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Radial head replacement in adults with recent fractures

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ABSTRACT

Radial head fractures are fairly common (20% of all traumatic elbow injuries). Non-operative treatment is indicated in non-displaced fractures, and direct stable internal fixation allowing early elbow mobilisation in most other cases. For severely comminuted fractures precluding stable fixation, replacement of the radial head was introduced in the 1970s as a better alternative to simple radial head resection, which can induce instability of the elbow and/or forearm, most notably in patients who have complex fractures with concomitant lesions to other structures. With contemporary implants (modular or monoblock, with or without a mobile cup), mechanical stability is close to that provided by the native radial head, although appropriate treatment of concomitant lesions remains crucial (e.g., re-attachment of the radial collateral ligament, or distal radio-ulnar stabilisation in patients with Essex-Lopresti fracture). The key technical points are selection of implant size and determination of the optimal implantation height. The two most common complications are capitellar overloading due to excessively high implantation of the prosthetic head, which causes stiffness and pain, and loosening of the stem. These complications may require removal of the implant at a distance from the injury. Studies have demonstrated satisfactory clinical outcomes in 60% to 80% of cases.

1. Introduction

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 [1].

Simple isolated non-displaced radial head fractures are treated non-operatively. In contrast, whenever possible, displaced fractures should be managed by anatomic reduction, stable fixation, and repair of any concomitant lesions, which are present in nearly 80% of cases [2–4]. Severe comminution, however, precludes radial head reconstruction. In this situation, radial head replacement can be considered, as a means of preventing elbow instability.

Radial head replacement was introduced in the 1970s as a better alternative to simple radial head resection. This procedure was initially designed to prevent ectopic ossification [5]. Since then, improvements in the knowledge of elbow biomechanics have allowed advances in the design of radial head implants and in the materials used to construct them.

The objective of this work is to describe the biomechanical role of the radial head, to discuss the role for radial head replacement in the treatment of radial head fractures in adults, and to assess the outcomes and main complications of this procedure in the light of recently published data.

2. Anatomy and biomechanics of the radial head

The radial head is part of the lateral compartment of the elbow. It articulates with the capitellum to form the humero-radial joint. In addition, the circumference of the radial head articulates with the radial notch of the ulna, forming the proximal radio-ulnar joint. Finally, the radial head is a key component of the forearm scaffold.

The radial head is not round; instead, it has an ellipsoid and conical shape, with a proximal-to-distal increase in size [6]. The longest axis (20–23 mm on average) is perpendicular to the radial notch of the ulna in neutral rotation. As a consequence, the annular ligament that encircles the radial head becomes slack when the forearm is in supination [6–8] (Fig. 1). The neck of the radius is about 13 mm long and forms an angle of about 17° with the radial shaft [6,8].

The blood supply to the radial head is most abundant peripherally, where it derives from metaphyseal arterial branches. These arteries form a terminal network, a configuration associated with a risk of post-traumatic necrosis and non-union [9]. The medial cortex is reinforced by trabeculae that converge towards the radial (bicipital) tuberosity. As a result, traumatic force
applied in valgus often causes lateral depression of the epiphysis and metaphysis.

2.1. Radial head and pronation/supination

Two factors allow pronation/supination of the forearm. One is the crankshaft shape of the radius composed of a pronating diaphyseal curve surmounted by a proximal supinating counter-curve formed by the neck and head of the radius. The other is the stability of the two-bone forearm scaffold, provided proximally by the radial head and annular ligament, quadrate ligament of Denucé, and interosseous membrane; and distally by the radio-ulnar ligament and triangular fibrocartilage complex.

2.2. Radial head and stability of the elbow

The ulnar collateral ligament (medial collateral ligament) is a primary stabiliser of the elbow in resisting valgus stress. Its anterior portion attached to the medial margin of the coronoid process makes a major contribution to this role, as demonstrated in biomechanical studies by Morrey et al. [10]. Thus, isolated lesions of the radial head with an intact ulnar collateral ligament do not cause valgus instability (Fig. 2). Sectioning the anterior and posterior portions of the ulnar collateral ligament results in only 6° to 8° of joint distraction provided the radial head is intact. However, section of the ligament combined with a radial head fracture causes valgus subluxation of the elbow (Fig. 3) [10].

Valgus stability after radial head replacement with a metal implant is similar to that provided by the native radial head. In contrast, silicone implants do not provide adequate biomechanical resistance (Fig. 4) [11,12].

