

Radial Head Fractures – An Instructional Review Of Current Concepts Of Management

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Abstract

Fractures of the radial head constitute a common injury pattern in adults. Although there is consensus regarding their classification, which is evident by the reproduction of the original classification system described by Mason and later modified by Johnston in the majority of the published articles, in terms of management the situation differs. Apart from the Mason I fractures which should be treated conservatively, different therapeutic approaches have been proposed for the more complex fracture types. These include identification of the presence of instability or mechanical block both of which warrant operative intervention, excision of the radial head alone or with replacement and open reduction and internal fixation of the fracture. A review of the relevant literature identifying the different trends and approaches is presented along with the current concepts in management. We propose a treatment algorithm for the optimal treatment of these common fracture types.

INTRODUCTION

Fractures of the radial head represent a common entity accounting for 33% of all elbow fractures (1-2). The typical mechanism involves the application of an axial load to the forearm by a direct fall onto the outstretched hand with the elbow in the extended and the forearm in the supinated position or by subluxation from a posterolateral rotatory movement which lead the radial head to hit against the capitellum of the humerus. The resultant fractures vary from the undisplaced ones to the more comminuted with the possibility of associated elbow instability patterns (3-4). The latter are usually caused by high energy trauma which ruptures the distal radioulnar joint and the interosseous membrane, an injury pattern referred to as the Essex-Lopresti lesion (5).

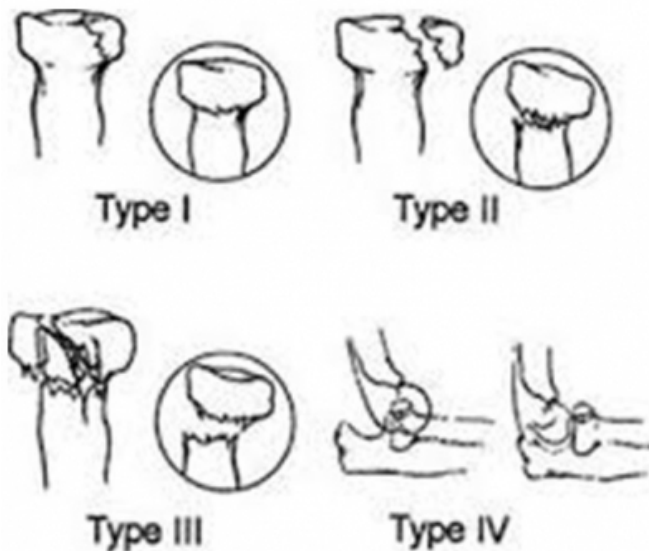
CLASSIFICATION

Several classification schemes have been introduced with the most widely used being that described by Mason (6). In his original article, Mason proposed a classification system in an attempt to provide a guide for optimal management. After evaluating the results of conservative and operative management of every radial fracture pattern in a period of 26 months' follow-up in terms of restoration of radiographic alignment, pain, range of motion, abstinence from and return

to work, he categorized the fractures into 3 types. Type I included all the undisplaced fractures, type II described the marginal fractures with displacement including impaction, depression and angulation and type III referred to the comminuted fractures involving the entire radial head. Johnston modified the original Mason classification adding a fourth type describing fractures associated with dislocation of the elbow (Fig. 1) (7). Despite the fact that it has been 60 years since its original presentation and the criticism about its reliability with the most recent being that from Ianuzzi reporting medium interobserver and intraobserver reliability and limited prognostic value, it is still the most widely accepted and used classification scheme in the literature (8).

Figure 1

Mason classification of fractures of the radial head as modified by Johnston. (from Broberg MA, Morrey BF. Results of treatment of fracture-dislocations to the elbow. Clin Orthop Rel Res 1987;216:109-119).



MASON I FRACTURES

All the undisplaced fractures of the radial head should be managed conservatively, providing that they are stable (2,9-13). This is the only type of the Mason classification where there is consensus regarding the optimal management. After a short period of immobilization, less than a week, with either a sling and swathe or a below-elbow back-slab the patient should resume stretching exercises of the elbow to avoid the impending stiffness due to contracture of the articular capsule associated with prolonged immobilization (14). Of note is the documentation of a recent study by Kaas that almost 70% of stable fractures of the radial head were associated with MRI evidence of ligamentous injury. Nevertheless, the functional outcome in terms of range of motion and the Mayo Elbow Performance Index remained unaffected (15-16). Furthermore, the incidence of symptomatic arthritis of the radiocapitellar joint following this fracture pattern is rare (17-19).

