



Indications for Radial Head Arthroplasty and Classification of Current Implants

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22.1 Introduction

Controversy still exist over the indications for fixation versus radial head replacement for displaced and comminuted radial head fractures. Although the excision of the radial head has been historically indicated in unreconstructable comminuted fractures, it can induce pain, instability, proximal migration of the radius, decreased strength, and osteoarthritis [1–3]. These unsatisfactory clinical outcomes are related to the critical role of the radial head in force transmission and stability of the elbow [4, 5]; the lack of these stabilizing effects are even more relevant in presence of associated ligaments or other bony injuries [4–6]. There is a substantial agreement in the literature that restoration of radiocapitellar contact, through the fixation or replacement of the radial head, is an essential point in the radial head fractures treatment [7–9]. On the other hand, capitellum wear due to the use of

implant arthroplasty remains a concern [10–12]. Radial head arthroplasty is a modern surgical option when faced with a complex fracture and associated elbow ligament injuries.

22.2 Indications for Radial Head Arthroplasty

Radial head arthroplasty is indicated in patients with complex pattern of radial head fractures. The Mason classifications of radial head fractures include nondisplaced fractures (type I), displaced partial head fractures (type II), and displaced fractures involving the entire radial head (type III) [13]. A modification of this original classification was then performed by Johnston [14] who added a fourth type including a displaced radial head fracture with associated elbow dislocation and by Broberg-Morrey [15] who defined the amount of radial head fracture displacement as follows:

- Type I: <2 mm.
- Type II: ≥ 2 mm and involvement $\geq 30\%$ of the joint surface.
- Type III: comminuted.
- Type IV: any type with elbow dislocation.

Finally, Hotchkiss in 1997 [16] modified Mason classification with respect to mechanical block to motion to guide the operative treatment. Interestingly, Ring in 2008 [17] showed the poor

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reliability of aforementioned radiographic classifications to assess elbow instability and emphasized the poor results of internal fixation in the presence of more than three fragments and associated dislocation, with bone and ligament injuries. On the basis of these assumptions, radial head arthroplasty is indicated in the following conditions:

1. Acute comminuted fractures in which a stable fixation is precluded; in this condition, fractures with three or more fragments or severe comminution are also included [17].
2. Complex elbow injuries, with bone fractures and ligament tears that involve greater than 30% of the articular rim of the radial head, which cannot be reconstructed [11].
3. Instability of the elbow after radial head excision [16].
4. Persistent pain and instability following radial head primary resections, malunions, or after complex elbow fracture dislocations involving the radial head [12, 18].
5. Suspected Essex-Lopresti lesions [7, 18].
6. Associated terrible triad injuries [7].
7. Unreconstructable radial head fractures with concomitant medial collateral ligament injury, interosseous membrane injury, or elbow dislocation [19, 20].

22.3 Contraindications and Current Trend

Radial head implant should be avoided in the presence of concurrent locally or remote infection. We also consider at high risk the use of radial head arthroplasty in fractures that extend beyond the bicipital tuberosity due to the mismatch of the rotational axis of the implant and the capitellum. In these conditions, cemented long-stem bipolar prostheses may minimize the effects of this mismatch, even though it remains at high risk of failure.

Overall, several controlled trials have shown the superiority of radial head replacement compared to internal fixation in terms of postopera-

tive complications and outcome scores for Mason type III and IV fractures [21–23]. These findings have likely contributed to the increase in utilization of radial head arthroplasty compared to the internal fixation and non-operative management for radial head and neck fractures. The shorter operative time with radial head replacement and improvement of radial head implant technology may have contributed to these trends.

22.4 Models of Radial Head Arthroplasty

Prosthetic models for replacement of the radial head can be divided in silicone prostheses, unipolar or bipolar, monoblock or modular, anatomical or non-anatomical, and cemented or press-fit [24, 25].

Silicone implants were used in the past after radial head resection. These prostheses are now rarely implanted because of high rates of loosening, fracture, and silicone synovitis [26] (Fig. 22.1).



Fig. 22.1 Silicone radial head implant



Fig. 22.2 Unipolar monoblock (Swanson Titanium Radial Head-Wright Medical Technology)

The compressibility of silicone makes it unable to restore the biomechanics of the elbow [27].

