TRAUMA

Radial head fractures in adults


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Fracture; Fracture-dislocation; Mason classification; Stability; ORIF; Replacement

Summary
The radial head is involved in both elbow flexion and extension as well as forearm rotation and is an important stabiliser of the elbow. Fractures account for one-third of elbow fractures in adults and can lead to marked disability. Radial head fractures can be part of a spectrum of injuries to the elbow leading to complex instability. Management of comminuted fractures is controversial, but the present trend is towards stabilisation to allow early mobilization. The majority of radial head fractures are undisplaced and do not require operative treatment. Associated injuries to the elbow potentially leading to instability should be sought. In comminuted fractures with an intact MCL where fixation is not possible excision gives satisfactory long-term results. If instability is present radial length should be restored either by ORIF or replacement and any associated bony or ligamentous injuries repaired to allow early mobilisation to prevent stiffness.

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Anatomy

The proximal radius consists of a disc-shaped head and the neck. They set at an angle of approximately 15° to the shaft. The head is elliptical, 270° of its notch of the ulna forming the proximal radio-ulnar joint. The concave proximal surface articulates with the capitellum and has a slightly larger radius of curvature than the capitellum, forming an incongruent articulation. This allows some translation of the articulating surfaces of the radiocapitellar joint. The annular ligament is an important stabiliser of the proximal radius which permits rotation but prevents proximal migration of the radius with elbow flexion due to the pull of biceps. The forearm muscles act to provide a posteriorly directed force to maintain reduction of the radial head.

On hand grip and forearm flexion the forces across the elbow are approximately three times body weight due to the long lever arm to the hand, balanced by the short moment arms of the muscles crossing the elbow (biceps, brachialis, triceps, forearm flexors and extensors). This force is shared approximately equally between the trochlea and the capitellum at the distal humerus. At the wrist 80% of the force passes through the distal radius and this is transferred to the ulna via the oblique fibres of the interosseous membrane. After radial head excision load is transferred through the interosseous membrane and the triangular fibrocartilage complex. The central band of the interosseous membrane is important in resisting proximal radial migration following radial head excision; if it stretches with time it can lead to distal radioulnar joint symptoms.1 An Essex-Lopresti lesion is a tear of the interosseous membrane with an associated comminuted radial head fracture (Fig. 1). If it

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is not recognised the radioulnar dissociation can lead to proximal radial migration and ulnar-sided wrist pain.

The primary stabiliser to valgus forces across the elbow is the anterior band of the medial collateral ligament (MCL). The radial head is a secondary stabilizer and has little role with an intact MCL. Thus, it is important to recognise a MCL injury associated with a radial head fracture as this can lead to marked instability.

Mechanism of injury

Radial head fractures follow a fall onto the outstretched hand with the elbow extended and the forearm pronated, applying an axial and valgus force to the elbow. The axial load forces the radial head posteriorly and the anterolateral rim of the radial head is loaded. The degree of comminution of the fracture is related to the energy of the fall. Continuing force will lead to tearing of the MCL and the elbow may dislocate. If there is a tear of the interosseous membrane the axial force will not be transmitted to the ulna and the MCL may not be torn.

Assessment

The wrist should be examined for any distal radioulnar joint injury and also the forearm for an interosseous membrane injury. Posterior interosseous nerve palsy and compartment syndrome should be checked for.

Radiographic anteroposterior and true lateral views of the elbow should be obtained. If fat-pad sign due to an elbow effusion is seen in the absence of any other obvious injury the radial head and neck should be carefully scrutinised. If an Essex-Lopresti lesion is suspected a standard posteroanterior view of the wrist should be taken to assess for ulnar variance. It is important to check for an associated coronoid fracture, as this is an indicator of a potential for recurrent instability. This is likely to occur with increasing elbow extension as it provides an attachment for the anterior capsule.

CT scanning is excellent in assessing the degree of comminution, fracture displacement and any associated injuries, and can provide useful 3-dimensional images (Fig. 3).

Classification

The most commonly used classification for radial head fractures was described by Mason in 1954 (Fig. 2). Johnston modified this in 1962 to include a Mason–Johnston Type IV.

- Type I: marginal fractures with minimal displacement and no mechanical block to movement.
- Type II: marginal fractures with displacement.
- Type III: comminuted fractures.
- Type IV: associated elbow dislocation.

Coronoid fractures have been classified by Regan-Morrey in 1989.

- Type I: Avulsion of the tip.
- Type II: < 50% involved.
- Type III: > 50% involved.

Treatment

Treatment depends on the amount of head involved, degree of displacement and any associated injuries.

Undisplaced fractures

An undisplaced fracture of the radial head (i.e. a step in the articular surface of less than 2 mm) can be managed non-operatively with a satisfactory outcome. Block to movement can be assessed for by aspiration of the haemarthrosis and instillation of local anaesthetic into the joint. Aspiration can be performed from the radiocapitellar joint or from the olecranon fossa posteriorly which may be easier to palpate. The arm is placed in a collar and cuff at 90° of elbow flexion and active mobilisation commenced as pain allows. As with any elbow injury it should be explained to patients that
a loss of extension commonly occurs which is not likely to cause a functional deficit.

Displaced fractures

10% of radial head fractures occur with an elbow dislocation. For it to occur and as the elbow is a congruent joint, it is likely the collateral ligaments will be damaged. Fixation of the radial head will improve stability and allow earlier mobilisation to prevent stiffness.

