Marginal radial head fractures with displaced fragments are relatively common, especially when associated with a concomitant posterior elbow dislocation. The separated fragments are usually displaced forward and outward into the lateral part of the elbow or proximally in the elbow joint. Ulnar displacement of the separated fragments has been described in few cases, and in most of them treatment consisted of excision of the entire radial head.

This article presents a case series of 4 Mason type 3 radial head fractures with medially displaced fragments that had to be excised via a separate medial incision. Surgery was performed using 2 incisions, the standard Kocher and a medial incision; complete radial head excision was performed. Clinical and radiological assessment was done for all cases. Pain and range of motion at 2 years and any evidence of heterotrophic ossification were assessed. All patients had some degree of flexion deformity at final follow-up. One patient had some loss of rotation. No heterotrophic ossification existed in any patient. The authors postulate that the medial displacement may have been due to a nutcracker effect that caused the medial portion of the radial head to be compressed between the capitellum and the radial shaft and lateral part of the radial head. Such injuries are rare, and postoperative loss of flexion should be expected. Posterior elbow dislocation may not be present in all cases.
Radial head and neck fractures are commonly seen in young to middle-aged adults and comprise approximately 20% of acute elbow injuries in this age group.\textsuperscript{1,2} Isolated radial head fractures are less common, comprising approximately 2% of all elbow fractures, and are mostly seen in situations when the patient has fallen on outstretched, supinated hands.\textsuperscript{2} The treatment of these fractures may be operative or nonoperative, depending on the degree of head comminution, the percentage of articular surface involved, the presence of loose intra-articular fragments, and the angulation between the radial neck and proximal shaft.\textsuperscript{1,3}

Marginal radial head fractures with displaced fragments are relatively common, especially when associated with a concomitant posterior elbow dislocation. The separated fragments are usually displaced forward and outward into the lateral part of the elbow or proximally in the elbow joint.\textsuperscript{1} The fragments of the radial head are commonly seen anterolaterally\textsuperscript{1,2} and are easily approached and removed via the standard lateral Kocher incision. Ulnar displacement of the separated fragments has been described in few cases, and in most of them the treatment consisted of excision of the entire radial head. These medially displaced fragments, which are unapproachable by the lateral approach, are rare and may be associated with concomitant elbow dislocation.\textsuperscript{3,6}

This article presents a series of 4 simple Mason type 3 radial head fractures with medially displaced fragments that had to be excised via separate medial incisions.

**Case Reports**

**Patient 1**

A 22-year-old man fell from a bike onto his outstretched right hand. On examination, tenderness and swelling were present over the lateral side of the elbow joint, and joint range of motion was painful and limited. Mild ecchymosis was present over the anterolateral side of the joint, and no significant deformity or swelling was present over the medial side. The distal neurovascular status was normal. Anteroposterior and lateral radiographs of the elbow revealed a Mason type 3 radial head fracture with a fragment displaced medially that more apparent on the anteroposterior view (Figure 1). This fragment was displaced to the anteromedial aspect of the proximal ulna, whereas the remnant of the head remained in its original location. The articular surface was facing laterally, and the fracture surface was medial.

Radial head excision was performed. The medial fragment was removed from the superficial fibers of the flexor digitorum profundus by a separate medial incision (Figure 2), and the other portion was removed via a standard lateral incision. A track extending from the elbow joint to the flexor digitorum profundus was identified by the congealed blood lining it. No instability was apparent on examination under anesthesia. Postoperatively, a plaster of Paris long-arm back slab was worn for 2 weeks, and physical therapy was subsequently started. At 2-year follow up, the patient had elbow flexion from 15° to 130° and full supination and pronation. No pain occurred with motion, and the patient was able to do heavy work. No evidence existed of heterotopic ossification of the joint on radiographs.

**Patient 2**

A 48-year-old man fell in the bathroom, landed heavily on his outstretched right arm, and felt sharp pain immediately in his elbow. He presented to the emergency room with tenderness over the elbow laterally, restricted movement, and mild swelling over the volar aspect of the forearm. Radiographs revealed a Mason type 3 radial head fracture. A comminuted portion of the radial head had migrated medially to lie medial to the coronoid (Figure 3). Radial head excision was performed by a standard lateral incision. For the medial fragment, a separate medial incision was used, and the comminuted portion, which was deeply embedded in the belly of the flexor digitorum profundus, was removed. At 2-year follow-up, the patient had a flexion deformity of 10° but no restriction of rotation. No pain occurred with movement.
Patient 3

A 27-year-old woman fell down the stairs and landed obliquely on her left arm. She immediately noticed a prominent deformity of her elbow and could not move it. She presented to the emergency room, where radiographs revealed a dislocated elbow with a Mason type 3 radial head fracture, which had a medially displaced fragment (Figure 4). No neurodeficit existed. The dislocation was reduced in the emergency department, and subsequent radial head excision with 2 incisions was performed. At 2-year follow-up, the patient had a flexion deformity of 18° with supination from 0° to 70°. Mild pain occurred on rotation.

Patient 4

A 25-year-old woman fell on her elbow. She presented to the emergency room with tender swelling of the elbow and mild tenderness and swelling over the medial aspect of the forearm. Radiographs revealed a Mason type 3 radial head fracture that was almost entirely displaced medially (Figure 5). The radial head was excised using twin incisions, and a track of congealed blood led from the elbow joint to the flexor digitorum profundus, where the head was entrapped in the muscle fibers. The patient started vigorous physiotherapy after 2 weeks. At 2-year follow-up, she had a flexion deformity of 12°. No restriction of rotation existed, and pain was absent.