The radial collateral ligament (lateral collateral ligament) contributes to the lateral stability of the humero-ulnar joint, preventing rotational instability in supination and in varus, most notably via its posterior portion attached to the ulna.
Fig. 4. Evaluation of valgus/varus stability with different procedures. RH: radial head.

Congruity of the humero-ulnar joint is also crucial, for both rotational and lateral stability. Resection of more than 50% of the olecranon or coronoid process causes instability [13].

Dynamic stabilisation by the muscles is more controversial. The flexors and pronators contribute to valgus stability of the elbow and the anconeus muscle to varus stability. The muscles attached to the lateral epicondyle of the humerus are involved in postero-lateral stabilisation of the elbow [13].

3. Clinical features

Radial head fractures are often caused by an indirect trauma produced by a fall onto an outstretched hand (FOOSH injury), with the elbow extended and the forearm pronated. Despite the overall oedema of the elbow, care should be taken to feel the bony landmarks of the elbow (olecranon, medial and lateral epicondyles, and radial head). Marked posterior prominence of the olecranon suggests dislocation of the elbow, which may be part of a terrible triad injury (radial head fracture, coronoid fracture, and postero-lateral dislocation of the elbow) or combined with of a fracture of both forearm bones.

Great care should be taken to identify concomitant lesions in patients with radial head fractures. Thus, visible medial bruising may indicate injury to the ulnar collateral ligament (Fig. 5); whereas pain and oedema of the forearm and wrist suggest damage to the interosseous membrane (Essex-Lopresti fracture).

4. Imaging workup

Standard radiographs of the elbow in the antero-posterior and lateral projections should be obtained, as well as a radial head-capitellum view (modified lateral view with the tube angled 45° towards the radial head, as described by Greenspan) [14]. Scrupulous attention should be directed to the detection of any concomitant lesions, such as a coronoid fracture. Displacement and comminution of the fracture are often underestimated on standard radiographs.Computed tomography (CT) provides a more accurate evaluation (Fig. 6).

An antero-posterior radiograph of the wrist, or ideally of both wrists, is used to assess the radio-ulnar index (ulnar variance). A positive index with the ulnar surface projecting more distally indicates ascension of the radius related to an Essex-Lopresti fracture. Marked displacement of the radial head fracture and pain and/or oedema of the wrist further support this diagnosis (Fig. 7).

Ultrasonography and magnetic resonance imaging (MRI) are helpful for diagnosing rupture of the interosseous membrane when the antero-posterior radiograph of the wrist is normal. A useful sign of inter-osseous membrane injury is herniation of the muscles into the inter-osseous space when moving the probe over the forearm in supination [15] (Fig. 8).

MRI is effective in detecting capitellar cartilage injuries.

5. Classifications

The first widely accepted classification was developed by Mason in 1954 based on 100 radial head fractures treated operatively or non-operatively and re-evaluated after more than 2 years [16]. Three fracture types that require different therapeutic approaches were distinguished: Type I, non-displaced marginal fissure or fracture; Type II, displaced marginal fracture with separation or impaction; and Type III, displaced comminuted fracture involving the entire radial head (Fig. 9). Subsequently, Broberg and Morrey added a type IV defined as a radial head fracture combined with elbow dislocation [17].

Hochkiss modified Mason’s classification by adding a number of clinical criteria. Type II is defined as a displaced fracture of the radial head or neck combined with mechanical blocking of joint motion or with loss of joint congruity. Type III is characterised by comminution, which precludes internal fixation and requires either resection or prosthetic replacement of the radial head (Table 1) [18].

A limitation of these classifications is their poor intra-observer and inter-observer reproducibility. Another key weakness is their failure to consider concomitant lesions, which are present in nearly 80% of multi-fragment fractures (particularly Type III fractures) [2–4].

The Mayo Clinic classification, in contrast, considers all concomitant lesions and therefore deserves preference [19] (Fig. 10). The radial head fracture is described as in Mason’s classification, and letters are added to indicate the concomitant lesions, in upper case if the lesion is treated and lower case otherwise. For instance, a Type III Lcm fracture is a Mason Type III fracture of the radial head with a repaired tear in the radial collateral ligament (L), an untreated coronoid fracture (c), and an untreated tear in the ulnar collateral ligament (m).

