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Results of arthroscopic fixation of Mason type II radial head fractures using Kirschner wires

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Abstract

The goals of this study are to report an arthroscopic technique for the treatment of Mason type II radial head fractures using Kirschner wires (K-wires), and investigate the feasibility and evaluate the results.

We retrospectively review 18 cases of closed Mason type II radial head fractures treated in our institution from August 2010 to May 2015. There were 13 males and 5 females with an average age of 30.6 (17–45 years) years. Injuries were caused by falling in 8 cases, by traffic accidents in 5 cases, and by sports in 5 cases. The average time from injury to admission was 3.9 days (1–11 days). All radial head fractures were confirmed on x-ray and computed tomography. The fracture fragments were fixed with percutaneous K-wires under arthroscopy.

All surgical wounds healed with primary closure, and no complication occurred, such as neurovascular injury, infection, or hardware failure. All patients were followed up for a mean period of 19 months (range: 14–29 months). Bone union was achieved for all patients with a mean time of 11 weeks. At final follow-up, range of motion of the elbow has no significant difference in comparison to the uninjured side. The mean Visual Analog Scale for these patients was 1.7 (range 0–3). According to the Broberg-Morrey score, there were 7 excellent, 9 good, 2 fair, and 0 poor results (with good or excellent results in 89%). Mayo elbow performance score and the disabilities of the arm, shoulder, and hand score were significantly improved postoperatively.

The present study demonstrates that arthroscopic fixation of Mason type II radial head fractures using K-wires provided a stable fixation with good clinical outcomes and patient satisfaction.

Abbreviations: CT-3D = computed tomography three-dimensional, DASH = disabilities of the arm, shoulder, and hand, K-wire = Kirschner wire, MEPS = Mayo elbow performance score, ORIF = open reduction and internal fixation.

Keywords: arthroscopy, Kirschner wire, outcome, radial head fracture

1. Introduction

Fractures of the radial head represent approximately 5.4% of all fractures, and 33% of elbow fractures.[1] These fractures are typically seen in isolation or with other fractures, dislocations, or soft tissue injuries.[2,3] The classification of fractures of the radial head was first done by Mason.[1] Options for treatment include nonoperative management, fragment or whole-head excision, reduction and internal fixation (RIF), and radial head arthroplasty.

Although the treatment options for type I and type III fractures are well-defined, controversy exists in treating type II fractures. The advent of arthroscopic surgical techniques has provided a novel approach to the treatment of radial head fractures. The well-known advantage of arthroscopy in contrast to open reduction and internal fixation (ORIF) is that the soft tissue is less traumatized. The goals of this study are to report an arthroscopic technique in the treatment of Mason type II radial head fractures using Kirschner wires (K-wires), and investigate the feasibility and evaluate the results.

2. Materials and methods

2.1. Patients

Eighteen patients with closed Mason type II radial head fractures were treated at the Chinese People's Liberation Army(PLA) General Hospital from August 2010 to May 2015. The study cohort consisted of 13 men and 5 women with a mean age of 30.6 years (range 17–45 years). The fractures were on the left side in 7 patients and right side in 11 patients. Injuries were caused by falling in 8 cases, by traffic accidents in 5 cases, and by sports in 5 cases. Patients were excluded from the study if they had prior elbow surgery, multiple ligamentous injuries, significant osteoarthritis, and interfering with the ability to proceed with the specified protocol.

Preoperative clinical and radiologic evaluations were done to assess the range of motion, pain, and to characterize the fracture radiologically. In every patient, computed tomography three-dimensional was done to determine the type of fracture and displacement. All cases were operated on by the same team. Clinical evaluation was carried out by 2 authors and the mean of each parameter was recorded in order to minimize intraobserver bias. The Mayo elbow performance score (MEPS), the Broberg–Morrey score, and the disabilities of the arm, shoulder, and hand

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(DASH) score were documented preoperative and sequential postoperative.

