



ELSEVIER

ORIGINAL ARTICLE

Clinical and radiographic outcome of revision surgery of total elbow prosthesis: midterm results in 19 cases

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Background: The aim of this study is to report on the midterm outcomes and complications of revision surgery of total elbow arthroplasty.

Methods: All patients who had undergone total elbow arthroplasty revision surgery between 2009 and 2014 with semiconstrained total elbow prostheses were prospectively enrolled in the study. Records were reviewed for demographic data; baseline measurements; and several follow-up assessments including the Mayo Elbow Performance Score (MEPS), visual analog scale (VAS) score for pain, Oxford Elbow Score, range of motion, satisfaction, and radiographs.

Results: A total of 19 revision arthroplasties were included. At a mean follow-up of 57 months, there had been 1 rerevision and 2 removals. One patient was excluded from follow-up because of confounding comorbidity. At last follow-up, MEPS values and VAS pain scores both improved ($P < .01$). The rate of combined good and excellent results on the MEPS was 53%. The mean VAS scores for pain at rest and with activity were 2 and 4, respectively. Fair results for the Oxford Elbow Score were reported, with a mean score of 28 points. Range of motion improved to an average flexion-extension arc of 108° ($P < .01$), and the pronation-supination arc improved to an average of 123° ($P < .01$). All elbows were stable at last follow-up ($P < .01$). Radiographs showed nonprogressive osteolysis around the prosthesis in 3 cases (19%) and suspicion of loosening in 1 (6%). In 11 patients postoperative complications occurred. Of 15 patients, 13 (87%) were satisfied with the result of the revision procedure.

Conclusion: Revision of total elbow prostheses leads to satisfactory results, less pain, and better elbow function. This procedure is related to a relatively high complication rate.

Level of evidence: Level IV; Case Series; Treatment Study

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Keywords: Elbow; total elbow arthroplasty; revision; outcome; prosthesis; complications

Our institution's medical ethical committee waived approval for this study because data were collected as part of routine clinical care. Patients were informed that data concerning their case could be submitted for publication.

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According to implant databases, total elbow arthroplasty (TEA) has been performed more often in the past 4 decades.⁷ TEA is considered a successful treatment for a variety of conditions, such as rheumatoid arthritis, acute fractures, and (post-traumatic) osteoarthritis.

Previous studies considered TEA to be successful. Although the results are improving, complication rates of up to 62% have been reported in primary TEA cases.^{3,11,16,18,23,24} This percentage is much higher compared with hip and knee arthroplasties.⁷ The long-term survival rates range from about 60% in post-traumatic cases to 90% in patients with rheumatoid arthritis after 10 years.^{4,9} As the number of total elbow replacements increases, more revision surgery can be expected. Aseptic loosening and instability are the most important reasons for revision.^{1,3,6,8,14-16,23} Polyethylene wear or malposition of the prosthesis can result in both loosening and instability.^{3,19} Other indications for revision are infection and periprosthetic fractures.¹³

Most surgeons use a semiconstrained type of TEA when performing a revision, as semiconstrained models provide intrinsic stability and relieve the often-affected ligamentous structures. Nevertheless, second revision rates remain high, with a rate of 28% to 30% 10 years after primary revision.¹³ Previous studies reporting on the outcome after revision surgery using the Coonrad-Morrey prosthesis showed good results in pain relief and elbow function, but improvement of range of motion (ROM) should not always be expected.^{12,17,20,21}

Considering the expected increase in TEA procedures, it is important to evaluate the results after revision surgery critically to support decision making on revision of TEA in the future. The aim of this study was to report on the clinical and radiographic outcomes of revision surgery of TEA using the Coonrad-Morrey total elbow prosthesis (Zimmer, Warsaw, IN, USA) in a European center that was not involved in the development of the prosthesis. We hypothesized that revision surgery would lead to improved elbow function.

Materials and methods

Patient population

All patients who received a revision of TEA at our institution between March 2009 and June 2014 were included. Preoperatively, patients were seen in the outpatient clinic and filled in patient-reported outcome questionnaires. The follow-up consisted of questionnaires at 1, 3, 5, and 7 years after revision and a visit to the outpatient clinic. Patients who forgot to make an appointment after surgery were actively recruited by telephone and asked to make an appointment. In all cases a Coonrad-Morrey TEA (Zimmer) was used. A highly experienced elbow surgeon (D.E.) performed all revision surgical procedures.

The preoperative medical history of all patients was collected. During preoperative assessment, ROM was determined with a goniometer and elbow function was evaluated with use of the Mayo Elbow Performance Score (MEPS). In addition, the patients completed a visual analog scale (VAS) score (0-10) for pain at rest and during activity. At post-operative follow-up visits, the assessments included the same parameters. Since 2013, the Oxford Elbow Score (OES) has been added to the



Figure 1 Regions of osteolysis as described by King et al.¹²

questionnaires. To assess patient satisfaction directly instead of retrieving it from other questions, a question regarding satisfaction with the revision was asked during all follow-up visits. This question could be answered yes, moderately satisfied, or no.

Plain anteroposterior and lateral radiographs were obtained preoperatively and at each reassessment. Two surgeons (B.T. and D.E.) analyzed the radiographs for loosening of the implant, periprosthetic fracture, periarticular ossification, lucency, and dislocation or subluxation. Osteolysis was evaluated as described by King et al.¹² (Fig. 1). Periarticular ossification was scored as described by Hastings and Graham.¹⁰ In case of discrepancy in analysis of the 2 observers, a consensus was made.

Surgical technique

The surgeon assessed the stability of the elbow joint with the patient under anesthesia just before the surgical procedure ([Supplementary Table I](#), available on the journal's website at www.jshoulderelbow.org): grade 1, stable; grade 2, mild instability; or grade 3, severe instability. During surgery, the patient was placed in the lateral decubitus position with the arm on an armrest. Routine antibiotic prophylaxis was given in 18 of 19 cases, because in 1 case, deep infection was suspected and valid surgical cultures had to be obtained. A sterile silicone ring tourniquet was placed around the upper arm, as proximally as possible to allow for proximal extension of the incision if needed. After incision, skin flaps were created as thick as possible to minimize the chances of necrosis. The ulnar nerve was routinely identified and cleared of scar tissue as needed but was not routinely transposed. Because all cases were referred to our center, no complete data were available on the management of the ulnar nerve during the initial surgical procedures. However, previous ulnar nerve transposition was not observed.

A variation in the extensiveness of loosening of the primary prosthesis was noted, with a variety of remaining bone stock and in the quality of the soft tissues as triceps tendon. All patients had an intact radial head. A triceps-splitting approach was used in 2 cases, whereas the triceps-tongue approach was used in 17. Using the Wrightington approach, we released the annular ligament with a bony attachment that could be easily refixated using a transosseous suture.²² Release of collateral stabilizing structures (if present) was per-

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