MASON II FRACTURES

The main dilemma regarding the management of Mason II fractures is whether to accept the displacement and continue with conservative management or to intervene surgically. The key to answering that is the presence of a mechanical block to elbow rotation.

There are many authors who advocate non-operative management of the stable pattern of these fractures, as the

long-term results are satisfactory (36, 39-43). Early active movement is essential to overcome the potential stiffness with good results up to 85% to 95% of patients (3, 43-45).

A mechanical block to forearm rotation constitutes the only clear indication to proceed with ORIF (3, 46-47). In the literature, the results after treatment of Mason II fractures with ORIF are reported to be good to excellent; Khalfayan 90% excellent results in 10 patients, Ring 93% good or excellent in 30 patients, King 100% good or excellent in 8 patients, Meier-Maccotty 90% good or excellent in 97.1% of cases and similar results according to Geel (46 patients) and Esser (11 patients) (44, 48-52).

The most recent article comparing ORIF versus excision of radial head for isolated Mason type-II fractures is from Zarattini, 2012. This was a retrospective study of 59 patients with a mean follow-up of 157 months. The results favored ORIF with patients in this group having achieved less residual pain, better strength and range of motion and lower incidence of severe posttraumatic osteoarthritis (53).

MASON III FRACTURES

-Radial head excision

In the past, following an initial failed attempt of conservative management the preferred option was that of radial head excision (6-7, 20-23). It was not until early 80s that the role of radial head as a secondary stabilizer of the elbow was appreciated (24-25). In cases of intact medial and ulnar collateral ligaments and interosseous membrane, the head of the radius acts as a secondary stabilizer to valgus stresses and approximately 60% of the load of the forearm can be transmitted through its surface (26-28). However, the situation changes when either of the ligaments or the interosseous membrane is torn, as the radial head then assumes the role of primary stabilizer and therefore is subjected to supraphysiological loads. A second role is attributed to the radial head as it provides stability to the distal radio-ulnar joint in resisting forearm axial forces (29-30). The combined injury to the interosseous ligament and the triangular fibrocartilage complex leading to axial instability of the forearm has been well recognized and defined as the Essex-Lopresti lesion (5).

Radial head excision, in case of associated ligamentous injury, can lead to chronic lateral instability of the elbow as the lack of the ulnar bony support normally provided by the radial head will result in long-term overloading of the medial collateral ligament and its subsequent failure as well as in an

increase in the carrying angle (26). A subgroup of patients who presented with posterolateral instability after radial head resection was identified by Hall, further emphasizing the need for accurate recognition of the unstable fracture patterns (54). Later findings include loss of range of motion of the elbow, radiologic evidence of osteoarthritis, pain and symptoms from ulnar nerve compression (1, 55). Additionally, the overall risk of subsequent dislocation of the elbow is increased (36). Further proximal migration of the radius, which was first described by Brockman in 1931, can lead to distal radioulnar joint subluxation with degenerative changes of the wrist joint (31-35). Of note, it has been reported that the degree of subsequent presence of degenerative radiologic findings after radial head excision does not correlate with the functional outcome of those patients (56). If delayed radial head excision is performed after an initial period of conservative management in case of stable patterns, then there has been found no difference between early and delayed excision in terms of elbow function (40).

In the case of concomitant coronoid fracture, the radial head should not be excised as that would lead to valgus instability. Every effort should be made to reconstruct the radial head with the alternative of its replacement in case it is proved to be impossible to fix (20, 36-38).

-Identifying instability patterns

There is evidence that Mason-III fractures are associated with medial or lateral collateral ligament or interosseous membrane injury in more than three quarters of cases (57-58). Nevertheless, the percentage of those fractures that have concomitant instability of the forearm, dislocation or fracture is less than 10% (59-61). Therefore, it is essential to diagnose the unstable fracture patterns, as this will guide the management decision.

It is important to document preoperatively the presence of bruising and associated tenderness on palpation of the medial collateral ligament, interosseous membrane and distal radio-ulnar joint, as this would raise the suspicion of an injury to these areas with possible instability.

Intraoperatively, the push-pull test is a reliable examination to evaluate a competent interosseous membrane and the associated longitudinal stability of the forearm. It involves the application of axial traction along with compression of the hand and wrist while observing for a change more than

3mm of the distance between the capitellum and the radial neck, after the radial head has been excised (62).

