Mason Type I Fractures of the Radial Head

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Abstract

Mason type I fractures are the most common fractures of the radial head. These fractures have a benign character and often result in good, pain-free function. Nevertheless, up to 20% of patients with a Mason type I fracture report loss of extension and residual pain. Currently, there is a lack of consensus concerning diagnosis and treatment of these fractures. The goal of this study was to systematically review incidence, diagnosis, classification, treatment, and outcome of Mason type I radial head fractures in adults and establish an evidence-based treatment guideline. A search of the MEDLINE, EMBASE, and Cochrane databases was conducted for English titles without restrictions on publication date. The authors included titles that addressed Mason type I radial head fractures and covered incidence, diagnostics, treatment, or functional or patient-related outcome. Included were randomized controlled trials; case-control studies; comparative cohort studies; case series with more than 10 patients; and expert opinions. Reference lists were cross-checked for additional titles. The search yielded 1734 studies, of which 95 met the inclusion criteria. Seven studies showed that the elbow extension test has a high sensitivity (88.0-97.6) to rule out Mason type I radial head fractures. If radiography is required, antero-posterior and lateral radiographs suffice. For pain relief, hematoma aspiration seems safe and effective. Mason type I fractures are best treated with 48 hours of rest with a sling, followed with active mobilization. Cast immobilization should be avoided. Mobilization should be encouraged and if needed supported by physical therapy. [Orthopedics. 2015; 38(12):e1147-e1154.]
Fractures of the radial head account for one-third of all fractures around the elbow and have an incidence of 2.5 to 2.8 per 10,000 adults per year.\textsuperscript{1,2} Radial head fractures are most commonly categorized according to the Mason classification.\textsuperscript{3} This classification is based on conventional radiographic findings: type I fractures are nondisplaced or minimally displaced fractures, type II fractures are displaced (more than 2 mm) fractures, and type III fractures are comminuted fractures.\textsuperscript{3}

The vast majority of radial head fractures (64\%-82\%) are Mason type I fractures.\textsuperscript{1,2,4} Currently, there is a lack of consensus concerning diagnosis and treatment of Mason type I fractures.\textsuperscript{5}

Mason type I radial head fractures have a benign character and often result in good, pain-free function. Nevertheless, up to 20\% of patients with a Mason type I fracture report loss of extension and residual pain.\textsuperscript{5-11} The current authors believe that an evidence-based guideline may optimize diagnosis, treatment, and outcomes in patients with Mason type I radial head fractures. Therefore, the goal of this study was to systematically review the literature on the diagnosis, treatment, and outcome of Mason type I radial head fractures in adults and establish an evidence-based diagnosis and treatment guideline.

\textbf{Materials and Methods}

This systematic review was conducted according to Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines.\textsuperscript{12}

\textbf{Data Sources}

With help from a clinical librarian, a search of the MEDLINE, EMBASE, and Cochrane Central Register of Controlled Trials databases was conducted on June 24, 2014, for studies that included the term \textit{Mason type I or nondisplaced radial head fracture} and reported incidence, diagnostics, treatment, or functional or patient-related outcomes. \textbf{Table 1} details the full search strategy of the MEDLINE database. Duplicates were identified and removed using Reference Manager 12.0 (Thomson Reuters, New York, New York).

\textbf{Study Selection}

Two reviewers (R.M.K., M.M.J.W.) independently reviewed all titles and abstracts for relevance. If the title and abstract did not provide sufficient information, the full text was examined. Studies were included if they addressed nondisplaced or minimally displaced radial head fractures without comminution and if they reported one of the following: incidence, diagnostics, treatment, or functional or patient-related outcomes. Publication language was restricted to English. To ensure a full overview of available evidence, randomized controlled trials (RCTs); case-control studies; comparative cohort studies; case series with 10 or more cases; and expert opinions were included. Studies were excluded if they (1) focused on pediatric or radial neck fractures, (2) addressed Mason type I fractures as part of a more complex injury, or (3) did not specify exact fracture details. Disagreement was resolved by means of discussion between the 2 reviewers. Subsequently, full-text articles were...
Data Extraction/Synthesis

All titles were organized per category. Data were extracted from eligible studies using a data collection form. Items included general information (authors, year, journal), study type, and focus of study. For each category (incidence, diagnostics, treatment, or functional or patient-related outcome), the level of evidence was determined using the Oxford Centre for Evidence-based Medicine Levels of Evidence (March 2009). Levels of evidence and grades of recommendations were given as used by the National Guideline Clearinghouse. Recommendations are summarized in boxes with levels of evidence.

