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Radial head, radiocapitellar and total elbow arthroplasties: A review of recent literature

Giuseppe Giannicola *, Federico M. Sacchetti, Giorgio Antonietti, Andrea Piccioli, Roberto Postacchini, Gianluca Cinotti

Department of Anatomical, Histological, Forensic Medicine and Orthopaedics Sciences, "Sapienza" University of Rome – Policlinico Umberto I, Piazzale Aldo Moro 3, Rome, Italy

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ABSTRACT

The outcome of prosthetic elbow surgery is continually evolving. We thoroughly reviewed the literature on this issue to analyse the indications, outcomes and complications of the numerous types of implants currently in use. Radial head replacement is recommended in comminuted fractures of the radial head and in post-traumatic conditions. Medium- and long-term results prove to be satisfactory in the majority of cases, with no evidence to indicate that some prostheses (monopolar vs. bipolar; cemented vs. press-fit) are more effective than others; nonetheless, the bipolar-cemented implant was found to be associated with a lower revision rate than other prostheses. Unicompartmental arthroplasty has recently been used for the treatment of osteoarthritis and rheumatoid arthritis when the lateral compartment is prevalently involved; the results reported to date have been encouraging, although further studies are warranted to confirm the validity of these implants. Total elbow arthroplasty is performed in a range of conditions, including distal humerus fractures in the elderly and elbow arthritis. In the former condition, linked elbow replacement yields excellent results with few complications and a low revision rate. In elbow arthritis, total elbow arthroplasty is indicated when patients suffer from disabling pain, stiffness and/or instability that prevent them from performing daily activities. Unlinked elbow arthroplasty, which is used above all in rheumatoid arthritis, also yields satisfactory results, although the risk of instability persists. The use of linked elbow arthroplasty, which yields similar results but lower revision rates, has consequently increased. Lastly, the results yielded by linked elbow prosthesis in post-traumatic conditions are good, although not quite as good as those obtained in rheumatoid arthritis. Early mechanical failure may occur in younger and more active patients after elbow arthroplasty. However, the careful selection of patients who are prepared to accept functional limitations imposed by elbow implants will enable indications for elbow arthroplasty to be extended to young subjects, particularly when no other therapeutic options are available.

Introduction

Elbow arthroplasties have undergone a considerable evolution in the last decades because of better anatomical and biomechanical knowledge, continuous development of biomaterials, improvement of operative techniques and better definition of the surgical indications. More extensive knowledge of anatomy and biomechanics has enabled improvement of the prosthetic design and more adherent reproduction of the elbow kinematic. There has been an increase in the survival of the implants as a result of the use of more biocompatible and wear-resistant materials, and the improvement of cementing techniques. The advent of surgical approaches that are less harmful for the extensor apparatus, the availability of better instrumentation and the more accurate definition of the indications and contraindications for surgery are among the factors that have considerably contributed to increase the quality of the clinical results and reduce the complications.[96,97]

The three main types of implants currently available are radial head prosthesis, unicompartmental lateral prosthesis and total elbow prosthesis. We report on the use of these implants based on a thorough revision of the recent literature.

Radial head arthroplasty

Prosthetic models for replacement of the radial head can be classified as unipolar or bipolar, monoblock or modular, anatomical or non-anatomical, and cemented or press-fit.[1–3] The unipolar

* Corresponding author at: Via Emilio Repossi 15, C.A.P. 00185 Roma, Italy. Tel.: +39 3484934300; fax: +39 0687198146.
E-mail address: giannicola.giuseppe@gmail.com (G. Giannicola).

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monoblock (e.g. Liverpool radial head replacement-Biomet, Swanson Titanium Radial Head-Wright Medical Technology) is becoming obsolete because the absence of modularity does not enable the anatomy and the radial head kinematic to be restored. Several biomechanical studies have shown the importance of an accurate reproduction of the size and orientation of the radial head to restore the complex articular movements of the elbow.[4–6] Subsequently, the modular unipolar implants (e.g. Evolve-Wright Medical Technology, MoPyc-Laboratory Bioprofile – Tornier, Avanta-Small Bone Innovations) (Fig. 1) have given better clinical results[7–9]; however, they can cause a slight articular "incongruity" that may lead, in the long term, to degenerative changes of the articular surfaces of the humeral capitellum, possibly responsible for local pain.[10,11] Even with implants of the last generation, it is difficult to reproduce the diameters, height, medial offset and cervico-cephalic angle of the native radial head despite the wide modularity available.

The introduction of anatomical modular implants (e.g., Anatomic radial head system-Acumed) (Fig. 2) only partially solved these problems, because they do not enable the reproduction of all the anatomical variants of the proximal radius. Furthermore, these implants require a meticulous surgical technique: the slightest mistake in their positioning may produce a significant articular incongruity. At present, little is known on the results of these implants.

Recently, bipolar modular prostheses have been developed (e.g., CRF-Tornier, rHead-Small Bone, Innovations) (Fig. 3) that better adapt to different patient anatomy and imply an easier surgical technique.[12] 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.[3,4,13,14] Another theoretical advantage of these implants is the decreased stress at the interface stem-bone and head-cartilage, which would enable reduction of aseptic loosening and decreased wear of the ulnar and humeral articular cartilage.

The stem of the modern, non-cemented implants can be smooth or rough. In the first case (e.g. Evolve, Wright Medical Technology), the smooth stem cannot undergo osteointegration and be press-fitted, it has endomedullary movements within the medullary canal (loose-fit) that permit a better congruence of the radial head with the humeral condyle during the pronation–supination and extension–flexion.[7] Therefore, periprosthetic radiolucency may occur, though it is often asymptomatic.[15] The covering of the rough stems (e.g. Anatomic Radial head system, Acumed), consists of an osteoconductive biomaterial that facilitates the primary press-fit and osteointegration of the prosthesis (fixed stem). With these implants, as with the cemented implants, the movement occurs between the radial head and the articular surfaces of the humeral capitellum for the unipolar prostheses, or between the stem, the head and the joint surfaces of the humeral capitellum for the bipolar prostheses. The stresses transmitted to the stem-bone or the cement-bone interface is, therefore, theoretically higher for the fixed stem implants, particularly in the case of unipolar implants.

Fig. 1. Modular unipolar radial head arthroplasty (Evolve-Wright Medical Technology).

Fig. 2. Anatomical modular radial head arthroplasty (Anatomic radial head system-Acumed).