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Original Research Article

Osteosynthesis, arthroplasty or resection of the radial head-which guarantees the best results in Mason III radial head fractures?

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ABSTRACT

Background: Fractures of the radial head are common, accounting for approximately one third of elbow fractures and 4% of all fractures. The most accepted classification is modified Mason, with type III being comminuted fractures, normally requiring surgery. There is currently no consensus on the most effective treatment method.
Methods: This study aims to compare the radiological and functional results of Mason III fractures, treated at our hospital between 2017 and 2022. During this period, 23 patients were surgically treated with osteosynthesis, arthroplasty or resection of the radial head. Inclusion criteria (isolated fractures of the radial head with follow-up of more than 6 months) and exclusion criteria (neurovascular, ligament injuries/ other associated fractures) were considered. Functional assessment was based on Broberg-Morrey elbow score; Mayo elbow performance score (MEPS) and QuickDASH.
Results: The differences in functional results between the various treatments were not statistically significant ($p>0.05$), despite the best results being seen in the arthroplasty group.
Conclusions: In our series there was a 47.82% complication rate. Five patients developed heterotopic ossification. Which was significantly higher than expected in the arthroplasty treatment group, with a statistically significant difference; but there was no translation in functional terms, since this group achieved the best functional scores. The group of patients who underwent osteosynthesis were those with the worst functional scores and the most complications (3 cases of post-traumatic arthrosis, 3 nonunions and 1 aseptic necrosis). Our series is small, but the results are similar to previous studies.

Keywords: Radial head fractures, Mason III, Arthroplasty, Osteosynthesis, Resection arthroplasty, Functional outcomes

INTRODUCTION

Radial head fractures (RHFs) are frequent, the majority of the studies shows that this type of fracture represent one-third of elbow fractures and 4% of all fractures, so, it constitutes a significant portion of elbow traumatic injuries in adults.[1,2]

Most of this fracture occurs in 3rd/ 4th life decade and are due to indirect trauma where patient falls with outstretched arm with elbow in pronation and partial flexion.[1-4]

Biomechanically, the radial head is a secondary valgus stabilizer of the joint especially when the medial collateral ligament is incompetent.[5] It perform the role of the main stabilizer of the elbow if coronoid is fractured, the medial collateral ligament is incompetent/LUCL is injured.[3]

The most accepted classification for this type of fractures is the modified Mason classification. Mason I are stable, marginal and non-displaced fractures that are commonly treated with conservative treatment. Mason II includes marginal fractures with more than 2 mm of displacement

and where the pronosupination could be affected. If this is the case, osteosynthesis (ORIF) is advised, if there is no mechanical block, the conservative treatment could be followed. Mason III and IV are comminuted or displaced fractures that need surgical intervention.

In a generic way, in young and active patients ORIF or radial head replacement (RHP) should be chosen.[1] Some authors defend that in re-constructible radial head fracture, ORIF should be tried while unreconstructible fractures should be addressed by arthroplasty. Resection of radial head is reserved for the low demanding patients, without instability and in most of cases, after a failed alternative management.[1,3,6]

However, there is no consensus about what surgical procedure that should be chose, especially due to residual instability from this type of injury.[1,3,4]

With this in mind, the purpose of this retrospective study is to compare the radiologic and functional results of Mason III fractures, treated in our hospital in the last 5 years with ORIF, arthroplasty (RHP) and radial head resection (RHR) as well as the complications registered.

METHODS

Sample characterization

It was a retrospective study with twenty-three patients with isolated comminuted RHF who were surgical treated in centro hospitalar e universitario de Coimbra between 2018 to 2022 who underwent surgical treatment.

To achieve this database, some inclusion criteria were applied, such as, isolated RHF who had at least 6-month follow-up. The exclusion criteria were the neurovascular or ligamentous lesions, other fractures and patients with less than 6-month of follow-up.

After applying the exclusion criteria, the number obtained was 23 patients, 11 treated with osteosynthesis, 7 with resection arthroplasty and 5 with RHP.

All patients were advised that they would have to undergo immediate postoperative rehabilitation. Follow-up appointments were based on a clinical and radiological assessment and at 1, 3 and 6 months post-operatively.

