ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 06, 2021

Non Re constructable Radial Head Fractures Management by Radial Head Replacement in Adult

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ABSTRACT

Radial head fractures are common lesions found in nearly 20% of elbow injuries, typically after a fall on the outstretched hand with the wrist extended and the forearm pronated. The radial head provides stability about the elbow and forearm in two ways. first ,it serves as a secondary stabilizer to valgus instability of the elbow with the primary stabilizer being the medial collateral ligament. Second the radial head also provides stability to the distal radio-ulnar joint to assist the forearm in resistant axial forces and enhancing grip strength. The spectrum of radial head injuries ranges from simple undisplaced fractures to comminuted fractures associated with other osseous and/or ligamentous injuries. The presence of a displaced or comminuted fracture should alert the surgeon to the possibility of an associated ligamentous or bony injury and this should be sought. The most common associated injuries affect the coronoid, proximal ulna, the medial and lateral collateral ligaments and the longitudinal radio-ulnar interosseous ligament. The wrist should also be assessed to rule out an associated EssexLopresti injury.The surgical option for managing displaced or comminuted radial head fractures consist of excision (early or late), internal fixation or radial head replacement.The aim of this study to review the best management duringtreatment of non reconstructable radial head fractures in adult.

Keywords: Non Reconstructable Radial Head Fractures; Radial Head Replacement

INTRODUCTION

The primary functions of the elbow are to position the hand in space, act as a fulcrum for the forearm, and allow for powerful grasping and fine motions of the hand and wrist. Loss of elbow function can cause significantdisability and affect activities of daily living, work-related tasks, and recreational activities. A proper understanding of the elbow joint biomechanics will aid in understanding the impact of the radial head on the elbow and upper limb **(1).** The elbow joint complex allows two types of motion. Flexionextensionwhich occurs at humeroulnar and humeroradialarticulations and pronation , supination which occurs at proximal radioulnar joint. To understand the elbow motion (kinematics). The axis of rotation, the carrying angle and the range of motion should be discussed Pronation and supination take place at the proximal radioulnar joints with theforearm rotating around a longitudinal line passing through the center of the capitellum and the radial head and the distal ulnararticular surface**(1).**

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Fractures of the radial head are common, constituting approximately one-third of all elbow fractures. These fractures typically occur when an axial load is applied to the forearm, causing the radial head to hit the capitellumof the humerus. The severity of these injuries varies from minimally displaced fractures needing minimal treatment to those with major displacement or comminution, requiring surgical fixation, excision, or replacement**(2)**Careful examination of the elbow will demonstrate instability often associated with dislocation of the elbow and a radial head fracture. One or more of the essential elements is often injured. These complex radial head fractures require different treatment recommendations. Again, it is essential to examine the elbow as well as the wrist and forearm for associated injuries at the elbow, in particular for olecranon fractures, coronoid process fractures, and medial or lateral collateral ligament injuries**(3)**.

The radial head is fractured in about 30% of cases of elbow trauma, and about 33% of elbow fractures and dislocations includeinjury to the radial head and/or neck. The incidence is estimated at 2.5 to 2.9 per 10.000 per year . Radial head fractures are most often the result from a fall on the outstretched hand with the elbow partially flexed and pronated **(4)**. Elbow fractures to the angle of flexion of the elbow during a fall, the so-called 'arc of injury'. The radial head only fractures at a flexion angle between 0 and 80 degrees. With flexion of <35 degrees either the coronoid process or the radial head (or both) may fracture**(5)**.

Pathophysiology:

The radial head is intra-articular, so anatomic reduction of bone fragments is necessary to minimize the risks of lateral posttraumatic arthritis from mechanical grinding. The intra-articular position also means that soft-tissue attachments to the most proximal portion of the bone are limited, so fractured fragments frequently lose their blood supply, resulting in avascular necrosis and potential nonunion. Luckily, the radial head mostly acts as a spacer preventing proximal migration of the radius, and as long as it maintains its structural support, the patient may do well **(6)**.

Mechanism of injury:

I-Direct Trauma: Here the violence is directed to the lateral side of the elbowjoint or the upper forearm**(7).** Non-or minimally displaced fractures of the radial head are themost often caused by a direct blow to the elbow. Conversely,displaced impacted and comminuted fractures are most frequently the result of a fall onto an outstretched hand**(8).**

II- Indirect Trauma: The mechanism through which indirect trauma can causefracture of the head of the radius can be one of the three possibleways: excessive valgus strain at the elbow; vertical compression along the long axis of the radius.

