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ORIGINAL ARTICLE

Retrospective cohort study on radial head replacements comparing results between smooth and porous stem designs

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Background: When necessary, radial head integrity after a fracture can be re-created by the use of a radial head arthroplasty if the radial head is judged irreparable. The purpose of this study was to compare the clinical and radiographic outcomes of metal modular radial head replacements with a smooth vs. a porous stem.
Methods: A retrospective cohort study of radial head replacements performed in the first 4 weeks after a trauma in an adult patient at our institution between 2000 and 2014 was completed. Patients were divided into 2 groups: a porous stem group (ExploR; Biomet Orthopedics, Warsaw, IN, USA) and a smooth stem group (EVOLVE; Wright Medical Group, Memphis, TN, USA). Primary outcomes were the Disabilities of the Arm, Shoulder, and Hand and Mayo Elbow Performance Index scores. Secondary outcomes were the visual analog scale score for pain, range of motion, grip strength, and radiographic evaluations.
Results: Of the 80 eligible patients, 57 agreed to participate (porous stem group, 36; smooth stem group, 21). Demographic data were similar between the 2 groups. Average follow-up was 6.3 years. Average Disabilities of the Arm, Shoulder, and Hand and Mayo Elbow Performance Index scores were similar between the 2 groups. Porous implants were more prone to osteolysis (64.3% vs. 23.5%; $P = .01$) and were associated with a greater loss of elbow flexion (6° vs. 1°; $P = .02$). The porous stem group showed a tendency toward more overstuffing (24.0% vs. 5.9%; $P = .21$).
Conclusion: Our results reveal that outcomes between smooth and porous stem metal modular radial head implants are equivalent. However, the smooth stem implant may represent the preferred option as it is associated with a lower rate of complications.
Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Radial head; radial head replacement; radial head arthroplasty; terrible triad injury; elbow trauma; radial head fracture

The Institutional Review Board of CHU de Québec–Université Laval approved this study: No. 2016-2756. The study was conducted in accordance with guidelines for the conduct of research on human subjects, and written consent from each patient was required before the clinical evaluation.

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Radial head fractures are the most common fractures of the elbow as they represent 33% of all elbow fractures.[27] When they are associated with other elbow injuries, elbow stability is often compromised.[11] In those cases, it is important to re-create radial head integrity as it is a secondary valgus stabilizer.[21,25,32,36] This can be performed by open reduction and internal fixation or, if the radial head is judged irreparable,[24] by the use of a radial head arthroplasty (RHA). Satisfactory outcomes have been reported with RHA in cases of nonreconstructable radial head fractures.[12,14,16,23,30,33,40] Many different types of radial head replacements have been developed and are available on the market. Some are monobloc, whereas others are modular. Modular prostheses can be categorized as monopolar or bipolar. Moreover, intramedullary stems can be cemented or noncemented or can have a "controlled expansion shaft." The noncemented stems can be loose in the medullary canal or fixed with a porous design. Surprisingly, given the multiple choices of RHA available, there is only 1 published study, to our knowledge, comparing clinical and radiographic outcomes between 2 types of RHA.[4] The purpose of this retrospective cohort study was to compare the clinical and radiographic outcomes of metal modular radial head replacements with a smooth stem vs. a porous stem. We hypothesized that both types of RHA would provide similar functional outcomes. Our secondary hypothesis was that the porous stem implant would be associated with greater periprosthetic osteolysis.

Materials and methods

Study design

A retrospective cohort study was conducted at our academic institution in 3 different hospitals to compare the outcomes of 2 different types of radial head replacements. The choice of implant was left to the discretion of the surgeon. The EVOLVE (Wright Medical Group, Memphis, TN, USA) implant has a modular monopolar head component with a noncemented loose-fitting stem. The ExploR (Biomet, Warsaw, IN, USA) is composed of a modular monopolar head with a porous press-fit stem. The similar head component of these 2 implants allows the evaluation of the different stem types. In fact, both implants have a modular monopolar head but differ with regard to their stem. The EVOLVE stem is smooth and therefore loosely placed into the medullary canal, whereas the ExploR stem has a porous texture and is tightly fitted into the medullary canal. Radiographic and clinical measures were collected during an additional clinical visit. The primary outcome measures were the Disabilities of the Arm, Shoulder, and Hand (DASH) and the Mayo Elbow Performance Index (MEPI). Main functional measures were the range of motion of the elbow and the grip strength.

Patient selection

Patients 18 years old and older who had a radial head replacement at our academic institution between 2000 and 2014 with a minimum 1-year follow-up were deemed eligible for this study. Patients were excluded if they had open fracture, pathologic fracture, fracture with a neurovascular injury, prior history of elbow disease or surgery before the elbow trauma, injury to the ipsilateral upper extremity altering the function of the limb, RHA inserted at or later than 4 weeks after the initial injury or inserted as a salvage procedure after a failed initial surgery, history of contralateral elbow fracture, new medical condition (neurologic, cardiac, metabolic) that could limit the patient's functional ability to perform the tests, inability to be contacted, and inability to consent as well as any other condition judged by the evaluator that would not allow reliable and reproducible results.

Study procedure

Eligible patients were contacted by phone by 1 of the investigators to explain the study. Once a verbal consent was obtained, patients were invited to the hospital to receive further information and eventually to participate in the study. Participant visits took place between January 2015 and March 2015. During this single visit, each patient was given ample details about the study and any other information requested to obtain an informed written consent to participate in the study.

Data collection

The patients' medical charts were reviewed by 1 of the investigators. Demographic data such as age at surgery, sex, limb dominance, medical history, smoking history, type of work (physical, sedentary, or none), and if it was a workers' compensation injury were collected. Also, the Mason radial head fracture classification[27] of the initial injury, associated injuries, delay between the injury and the surgery, surgical approach performed, type of RHA used, and other surgical fixation during the index surgery were recorded. The postoperative period was also examined, recording the type and duration of immobilization as well as heterotopic ossification prophylaxis use. Finally, postoperative complications such as infection, abnormal bleeding, iatrogenic neurologic injury, ankylosis, radiocapitellar instability, and reintervention with or without implant removal were recorded.

Specific assessments were achieved through bilateral elbow radiographs, a series of functional tests (DASH, MEPI, visual analog scale [VAS]), and a physical examination. Measures were compared between patients with a smooth stem and patients with a porous stem. A single blinded evaluator performed the clinical evaluations. All of the data were collected during the single visit to the hospital. The specific assessments were achieved with the use of standardized radiographic imaging of both elbows (anteroposterior and lateral views), functional questionnaires, and a physical examination.

Radiographic evaluation

Anteroposterior and lateral radiographs of both elbows were taken in a standardized manner with a circle of 25 mm for magnification correction. Osteolysis, degenerative changes, overstuffing of the radial head, and heterotopic ossifications were recorded.

The amount of osteolysis around the stem was divided into 7 zones[20] and analyzed on anteroposterior and lateral views (Fig. 1).[34] It was also evaluated according to the number of cortices involved (anterior, posterior, medial, lateral) and its width (<2 mm or >2 mm). Degenerative changes were classified according to the Broberg and Morrey system.[6] Overstuffing of the RHA was measured by comparing the joint line of the injured elbow with the contralateral elbow,