Physical examination included the measurement of active range of motion (AROM) as flexion, extension, pronation and supination with the use of a goniometer. Functional outcomes were assessed using the Broberg-Morrey elbow score (0-100 points) and the MEPS (0-100 points). Subjective patient's satisfaction was evaluated by using the QuickDASH. Moreover, X-rays in standard anteroposterior and lateral views of the elbow joint were taken and analyzed.

Results were based on the rate of pseudarthrosis, aseptic necrosis, post-traumatic arthritis, heterotopic ossification, and functional outcomes. These were evaluated according to Broberg-Morrey elbow score, MEPS and QuickDASH. Ethical approval was obtained for all patients.

Statistical analysis

Statistical analysis involved descriptive statistics measures (absolute and relative frequencies, means and respective standard deviations) and inferential statistics.

In this, the Anova One-Way test, the Kruskal-Wallis test and the chi-square independence test were used.

Distribution normality was analyzed using Shapiro-Wilk test and distribution homogeneity using Levene test.

Chi-square assumption that there should be no more than 20% of cells with expected frequencies less than 5 was analysed. In situations where this assumption was not satisfied, chi-square test used by Monte-Carlo simulation.

Differences were analyzed with support of standardized adjusted residuals. The significance level to reject the null hypothesis was set at $\alpha \leq 0.05$.

Statistical analysis was performed using SPSS software (Statistical package for the social sciences) version 28.0 for Windows.

RESULTS

The mean age was 48.7 years, ranging from a minimum of 21 to a maximum of 83 years. The groups were equivalent in terms of age, f (2, 20)=3337, p=0.056.

Table 1: Sample characterization, (n=23).

Variables	N	Mean	SD
Arthroplasty	5	51.40	12.89
Resection arthroplasty	7	58.57	15.36
Osteosynthesis	11	41.18	13.91
Total	23	48.70	15.60

Functional results (Mayo elbow performance score, Broberg-Morrey and QuickDASH), flexion, extension, pronation and supination.

Differences in functional outcomes depending on the type of treatment are not statistically significant (p>0.05).

Complications

We found the following statistically significant differences: In the arthroplasty treatment, the proportion of subjects with heterotopic ossification is significantly higher than expected, χ^2 (2)=13.952, p=0.002.

Table 2: Functional results.

Variables	Arthroplasty		Resection arthroplasty		Osteosynthesis		Sig.
	Mean	SD	Mean	SD	Mean	SD	
MEPS	85.00	10.00	84.29	7.87	82.50	10.11	0.723
Broberg-Morrey	84.20	9.71	82.29	8.10	78.13	11.49	0.329
QuickDASH	6.94	6.22	14.59	7.99	14.90	10.05	0.127
Flexion	122.00	13.04	122.86	7.56	119.17	9.96	0.648
Extension	-13.00	10.95	-9.28	3.45	-13.33	11.34	0.799
Pronation	82.00	8.37	87.14	4.88	83.75	5.28	0.324
Supination	79.00	10.25	71.43	19.52	69.58	14.37	0.578

Table 3: Complications.

Variables	Arthroplasty		Resection arthroplasty		Osteosynthesis	
	N	%	N	%	N	%
Post traumatic arthritis	0	0.0	0	0.0	3	25.0
Pseudarthrosis	0	0.0	0	0.0	3	25.0
Aseptic necrosis	0	0.0	0	0.0	1	8.3
Heterotopic ossification	4	80.	1	14.3	0	0.0

DISCUSSION

There is no consensus about what surgical procedure should be chose.[1,3,4] However, the main goals of treatment are to restore forearm and elbow stability, to preserve forearm and elbow motion and to maintain the relative length of the radius. Some authors advise that we should preserve the native radial head, whereas others believe that the most important is to restore of the radiocapitellar contact, what we could achieve with radial head arthroplasty.

The radial head is essential for elbow biomechanics.[7,8] It is the primary restraint to the proximal migration of the radius and, therefore, contributes to elbow and forearm stability.[9] It is also important for forearm rotation and elbow flexion and extension. Early treatment included radial head excision but due to a high complication rate, this option is rarely indicated.[7] This treatment option can lead to distal radioulnar joint arthritis, elbow instability, increased elbow valgus, which might lead to ulnar nerve neuropathy symptoms and reduction in elbow extension.[10,11]