This study was approved by the institutional review board of our hospital, and informed consent was obtained from all patients. All activities associated in this study were performed in accordance with the ethical standards of the Institutional and/or National Research Committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

2.2. Surgical procedure

The time from injury to surgery ranged from 1 to 11 days, with a mean of 3.9 days. Patients received brachial plexus block anesthesia. We perform the procedure with the patient in the supine position with the shoulder placed in 90° of abduction and elbow placed in 90° of flexion and with 10 pounds of traction. Two portals are used, including the anteromedial working portals while the anterolateral portal accommodates the arthroscope. Surgical evaluation and arthroscopic fixation were performed by the senior author.

After a diagnostic elbow arthroscopy, the radial head fracture was evaluated using a probe to determine the degree of displacement. Debridement was made with shaver and radiofrequency probe. Reduction of the fracture was performed by leveraging the percutaneous 2.0 mm K-wire and a probe. After confirming of reduction, two 1.5 mm K-wires were inserted across the fracture line to maintain the reduction status. A length of 8 mm of the K-wire was reserved outside of the skin and bended for 90°.

2.3. Postoperative management and evaluation

Immediately postoperatively, all patients participated in a uniform rehabilitation protocol. The injured elbow was fixed at 90° of flexion using brace for 4 to 6 weeks. Exercise was encouraged after removal of the braces and K-wires. Anterior-Posterior and lateral x-rays of the affected elbow were performed at 1, 4, 12, and 24 weeks to confirm fracture healing. Clinical follow-up included measurement of flexion/extension, pronation/supination.

2.4. Statistical analysis

All quantitative data were analyzed using a rank sum test and are expressed as means ± standard deviation (SD). Statistical analyses were performed using SPSS 13.0 software (SPSS Inc, Chicago, IL). The level of significance was defined as $P = .05$.

3. Results

All the surgical wounds healed with primary closure, and none of the patients had neural injuries, wound infections, or pullout of the K-wire during the follow-up period. A total of 18 patients were followed up for a mean interval of 19 months (range: 14–29 mos). Bone union was achieved in all patients within a mean time of 11 weeks (range: 9–14 weeks). The implants were removed within a mean time of 7 weeks (range: 6–9 weeks).

At the last follow-up, the mean arc of motion in elbow flexion was 137.0° ± 8.9° on the injured side and 142.0° ± 6.3° on the uninjured side ($P > .05$). The mean arc of motion in forearm pronation-supination was 142.2° ± 7.2° on the injured side and 145.8° ± 5.7° on the uninjured side ($P > .05$) (Table 1). The mean Visual Analog Scale for these patients was 1.7 (range 0 to 3). According to the Broberg-Morrey score, there were 7 excellent, 9 good, 2 fair, and 0 poor results (with good or excellent results in 89%). The mean MEPS was 94.5 ± 3.3 (10 excellent, 8 good, 0 fair) and the mean DASH score showed an average of 8.2 ± 4.3 (12 excellent, 6 good, and 0 fair) (Fig. 1).

Table 1

Range of motion of postoperative and uninjured elbow joint.

	Postoperative	Uninjured elbow	P
Flexion–extension	137.0 ± 8.9	142.0 ± 6.3	>.05
Pronation–supination	142.2 ± 7.2	145.8 ± 5.7	>.05

4. Discussion

Radial head plays an important role in pronation and supination of the forearm and an important stabilizer of the elbow. Incomplete reduction of radial head fractures often results in elbow pain, limited flexion and rotation. The goals of treatment of radial head fractures have developed more and more towards restoring function and stability of the elbow. At present, treatment options for the radial head fractures include nonoperative management, reduction with fixation, and resection of radial head or radial head prosthesis replacement.[4,5] Indications for each depend on a variety of factors such as preoperative fracture classification, degree of comminution, displacement, degree of soft tissue injury, age, and the general condition of patients.[6,7]