Table 1

<table>
<thead>
<tr>
<th>Mason classification as modified by Hotchkiss [18],</th>
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<tr>
<td>Type I</td>
</tr>
<tr>
<td>Range of pronation/supination limited only by pain and oedema</td>
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<tr>
<td>Articular fracture &lt; 2 mm or marginal fracture of the radial head</td>
</tr>
<tr>
<td>Type II</td>
</tr>
<tr>
<td>Motion range limitation due to mechanical impingements or loss of joint congruity</td>
</tr>
<tr>
<td>Type III</td>
</tr>
<tr>
<td>Reconstruction not feasible according to criteria assessed intra-operatively or radiologically</td>
</tr>
<tr>
<td>Excision required to restore range of motion</td>
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</table>
6. Therapeutic strategy and indications

Type I fractures are managed non-operatively and Type II fractures by reduction and stable internal fixation [2,20]. Radial head replacement is considered only in Type III fractures for which anatomic reduction and stable internal fixation allowing early mobilisation would be difficult or impossible to achieve. Thus, radial head replacement is an alternative to a challenging internal fixation procedure or radial head excision.

6.1. Isolated multi-fragment fracture of the radial head

The absence of any concomitant lesions is very difficult to establish with absolute certainty, even based on the above-described clinical and imaging findings. In most cases, the radial head fracture is only apparently isolated. Consequently, when the radial head cannot be reconstructed, resection arthroplasty is not advisable. In Type III multi-fragment fractures, resection arthroplasty is followed by proximal migration in nearly 50% of cases, cubitus valgus in 30% of cases, and medium-term humero-ulnar osteoarthritis in 50% of cases [21]. Radial head replacement is thus the immediate solution when stable internal fixation is not feasible.

6.2. Terrible triad of the elbow

Terrible triad injury consists of postero-lateral elbow dislocation, a radial head fracture, and a coronoid fracture. Simple reduction is often unstable and surgery is therefore warranted. The goal of surgery is to reconstruct the lateral column of the elbow, at all costs, to avoid the development of postero-lateral instability [13]. The lateral column includes the radial head and the radial collateral ligament. In terrible triad injury, there is no role for radial head excision when internal fixation is not feasible. Instead, the treatment should combine radial head replacement, internal fixation of the coronoid, and re-attachment of the radial collateral ligament (to the lateral pillar, using bone anchors in most cases or, more rarely, trans-osseous suture fixation). If the elbow remains unstable after completion of these procedures, a medial approach is used to re-attach the ulnar collateral ligament [22].

6.3. Proximal fracture of both forearm bones

The radial head fracture may be accompanied with a fracture of the proximal ulna [23]. Stabilisation of the ulnar fracture requires strong plate fixation capable of withstanding the major stresses that tend to dislocate the elbow. When internal fixation of the radial head is not feasible, radial head replacement should be performed to reconstruct the radial column, as healing of the ulnar fracture is difficult to obtain in the absence of radial column reconstruction [23].
6.4. Can radial head replacement be used in all age groups?

Multi-fragment radial head fractures can be caused by a high-energy trauma in a young individual. Anatomic reduction followed by stable internal fixation is the best option in this situation. However, it would be unwise to insist on this strategy when perfect reduction and/or stable fixation cannot be achieved, as post-operative immobilisation would be necessary. Radial head replacement allowing early mobilisation is preferable.

In published studies, mean age of patients treated with radial head replacement was about 50–60 years, and the lowest end of the age range was 16 years [24–29]. However, younger age is associated with a significant increase in the risk of revision surgery, for which the main reason is loosening of the implant [24].

7. Types of radial head implants

7.1. Swanson-type Silastic™ implants

Silastic™ implants became popular in the 1970s based on data published by Swanson. These semi-rigid cementless implants were sometimes used as temporary spacers to prevent ascension of the radius in patients with instability of the forearm scaffold [30]. Advantages of using a yielding material such as silicone elastomer are good clinical tolerance despite possibly imperfect implant position and greater ease of removal compared to rigid implants. However, in patients with ulnar collateral ligament injuries, Silastic™ implants cannot act as secondary valgus stabilisers [10]. Finally, high rates of osteolysis (triggered by silicone particles: siliconitis) and of implant fractures have been reported. Because these complications require removal of the implant at a more or less early date, Silastic™ radial head implants are no longer recommended [31].

7.2. Metal implants

Long-term outcome data are available for several contemporary models of rigid radial head implants. They can be classified based on three main criteria:

- intra-prosthetic mobility;
- modularity;
- stem fixation (cemented, cementless, or floating in the intramedullary canal) (Fig. 11).
Bipolar implants were developed after the Judet prosthesis to improve proximal radio-ulnar congruity via self-alignment of the cup (with a decrease in local stresses) [32]. In vitro, bipolar implants provide less stability than do monoblock implants, although this difference has not been demonstrated clinically [33]. Furthermore, there have been reports of cup disassembly related to insufficient retention within the implant, in patients with residual elbow instability [26] (Fig. 12).

