Indications and surgical results of radial head fractures

E. Galindo Martens, A. Fernández Domingo, F.J. Sainz Lozano and J. Sánchez Moreno
Hospital Central Fraternidad-Muprespa, Madrid, Spain.

**Purpose.** The purpose of this study was to look into the results of the treatment of radial head fractures in working age patients in order to establish a systematic way of treating them either orthopedically or surgically, on the basis of Mason’s classification and of their related lesions.

**Materials and methods.** A retrospective study was carried out of 72 patients who had suffered a radial head fracture caused by an occupational accident. The statistical analysis conducted included the following quantitative and qualitative variables: epidemiological aspects, patient evolution, complications, treatment method employed and stage the fracture was at according to Mason’s classification. Epidemiologically, a highly homogeneous group was obtained since only working age patients were included (mean age was 35 years), with 80% of them being male. The most common mode of injury was a fall on the outstretched hands (84% of cases).

**Results.** The best functional results were obtained with orthopedic treatment for grades I and II with no joint blocks. The remaining patients treated through an open reduction and osteosynthesis improved more rapidly than with a total resection of the radial head. In addition, they preserved their function better and had fewer complications in the long term. In those cases in which it was not possible to carry out a stable osteosynthesis, the radial head was resected. Only where the medial collateral ligament or the interosseous membrane (Essex-Lopresti injury) were damaged, patients were subjected to the replacement of the radial head by a metal prosthesis.

**Conclusions.** The importance of the radial head as a stabilizer of the elbow and wrist joints, together with the poor long-term evolution of total resection, make it necessary to make an attempt to carry out an open reduction and internal fixation. Only in highly comminuted articular fractures where stable fixation is out of the question will other surgical possibilities have to be considered.

**Key words:** elbow, radial head fracture, radial dome, prosthesis.

**Indicaciones y resultados quirúrgicos de las fracturas de la cabeza radial**

**Objetivo.** Se pretende analizar los resultados del tratamiento de las fracturas de cabeza radial en pacientes en edad laboral, y establecer una sistemática de tratamiento, ya sea ortopédico o quirúrgico, en función de la clasificación de Mason y de las lesiones asociadas.

**Material y método.** Se realiza un estudio retrospectivo de 72 pacientes que sufrieron una fractura de cabeza radial causada por accidente laboral. En el análisis estadístico se incluyeron como variables cuantitativas y cualitativas: aspectos epidemiológicos, evolución de los pacientes, complicaciones, método de tratamiento empleado y estadio de la fractura según la clasificación de Mason. Epidemiológicamente se obtuvo un grupo muy homogéneo, al estar limitada la edad al ámbito laboral (la edad media fue de 35 años), siendo el 88% pacientes varones. El mecanismo de producción más frecuente fue la caída sobre las manos en un 84% de los casos.

**Resultados.** Los mejores resultados funcionales se obtuvieron con el tratamiento ortopédico para los grados I y II sin bloqueos articulares. El resto de los pacientes tratados por reducción abierta y osteosíntesis mejoraron más rápidamente que con la resección total de la cabeza radial, conservaron mejor la función y tuvieron menos complicaciones a largo plazo. En los casos en que no fue posible realizar una osteosíntesis estable se resecó la cabeza radial. Sólo cuando hubo lesión del ligamento colateral medial o de la membrana interósea (lesión de Essex-Lopresti), los pacientes se beneficiaron de la sustitución de la cabeza radial por una prótesis metálica.

**Conclusiones.** La importancia de la cabeza radial, como elemento estabilizador de las articulaciones del codo y de la muñeca, y la mala evolución a largo plazo de la resección total, hace necesario el intento de una reducción abierta y fijación interna. Sólo en fracturas articulares muy comminutas, en las que no sea posible una fijación estable, habrá que buscar otras opciones quirúrgicas.

**Palabras clave:** codo, fractura cabeza radial, cúpula radial, prótesis.
The timing and method of treatment of radial head fractures are still a subject of controversy. A review of the literature shows disconcerting results since very few authors act systematically\textsuperscript{1-3} on the basis of a classification. This is probably due to the fact that the most frequently used classifications\textsuperscript{4-5} do not consider the age and condition of the patient or possible associated lesions.

Historically, complete resection of the radial head was the method of choice, owing to the fact that it allowed a rapid reduction of pain and improved range of movement\textsuperscript{3}. The identification of the radial head as a stabilizer\textsuperscript{6-14} of the elbow and wrist joints together with the advances made in the field of surgical techniques\textsuperscript{15-27} and prosthetic implants\textsuperscript{8,10,28,29} have unveiled the role of fracture stabilization as a way of improving patient outcome, either by means of open reduction or the use of a metal prosthesis.

In this article we carry out a retrospective review of 72 cases treated over the last 6 years with the aim of establishing a systematic form of treatment based on the results we have obtained.

MATERIALS AND METHODS

A retrospective study of consecutive cases was performed, including all patients diagnosed with a radial head fracture in the last 6 years who had been followed up for a minimum of 1 year. From 1996 to 2001, we had 72 fully documented radial head fractures that complied with the requirements to be included in this study. In all cases, the Mason-Hotchkiss\textsuperscript{4} classification was used to define the severity of the lesion.