And associated momentary elbow dislocation**(7).**

Mason classification of radial head fractures; Type I radial head fractures (minimally displaced) areusually simple, straightforward fractures secondary to alongitudinal compressive force and usually they are notassociated with injuries to the other essential anatomicalsupport structures.Type II radial head fractures (moderately displaced) arearticular fractures of the radial head or angulatedfractures of the radial

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 06, 2021

head and proximal shaft or neckarea**.** These are often caused by acombination of axial and rotational forces and may bemost commonly associated with a fall on the outstretched hand and a resulting wrist injury **(9)**. With type II injuries it is important to check not only for injuries of the essential anatomical structures (eg, coronoid process), but also for wrist or forearm injuries associated with the axial directed force, particularly injuries to the distal radioulnar joint**(10).**Type III radial head fractures, comminuted fractures othe radial head are often associated with injury to the other essential anatomical support elements of the elbow (medial collateral ligament, coronoid process, capitellum) **(3)**. A fourth type to the Masonclassification: radial head fracture with dislocation of the elbowjoint. Type IV radial head fractures involve a comminuted radialhead fracture and elements of elbow and/or forearm instability **(11)**.

The Arbeitsgemeinschaft fur Osteosynthesefragen (AO)Foundation developed the AO classification for long bone fractures.Fractures of the proximal radius are divided into three types: extra- articular head radius fx, articular isolated head radius fx, Articular head radius and proximal ulna fx **(12)**

Clinical picture:

The patient with radial head fracture-dislocations usuallypresents with a history of a fall on the outstretched hand. Blunt or penetrating trauma rarely causes radial head injury. The wrist especially the distal radioulnar joint may be damaged simultaneously and the presence of wrist pain, grinding, or swelling should bedetermined. Neurovascular symptoms of numbness, tingling, or loss of sensation should be identified to rule out nerve or vascular injury. The presence of severe pain should alert the examiner to the possibility of compartment syndrome**(6)**.

Physical examination:

The physical examination of elbow injuries always mustinclude the wrist, because injury to the radial head also may involve the distal radioulnar joint. If the wrist is unstable, this instability may not only need direct treatment, but also affect the choice of treatment at the elbow. when there is a risk of proximal migration in association with a distal radioulnar joint injury, excision of the radial head (without replacement) may be contraindicated**(13)**. Patients with radial head fractures and dislocations presentwith localized swelling, tenderness, and decreased motion. Thephysician needs to carefully examine any wounds to make sure noopen fractures are present. All 3 major nerves of the forearm are in danger withelbow fractures and dislocations, so the examiner should alsocarefully assess neurovascular function for all of the nerves of theforearm and hand. Radial nerve function is especially important toassess with displaced fractures through the neck of the radius. The motor (posterior interosseous) branch provides extension for thefingers and wrist.

The examiner must also assess the firmness of all compartments, check for pain with passive stretch, and measure compartment pressures if in doubt to avoid missing compartment syndromes. Elbow stability needs to be assessed even with seemingly

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nondisplaced radial neck fractures. The elbow is testedwith valgus stress at 30° of flexion to determine the competency of the medial collateral ligament**(8).**

Radiological investigations:

Most radial head injuries can be assessed adequately withmstandard plain radiography of the elbow. Standard radiographic evaluation of radial head fractures includes AP and lateral views of the elbow. Because of the typical mechanism of injury (a load applied from distal to proximal), wrist views usually are advisable and, of course mandatory, if there are symptoms at the wrist**(3)**. Often a nondisplaced radial head fracture cannot be seen directly on plain radiographs. In those instances, the only clue may be an enlarged posterior fat pad visible on the lateral view. Because the posterior fat pad is intracapsular but extrasynovial, a visible posterior fat pad indicates fluid (eg, blood) with the joint. In the setting of trauma, the presumption is an occult radial head fracture is present **(14).**

CT scanning of the elbow is useful to define fracture patterns. Although additional views (eg, radiocapitellar view, shot with the forearm in neutral rotation and the beam angled 45° cephalad) might be useful if initial films are negative, it is reasonable simply to diagnose empirically a nondisplaced fracture on the basis of history and the presence of a posterior fat pad sign(**15)**.