RESULTS

The search yielded 1734 original titles, of which 95 were included in the analysis (Figure 1).

Study Characteristics

The majority of the articles included in this study were cohort studies (Table 2). All titles were organized according to the following categories: incidence, diagnostics, treatment, or functional or patient-related outcome. The results are described per category.

Incidence

Mason type I fractures of the radial head account for 64% to 82% of all radial head fractures and up to one-fourth of all fractures around the elbow. For all types of radial head fractures combined, there is a male to female ratio of 2:3, with a higher mean age for female patients (range, 48-54 years) as compared with male patients (range, 37-41 years). Osteoporosis is mentioned to be the cause of this skewed distribution. Because radial head fractures can be indicative of osteoporosis in women older than 50 years, some authors suggest considering bone mineral density (BMD) measurement in this patient category.

Level 3: There are signs that women older than 50 years with a radial head fracture should undergo BMD measurement. Grade of recommendation: C.

Diagnostics

Patients typically present with a painful swollen elbow with limited motion after a fall on the outstretched hand. In most Mason type I radial head fractures, tenderness is localized over the radial head. The physical examination should also include the wrist to exclude scaphoid fractures and/or distal radius fractures. In case of instability of the wrist, the physician should be aware of a possible rupture of the triangular fibrocartilage complex and interosseous membrane (Essex Lopresti lesion). The interosseous membrane is an important stabilizer during axial loads on the forearm, and lesions are often not recognized.

Mason type I radial head fractures cause an intra-articular hematoma that limits the elbow range of motion (ROM). The elbow extension test uses this phenomenon to rule out intra-articular fractures of the elbow: an elbow that can be fully extended is unlikely to be fractured. The current authors found 7 cohort studies on this elbow extension test: all report high sensitivity (88.0-97.6) but low speci-
ficity (48.5-69.5) for detecting elbow fractures. However, Jie et al found that 14 (8%) of 174 patients with normal elbow extension had a Mason type I fracture.

Hematoma aspiration can reduce intra-articular pressure and aid assessment of ROM. Motion blockage during flexion and extension and forearm rotation can be caused by fracture incongruence or presence of loose bodies. Hemarthrosis of the elbow joint can result in a fat-pad sign on radiographs. Effusion in the elbow joint causes the anterior (and/or posterior) fat pad to rise away from the humeral cortex, producing a radiolucent crescent effect. This image, as perceived on a lateral radiograph, has a sensitivity and specificity of 83% to 85% and 50% to 82%, respectively, for the presence of a radial head fracture. The negative predictive value (NPV) of this sign is 29% to 47%. Unfortunately, no specific data on Mason type I fractures were found.

Anteroposterior (AP) and lateral radiographs are obtained to diagnose radial head fractures. Many variants of angulated radiographs exist, of which the Greenspan or radiocapitellar view is the most widely used. This radiocapitellar view increases sensitivity of radiographic diagnosis by 1%; most fractures are diagnosed on AP and lateral radiography alone. Originally, this view should show the full extent of articular displacement. The authors found no data to support this statement. If no fracture is diagnosed on AP and lateral radiography but a fat-pad sign is obvious, an additional Greenspan or radiocapitellar view detects fractures in 5% of cases. In patients with a fat-pad sign but no fracture on initial radiography, follow-up radiography after 7 to 14 days showed fractures of radial head and neck in 10 (31%) of 32 patients.

One study obtained magnetic resonance imaging (MRI) data of 20 patients with a fat-pad sign but no evident fracture on conventional radiography: 15 patients had occult fractures around the elbow, 13 of these of the radial head (65% of total group). Advanced imaging techniques such as MRI or computed tomography (CT) show a high prevalence of associated injuries in patients with Mason type I fractures. Bone bruise, chondral damage of the capitellum, or partial or complete rupture of the lateral collateral ligaments is found in 70.6% of patients; partial lesions of the interosseous membrane are found in 64.3%. However, none of these findings has implications for treatment or outcome.

Table 2

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Background/History</th>
<th>Classification</th>
<th>Diagnostics</th>
<th>Treatment</th>
<th>Outcome</th>
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<td>7</td>
<td>29</td>
<td>36</td>
<td>6</td>
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</table>

Level 2: It is likely that the elbow extension test can rule out Mason type I fractures of the radial head with a sensitivity of 88.0% to 97.6%. Grade of recommendation: B.

Level 2: It is likely that AP and lateral radiographs are sufficient to reveal a radial head fracture. Grade of recommendation: B-C.

Level 2: A fat-pad sign has a high NPV of 87% to 98%; it is likely that the absence of a fat pad can rule out a fracture. Grade of recommendation: B.

