

# Radial head fractures

## Abstract

Radial head fractures are a common fracture involving the elbow joint. Patients typically present after a fall onto an outstretched hand with elbow pain and swelling. Without adequate treatment, this can lead to long-term complications, including loss of elbow motion and pain. Radial head fractures may also be associated with other injuries including elbow dislocation, neighbouring bony fractures and associated ligamentous rupture. It is therefore imperative that hospital clinicians understand the diagnosis and treatment of this condition. The plain radiograph is the optimum method to diagnose a radial head fracture. These fractures can be managed using a variety of techniques, from non-surgical conservative methods for the undisplaced fracture through to surgical fixation, radial head replacement and excision for the more complex, displaced fracture.

**Key words:** Elbow; Fracture; Head; Radial; Radius

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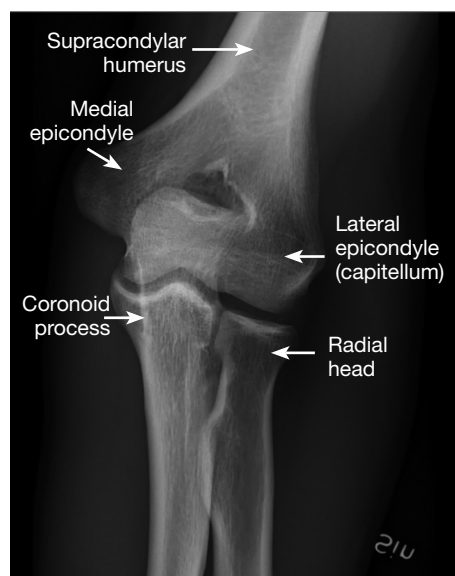
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## Introduction

The radial head is an important stabiliser of the elbow in valgus and external rotation (Kodde et al, 2015). It articulates with the capitellum and proximal ulna in the elbow joint (Pappas and Bernstein, 2010) (Figures 1 and 2). The radial head fracture is a common injury and accounts for one-third of all elbow fractures (Kodde et al, 2015). It can be a serious injury, with complications including loss of elbow motion and persistent elbow pain (Mason, 1954; Herbertsson et al, 2004). It can range from an isolated injury to a more severe injury, such as terrible triad syndrome (described below). This article discusses the epidemiology, clinical features, recommended investigations, classification and treatment of the radial head fracture.

## Epidemiology

Radial head fractures have a reported incidence of between 2.5 (Herbertsson et al, 2004) and 2.8 (Kaas et al, 2010) per 10000 per year. They are the most common fracture involving



**Figure 1.** Antero-posterior view of left elbow (normal).



**Figure 2.** Lateral view of left elbow (normal).

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the elbow joint (Mason, 1954). The mean reported age at presentation varies from 44 years (Duckworth et al, 2012) to 48 years (Kaas et al, 2010).

## Clinical features

Radial head fractures classically occur following a fall onto an outstretched hand with the elbow partially flexed and pronated (Harrison et al, 2007), placing the radial head in an at-risk position. The patient will present with elbow pain following injury, with various levels of swelling and bruising at the elbow. On examination, there is usually tenderness over the lateral aspect of the elbow on palpation, and occasionally visible bruising. There may also be elbow pain on pronation and supination of the forearm, sometimes with associated elbow crepitus. An elbow effusion may be present (Gawande et al, 2017).

Posterolateral rotatory dislocation of the elbow can occur in up to 14% of radial head fractures (van Riet et al, 2005). When this occurs, neurological injury affecting the median (particularly anterior interosseous branch) and ulnar nerves can occur in up to 20% of cases (Morrey, 2009). There may also be disruption to the brachial artery (Ayel et al, 2009).

A radial head fracture associated with a fracture of the ulnar coronoid process together with elbow dislocation is a highly unstable injury, known as the ‘terrible triad’ (Chen et al, 2014). This injury almost always requires surgical intervention. It is associated with poor long-term outcomes, with stiffness, pain, arthritis and joint instability often complicating recovery (Rockwood and Green, 1996).