King et al in their study advised ORIF if stable reduction is obtained. If it not obtained, RHP or resection should be performed.[12] Therefore, attempts to maintain the radial head by open reduction and internal fixation was a popular treatment option with satisfactory results.[13-16] However, many studies describe high rate of complications such as aseptic necrosis, nonunion, failure of fixation and less than 100º of forearm ROM in ORIF group.[15,17] Chen et al and Ikeda et al reported significantly better functional results and less complications in ORIF group when compared to resection group.[16,18,19]

Beingessner et al studied the biomechanical effects of radial head excision and prosthetic arthroplasty on elbow kinematics in a cadaver model and they concluded that head replacement improves stability but still does not return the elbow to its normal function.[20]

Comparing RHR and RHP, Facco et al in their study concluded that RHP had better functional results specially in supination.[1]

The majority of the studies about radial head arthroplasty reported an excellent or good results, with some patients had radiographic lucency around the prothesis but only a minority of them correlated with pain.[21-23]

The most common complication of RHP was pain and functional deficits, that are correlated with radio-capitellar joint overstuffing.[6,23]

Sun et al in their meta-analysis comparing ORIF versus RHP treatment for Mason type III RHFs found higher satisfaction rate, better Broberg-Morrey elbow score and MEPS results, shorter operation time, lower incidence of bone nonunion or absorption and lower internal fixation failure in patients treated with RHP.[24]

Zwingmann et al in their meta-analysis of a total of 302 patients compared all the three treatments and concluded that ORIF obtained a success rate of 92% and has proved superior to other techniques although the results were not statistically significant (p=0.266).[25] Facco et al defend that RHP obtained better results in ROM evaluation, while ORIF showed the worst results between the three techniques, with higher revision rate or implant removal rate, but with no superiority of one technique compared to the other (p>0.05).[1]

Our study reached similar conclusions of the above-mentioned studies. We found no statistically significant differences (p>0.05) in functional outcomes depending on

the type of treatment, however, arthroplasty achieved better MEPS, Broberg-Morrey and QuickDASH scores and better supination.[1,24] The ORIF group reach the worst functional scores, despite of not being statistically significant difference.[1,15,17,24] With regard to the complications, the only statistically significant differences was found in the arthroplasty treatment, with the high proportion of subjects with heterotopic ossification. Nevertheless, this complication doesn't seem to be symptomatic since this group achieved the best functional scores. The ORIF group registered 3 patients with post-traumatic arthritis, 3 patients with pseudarthrosis and 1 with aseptic necrosis out of a total of 11 patients. And as we had seen, this group was also the group with worst functional scores, in spite of not being statistically significant difference, this could mean that these complications could be more relevant than heterotopic ossification.

This study has some limitations such as: it was a retrospective and non-randomized study; each group counts with a small number of patients; the follow-up was not accepted by all patients; was only with a relatively short follow-up; the ORIF group contemplate patients with different kinds of fixation such as, isolated screws or plates and the RHP group doesn't take into account the type of prothesis that is used. More studies that are prospective, especially with large samples in each group are desirable to achieve more reliable conclusions about this matter.

CONCLUSION

In spite of the best way to treat this fracture remains unclear it is possible to see, that some stereotypes are true and are present in the majority of the studies, such as ORIF achieve worse functional results and more complications, mainly because the comminution and risk of devascularization, but with no statistically significant differences. RHR is more suitable for older patients, with lower functional demands, since achieve worse ROM, especially in supination. RHP achieve better outcomes in majority of the patients, with comminuted fractures, with low complication rate, but it is extremely important to not overstuffing the radiocapitellar space with a too large prothesis, since it will decrease significantly the results.