Modular implants offer two advantages:

• the optimal head size can be chosen;
• the height of the head and neck can be adjusted to match the height of the resection, which is a crucial technical point.

Some implant types also allow adjustment of the head-neck angle to achieve the indispensable goal of replicating the patient’s native anatomy as closely as possible. This possibility is particularly valuable when anchoring a long straight stem into the shaft, as the axis of these stems differs from that of the shorter radial neck.

Fixation within the intra-medullary canal is usually achieved using either a cemented stem, which is often smooth, or a cementless press-fit stem. Primary stability of press-fit stems is difficult to obtain, as micro-fractures are common, particularly when the stem diameter is oversized by 1 mm or more [34]. Furthermore, stress shielding has been reported as a cause of early proximal peri-prosthetic osteolysis [34].

It has been suggested that the implant can be left loose in the proximal radial shaft, with no attempt to achieve primary stability by press-fit implantation. The goal is to allow self-alignment of the
prosthesis on the capitellum. The development of radio-lucencies around the stem do not seem clinically relevant, and satisfactory medium-term outcomes have been reported [35].

Promising early outcomes have been reported with implants made of pyrolytic carbon [36]. This material is well tolerated when placed in contact with the capitellar cartilage. However, longer-term data are needed to validate pyrocarbon implants.

There is now a recommendation not to use Swanson-type implants. No clinical studies have established that any of the other implant types is superior over the others.

8. Operative technique: tips and tricks

The Kocher lateral approach between the extensor carpi ulnaris and anconeus is the most widely used. Another option is the Kaplan approach, which is located more anteriorly, between the extensor carpi radialis longus and the extensor digitorum communis.

The annular ligament is spared to allow its suture if needed at the end of the procedure. Careful attention is directed to sparing the radial collateral ligament (particularly its ulnar portion) if this structure was not damaged at the time of the trauma.

Pronation of the forearm places the inter-osseous nerve at a safe distance when approaching the neck of the radius.

When primary internal fixation of the olecranon via the posterior approach is performed also in a patient with proximal fractures of both forearm bones, a single posterior skin incision can be performed. The radial head is then approached either via a lateral arthrotomy or through the olecranon fracture.

The capitellar cartilage should be evaluated during the arthroscopy. Although the condition of the capitellar cartilage has no bearing on the therapeutic conditions, it is among the factors that govern the long-term prognosis.

The technique for implanting a radial head prosthesis, with or without ancillary instruments, may appear simple. Nevertheless, two fundamental principles must be applied [20]: the implant must replicate the thickness and diameter of the native radial head, and it must be positioned at the same height. Low implant position may result in residual elbow instability, whereas high implant position places excessive stress on the condyle, which rapidly causes joint damage with pain and motion range limitation at the elbow, particularly in patients with trauma-induced osteochondral lesions of the capitellum [37].

Reconstitution on the operating table of the native head, as if putting a puzzle together, confirms that all the intra-articular fragments have been removed and provides guidance about the implant diameter that best replicates the native radial head (Fig. 13).

A fluoroscopic evaluation after placement of the trial prosthesis is recommended to confirm that the best size has been chosen. When there is doubt between two sizes, the smallest size should be selected.

Replicating the height of the native radial head is the second technical challenge. The match with the native geometry must be as close as possible. When the forearm scaffold is unstable (Essex-Lopresti fracture), reduction and pin fixation of the distal radio-ulnar joint should be performed before determining the size and height of the implant, to avoid errors due to ascension of the radius relative to the ulna.

A number of anatomical landmarks help to determine the optimal implant height on fluoroscopy images (Fig. 14):

- alignment of the implant on the ulnar notch, with no overshoot, on the lateral view;
- and symmetric appearance of the medial and lateral sides of the humero-ulnar joint space.

Tests using trial implants are indispensable. The radial neck can be recut at the level of the radial notch of the ulna to lower an excessively high implant. If the implant is too low, the length of the prosthetic neck can be increased by choosing an appropriate modular stem.

The radius is a very slender bone and should therefore be prepared with great care to avoid creating micro-fractures of the neck. When a cemented stem is used, low-viscosity cement may be preferable. The shaft can be occluded by a fragment of the head or an artificial plug to allow cement fixation under pressure and to avoid distal cement leakage.