Treatment of Mason type II fractures is still discussed controversial. Options include nonoperative management,[8] reduction and internal fixation. Guzzini et al[8] reported nonsurgical treatment of Mason type II radial head fractures in athletes resulting in a good or excellent mid-term functional outcome. However, in 11.53% of patients degenerative changes were noted in injured elbows when compared to uninjured elbows. At present, for Mason type II fractures ORIF has become the accepted treatment, because it reconstructs the normal anatomy of the radial head, and restores normal elbow function.[9] Kovar et al[10] analyzed 1047 patients suffering from fractures of the radial head or neck classified according to Mason and concluded that in type II to IV surgical intervention should be considered. However, ORIF may lead to significant postoperative pain, postoperative joint stiffness, heterotopic ossification, and other complications.[11,12]

Advances in surgical technique have broadened the indications and improved the safety of elbow arthroscopy.[13–15] Comparison of the arthroscopic method with the open technique showed a significantly shorter rehabilitation time for the arthroscopic surgical procedure. Currently arthroscopy is widely used in loose body removing, synovial resection, and cartilage resurfacing. The indications and surgical techniques still need further study. In our study, the results showed that the fractures were anatomically reduced and we achieved bony union. We observed good elbow function at follow-up. Although arthroscopic radial fracture reduction and fixation is a technically demanding procedure and requires the skill of arthroscopy, reduction under arthroscopy is more accurate and reduces the rate of osteoarthritis.

We limited the indications of arthroscopic intervention to Mason type II radial head fractures, because Type II fractures are relatively easy to reduce percutaneously. Rolla et al[16] reported arthroscopic treatment of fractures of the radial head in 11

Figure 1. A, a 32-years-old male patient with radial head fracture after traffic accident. AP x-ray shows a displaced bone fragment. B, an arthroscopic image showing a displaced bone fragment. C, the x-ray image obtained 1 week after stabilization showed correct reduction of fragment and fixation with 2 percutaneous K-wires. AP, anterior-posterior; D, x-ray image obtained 2 years after the operation.

patients. In their study, patients with Mason type III and type IV also achieved satisfactory results. However, the problems in this study are the small number of cases, and the difficulty of surgery. For type III and IV fracture it is a better choice to perform ORIF and even radial head resection or replacement. Michels et al[17] reported fourteen patients with Type II fractures treated with an arthroscopic technique. The follow-up was performed at average 5 years 6 months and they reported a satisfactory functional outcome. They fixed the fractures with Herbert screws, however as they noted that some fragments were too small to allow stabilization with screws. We used 2 percutaneous 1.5 mm K-wires for fixation, and achieved a satisfactory outcome. The arthroscopic technique has the advantages of the reduced infection rate, a good cosmetic aspect, and a limited exposition to x-rays.

There were some key points of this arthroscopic technique. First, Kaas et al[2] and Kodde et al[3] reported that Radial head fractures were usually accompanied by injury of the lateral collateral ligament and fractures of capitulum of humerus or coronoid process. The elbow should be carefully evaluated preoperatively. Second, the hematoma and cartilage debris within the joint should be debrided to evaluate the displacements of the fracture fragments. Third, postoperative active and passive functional exercise is the key to functional recovery. The brace was usually limited to 6 to 8 weeks to avoid the occurrence of elbow stiffness.

There are weaknesses in this study that include the retrospective design and lack of randomization. Nonetheless, we do not feel that these limitations significantly weaken our conclusions. In the future, controlled studies comparing conservative treatment or different fixation methods are needed to determine which treatment is associated with the lowest morbidity, more rapid rehabilitation, and higher patient satisfaction.

5. Conclusions

In summary, arthroscopic fixation of the Mason type II radial head fractures using K-wires is a safe procedure. This method is minimally invasive and provides good functional recovery with a lower risk of complications.

Author contributions

Conceptualization: J. Wang, W. Qi.
Data curation: J. Wang, W. Qi.
Formal analysis: J. Wang, W. Qi.
Investigation: S. Tao.
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Supervision: S. Tao, Y. Liu.
Visualization: X. Shen.
Writing – original draft: J. Wang, W. Qi, X. Shen.
Writing – review & editing: J. Wang, W. Qi.

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