still was found: to EDC group, alternative two weeks plaster immobilization of elbow joint or