



ELSEVIER

ORIGINAL ARTICLE

Results of cementless total elbow arthroplasty using the Discovery elbow system at a mean follow-up of 61.8 months

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Background: The available literature on the use of a cementless total elbow arthroplasty (TEA) design and its results are limited. This clinical study reports the outcome of the cementless Discovery elbow system.
Methods: Patients were operated on by a single surgeon between 2007 and 2014. Nineteen patients (20 elbows) were available for review, 2 women (1 bilateral TEA) and 17 men. The age of the patients ranged from 27 to 75 years (mean, 48 years). The mean follow-up was 61.8 months (range, 12-156 months). Patients were assessed for range of motion, pain, and satisfaction level. Outcome scores included the Mayo Elbow Performance Score, the Liverpool Elbow Score, and the 12-Item Short Form Health Survey (version 1). Radiographs were reviewed to evaluate for loosening.

Results: The mean Mayo Elbow Performance Score was 77.25, and the mean Liverpool Elbow Score was 6.76. The mean flexion range was 123°, and the mean extension lag was 35°. The mean pronation was 59°, and the mean supination was 58°. On radiologic evaluation, there were no signs of loosening; however, in 2 cases, nonprogressive radiolucent lines were observed. No signs of infection were detected at final follow-up, and no elbows were revised. More than 90% of patients were satisfied with the overall outcome.

Conclusion: The cementless TEA seems to be a reliable option for treatment of varying elbow diseases. Long-term results are needed to assess the survivorship of this design.

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

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Keywords: Total elbow arthroplasty; Discovery elbow; clinical outcome; cementless; loosening; linked

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The elbow joint is essential for upper limb range of motion (ROM) needed for everyday activities of living, such as personal hygiene needs.^{5,31} During the past 4 decades, total elbow arthroplasty (TEA) has become a viable option for patients with advanced elbow disease.^{12,25} Improvements in implant designs and an increased understanding of elbow biomechanics

have led to improvements in surgical outcomes for patients.^{14,15} Aseptic loosening of components, mainly the ulnar stem, is the leading cause of implant failure in a TEA. Whereas loosening can be caused by the primary failure of the bone-cement interface, secondary failure is associated with osteolysis initiated by particle debris from the polyethylene or cement^{14,45} or infection.^{22,30,49} The biomechanical properties of the TEA design have a profound impact; aseptic loosening occurred in 25% of the abandoned constrained designs, in 6%-17% of the semiconstrained designs, and in <2% of the nonconstrained designs.¹⁴ Polymethyl methacrylate has been used for >60 years. Cemented implants were designed to accommodate high stress loads as the cemented implants transfer the load over a larger surface area compared with the cementless implants^{6,47}; however, the successful use of cement can depend on surgical technique of cementation.^{7,43} Concerns about aseptic loosening and cement inducing third-body wear, along with the promise of biologic fixation and bone preservation, have led to the popularization of cementless implants.³² In 2003, the most common total hip replacement (THR)⁴⁰ was the all-cemented implant used in 60.4%, whereas an all-cementless THR was used in only 16.8%, with hybrid THR implants used in 12.3%. During 13 years, there has been a significant increase in the cementless option; in 2016, all-cemented implants represented only 31.0%, whereas an all-cementless THR has surged to 39.4% and hybrid THR implants have doubled to 25.7%.³³ Reports suggest that the increased use of a cementless design in joint replacements is underpinned by an increased confidence in the patient's function and the implant's longevity, with no significant differences seen in long-term outcomes.^{8,39,40,48} Despite this, the use of a cementless TEA design is less popular than in other joints. Factors that may have limited its use were early poor results with a cementless TEA, frequently implanted as a hybrid, often together with small numbers of patients reported, short follow-up, and the lack of Food and Drug Administration approval for cementless use until recently.^{4,9,41,23,28,42} Furthermore, most of the cementless implants were unconstrained prostheses, which may have been a key issue in the failures observed.

