RESEARCH ARTICLE

The Best Option in Treatment of Modified Mason Type III Radial Head Fractures: Open Reduction and Internal Fixation Versus Radial Head Excision

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Abstract

Background: Radial head fractures commonly occur during elbow traumas. Among those, treatment of Mason type III fractures is still under controversy. Common treatment methods for these fractures include open reduction and internal fixation (ORIF) as well as radial head excision. In this study, we compared long-term outcomes of both methods in treatment of patients with Mason type III fractures of radial head.

Methods: Fifteen men and five women with Mason type III radial head fractures were evaluated retrospectively. Ten patients had undergone excision whereas the other ten patients had been treated with ORIF. Outcomes were assessed based on stability and range of motion of the elbow joint, grip strength, and pain. Data were gathered using Mayo elbow performance index (MEPI), Oxford elbow score, and disability of arm-shoulder-hand (DASH), along with the short form (SF)-36 questionnaire.

Results: The mean age of the subjects was 36.25±9.22 years and the mean follow-up time was 25.05±11.43 months. The ranges of extension and supination, and frequency of pain reporting was significantly different between the groups. The average grip strength in the operated side was significantly higher in the ORIF group, compared with the excision (*P= 0.03*). Ten (100%) patients of ORIF group and 5 (50%) patients of excision group had elbow joint stability (*P=0.01*). Mean MEPI and DASH scores were significantly higher in ORIF group (*P<0.001* and *=0.04*, respectively).

Conclusion: The results are in favor of ORIF method. Therefore, this method is recommended and preferred over excision in treating radial heads with Mason type III fracture.

Level of evidence: III

Keywords: Excision, Mason type III, Open reduction and internal fixation, ORIF, Radial head fractures, Resection

Introduction

Radial head fractures comprise 4% of all fractures and 33% of elbow fractures (1). With an incidence of 2.8 cases per 10,000 each year, fractures of the radial head mostly involve working young adults Road Traffic accidents are among the major causes of these fractures (2). Ninety percent of radial head fractures

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are isolated and only 10% are accompanied by elbow dislocation, forearm instability, or another fracture (3, 4).

These fractures range from mild injuries with well-established treatments to complex and complicated fractures in which optimal treatment remains controversial. Modified Mason classification is the currently used method to classify the radial head fractures (5). Fractures of Mason type I and II can be treated non-operatively or by open reduction and internal fixation (ORIF), respectively (6). however, optimal surgical management of Mason type III and IV fractures remains controversial (7).

It has been generally accepted that radial head excision (radial head resection) is the preferred treatment option regarding dislocated and comminuted fractures of the radial head, especially for those blocking the joint motion (8, 9). However, its long-term complications, especially reduced grip strength, gradually resulted in limitation of its use (10). There are conflicting evidence suggesting radial head arthroplasty (RHA) as the preferred treatment in Mason type IV fractures, but the treatment for modified Mason type III fractures is still controversial (3, 11).

This study was performed to compare the outcomes of two common treatments among patients suffering from modified Monson type III isolated fractures of the radial head: ORIF and radial head excision.

Materials and Methods

This ethically approved case series study (ethical approval No.: 920708) was performed on 20 patients with diagnosis of modified Mason III comminuted radial head fractures who were admitted to orthopedic department of our level three Hospital between March 2006 and March 2015.

All patients were aged 18-60 years with isolated Monson type III fractures of the radial head, with no other accompanying fracture or dislocation, confirmed during operation. They were treated by either radial head excision or ORIF with miniplates and screws. Our exclusion criteria were pathologic fractures, open fractures, comminuted fractures with more than three fragments, and comorbidities (i.e. diabetes mellitus, infectious diseases, rheumatoid arthritis, osteoarthritis, multiple myeloma, and bone tumors).

All the patients who met our inclusion criteria were referred to Hand and Upper Extremity clinic for initial assessment. A written consent form was obtained from all patients. Physical and radiological examinations were performed for all patients during the follow-up visit. In addition, the grip strength was assessed by a sphygmomanometer cuff, the range of motion of the elbow (in flexion, extension, supination, and pronation) was measured using an orthopedic goniometer, and elbow joint stability was assessed by clinical tests and physical examination. The treatment success was objectively evaluated by the researcher using Mayo elbow performance index (MEPI) (12). Moreover, the participants filled in the short form (SF)-36 questionnaire, Oxford elbow score questionnaire, and disability of arm-shoulder-hand (DASH) questionnaire in order to evaluate the subjective aspect of the treatment success (13-15).