The integrity of the medial collateral ligament can be tested by applying a valgus force to the elbow which is flexed at 30°. If the distance between the capitellum and the radial neck, as the radial head is already resected, is reduced by 2mm then the anterior band of the medial collateral ligament is torn.

-ORIF

The design of new implants and instrumentation has raised the possibility of successful reconstruction in terms of anatomic alignment, stability and elbow motion (44-45, 49-50, 63, 68). The degree of comminution is a factor that should be evaluated preoperatively since there is evidence that the more comminuted the radial head is, the less satisfaction the patient report (46).

Ikeda et al, have concluded that open reduction and internal fixation of the Mason type-III fractures have superior outcomes in terms of joint motion, strength and elbow function comparing to those who underwent resection (64). Furthermore, according to the results of a large meta-analysis with a total of 1264 patients, Zwingmann reported a success rate of 92% in case of open reduction and internal fixation with screws, biodegradable pins or plates (65). Cooney has also recommended open reduction and internal fixation comparing to resection, if anatomic realignment can be achieved (69).

On the contrary, there are trials having reported low success rates after open reduction and internal fixation of these fractures. Ring et al, presented their series of open reduction and internal fixation of 26 cases, 10 of which required removal of the hardware due to chronic pain or fixation failure and 5 of the remaining had an unsatisfactory functional outcome (49). Similar results have been reported by Cai et al who showed 22% satisfaction rate and Heim et al with a failure to heal rate more than 50% (66-67).

-Radial head replacement

Radial head replacement is the preferred method of management in cases of failure to reconstruct the comminuted radial head with associated elbow instability. Two of the most recent articles regarding these types of

fractures, conclude that radial head replacement achieves favourable results (14,70). When axial or valgus instability is evident, then the use of radial head prosthesis is indicated (71-73).

There are many different types of radial head prosthesis including monopolar, bipolar, press-fit, cemented, silicone, pyrocarbon and metallic ones. Metallic prosthesis is the most widely used as it has been shown to reproduce the normal elbow kinematics better than the elastic ones (74-75). In the case of associated elbow instability, the inherent stiffness of the metallic head can withstand the increased forces acting on the radiocapitellar joint better than the silastic ones.

However, Morrey has suggested that the reconstruction of the medial collateral ligament which is the primary restraint at valgus stress can reduce those forces and thus, increase the rate of success of the silastic head (76). On the contrary, silastic prostheses have been involved in the production of synovitis by their fragmentation over time (31, 77-78). One of the major differences between the bipolar and the monopolar prostheses is the fact that the former achieve better congruency with the capitellum thereby decreasing the forces at the radiocapitellar joint with the disadvantage of less stability and osteolysis due to polyethylene wear and that the latter achieve better stability with the expense of asymptomatic bone loss at the radial neck (79-85).

Furthermore, the optimum position of the prosthesis along with the radial neck cut is of great importance since a cut that is too little would result in stiffness and pain and a cut that is too much would result in instability (86). It should be noted that there are studies that have shown that metallic prostheses are associated with reduced strength and range of motion (87-89).

MASON TYPE IV

In the case of the more complicated type III fractures, reduction should be attempted first and then it should be managed as a type III fracture. Due to the unstable pattern of this injury, it should be managed with either open reduction and internal fixation or excision and arthroplasty. Better results have been reported with open reduction and internal fixation (65). Should excision and replacement with a prosthesis be undertaken, then the outcomes favor primary to secondary implantation (65).

CONCLUSION

Despite the large number of studies available, there is lack of consensus regarding the optimal management of radial head fractures, except for the undisplaced stable fractures that

should be treated conservatively. We present a treatment algorithm for the optimal management of these fractures based on the available literature and our experience (Table 1). Nevertheless, further research in the form of prospective randomized trials comparing the results of conservative, open reduction and internal fixation and radial head replacement therapy is needed in order to identify the best management of individual fracture patterns.

Table 1

Proposed algorithm for the management of radial head fractures.

	Management
Mason I	Conservative
Mason II	Conservative, unless: <ul style="list-style-type: none"> • Mechanical block without instability → ORIF or excision of fragment • Mechanical block with instability → ORIF +/- ligament reconstruction
Mason III	Surgical: <ul style="list-style-type: none"> • ORIF +/- ligament reconstruction or • Excision and arthroplasty +/- ligament reconstruction
Mason IV	Reduce and treat as Mason III

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