The limitations of previous studies included implants that are no longer in use, small numbers, and results based on limited assessments, such as radiologic signs of loosening and pain or cohorts of patients with rheumatoid arthritis. This study aimed to look at patients' postoperative functional joint-specific scores while examining their overall satisfaction and radiographic evaluation, thus giving an overall outcome assessment.

Methods

Patients

A retrospective review was conducted of a case series including all primary cementless TEAs performed in a single center by the same surgeon (S.P.F.; July 2007–August 2014). Nineteen patients (20 elbows) were available for review at an arthroplasty review clinic;

1 patient had bilateral TEA with the cementless design, and 2 further patients were lost to follow-up. Three other patients had the contralateral elbow replaced with a cemented Discovery elbow (Biomet, Warsaw, IN, USA) total elbow replacement. The inclusion criteria were all patients who had implantation of the Discovery elbow using the cementless design only.

All patients were seen and assessed at clinical review with a radiograph of the elbow performed in an anteroposterior view at maximum extension and a lateral view in 90° of flexion. All adverse radiologic findings were recorded, with evaluation of loosening undertaken using the Discover elbow radiologic assessment criteria.¹⁸ Scores and clinical assessments were completed by the experienced research team. The joint-specific scores used were the Mayo Elbow Performance Score (MEPS)²⁹ and the Liverpool Elbow Score (LES). The validated LES assesses the elbow joint objectively and subjectively. It consists of a 9-item patient-answered questionnaire (use of other arm, combing hair, washing, feeding, dressing, household activities, lifting, pain, sport and leisure) and a 6-item clinical assessment (flexion, extension, pronation, supination, strength, and ulnar nerve). ROM was obtained by an experienced team member while the patient was standing; active range of flexion, extension, pronation, and supination was recorded. The LES has been demonstrated to be reliable, internally consistent, responsive, and sensitive to changes in the patient's elbow condition. All responses are entered on a numerical scale, where 0 is the worst and 10 is the best.^{38,44} Patients' outcomes were also assessed using a satisfaction level and pain score. Patient satisfaction was measured using a 4-point Likert scale,²⁴ as follows: 0, not satisfied; 1, somewhat satisfied; 2, satisfied; and 3, very satisfied. Pain was rated by the patients as follows: 0, none; 1, mild; 2, moderate; and 3, severe. The 12-Item Short Form Health Survey, version 1 (SF-12v1),⁴⁶ a short version of the 36-Item Short Form Health Survey from QualityMetric, is a generic health care survey, recording patients' functional health and well-being from their point of view. The SF-12v1 survey provides a psychometrically based physical component summary and a mental component summary; a score of 50 is the average score.

Data were entered into Excel (Microsoft, Redmond, WA, USA) and analyzed using SPSS Statistics for Windows (version 24.0; IBM, Armonk, NY, USA).

Cementless implant design and surgical procedure

The Discovery elbow system has been designed to avoid complications associated with other TEAs, and it has been modified to allow press-fit implantation; instruments have been changed, and different reamers are used. This system facilitates more accurate positioning of the elbow flexion-extension axis, ensuring stability without using a true hinge. Hence, its "floppy hinge" allows 6° to 8° of varus-valgus motion and a rotational motion; the increased area of contact between the cobalt-chrome and ultrahigh-molecular-weight polyethylene avoids edge loading and reduces stresses in the ultrahigh-molecular-weight polyethylene, and the design allows posterior access during bushing revision.^{10,17} The cementless stem has a porous coating and hydroxyapatite coat to enhance the biologic integration. The design is a reliable option for patients with disabling elbow disease as it restores the functional arc of motion that is needed for activities of daily living.^{1,17,21}

Patients were operated on in a lateral position; a posterior midline incision was used, and the ulnar nerve was identified and protected. The Newcastle approach was used in all patients.² After the

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