Level 2: A fat-pad sign has a high NPV of 87% to 98%; it is likely that the absence of a fat pad can rule out a fracture. Grade of recommendation: B.

Level 2: It is likely that up to 65% of patients with a positive fat-pad sign and no evident fracture on conventional radiographs have a radial head fracture. Grade of recommendation: B.

Level 2: It is likely that advanced radiography (MRI or CT) reveals associated injuries in up to 70.6% of patients with Mason type I radial head fractures. These findings do not alter treatment or
outcome. Grade of recommendation: B.15,21,42,43

Classification
Radial head fractures were originally classified by Mason as nondisplaced (type I), displaced (type II), and displaced and comminuted (type III).3 Johnston44 later added a fourth type: a radial head fracture with an elbow dislocation. Broberg and Morrey45 subsequently modified the classification by including radial neck fractures and stratifying fractures based on fragment displacement (≥2 mm) and size (≥30% of articular surface). This modified Mason classification remains the most widely used in clinical practice, although interobserver reliability is poor to moderate (κ=0.45-0.85).46-50 Observers frequently disagree on displacement, and it is likely that Mason type I fractures are underdiagnosed.51

Level 2: It is likely that interobserver reliability of the modified Mason classification is poor to moderate. Grade of recommendation: B.46-50

Level 2: It is likely that observers disagree on displacement of fractured parts and that Mason type I fractures (with displacement <2 mm) are underdiagnosed. Grade of recommendation: B.51

Treatment
Harding et al52 performed a systematic review addressing the timing of mobilization after Mason type I and II fractures.52 Patients were randomized into immediate mobilization, 2 weeks of above-the-elbow plaster immobilization in 90° of elbow flexion, or 2 weeks of plaster immobilization of the elbow in full extension. Patients treated with an extension cast had more pain but less extension deficit compared with the other groups. Nonetheless, the authors concluded that the evidence was too poor to give any recommendations.

Liow et al53 randomized 60 patients into immediate mobilization or mobilization after 5 days of sling treatment. There was no change in outcomes at 4 weeks or 3 months; however, patients treated with immediate mobilization had less pain and better function 7 days after injury.53 Paschos et al54 randomized 180 patients into immediate mobilization, 48 hours of sling immobilization, or 7 days of cast immobilization. Outcome measures included pain, ROM, strength, and function. Cast immobilization had limited benefit regarding pain reduction and yielded an increased risk of impaired outcome, such as lower grip strength and ROM deficits greater than 10° after 24 months of follow-up. Patients in the immediate mobilization group experienced more pain in the first 3 days. Patients treated with 48 hours of sling immobilization before mobilization had the best outcomes in terms of pain, grip strength, and ROM.54

Three RCTs and one cohort study addressed hematoma aspiration.55-59 A review of 2 RCTs that compared aspiration with no aspiration showed instant pain relief in 77% to 92% of patients following aspiration.57,59 No complications were mentioned. The cohort study showed a reduction of intra-articular pressure from 77 to 17 mm Hg following aspiration, combined with a decrease in visual analog scale (VAS) pain score from 5.5 (range, 4-8) to 2.5 (range, 1-4).58 The third RCT by Chalidis et al56 compared aspiration alone vs aspiration with intra-articular bupivacaine injection in the treatment of Mason type I fractures. Intra-articular anesthetic offered no benefit over aspiration alone. The most widely used technique for aspiration of the elbow joint was described by Quigley60 in 1949 (Figure 2).

The current authors found no comparative data focusing on the value of the use of a pressure bandage in the initial treatment of Mason type I fractures, as well as no data on routine physical therapy.

One study addressed the need for routine follow-up by offering the option of a virtual clinic appointment if necessary: this resulted in direct discharge of 90% of patients with Mason type I to II fractures. Although no physical examination was performed at follow-up, 82% of patients were satisfied with the outcome of their injury.61

Level 1B: It is shown that mobilization following a 48-hour resting period with a sling yields the best results in terms of pain and ROM. Grade of recommendation: A.54

Level 1B: It is shown that hematoma aspiration is safe and reliable and results in immediate patient relief and earlier return to function. Grade of recommendation: A.55-59

Level 1B: It is shown that supplemental intra-articular anesthetic has no advantages over hematoma aspiration alone. Grade of recommendation: A.56

Level 3: There are signs that routine follow-up is not necessary for patients with Mason type I fractures. Grade of recommendation: C.61

Outcome
Overall, 86% to 100% of patients are expected to have a good functional result with a mean flexion/extension arc of 141° and a rotation arc of 179° within 2 to 3 months after trauma.62-65 Long-term results (>12 months) indicate that up to 20% of patients may still have mild complaints of the affected arm, defined by residual pain or a deficit in flexion-extension arc of less than 30°.11,64,66 Up to 10% of patients with a Mason type I fracture used painkillers for an average of 46 months (range,
7-101 months) after trauma. Overall, no patients had to change their occupation, although up to 23% of patients preferred not to use the injured arm for heavy exercises. There are signs that older patients and patients with low socioeconomic status show less favorable outcomes in terms of self-reported functional results. A protective attitude toward stretch pain during recovery seems to lead to less elbow motion 1 month after injury.