Finally, radial head replacement does not necessarily ensure stability of the elbow and forearm scaffold if the concomitant lesions are left untreated.

To prevent elbow instability, it is important to re-attach the radial collateral ligament complex, which is often detached proximally, as well as the muscles inserted on the lateral epicondyle. Either bone anchors or trans-osseous suture fixation can be used. This step is particularly crucial in terrible triad injury, together with fixation of the coronoid (if allowed by the bone fragment). If the elbow remains unstable, an additional medial approach is performed to re-attach the ulnar collateral ligament. When this step is insufficient, external fixation is required (Fig. 15).

Fig. 13. Intra-operative selection of the head size that best replicates the patient’s native anatomy.

Fig. 14. Implant position criteria determined by intra-operative fluoroscopy. The lateral and medial sides of the humero-ulnar joint space should be symmetrical. The implant aligns with the radial notch of the ulna.
To prevent forearm scaffold instability due to an Essex-Lopresti fracture, the recommended procedure is pinning in supination to stabilise the distal radio-ulnar joint. If needed, repair of the triangular fibrocartilage complex is recommended to allow healing of the inter-osseous membrane. The diagnosis of Essex-Lopresti fracture rests on pre-operative imaging (ultrasonography or MRI) and, above all, on the intra-operative radius joystick test described by Soubeyrand et al. [38] (Fig. 16). The instability can also be visualised on fluoroscopy images centred on the distal radio-ulnar joint, which show piston motion of the radius during dynamic manoeuvres.

During the post-operative period, early mobilisation within a safe range is recommended for the first 6 weeks. The elbow should not be fully extended. After repair of the radial collateral ligament complex, the forearm should be kept in pronation. In patients with elbow instability, great care should be taken to remain within the safe range of motion, which should be determined intra-operatively.

9. Outcomes and complications

9.1. Outcomes

After radial head replacement for a recent fracture, the outcome is satisfactory in 60% to 80% of cases (Table 2). Burkhart et al. [40] reported that the clinical outcomes remained satisfactory in the long term (after more than 8 years), despite the development of humero-ulnar osteoarthritis.

In a recent study of 105 cementless monoblock implants re-evaluated after more than 6 years, Duckworth et al. [24] found a
Table 2
Main case-series studies of radial head replacement to treat recent fractures.

<table>
<thead>
<tr>
<th>Reference</th>
<th>n</th>
<th>Type of implant</th>
<th>Flex/Ext (°)</th>
<th>Pron/Sup (°)</th>
<th>Grip strength vs. contralateral upper limb</th>
<th>Satisfactory objective outcome (%)</th>
<th>Mean follow-up (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judet et al. [25]</td>
<td>5</td>
<td>Bip</td>
<td>138/-6</td>
<td>86/82</td>
<td>100</td>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>Alnot et al. [28]</td>
<td>18</td>
<td>Bip</td>
<td>126/-18</td>
<td>77/79</td>
<td>75%</td>
<td>100</td>
<td>1.5</td>
</tr>
<tr>
<td>Dotzis et al. [39]</td>
<td>12</td>
<td>Bip</td>
<td>140/-14</td>
<td>87/84</td>
<td>90%</td>
<td>83</td>
<td>5</td>
</tr>
<tr>
<td>Doornberg et al. [35]</td>
<td>27</td>
<td>Mod not bip</td>
<td>131/-20</td>
<td>73/57</td>
<td>82</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Flinkkilä et al. [27]</td>
<td>42</td>
<td>Mod not bip</td>
<td>136/-20</td>
<td>75/73</td>
<td>85%</td>
<td>62</td>
<td>4</td>
</tr>
<tr>
<td>Allavena et al. [26]</td>
<td>14</td>
<td>Bip</td>
<td>113/-29</td>
<td>71/73</td>
<td>85%</td>
<td>71</td>
<td>4</td>
</tr>
<tr>
<td>Burkhart et al. [40]</td>
<td>9</td>
<td>Bip</td>
<td>124/-21</td>
<td>64/64</td>
<td>100</td>
<td>76</td>
<td>8.8</td>
</tr>
<tr>
<td>Popovic et al. [41]</td>
<td>51</td>
<td>Bip</td>
<td>130/-14</td>
<td>68/71</td>
<td>85%</td>
<td>61</td>
<td>2.4</td>
</tr>
<tr>
<td>Grewal et al. [42]</td>
<td>26</td>
<td>Mod not bip</td>
<td>138/-25</td>
<td>71/56</td>
<td>85%</td>
<td>68</td>
<td>8.4</td>
</tr>
<tr>
<td>Moro et al. [43]</td>
<td>25</td>
<td>Mono</td>
<td>140/-8</td>
<td>78/68</td>
<td>85%</td>
<td>89</td>
<td>2.5</td>
</tr>
<tr>
<td>Lamas et al. [44]</td>
<td>47</td>
<td>Mod not bip</td>
<td>140/-6</td>
<td>75/67</td>
<td>85%</td>
<td>89</td>
<td>4</td>
</tr>
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</table>