The mechanism of injury leading to a radial head fracture (high energy axial load onto a forearm) may also lead to rupture of the interosseous membrane, leading to dislocation of the distal radio-ulnar joint. Known as the Essex-Lopresti injury, this is often missed by clinicians (Trousdale et al, 1992). The clinician should always examine the wrist for associated injury when assessing a patient with a radial head fracture (Pappas and Bernstein, 2010) and be alert for signs such as tenderness over the dorsal midshaft of the forearm and pain on wrist palpation. It is imperative for the clinician to arrange radiographs of the forearm and wrist as well as the elbow if this injury is suspected, although magnetic resonance imaging has demonstrated the highest sensitivity rates for diagnosing a ruptured interosseous membrane (Loeffler et al, 2014). Like the terrible triad injury, the Essex-Lopresti injury has very poor outcomes if not treated in a timely manner (Masouros et al, 2019).

A radial head fracture can also be associated with ulnar fracture in up to 12% of cases (van Riet et al, 2005) and scaphoid fracture in up to 6% of cases (Wildin et al, 2001).

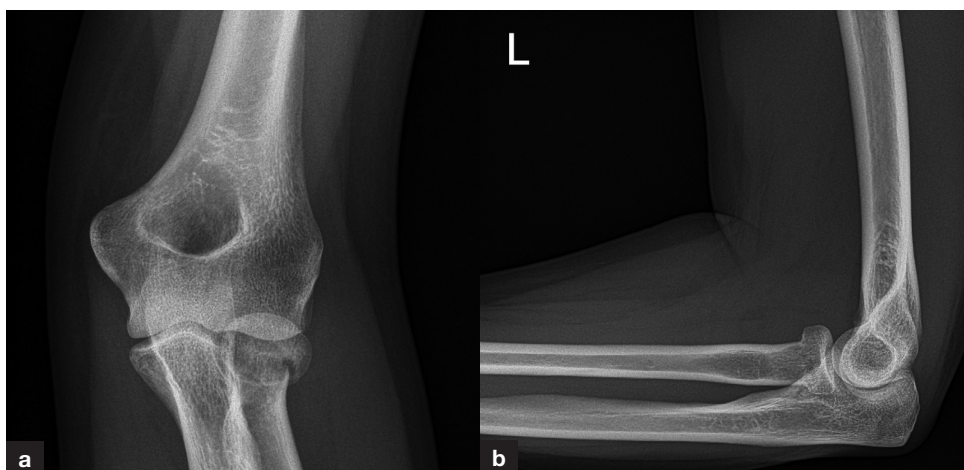
## Investigations

The key investigation to diagnose a radial head fracture is the plain radiograph, with antero-posterior and lateral views of the elbow joint (Figure 3). Sometimes the fracture is very difficult to see on the radiograph, especially if undisplaced, and an elbow effusion may be the only sign present. On a lateral projection, the clinician should look for the ‘sail sign’. This is elevation of the posterior fat pad as a result of bleeding within the synovium of the elbow joint, which is in keeping with an occult fracture. In an adult trauma patient, the history and presence of a posterior fat pad sign is enough to presume an occult radial head fracture (Pappas and Bernstein, 2010). As discussed previously, radiographs of the forearm and wrist may also be important to exclude associated injury.

If more complex injury is suspected or the fracture is comminuted, computed tomography may provide enhanced images, with magnetic resonance imaging providing superior views of soft tissues.

## Classification

Radial head fractures were originally described by Mason (1954) and later modified. This modified classification, the Broberg–Morrey classification (Hotchkiss, 1997), is the system most commonly used to classify radial head fractures (Pires et al, 2011) using plain radiographs (Table 1).



**Figure 3.** a. Antero-posterior and (b) lateral views of displaced radial head fracture.

<b>Table 1. Modified Broberg–Morrey classification</b>	
<b>Modified Broberg–Morrey classification</b>	<b>Radiograph finding</b>
Mason type I	Undisplaced (<2 mm displacement)
Mason type II	>2 mm displacement and involving >30% of the radial head
Mason type III	Comminuted
Mason type IV	Associated elbow dislocation

*From Hotchkiss (1997)*

## Management

### Initial steps

When assessing the patient with a radial head fracture, care should be taken to not miss associated injury. Distal neurovascular status should be thoroughly tested and documented in all patients with a suspected radial head fracture. The radial and brachial pulses should be felt in the affected arm.

The anterior interosseous nerve should be tested by asking the patient to make an ‘O’ with the tips of the index finger and thumb. If the nerve is damaged, the patient will be unable to make an O and the pulps of the digits will be opposed instead (Assiotis et al, 2019).

The ulnar nerve should be tested by checking sensation on the little and medial half of the ring finger on the affected side, and also by checking abduction of the digits (Assiotis et al, 2019).