Associated injuries:

Injuries associated with radial head fractures include theEssex-Lopresti lesion (tear of the interosseous membrane, distalradioulnar joint disruption) and the terrible triad of the elbow(elbow dislocation, coronoid fracture, and radial head fracture) **(13)**.In a retrospective study of 333 patients with a radial head fracture, clinically relevant associated injuries of the ipsilateral upper extremity were diagnosed in 39% of the patients**(16)**. There is a strong correlation between the likelihood of associated injury and the severity of the radial head fracture. The incidence can increase from 20% in Mason type I fractures to 80% in type III fractures. Loss of cortical contact between fracture fragments in type II fractures is also strongly predictive for a complex injury pattern**.**Partial lesions of the interosseous membrane with MRI in nine of 14 patients, of which seven reported pain in the region on the distal interosseousmembrane (IOM) **(17)**.

Ligamentous injuries:

As the radial head fractures with the elbow in flexion andpronation with the hand fixed on the ground, the lateral collateral ligament (LCL) ruptures as a result of the forced supination of the forearm when the body rotates internally on the elbow under axial compression as the body approaches the ground. If the rotational and axial forces continue, a posterolateral dislocation finally can occur, with or without rupture of the medial collateral ligament(MCL). The MCL can also rupture as a of a valgus moment**(15)**. Ligamentous injuries are found with MRI in 61% to 80% of the patients with a radial head fracture. a clinically relevant LCL lesion in 11% of cases, a MCL lesion in 1.5% and a combination of both MCL and LCL lesions in 6%**(16)**.

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Elbow dislocation, coronoid process fractures and the'terrible triad of the elbow:

Three to 14% of all radial head fractures are accompanied by aposterolateral dislocation of the elbow. It occurs after a fall on the (nearly) extended arm. During posterolateral dislocation, the ligamentous structures and the capsule are ruptured in a circle from lateral to medial**(12)**. The axial compression and supination cause the LCL to rupture, which results in a posterolateral rotator movement of theforearm. After rupture of the dorsal and ventral elbow capsule, the elbow joint dislocates as a result of the axial forces. The coronoid process is pushed under the trochlea of the humerus, causing a shear fracture. Until this phase, the dislocated elbow can self-reduce. inally, the MCL ruptures as the coronoid process is pushed further under and behind the trochlea, although this does not occur in all cases**(14,16)**. The combination of an elbow dislocation, radial head fracture and coronoid fracture is called 'the terrible triad of the elbow' because it can result in severe joint instability and many posttraumatic complications**(18)**.

The injury pattern is similar to both-bone forearm fractures. Monteggia fracture-dislocations are included here because of the importance of not missing either injury. The isolated injuries (radial head dislocation by itself or ulna [nightstick] fracture by itself) are often treated by closed treatment with good results, but the combined injury can almost never be treated by closed methods**(13)**.

Management

The treatment of these fractures depends on the amount of angulation and displacement. The guidelines for head and neck displacement vary slightly in different texts and between authors; however, the guidelines below have become accepted standards **(19,20)**. Fractures with less than 30 of angulation and less than 5 mm of displacement do not require reduction. They can be treated symptomatically in a sling initially with early mobilization. Some authors suggest closed manipulation for patients nearing skeletal maturity for fractures with greater than 15angulation. In fractures with angulation between 30 and 60, closed reduction should be attempted. If less than 45 of angulation is achieved with minimal translation and 60 of pronation/supination are obtained, then reduction can be deemed acceptable. The stiffness incurred when an open procedure is carried out does not justify any potential gains obtained by improved accuracy of reduction**(21,22)**.

Fractures that are angulated more than 60 and with more than 5 mm of translation are not likely to be reducible by manipulation alone therefore surgical intervention is justified. However, closed manipulation should still be attempted once in the operating room prior to an open surgical intervention. Closed manipulation: The degree of forearm pronation/supination at the time of injury will have dictated the deformity, hence knowledge of this can aid in selecting the reduction manoeuvre. One method is to rotate the forearm under fluoroscopy until the radial head is in profile, with maximum visible deformity. A reduction is then performed by the external

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 06, 2021

application of pressure in this position of rotation to attempt to push the head up against the capitellum**(23,24)**.