Bip: bipolar; Mod: modular; Mono: monoblock; Flex: flexion; Ext: extension; Pro: pronation; Sup: supination.

Fig. 17. a and b: young patient 4 years after treatment of a complex radial head fracture by implantation of a cemented bipolar prosthesis. Although the clinical outcome is good (a), the implant is loose and the stem is tilted in an area of diaphyseal osteolysis (b).
28% revision rate. Independent risk factors for failure were young age and the use of silicone implants.

However, in the large multicentre study of 315 radial head implants of any type conducted by the French Society for the Shoulder and Elbow (SOFEC), revision because of clinical failure was required in only 26 (8%) cases. Reasons for failure were loosening, instability, painful stiffness due to overstuffing, and/or radio-capitellar osteoarthritis [45].

9.2. Complications

9.2.1. Aseptic loosening

Stem loosening does not seem to correlate with clinical symptoms. A radiolucent line is often visible surrounding the stem even in patients who remain completely asymptomatic (Fig. 17). Typical features of pain related to aseptic loosening consist of a mechanical time pattern and location at the forearm with radiation to the wrist.

A radiolucent line is a consistent finding when the stem is intentionally left loose in the shaft [35]. Radiological signs of loosening usually develop fairly early (within 12 months) with cementless press-fit stems and may develop later on with cemented implants, particularly those having a bipolar design [1,27].

In patients with functional impairment, implant removal rather than exchange is recommended, particularly if the concomitant lesions caused by the trauma have had time to heal.

9.2.2. Elbow instability

Elbow instability after radial head replacement is often ascribable to incomplete treatment of all the concomitant lesions. An example is failure to re-attach the radial and ulnar collateral ligaments and to perform internal fixation of the coronoid process in patients with terrible triad injury [22].

The type of implant may influence elbow stability. In theory, fixed-cup implants provide a greater degree of elbow stability than do bipolar mobile-cup implants [33]. If the radial ligament complex is deficient, postero-lateral subluxation of a mobile cup may occur, as demonstrated by O’Driscoll. In this situation, there is a risk of cup disassembly [26].

In every case, the treatment of residual elbow instability after radial head replacement rests on the repair of the concomitant ligament and bone lesions, as opposed to leave on with cemented implant itself, which should be left in place if it is properly positioned. External fixation to neutralise dislocating forces may be useful to protect the healing process.

9.2.3. Overstuffing with radio-capitellar pressure elevation

Excessive pressure applied to the humeral condyle by the radial head causes pain and stiffness of the elbow. The most common cause is malposition of the implant, which is usually too high [1,22,37]. However, even when the implant is optimally positioned, persistent forearm scaffold instability (Essex-Lopresti fracture) with failure of the intra-osseous membrane to heal can result in radio-capitellar pressure elevation.

The trauma responsible for the radial head fracture fairly often causes osteochondral damage to the capitellum, which worsens in the event of overstuffing. In patients with radiological erosion of the capitellum, implant removal relieves the pain (Fig. 18).

9.2.4. Osteoarthritis

Capitellar osteoarthritis is ascribable not only to cartilage lesions caused by the initial trauma, but also to increased stress on the radio-capitellar compartment and/or to persistent postero-lateral instability.

The osteoarthritis is usually progressive and extends to the humero-ulnar compartment. Removal of the implant seems to accelerate the pace of osteoarthritis progression.

10. Conclusion

There is a sound rationale for including radial head replacement into the therapeutic strategy for multi-fragment radial head fractures for which reliable internal fixation is not feasible (type III fractures).

Resection arthroplasty on an emergency basis is best avoided, as ligament damage is very common and can result in instability of the elbow and/or forearm scaffold. Silicone implants should not be used. Among the other types of implant, none has been proven superior over the others.

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 residual instability.

Comprehensive management of the concomitant lesions is indispensable to ensure stability of the elbow.

Disclosure of interest

The author declares that he has no competing interest.

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References