The population studied was limited to workers, therefore there are no patients under 18 or over 65 years of age in this series, which makes the group fairly homogeneous. 88% of patients were male and 12% female. The mean age was 35 years (range: 19-63); the standard error of the mean was 1.58. The right elbow was involved in 55% of cases. No bilateral lesions were observed. In 84% of cases, the fracture was caused by a fall on the hands with an outstretched pronated arm, which provoked an impact of the radial head onto the capitellum. The rest of the fractures were caused: 9% by a direct blow and 7% by a traffic accident (Figure 1). About 12% of the patients had associated lesions, the most frequent being fractures of the distal end of the radius (3%), and of the pyramidal bone (3%). Conservative orthopedic treatment was used in 55% of cases and surgery in 45% (Table 1). The first indication for surgery was limitation of prono-supination of the forearm, frequently caused by a displacement greater than 2 mm of some fragment of the radial head. Conservative orthopedic treatment was used, as described below, in grade I and grade II fractures without passive limitation of movement, in spite of the creaking sound heard occasionally.

In patients who required surgery, mean time to operation was 9 days (standard error of the mean was 3.10), although almost 50% of the patients were operated on during the first two days. Of those that underwent surgery, 37% required removal of the ORIF material in a mean time of 4.3 months (standard error of the mean 0.98). Mean time to return to work was 4.4 months (standard error of the mean 0.62). On exploration there was pain, mainly in the radial head (98%), and crepitation on prono-supination when there was displacement (grades II, III and IV; 49%). The fatty pad was assessed by antero-posterior and lateral X-rays.

In our hospital we use the Mason-Hotchkiss\textsuperscript{4} classification to assess the severity of the lesion:

**Type I** (Figure 2A): Nondisplaced fracture (< 2 mm), without a mechanical block on prono-supination. These accounted for 51% of cases seen. No associated lesions were seen in this group. 80% of fractures of this type do not require rehabilitation.

**Type II** (Figure 2B): Marginal fracture with displacement (< 30% of the radial head, displacement < 2 mm). Often accompanied by a mechanical block. These were 24% of the cases seen and 6.5% had associated lesions (3% fractures of the pyramidal bone).

**Type III** (Figure 2C): Total articular comminuted fracture of the radial head. These accounted for 15% of the cases seen and 4.5% had associated lesions (3% lumbar fractures).

### Table 1. Most frequently employed surgical techniques based on Mason’s classification

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonoperative</td>
<td>97</td>
<td>18</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>K-wire</td>
<td>0</td>
<td>6</td>
<td>27</td>
<td>0</td>
</tr>
<tr>
<td>One screw</td>
<td>1</td>
<td>47</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Two screws</td>
<td>2</td>
<td>12</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td>Total resection</td>
<td>0</td>
<td>5</td>
<td>55</td>
<td>71</td>
</tr>
<tr>
<td>Partial resection</td>
<td>0</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Prosthesis</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

K-wire: Kirschner wire

Figure 1. Epidemiological data of this study. TA: traffic accident.
Type IV (Figure 2D): Fractures type I, II and III in association with elbow dislocation. These were 10% of the cases seen.

As to the surgical technique used, the operations were performed by different surgeons belonging to the same team. The patient was placed in a supine position and the usual approach was postero-lateral as described by Kocher, although, occasionally, another approach was used or this approach was extended if there were associated lesions of the elbow that required repair. The epicondyle and radial head were located (Figure 3A) and an oblique incision was made from the epicondyle in a distal direction. It is important to keep the forearm in the prone position during the whole procedure (Figure 3B) to protect the posterior interosseus nerve, which is anterior to the joint capsule and the radial head. Once the fascia is located (Figure 3C) dissec-
Figure 3. A) Lateral approach to the radial head. B) It is imperative to keep the elbow in a prone position during the surgical procedure. C) View of the joint capsule. D) View of the fracture prior to its reduction and bone fixation. E) Appearance on closing the wound, before suturing the radial collateral ligament.
tion is continued between the posterior ulnar muscle and the anconeus up to the joint capsule, which is opened with a straight or T-shaped incision. The collateral radial ligament complex is sectioned (Figure 3D) to open the articulation as if it were a book. At the end of the operation it is important to reattach the collateral radial ligament in the epicondyle with a non-resorbable transosseus suture (Figure 3E).

RESULTS

In our hospital 97% of Mason type I fractures were treated conservatively. This treatment consisted in: aspiration of the hematoma through a lateral approach (to avoid the ulnar nerve), injection of anesthetic at 1% with adrenaline into the joint, use of a sling, and early mobilization from the third day if pain allowed this. The following results were obtained: 63% of cases achieved complete mobility and 37% had a 10-20% limitation of extension. The mean absence from work was 3 months. 20% of the patients required rehabilitation.