Level 3: There are signs that 86% to 100% of patients recovering from Mason type I fractures have good long-term functional results in terms of ROM. Up to 20% of patients may still have mild complaints of the affected arm, defined by residual pain or a deficit in flexion-extension arc of less than 30°. Grade of recommendation: C.

Level 3: There are signs that older patients and patients of a low socioeconomic status with radial head fractures show less favorable outcome in terms of self-reported functional results. Grade of recommendation: C.

Level 3: There are signs that a protective attitude toward stretch pain during recovery from radial head fractures is associated with less elbow motion 1 month after injury. Grade of recommendation: C.

**Discussion**

This systematic review aimed to address the incidence, diagnostics, treatment, and functional or patient-related outcomes of Mason type I radial head fractures and to suggest an evidence-based treatment guideline.

After a literature search, available evidence was limited: only 6 randomized trials were found; many of the other studies were descriptive in nature.

If a patient with elbow complaints after trauma retains the ability to fully extend the joint, some authors state that radiographic evaluation is unnecessary. However, Jie et al described Mason type I fractures in 8% of patients with normal elbow extension. The current authors conclude that the elbow extension test may be beneficial in situations where radiography is not easily accessible, but they do not recommend strict implementation in daily practice.

For radiographic evaluation, AP and lateral radiographs will suffice. The additional Greenspan or radiocapitellar view has very limited additional value in diagnosing radial head fractures. Moreover, the clinical relevance of advanced imaging such as MRI or CT imaging is low; therefore, the authors do not recommend regularly obtaining these scans in patients suspected of having a Mason type I radial head fracture.

The presence of a displaced fat pad caused by traumatic elbow effusion has a high NPV: patients with radiographs not showing a fat-pad sign can safely be treated as if they did not have a fracture. In patients with a displaced fat pad but no evident fracture, an additional radiograph such as the Greenspan view can be obtained. If this view does not reveal any fractures, patients may be treated as if they have a nondisplaced fracture and undergo repeat radiography 7 to 14 days later.

Early mobilization is key in the treatment of Mason type I fractures. However, a short delay in mobilization seems beneficial. The authors found that a 48-hour resting period with a sling followed by active mobilization may result in superior results compared with immediate mobilization or prolonged immobilization protocols. The
value of a pressure bandage is unknown, but it is unlikely to do harm if used in the first 48 hours after trauma only.

Cast immobilization is frequently applied for pain relief. The authors found that it has limited benefit in pain reduction and yields an increased risk of impaired outcomes, such as lower grip strength and deficits in flexion/extension arc.

Fracture hematoma aspiration in patients with radial head fractures seems safe and reliable and results in immediate pain relief and earlier return to function. No additional effect was found for the use of supplementary intra-articular anesthetic after hematoma aspiration. With the possible chondrotoxicity of local anesthetics in mind, the authors recommend refraining from using intra-articular anesthetics in the management of radial head fractures.⁶⁹,⁷⁰

Jayaram et al⁶¹ suggested that routine follow-up is not necessary for patients with Mason type I fractures; rather, they recommended providing them with an information leaflet and a specialized help line. Until more data are available on the safety of this strategy, it seems wise to see patients at least once after 7 to 14 days to ensure improvement. Patients who show a protective attitude during mobilization may benefit from professional support and encouragement by a physical therapist.

Although 86% to 100% of patients have a good functional result, there is the possibility of a reduction in elbow extension of up to 30°. Overall, no patients have to change their occupation, although up to 23% of patients prefer to not use the injured arm for heavy tasks. Up to 10% of patients with a Mason type I fracture use painkillers for their elbow complaints at an average of 46 months (range, 7-101 months) after trauma.

**Conclusion**

Mason type I fractures of the radial head account for 64% to 82% of all radial head fractures and up to one-fourth of all fractures around the elbow. Mason type I radial head fractures are best treated with hematoma aspiration for pain relief, followed by a 48-hour resting period with a sling and subsequent mobilization. A treatment guideline based on the given recommendations is suggested in **Figure 3**.

**References**