Unipolar monoblock prostheses consist of a radial head that doesn't move separately from the radial neck. The unipolar stem could be fixed as press-fit or cemented way. These implants are becoming obsolete because of the absence of modularity. These prostheses don't allow to restore the anatomy and the radial head kinematic (Fig. 22.2). Different studies underline the importance of an accurate reproduction of the size and orientation of the radial head to restore the complex articular movements of the elbow [25, 28].

Unipolar modular prostheses, the evolution of monoblock, have gained better results (Fig. 22.3). The problem of these implants is the "incongruity" that can cause local pain for degenerative changes of the capitulum humeri [25, 29].

The difficulties of unipolar implants are to reproduce the height, diameters, medial offset, and cervicocephalic angle of the native radial head.

Bipolar modular prostheses have a design that allows semiconstrained articulation of the radial head with the fixed metal stem. They may rotate 10° – 15° in all planes. This design could reduce stress at the implant-bone interface and increase the contact area of the capitellar joint [30] (Fig. 22.4).

Judet [31] introduced a floating head bipolar prosthesis with a longer stem that allows 35° of motion in any direction.

Bipolarity permits an "automatic" positioning of the radial head with respect to the neck and the opposite articular surfaces. However, this may be associated with reduced articular stability and possible tribologic drawbacks related to wear of the polyethylene positioned between the stem and the radial head [25].

This increased motion is greater potential for osteolysis, particle disease, and osteoarthritis at the radiocapitellar joint space. A resurfacing of the capitulum humeri could solve the last problem [26].

Anatomical modular prostheses could restore the right radial length and give the "congruity" of the humeral-radial articulation (Fig. 22.5). The uncemented stem could be smooth or rough. The smooth one has endomedullary movements (loose-fit) that permit a better congruence of the radial head with the humeral condyle during pronation-supination and extension-flexion. The rough stem could be covered by osteoconductive biomaterials that facilitate the primary press-fit and osteointegration [25].

22.5 Overview

The indication for radial head arthroplasty is for Mason type III and IV fractures.

The goal of all kind of implants should be the restoration of joint stability, preservation of range of motion, and maintenance of radial length in patients with complex radial head fractures [32].

In literature the quality of evidence is poor for different reasons: small number of patients of the series, heterogeneous injury pattern of fracture, etc.



Fig. 22.3 Unipolar modular radial head arthroplasty (Evolve™ PROLINE—Wright)

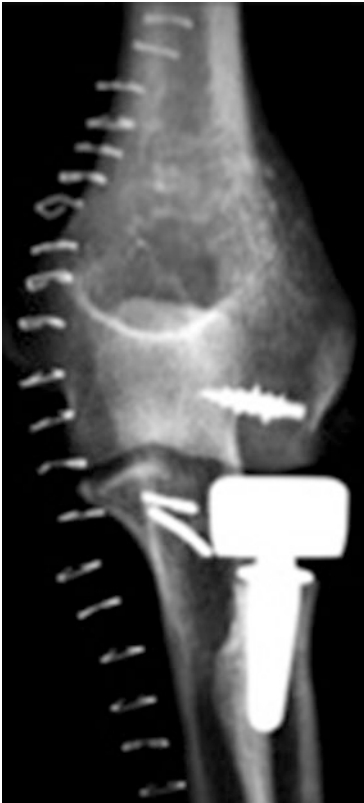


Fig. 22.4 Bipolar modular radial head arthroplasty (CRF-Tornier)

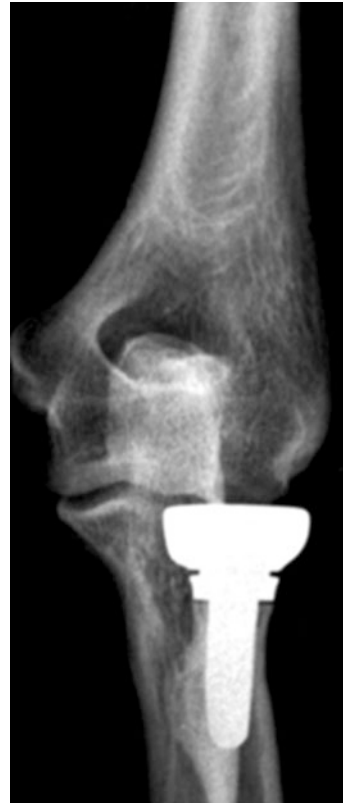


Fig. 22.5 Anatomical modular radial head arthroplasty (Acumed)

Outcomes of each implants, rate of success, and complications will be illustrated in the following chapters.

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