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REFERENCES

1. Facco DSG, Setaro PLN, Martiniani LSM. Mason type III fractures of the radial head: ORIF, resection or prosthetic replacement ? Musuloskeletal Surg-Springer. 2022;123456789.
2. Kovar FM, Jaindl M, Thalhammer G, Rupert S, Platzer P, Endler G, et al. Incidence and analysis of radial head and neck fractures. World J Orthop. 2013;4(2):80-4.
3. Contreras-Joyaa M, Jiménez-Martína A, Santos-Yuberoa FJSN-M, Najarro-Cida FJ, Sánchez-Sotelo SP-H. Radial head arthroplasty, 11 years' experience: A series of 82 patients. Rev española cirugíía ortopédica y Traumatol. 2015;59(5):307-17.
4. Mason ML. Some observations on fractures of the head of the radius with a review of one hundred cases. Br J Surg. 1954;42(172):123-32
5. Morrey BF, An KN, Stormont TJ. Force transmission through the radial head. JBJS. 1988;70(2):250-6.
6. Clembosky G, Boretto JG. Open Reduction and Internal Fixation Versus Radial Head. J Hand Surg Am. 2009;34(6):1120-3.
7. Hotchkiss RN, Weiland AJ. Valgus Stability of the Elbow. J Orthop Res. 1987;5(3):372-7.
8. Hall JA, McKee MD. Posterolateral rotatory instability of the elbow following radial head resection. J Bone Joint Surg Am. 2005;87(7):1571-9.
9. Stuffmann E, Baratz ME. Radial Head Implant Arthroplasty. J Hand Surg Am. 2009;34(4):745-54.
10. Ruan H, Fan C. A comparative study of internal fixation and prosthesis replacement for radial head fractures of Mason type III. Int Orthop. 2009;33(1):249-53.
11. Geel CW, Palmer AK. Radial head fractures and their effect on the distal radioulnar joint. A rationale for treatment. Clin Orthop Relat Res. 1992;(275):79-84.
12. King GJ, Zarzour ZD, Patterson SD, Johnson JA. An anthropometric study of the radial head: implications in the design of a prosthesis. J Arthroplasty. 2001;16(1):112-6.
13. Kelberine F, Bassères B, Curvale G, Groulier P. Fractures of the radial head. Analysis of a series of 62 surgically treated cases. Rev Chir Orthop Reparatrice Appar Mot. 1991;77(5):322-8.
14. Ring D. Displaced , unstable fractures of the radial head : Fixation vs. replacement-What is the evidence ? Inj Int J Care Inj. 2008;39(12):1329-37
15. Ring D, Quintero J, Jupiter JB. Open reduction and internal fixation of fractures of the radial head. J Bone Joint Surg Am. 2002;84(10):1811-5.
16. Chen J, Zhang B, Su J, Li Q, Cao L. Open reduction and internal fixation versus resection for radial head fractures : a meta-analysis. Int J Clin Exp Med. 2016;9(2):2076-84.
17. Heim U. Combined fractures of the radius and the ulna at the elbow level in the adult. Analysis of 120 cases after more than 1 year. Rev Chir Orthop Reparatrice Appar Mot. 1998;84(2):142-53.
18. Ikeda M, Sugiyama KM, Kang C, Takagaki T, Oka YPI. Comminuted Fractures of the Radial Head. J Bone Jt Surg. 2005;87(1):76-84.
19. Ikeda M, Sugiyama K, Kang C, Takagaki T, Oka Y. Comminuted fractures of the radial head: comparison of resection and internal fixation. Surgical technique. J Bone Joint Surg Am. 2006;88(1 Pt 1):11-23.
20. Beingessner DM, Dunning CE, Gordon KD, Johnson JA, King GJW. The effect of radial head excision and arthroplasty on elbow kinematics and stability. J

Bone Joint Surg Am. 2004;86(8):1730-9.
21. Grewal R, MacDermid JC, Faber KJ, Drosdowech DS, King GJW. Comminuted radial head fractures treated with a modular metallic radial head arthroplasty. Study of outcomes. J Bone Joint Surg Am. 2006;88(10):2192-200.
22. Harrington IJ, Sekyi-Out A, Barrington TW, Evans DC, Tuli VM. The Functional Outcome with Metallic Radial Head Implants in the Treatment of Unstable Elbow Fractures. J Trauma Inj Infect Crit Care. 2001;50(1):46-52.
23. Doornberg BJN, Parisien R, Ring D, Service UE, General M, Boston H. Radial Head Arthroplasty with a Modular Metal Spacer to Treat Acute Traumatic Elbow Instability. J Bone Jt Surg. 2007;89(5):1075-80
24. Sun H, Duan J, Li F. Comparison between radial head arthroplasty and open reduction and internal fixation in patients with radial head fractures (modified Mason type III and IV): a meta-analysis. Eur J Orthop Surg Traumatol. 2016;26(3):283-91.
25. Zwingmann J, Welzel M, Dovi-Akue D, Schmal H, Südkamp NP, Strohm PC. Clinical results after different operative treatment methods of radial head and neck fractures: a systematic review and meta-analysis of clinical outcome. Injury. 2013;44(11):1540-50.

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