The forearm and wrist should be examined for any obvious deformity or tenderness. An associated tear in the interosseous membrane may cause disruption of the distal radioulnar joint (Pappas and Bernstein, 2010).

Patients presenting with elbow swelling as a result of their fracture may obtain some symptomatic benefit following haematoma aspiration (Ditsios et al, 2011).

### Treatment of the fracture

Mason I fractures (<2 mm displacement) can often be managed conservatively with a sling for support and early mobilisation (Mahmoud et al, 2014). An alternative method is application of an elbow splint at 60° flexion for 1 or 2 weeks, with unrestricted movement afterwards (Morrey, 2009). With early mobilisation, this injury often heals well with little to no complication (Pappas and Bernstein, 2010).

Controversy exists regarding the optimum management of Mason II (displaced) fractures, with previous observational studies showing similar outcomes following both conservative management and surgery with open reduction internal fixation. A systematic review concluded that there is currently not enough evidence to deem one method superior to

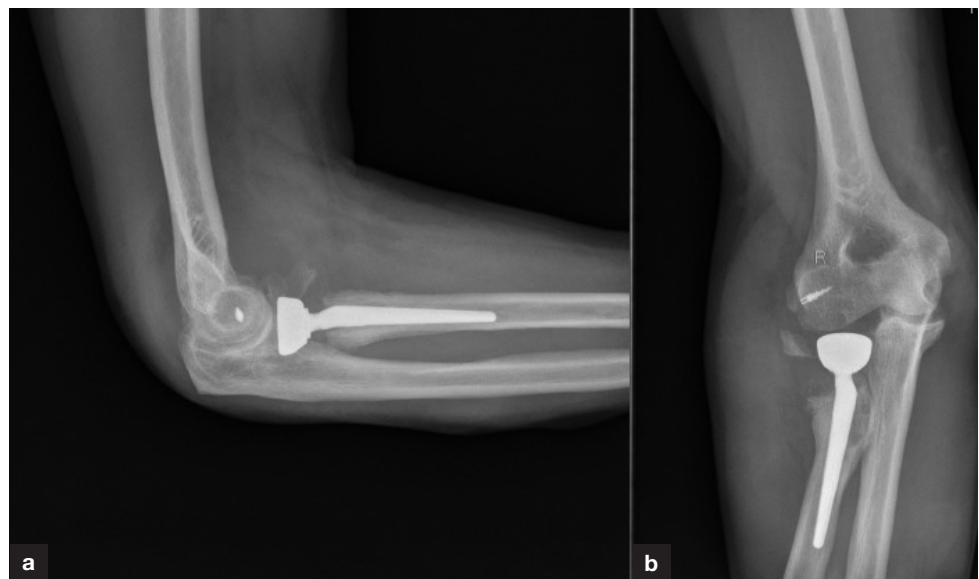
the other (Kaas et al, 2012). Common practice is to assess the patient for any signs of a mechanical block following injury and, if present, the surgical route is often preferred (Pike et al, 2009). Complications of open reduction internal fixation may include heterotopic ossification, elbow stiffness, hardware failure and fracture non-union (Kusnezov et al, 2018). If symptoms are persistent, a delayed radial head excision (Herbertsson et al, 2004) or radial head arthroplasty (Chapman et al, 2006) may be performed. An example of an X-ray post-open reduction internal fixation is seen in **Figure 4**.

Mason III/IV (comminuted and complex injuries) usually require surgery, with options including open reduction internal fixation, radial head arthroplasty and radial head excision. The choice of treatment is dependent on the complexity of the fracture, with radial head arthroplasty and radial head excision reserved for cases where open reduction internal fixation is deemed not suitable (eg multiple fracture fragments) (Ring et al, 2002). Radial head arthroplasty (**Figure 5**) has the advantage of restoring the anatomy and stability of the elbow, but may have long-term problems related to prosthesis ageing, loosening, wear and capitellar arthritis (Chen et al, 2011).