Surgical management:

The options for surgical management include percutaneous manipulation with K wire fixation, flexible intra-medullary nail fixation and open fixation using a lateral approach **(25)**. If a percutaneous K wire is to be used to stabilize the fracture it can first be used to joy-stick the fragment into reduction through a posterior insertion point. An open lateral approach can be used to reduce the fragment if needed and, if the fracture remains unstable, a K wire can be inserted across the fracture line from proximal to distal or distal to proximal. Trans-capitellar wires are to be avoided because of the risk of pin breakage**(26,27)**. An intramedullary flexible nail, with a bend at the end, can be inserted from distal to proximal fashion to engage the head fragment and can then be rotated to achieve reduction. Open reduction should only be used as a last resort when other less-invasive means have failed, as it results in stiffness**(28)**.

i. **Radial head excision:**

In severely comminuted radial head fractures, radial head excisionmay be an option. This is technically easier than attempting internal fixation. There are conflicting reports about the outcome of radial head excision in the acute setting. It is certainly contraindicatedin presence of an injury to the MCL or the interosseous membrane. Even in the absence of ligamentous injury, excision has been associated with delayed complications including pain, joint instability, decreased strength, cubitus valgus and osteoarthritis **(28)**. In the setting of uncertainty regarding the presence of an associated soft tissue injury, it is probably better to avoid excision in the acute setting. Delayed excision of the radial head for a failed fixation or arthroplasty is always an option, and is usually associated with a good functional outcome**(29)**.

ii. **Radial head fixation:**

Internal fixation of the radial head is the preferred treatment if itcan be achieved. It is technically demanding surgery and the surgeon should always have radial head replacements available in case the radial head is not reconstructable. The tendency is for the fracture to mal-reduce into a shortened and valgus position**(27)**.

Itis important to differentiate between a partial articular fracture where a part of the articular surface is still connected to the radial shaft and a complete articular fractures where there is a complete separation of the head from the shaft with comminution of the head fragment. The options for fixation are e mini-fragment screws and plates, headless Herbert-type compression screws and pre-contoured plates. Temporary fixation is usually achieved with K wires and definitive fixation is carried out using 1.5 or 2mm mini-fragment screws**(30)**. Subchondral bone gives the best purchase for screws and counter-sinking the screw heads is essential to avoid impingement. If the fracture extends into the radial neck, a T- or L-shaped plate may be required. The bicipitaltuberosity is the most distal extent for placement of the plate, as dissecting further distally risks injury to the posterior interosseousnerve. It is important to visualize the articular surface, either under vision or under image guidance, to make sure the articular surface is reduced properly. If a plate is being used, it is important to place this in the safe zone. This is the arc of the radial head that is non-articular, hence metalwork in this zone will not interfere with forearm rotation**(31)**.

iii. Radial head replacement:

Radial head replacement arthroplasty is considered when thefracture is displaced, comminuted and stable internal fixation is not possible. It is also considered when the fracture involves more than one third of the radial head. Radial head replacement is particularly indicated for fractures with associated ligamentous injury (elbow dislocation or distal radio-ulnar joint disruption) and coronoid or olecranon fractures which are displaced or unstable. The difficulty is deciding which of the radial head fractures meet these criteria**(32)**.

A study from Mayo clinic showed that radial neck lengthening of as little as 2.5 mm altered the radio-capitellarbiomechanics, with a significant decrease in varus-valgus laxityand the ulna tracking in external rotation. Radial neck shortening had the opposite effect. The Mayo group thus recommend erring towards a smaller size implant than the native head, both with regards to diameter and thickness **(33)**. It is important to check theradial neck for undisplaced fractures prior to insertion of the prosthetic head. Any undisplaced fractures should be prophylactically wired before insertion of the prosthesis or displacement and collapse may occur when the prosthesis is inserted. The prosthesis is most commonly inserted uncemented, as the prosthetic radial head functions as a spacer taking compressive loads**(34)**.

CONCLUSION

There is no clear evidence in this review of the superiority of one type of metallic radial prosthesis over another**.** The results can be good in either of these forms of treatment, with outcome being related to the fracture pattern and the presence of associated injuries**.**

Undisplaced fractures are managed nonsurgically, with symptomatic treatment and early mobilization. Radial head excision is to be avoided if possible in the acute setting, except in elderly and low demand individuals without any associated osseous or ligamentous injuries. Comminuted fractures in younger patients with larger fragments should be fixed if possible, with the understanding that they may require a further operation for metalwork removal. The use of lowprofile implants in the safe-zone is encouraged. If the fracture fragments are small and if fixation is not possible in the safezone, or in the presence of significant metaphysealcomminution, a replacement arthroplasty is advocated. Metallic implants are preferred to silastic prostheses.

Great care is essential to determine the optimal height of the implant and to avoid overstuffing responsible for pain and/or stiffness or, on the contrary, for

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 06, 2021

residual instability. The possibility of proximal migration of the radius and an increase in the carrying angle also must be considered.

Osteoarthritic changes in both the elbow and wrist are frequent radiographic consequences of the excision procedure; however, these complications often are without functional impairment.

No Conflict of interest.

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