Oxford elbow score is a patient reported outcome measure with 12 items assessing the outcomes of elbow surgery. It has three domains (pain, elbow function, and social-psychological) and four questions in each. Its Persian version has been shown valid, reliable and responsive (13).

The SF-36 questionnaire consists of an 8-scale profile functional and psychometrical health measures used to investigate the quality of life, burden of diseases and health benefits of treatments. All elements are summarized in two major measures of physical component summary (PCS) and mental component summary (MCS). The Persian translated version of SF-36 questionnaire has already been validated (14).

The DASH is a questionnaire with 30 items, designed to evaluate symptoms and physical function of the patients suffering from musculoskeletal disorders of the upper limb, monitoring the symptomatic and functional changes in these patients. The cross-culturally adapted Persian translation of DASH questionnaire, which has been validated, was used (15).

Data were analyzed using SPSS, version 11.5 for Windows (Chicago, IL, USA). Since the number of patients were 20, we used nonparametric tests for continues variable, and Chi-Square test for nominal ones. *P values < 0.05* were considered as statistically significant.

Results

Of the twenty participants, 15 (75%) were men and five (25%) were women. The mean follow-up time was 25.05±11.43 months. The mean age was 36.25±9.22 years. Basic information of the subjects are presented in Table 1.

Ten patients (100%) of ORIF group and five patients (50%) of excision group had elbow joint stability (*P=0.01*). The two groups showed a significant difference regarding the frequency of elbow pain in the follow-up (*P=0.045*). Table 2 shows the detailed follow-up results on elbow pain, range of motion, and stability of the elbow.

The mean range of extension was 178±4.2 degrees in the ORIF group and 165±13.5 degrees in the excision group. The groups differed significantly considering the range of extension (*P=0.01*), as well as the range of supination (*P=0.047*). The average grip strength in the operated side was significantly higher in the ORIF group (*P=0.03*). Table 3 shows the detailed information on grip strength and range of flexion, extension, supination, and pronation.

The ORIF group had significantly higher scores in MEPI index, compared with the excision group (93.5±4.7 versus 83.5±7.8; *P<0.001*). There were significant differences between the groups regarding the mean scores of DASH (*P=0.04*) and the physical component of SF-36 (*P=0.04*). Detailed results of specific functional outcome measures are presented and compared between the two groups in Table 3.

Table 1. Patients characteristics

Variable		Group*		Total* (N=20)	*P***
		ORIF (N=10)	Excision (N=10)		
Age (years)		34.70±9.15	37.80±9.51	36.25±9.22	0.46
Sex	Male	8 (80%)	7 (70%)	15 (75%)	0.60
	Female	2 (20%)	3 (30%)	5 (25%)	
Side	Dominant	7 (70%)	5 (50%)	12 (60%)	0.65
	Non-dominant	3 (30%)	5 (50%)	8 (40%)	
Follow-up time (months)		22.20±7.88	27.90±13.98	25.05±11.43	0.28

ORIF: open reduction and internal fixation Group*
* Values are shown as No (%) or mean±standard deviation (SD), where appropriate.
** Wilcoxon test or Chi-square test are used and *P values <0.05* are considered statistically significant.

Table 2. Comparison of pain, joint stability and range of motion between the study groups

Variable		ORIF group (N(%))	Excision group (N(%))	*P**
Complaint of pain		1 (10%)	5 (50%)	0.045
Stability		10 (100%)	5 (50%)	0.010
ROM	>100 º	10 (100%)	8 (80%)	0.130
	50-100 º	0	2 (20%)	

ORIF: open reduction and internal fixation; ROM: range of motion
* Wilcoxon test or Chi-square test are used and *P values <0.05* are considered statistically significant.