Displaced fractures should undergo open reduction and internal fixation (Fig. 4). A Kocher approach is most commonly used and develops the interval between extensor carpi ulnaris and anconeus. The forearm is kept in pronation during the dissection to protect the posterior interosseous
nerve. The annular ligament is normally preserved as it is an important stabiliser and to prevent damage to the nerve which passes around the radial neck just distal to the annular ligament. To improve exposure of the radial head the annular ligament can be divided, and subperiosteal elevation of ECRB, ECRL and capsule off the lateral supracondylar ridge will improve access to structures on the medial side of the joint.

Alternatively a posterolateral approach can be used by stripping the anconeus and supinator from the ulna. This allows access to the medial ligament. The patient will need to be in the lateral position with the arm over a support.

Headless screws are used for fixation with Herbert screws as these are possibly less bulky. If a plate is required it should be placed in the ‘safe zone’, opposite the sigmoid notch of the ulna with the forearm in neutral rotation.

**Comminuted fractures**

If the radial head is too comminuted to allow fixation a decision has to be made whether to remove the fragments, or excise or replace the head. If greater than a third of the head is involved there is loss of ‘capture’ of the capitellum. If the radial head is unstable then excision is indicated. The accepted treatment for comminuted fractures of the radial head not amenable to internal fixation with an intact MCL is excision. The reported long-term results are good with one study showing 17 out of 21 as excellent results at 16–30 years follow-up. They also suggested the use of indomethacin for 6 weeks post-operatively to prevent heterotopic ossification. Another study with more than 8 years follow-up also showed good results. They suggested the MCL and interosseous membrane lengthen with time with ulnar variance having become increasingly positive by an average of approximately 2 mm, and cubitus valgus having increased to an average of 9°. This has been suggested by other studies but generally these changes do not seem to cause symptoms.

However, the potential for complications such as weakness, cubitus valgus and wrist pain due to proximal radial migration affecting the distal radio-ulnar joint mean reconstruction of the radial head is the ideal. Improved fixation with low profile devices and more extensile exposures may allow fixation of even markedly comminuted fractures. A study of 28 patients with a Mason III fracture...
who had either ORIF or excision showed improved function and strength in the ORIF group. The fixation was a combination of headless screws and low profile T-plates to hold any fragments too small to take a screw.

A head replacement will be required if there is valgus instability due to rupture of the MCL to act as a spacer until healing of the MCL occurs (Fig. 5). The MCL is not normally repaired unless instability persists although a cadaveric study has suggested ligament repair alone may be superior to radial head replacement in resisting valgus stress.

Radial head replacement is indicated in comminuted fractures with a ruptured MCL. Initially silastic replacements were used but have shown poor long-term results. Biomechanical studies have shown Swanson silastic replacements are poor at resisting proximal radial migration and can fracture or lead to synovitis in the longer term. Metal or ceramic prostheses are now used that maintain the space for valgus stability. Modern designs are short stemmed for ease of insertion and extraction, uncemented and monoblock. The replacement is a hemiarthroplasty and due to the variation in size of radial heads the design of prostheses does not generally provide a congruent articulation. There is little evidence to suggest they transmit physiological loads and therefore do not act as true replacement joints. They have shown reasonable results with some loss of movement and strength the norm. Partly this probably reflects the increased severity of the injury when a prosthetic head is required and also from concern about instability leading to prolonged immobilisation post-operatively resulting in stiffness. Improved results have been seen with early surgery to allow early mobilization.

The Judet prosthesis was developed to theoretically allow a more congruent articulation with the capitellum. It is a modular design with a ball and socket articulation between the stem and head. Good results have been reported even in chronic situations. A radial head replacement can be removed at a later date for lateral elbow pain or if erosion of the capitellum occurs. An extensive soft tissue release is likely to be required to remove a radial head replacement.

Fracture with elbow dislocation

Elbow dislocation combined with radial head and coronoid fractures can be markedly unstable and has been named ‘the terrible triad’ by Hotchkiss due to poor results reported. There is a high incidence of redislocation whilst in plaster and operative treatment with fixation of even a small coronoid fragment is indicated. The aim is to achieve stability and early mobilisation. Several factors are important to consider when treating these injuries. The coronoid fracture should be fixed (Type II or III) or the anterior capsule repaired if an avulsion of the tip of the coronoid is present (Type I). If a radial head replacement is used it is important not to ‘overstuff’ the radiocapitellar joint as this can lead to instability or reduced movement. The aim is to restore radial length to within 2–3 mm to achieve stability. A pre-operative radiograph of the normal side may be helpful to assess radial length. Both medial and lateral collateral ligaments may need to be repaired. They commonly have avulsed from their origins on the distal humeral epicondyles. If the elbow remains unstable after repair a hinged external fixator may be necessary.

Mobilisation is commenced at 2 weeks with active movements but avoiding the last 30° of extension for 4 weeks.

Complications

Complications include pain, stiffness, decreased strength, posterior interosseous nerve palsy, post-traumatic arthritis, instability, cubitus valgus, mal- and non-union.

The functional range of movement of the elbow is from 30° to 150° flexion. Patients commonly loose the terminal 15° of extension and, if persisting after 6 months, it should be explained it is unlikely to resolve. An arthroscopic or open release should be considered at this stage if a 35° loss of extension is present.
Pin palsy is likely to be a neuropraxia. Exploration is indicated if it occurs with an open fracture or as a new finding following a closed reduction or open surgery.

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References