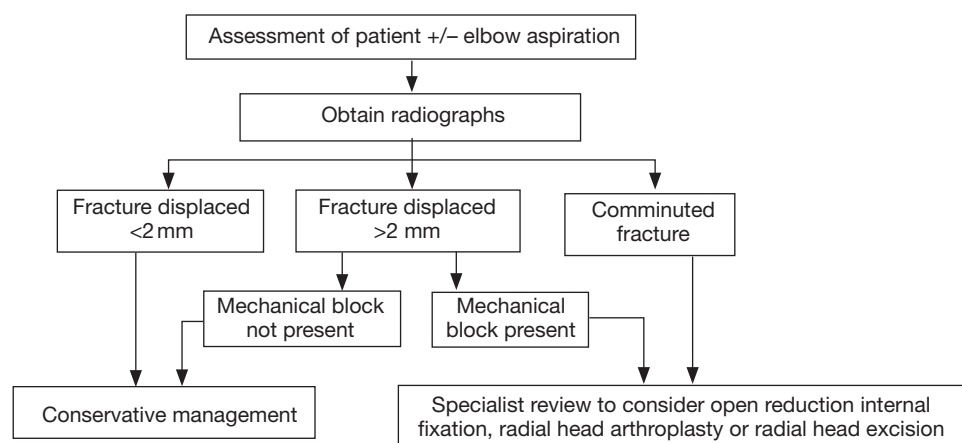
If there is any elbow dislocation present, the ulnohumeral joint is reduced to restore function. Associated bony injuries should be treated along with the fracture. Any torn ligaments are also often repaired (Morrey, 2009).



**Figure 4.** Example of open reduction internal fixation of radial head fracture. a. Lateral view. b. Antero-posterior view.



**Figure 5.** Example of radial head arthroplasty using a metal implant. a. Lateral view. b. Antero-posterior view.



**Figure 6.** Suggested treatment algorithm for radial head fractures.

The authors' suggested algorithm for treatment of a radial head fracture is summarised in **Figure 6**.

## Conclusions

Radial head fracture is a common injury which can cause pain and impaired elbow function. It should be considered in any trauma patient complaining of lateral elbow pain. Plain antero-posterior and lateral radiographs of the elbow should be obtained in the first instance, and the forearm and wrist examined for signs of associated injury. Management of the radial head fracture aims to preserve the stability and functionality of the elbow joint. Mason I fractures are often managed conservatively. Mason II fractures can be managed either conservatively or by open reduction internal fixation. Mason III/IV fractures can be managed by open reduction internal fixation, or radial head arthroplasty or excision for the more complex injury.

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### Conflicts of interest

The authors declare no conflicts of interest.

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## References

- Assiotis A, Khan AM, Sankey AR, Dattani R. Elbow dislocations. *Br J Hosp Med*. 2019;80(7):C98–C102. <https://doi.org/10.12968/hmed.2019.80.7.C98>
- Ayel JE, Bonneville N, Lafosse JM et al. Acute elbow dislocation with arterial rupture. Analysis of nine cases. *Orthop Traumatol Surg Res*. 2009;95(5):343–351. <https://doi.org/10.1016/j.otsr.2009.04.013>
- Chapman CB, Su BW, Sinicropi SM et al. Vitallium radial head prosthesis for acute and chronic elbow fractures and fracture-dislocations involving the radial head. *J Shoulder Elbow Surg*. 2006;15(4):463–473. <https://doi.org/10.1016/j.jse.2005.09.010>
- Chen HW, Liu GD, Wu LJ. Complications of treating terrible triad injury of the elbow: a systematic review. *PLoS ONE*. 2014;9(5):e97476. <https://doi.org/10.1371/journal.pone.0097476>
- Chen X, Wang SC, Cao LH et al. Comparison between radial head replacement and open reduction and internal fixation in clinical treatment of unstable, multi-fragmented radial head fractures. *Int Orthop*. 2011;35(7):1071–1076. <https://doi.org/10.1007/s00264-010-1107-4>
- Ditsios KT, Stavridis SI, Christodoulou AG. The effect of haematoma aspiration on intra-articular pressure and pain relief following Mason I radial head fractures. *Injury*. 2011;42(4):362–365. <https://doi.org/10.1016/j.injury.2010.09.003>

## Key points

- Radial head fractures are a common elbow injury.
- Plain antero-posterior and lateral radiographs of the elbow are the key to diagnosis.
- Treatment options range from conservative management to surgical techniques including fixation, replacement and excision of the radial head.
- Specialist advice should be sought for the more complex radial head injury.