As regards type II fractures, osteosynthesis was performed in 54% of the cases (with one screw in 46%), orthopedic treatment in 18%, partial resection in 12% and other techniques in 16% (Figure 4). A better outcome was observed in patients treated with screws, since they were less time away from work, improved mobility and needed fewer re-interventions. The worst results as to mobility were seen in the cases in which osteosynthesis was obtained using K-wires and total radial head resection was performed. In our environment quick recovery with fewer sequelae and a speedy return to work are the main goals, therefore osteosynthesis must be attempted if the displacement and the ing results were seen with this last group of patients: 83% suffered loss of movement greater than 30% on extension or on prono-supination. Mason type III fractures were those with most complications and repeat surgeries.

As to the group of patients with Mason type IV fracture, in most cases resection of the radial head was performed, although they may be treated with a sling if there is a non-displaced fracture of the radial head. Furthermore, osteosynthesis must be attempted if the displacement and the

Figure 4. Different types of osteosynthesis in a Mason grade II fracture. A) K-wire. B) One screw. C) Two screws.

Figure 5. Radial head resection.
comminution allow it (Figure 2D). This is the second type of fracture with greater re-operations and postoperative complications (two cases of residual instability).

In two patients with a Mason type IV comminuted fracture-dislocation, metallic radial head prostheses were used (Figure 7). Evolution was satisfactory although functionally these patients wound up with a 20% total mobility limitation (Figure 8).

For Mason grades III and IV the rate of surgical complications continues to be high (Table 2). The most frequent complication was a decrease in mobility in Mason grades II and III. There were also two cases of instability and one of valgus of the ulna, possibly due to a lesion of the medial collateral ligament that was not detected. In the long term, the most frequent complication was failure of the surgical material (especially mobilization of Kirschner wires) that had to be removed after a mean time of 4 months in up to 37% of all patients operated. Of the patients who went to surgery 18% required an arthroscopic arthrolysis due to limitations of movement (Figure 9).

Occasionally, on performing surgery, it was found that the fracture had a greater degree of comminution than expected. In these cases we thought it best to carry out osteosynthesis as a first step to prevent proximal migration of the radius and later, if evolution was not entirely satisfactory, the radial head could be resected. This was the case in 5% of the patients who underwent surgery.

**DISCUSSION**

On review of the literature, we have found unanimous agreement as to conservative treatment for Mason type I fractures, with an excellent prognosis in 2-3 months.\(^5\)\(^,\)\(^35\)\(^-\)\(^37\)

**Table 2.** Complications according to Mason’s classification\(^4\)

<table>
<thead>
<tr>
<th>Patients</th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
<th>Grade IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valgus of the ulna</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Decrease of strength</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pain</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Instability</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Plate mobilization</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Südeck’s atrophy</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Decrease of mobility</td>
<td>8</td>
<td>11</td>
<td>13</td>
<td>5</td>
</tr>
</tbody>
</table>
In the case of Mason type II fractures, there is less unanimity. Treatment proposed goes from early radial head resection to orthopedic treatment, but current advances, a better understanding of elbow biomechanics and the development of new implants, have made osteosynthesis the technique of choice.

In the case of Mason type III fractures, resection of the radial head has been the traditional treatment. However, the latest studies recommend that osteosynthesis be attempted and advise against performing an immediate resection of the radial head since this could cause a proximal migration of the radius, elbow instability and early osteoarthritis.

When osteosynthesis is impossible and there is a lesion of the medial collateral ligament of the elbow, use of a radial head prosthesis is mandatory. In these circumstances, resection of the radial head may lead to valgus instability, or cause a proximal migration of the radius. In such circumstances, the best option is to implant a metal prosthesis since the use of a silicone prosthesis is a contentious issue given that in 1982 Gordon and Bullough associated it with synovitis and that subsequent cadaver studies demonstrated that this prosthesis was unable to prevent migration of the radius.

Radial head fractures continue to cause controversy, especially in the case of Mason types II and III. Probably, the cause is the unsatisfactory results obtained with the treatments currently available. In spite of the fact that the radial head was considered a part of the elbow joint without great functionality, currently its importance as a stabilizing element of the elbow and forearm has been recognized. It is therefore necessary to follow the AO recommendations and preserve the anatomy of the elbow by means of ORIF or a metal prosthesis, especially in patients who work.

The greatest advantage of using a prosthesis is the immediate stability achieved, without the risk of a premature collapse. Nonetheless, possible long-term complications are not entirely known at the present time.

In conclusion, type I and II fractures without a mechanical block can be treated orthopedically while the rest of the fractures require osteosynthesis, at least in the acute phase.

Type III fractures that are very comminuted and intraarticular cannot be treated by osteosynthesis and constitute only cases that can benefit from a complete deferred resection of the radial head. In Mason type III fractures with a poor evolution after osteosynthesis, with rupture of the collateral medial ligament of the elbow or the interosseous membrane (such as Essex-Lopresti fractures), and especially in young adults in their working years, we recommend the radial head be replaced by a metal prosthesis (Figure 10).

REFERENCES


**Conflict of interests:** We, the authors, have not received any economic support to carry out this study. Nor have we signed any agreement with any commercial firm to receive benefits or fees. On the other hand, no commercial firm has provided nor will provide economic support to non-profit foundations, educational institutions or any of the other organizations that we are members of.