RESULTS

A total of 4 cases of Mason type 3 radial head fractures were included in the current study. The cases included 2 men and 2 women. Three patients were young (age range, 22-27 years) and 1 was middle-aged (48 years). Two patients fell on an outstretched arm, and 2 fell directly on the elbow. Only 1 patient had elbow dislocation as a concomitant injury. Complete radial head excision was performed in all cases using twin incisions: a standard Kocher lateral approach and a medial incision directly over the radial head fragment (Figures 2, 6). Physiotherapy was started 2 weeks postoperatively, and final follow-up occurred at 2 years. All patients had some loss of flexion (average loss, 13.7°), and 1 patient had supination from 0° to 70°. Only 1 patient had pain on movement. No evidence of heterotopic ossification existed in any patient. Radial head prosthetic replacement was not attempted because it was not available at the authors’ institution.

DISCUSSION

Radial head fractures are among the most common fractures occurring around the elbow in adults, accounting for 1.5% to 4% of all fractures and approximately 33% of all elbow fractures. Although radial head fractures can occur in isolation, associated fractures and ligament injuries are common. Assembling the clinical presentation, physical examination, and imaging into an effective treatment plan can be challenging. The characteristics of the radial head fracture influence the technique used to optimize the outcome.

The mechanism of injury in radial head and neck fractures is usually a fall onto an outstretched hand with a partly flexed elbow and pronated forearm, causing a
longitudinal impact of the radius against the capitellum. The force of trauma is transmitted along the forearm, producing a valgus stress at the elbow and causing compression of the radial head against the capitellum, which results in fracture due to shear between the vertically aligned trabeculae and may injure the capitellum.\(^2\)

Clinically, moderate to severe pain, local tenderness with swelling, and a positive fat pad sign with a fracture line on radiography are diagnostic features. Conventional radiography with anteroposterior and lateral views is usually adequate for detection of radial head and neck fractures. Internal and external oblique radiographs are occasionally required. Computed tomography with reconstruction images is helpful to aid in decision making.

Mason’s\(^2\) classification, based on the severity of radial head and neck fracture, is used clinically to formulate the type and extent of treatment. Mason\(^2\) classified radial head fractures into 3 groups: type I is an undisplaced marginal fracture, type II is a displaced marginal fracture, and type III is a comminuted fracture. A fourth group was subsequently added: type IV, which includes any radial head fracture with dislocation of the humeroulnar joint.

The usual displacement in marginal radial head fractures is forward and outward, into the lateral aspect of the elbow or proximal migration toward the elbow joint. Medial displacement of the fragments has been rarely described. Watson-Jones\(^3\) described 2 cases, 1 of them with ulnar nerve palsy. El Ghawabi\(^4\) reported 3 cases suggesting 2 different types of injury: with and without elbow dislocation. According to his classification, in the first type, the whole head is displaced medially without elbow dislocation, whereas in the second type, with posterior elbow dislocation, the radial head is damaged by the severity of the trauma and usually divided into many fragments, with some of them dislocated to the ulnar side. According to El Ghawabi,\(^4\) the second type is caused by more severe trauma and may be associated with a valgus strain damaging the medial structures in addition to the indirect compressive forces, which may predispose to subsequent heterotrophic ossification. In a study by Eid,\(^5\) 6 of the 8 patients who had comminuted radial head fracture with medial displacement of the fragments also had posterior dislocation of the elbow, and 2 of them had ulnar palsy, probably due to traction during the elbow trauma. Tudisco et al\(^6\) reported 2 cases with medial displacement of the fragments following fracture of the radial head associated with a posterior elbow dislocation.

As per the classification of El Ghawabi,\(^4\) current patients 1, 2, and 4 are the first type, which involves medial displacement of the radial head without concomitant elbow dislocation, and case 3 is the second type. Few similar cases have been reported in the literature: 2 by Watson-Jones\(^3\) (1 of whom had ulnar nerve palsy), 2 by El Ghawabi,\(^4\) and 2 by Eid.\(^5\) The mechanism of this type of injury is not fully understood. El Ghawabi\(^4\) postulated that the radial head or part of it squeezing between the capitellum and radial stump may cause medial displacement or that transient dislocation of the elbow may exist. In addition, in current patients 1 and 2, the articular surface of the fragment was facing laterally toward the joint, meaning that it had rotated 180° as it traversed the tract. The ulnar displacement of the radial head may be due to a nutcracker effect that causes the medial portion of the head to be squeezed between the capitellum and the radial shaft and lateral part of the radial head, causing the medial splay. These patients presented to the emergency department immediately after injury and were sure that the limb was in the same position as at the time of initial injury with no evidence of dislocation. Patient 3 had a concomitant elbow dislocation, but contrary to the description by El Ghawabi,\(^4\) the medial fragment was whole and not comminuted. Also, no heterotopic ossification existed in any case. This is contrary to El Ghawabi’s\(^4\) findings, and the current authors believe that earlier institution of physiotherapy in their cases (2 weeks postoperatively) was beneficial to their results.

**Conclusion**

Medial displacement may be due to a nutcracker effect that causes the medial portion of the radial head to be compressed between the capitellum and the radial shaft and lateral part of the radial head, akin to the cracking of a nut, causing splay of the fragment in the medial direction. The rotation can be ascribed to the mechanics of the injury, whereby the fracture starts at the articular surface and proceeds downward toward the neck while getting splayed at the same time, so that the momentum of the injury causes the fragment to rotate while displacing medially. El Ghawabi’s\(^4\) classification should be modified in that the comminution of the medially displaced fragment may not be associated with elbow dislocation and vice versa.

**References**