- Duckworth AD, Clement ND, Jenkins PJ et al. Socioeconomic deprivation predicts outcome following radial head and neck fractures. *Injury*. 2012;43(7):1102–1106. <https://doi.org/10.1016/j.injury.2012.02.017>
- Gawande J, Jain S, Santoshi JA. Neglected bilateral radial head fracture with a rare presentation: a case report. *Chin J Traumatol*. 2017;20(4):246–248. <https://doi.org/10.1016/j.cjtee.2016.07.003>
- Harrison JWK, Chitre A, Lammin K, Warner LG, Hodgson SP. Radial head fractures in adults. *Curr Orthop*. 2007;21(1):59–64. <https://doi.org/10.1016/j.cuor.2006.10.003>
- Herbertsson P, Josefsson PO, Hasserijs R et al. Uncomplicated Mason type-II and III fractures of the radial head and neck in adults. A long-term follow-up study. *J Bone Joint Surg Am*. 2004;86(3):569–574. <https://doi.org/10.2106/00004623-200403000-00016>
- Hotchkiss RN. Displaced fractures of the radial head: internal fixation or excision? *J Am Acad Orthop Surg*. 1997;5(1):1–10. <https://doi.org/10.5435/00124635-199701000-00001>
- Kaas L, van Riet RP, Vroemen J, Eygendaal D. The epidemiology of radial head fractures. *J Shoulder Elbow Surg*. 2010;19(4):520–523. <https://doi.org/10.1016/j.jse.2009.10.015>
- Kaas L, Struijs PA, Ring D, van Dijk CN, Eygendaal D. Treatment of Mason type II radial head fractures without associated fractures or elbow dislocation: a systematic review. *J Hand Surg Am*. 2012;37(7):1416–1421. <https://doi.org/10.1016/j.jhsa.2012.03.042>
- Kodde IF, Kaas L, Flipsen M, van den Bekerom MP, Eygendaal D. Current concepts in the management of radial head fractures. *World J Orthop*. 2015;6(11):954–960. <https://doi.org/10.5312/wjo.v6.i11.954>
- Kusnezov N, Eisenstein E, Dunn JC et al. Operative management of unstable radial head fractures in a young active population. *Hand*. 2018;13(4):473–480. <https://doi.org/10.1177/1558944717715136>
- Loeffler BJ, Green JB, Zelouf D. Forearm instability. *J Hand Surg Am*. 2014;39(1):156–167. <https://doi.org/10.1016/j.jhsa.2013.07.010>
- Mahmoud SS, Moideen AN, Kotwal R, Mohanty K. Management of Mason type I radial head fractures: a regional survey and a review of literature. *Eur J Orthop Surg Traumatol*. 2014;24(7):1133–1137. <https://doi.org/10.1007/s00590-013-1386-8>
- 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):123–132. <https://doi.org/10.1002/bjs.18004217203>
- Masouros PT, Apergis EP, Babis GC et al. Essex-Lopresti injuries: an update. *EFORT Open Rev*. 2019;4(4):143–150. <https://doi.org/10.1302/2058-5241.4.180072>
- Morrey BF. *The elbow and its disorders*. 4th edn. Philadelphia (PA): Saunders/Elsevier; 2009:1211.
- Pappas N, Bernstein J. Fractures in brief: radial head fractures. *Clin Orthop Relat Res*. 2010;468(3):914–916. <https://doi.org/10.1007/s11999-009-1183-1>
- Pike JM, Athwal GS, Faber KJ, King GJ. Radial head fractures: an update. *J Hand Surg Am*. 2009;34(3):557–565. <https://doi.org/10.1016/j.jhsa.2008.12.024>
- Pires RES, Rezende FL, Mendes EC et al. Radial head fractures: Mason Johnston's classification reproducibility. *Malays Orthop J*. 2011;5(2):6–10. <https://doi.org/10.5704/MOJ.1107.002>
- 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):1811–1815. <https://doi.org/10.2106/00004623-200210000-00011>
- Rockwood CA, Green DP. *Rockwood and Green's fractures in adults*. Philadelphia (PA): Lippincott-Raven; 1996.
- Trousdale RT, Amadio PC, Cooney WP, Morrey BF. Radio-ulnar dissociation. A review of twenty cases. *J Bone Joint Surg Am*. 1992;74(10):1486–1497. <https://doi.org/10.2106/00004623-199274100-00007>
- van Riet RP, Morrey BF, O'Driscoll SW, Van Glabbeek F. Associated injuries complicating radial head fractures: a demographic study. *Clin Orthop Relat Res*. 2005;441:351–355. <https://doi.org/10.1097/01.blo.0000180606.30981.78>
- Wildin CJ, Bhowal B, Dias JJ. The incidence of simultaneous fractures of the scaphoid and radial head. *J Hand Surg Br*. 2001;26(1):25–27. <https://doi.org/10.1054/jhsb.2000.0495>