Table 3. Comparison of results of functional measures between the open reduction and internal fixation (ORIF) group and the radial head excision group

Follow-up results		ORIF group (Mean±SD)	Excision group (Mean±SD)	*P**
Flexion (º)		137.00±6.74	135.00±7.07	0.520
Extension (º)		178.00±4.21	165.00±13.54	**0.010**
Supination (º)		88.00±4.21	81.00±9.66	**0.047**
Pronation (º)		76.50±6.68	71.00±7.37	0.090
Grip strength (mm Hg)	Affected	167.00±35.60	132.00±32.93	**0.030**
	Spaired	172.00±30.47	171.00±39.28	0.950
MEPI score		93.50±4.74	83.50±7.83	**<0.001**
DASH score		7.63±10.48	16.82±12.03	**0.040**
Oxford score		45.30±3.74	41.40±5.94	0.090
SF-36 score	PCS	57.42±1.93	53.06±5.82	**0.040**
	MCS	54.13±5.80	48.27±6.79	0.055

ORIF: open reduction and internal fixation; SD: standard deviation; MEPI: Mayo elbow performance index; DASH: disability of arm-shoulder-hand; PCS: physical component summary; MCS: mental component summary
* Wilcoxon test is used and *P values <0.05* are considered statistically significant.

Discussion

The optimal method for treating modified Mason type III comminuted radial head fractures has continuously been an issue of controversy. Excision of the radial head has been the preferred method in the treatment of comminuted multi-segment fractures of the radial head (9). However, this method has serious complications such as longitudinal radial migration, radio-ulnar convergence, elbow joint instability, and reduced grip strength that cause disability, especially in young manually active patients (5, 16).

ORIF, on the one hand, is a surgically demanding procedure and can be associated with complications such as early failure, nonunion, joint dysfunction and metaphyseal bone loss, which has made ORIF a less preferential option for Mason type III and IV fractures that are comminuted and completely displaced (5, 17). On the other hand, considering the favorable outcomes reported in previous studies and meta-analyses, ORIF has a high success rate in treating these fractures ORIF has also been reported to be the favorable treatment modality, composing over 20% of surgeries involving the elbow in the United States (18, 19).

In the present study, ORIF led to better improvement in range of extension, compared with excision, which is in line with the results of Ikeda et al. (17). In addition, we found that the range of supination was significantly higher in the ORIF group, compared with the excision group, which was also consistent with the findings of Ikeda and colleagues (17). However, the groups did not differ significantly regarding the range of flexion and pronation motions.

We found the mean grip strength of the operated hand to be 167 mmHg in the ORIF group and 132 mmHg in the excision group (*P=0.03*), which is thoroughly consistent with the results reported by Wilcke, Wei, Jeudy and Grewal with mean grip strength of 94%, 75%, 83% and 80% in the ORIF groups, respectively (19-23). These findings were also in line with the findings from a recent meta-analysis from Wang and colleagues that evaluated the advantages of ORIF for unstable fractures of the radial head (24).

Our post-operative findings showed that 100% of patients in the ORIF group had stable elbow joints whereas only 50% of patients in the excision group had stable elbow joints after operation. We also found that the frequency of the patients' complaint of pain after surgery was significantly higher in the resection group, compared with the ORIF group. Both of these findings were consistent with the results of Ikeda and colleagues (17).

In this study, the outcome evaluation demonstrated higher degree of function in patients undergone ORIF of the radial head. There are a number of similar recent studies such as the one carried out by Karlsson et al. who reported a mean score of 96.4 for MEPI and the study by Antuna et al. with the mean MEPI score of 95, reporting favorable outcomes obtained from radial head excision (25, 26). The mean DASH score in our patients after an average follow-up period lasting for 22.2 months was 7.63 in the ORIF group, which is concordant with the previous studies on patients with comminuted fractures of the radial head (24, 27).

The mean MEPI score in our excision group was 83.5. Inconsistently, recent results by Iftimie et al. showed a mean MEPI score of 98.6 in the patients undergone radial head excision following complex radial head fractures (28). Goldberg et al. have also reported good functional outcomes in patients undergone radial head excision (29). Possible etiologies for these inconsistencies might be because of the difference in the time of follow-up, inclusion of fracture types other than Mason type III that have different prognoses, or the difference in surgical techniques.

This study has several limitations. The major limitations are its observational and retrospective design. The differences in baseline characteristics, which could not have been recorded, could have affected the treatment outcomes. Another limitation is our relatively short follow-up period. A long-term follow-up would have obtained stronger evidence. Moreover, a bigger sample size would have yielded more accurate results and significant differences.

In conclusion, clinical outcomes for elbow joint stability, grip strength, pain frequency, and range of extension and supination motions were in favor of ORIF, compared with radial head excision, which is also associated with more complications. Therefore, it is recommended for orthopedic surgeons to perform open reduction and internal fixation in cases with comminuted unstable Mason type III fractures of the radial head.

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