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Minimum 20-Year Follow-Up Results of Revision Total Hip Arthroplasty With Improved Cementing Technique

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ABSTRACT

A consecutive, non-selective cohort of 83 (77 patients) cemented total hip arthroplasty revisions using contemporary cementing techniques was analyzed at a minimum of 20 years following the index procedure. No patients were lost to follow-up. The average age at revision was 62.4 years (23 to 89). Twenty-two hips (26.5%) had had a reoperation, eighteen (21.7%) for aseptic loosening, 3 (3.6%) for femoral prosthesis fracture and 1 (1.2%) for dislocation. The incidence of re-revision for aseptic femoral loosening was 7.5% and for aseptic acetabular loosening was 21.7%. These results confirm that cemented femoral revision using improved cementing techniques is a durable option in revision hip surgery. In contrast to this, THA revisions using a cemented acetabular component have been less durable at this length of follow-up.

The prevalence of loosening and re-revision and the complications reported in revision total hip arthroplasty (THA) with first-generation cementing techniques were not encouraging [1–8]. In the late 1970s surgeons became more experienced [2], and newer cementing techniques were introduced [9–11]. Better materials became available and improved criteria for the cemented fixation of femoral components were established. Techniques introduced during the 1970s included the use of an intramedullary plug and gun delivery of the cement [9–11]. Several authors have reported improved results on the femoral side in both primary THA [9,11–14], and more recently in revision surgery [15–18].

Our aim was to evaluate the results of cemented revision THA using improved cementing techniques and after experience had been gained in performing the revision procedure. This study represents, to our knowledge, the only minimum 20 year follow-up of cemented revision THA using contemporary cementing techniques.

Materials and Methods

Between 1977 and 1983 the senior author (RCJ) performed 83 consecutive cemented revisions for aseptic failure of a previous cemented THA in 77 patients. Both components were revised in 66 hips, only the femoral component in 14, and only the acetabular component in 3 hips. No patients were lost to follow-up during the minimum twenty-year follow-up period.

The average age of the 77 patients at the time of revision was 62.4 years (range 23–89). In the entire series, there were 34 men (35 hips) and 43 women (48 hips). The right hip was revised in 48 and the left in 35 cases. The reason for revision was aseptic loosening in 48 hips, dislocation in 17 hips, fracture of the femoral component in 8 hips and for other reasons in 10 hips. The index revision was the first revision in 80 hips, and the second revision in 3 hips. All femoral and acetabular components were cemented. The type of component used varied, depending on the date of surgery. The most commonly used components were the Charnley Total Hip (22.25 mm head, polished stem) and the Iowa Total Hip (28 mm head, matte finish stem).

At the 20 year follow-up interval, 21 patients (25 hips) were living and 56 patients (58 hips) were deceased. Of the living patients, 19 (23 hips) had minimum twenty-year radiographs, with an average radiographic follow-up of 21.4 years. For the entire patient series, the average length of radiographic follow-up was 12.7 (range, 0.2 to 27.1 years). The clinical outcome of the 21 living patients was obtained using a standard system of terminology for reporting [19].

Disclosures: JJC — Consultant and Royalties from DePuy (for intellectual property transfer for hip and knee implants) and Royalties from Lippincott, Williams & Wilkins (for books edited); RCJ — Royalties (Zimmer).

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A telephone questionnaire was completed by the families of the deceased patients.

Operation

A transtrochanteric approach was used in all cases. Femoral and acetabular reamers, and high speed burrs were used to remove neocortex. Cephalosporin (2 g) was used in each pack of Simplex P cement (Howmedica, Rutherford, New Jersey). An Oh-Harris syringe (Johnson and Johnson, New Brunswick, New Jersey) was used to introduce a distal cement plug 2 cm in length. After drying the femoral canal with sponges, and later in the series with 1:500,000 Epinephrine solution, cement was injected in the doughy stage using a cement gun. The doughy cement in the femur was pressurized by digital impaction. A plunger system was used to pressurize the acetabular cement. No structural allografts were used but any defect was filled with cement before the acetabular component was placed as inferiorly and medially as possible.

Radiological Assessments

Radiographs were evaluated by at least two observers (BNT, CAG, SSL, with JJC reviewing all radiographs) with agreement by consensus. For all patients, observations and measurements were based on comparison of the anteroposterior radiographs of the pelvis made soon after revision and those at the latest follow-up. Correction for magnification was made by comparing the measured diameter of the femoral head to that of the known diameter.

Loosening of the femoral component was classified according to the criteria of Harris et al [10]. Definite loosening was defined as subsidence of the femoral component [20], fracture of the cement or stem, or a radiolucent line at the cement-prosthesis interface at the superolateral aspect of the shoulder of the prosthesis (Gruen zone I) [21] [so-called debonding] as seen on serial radiographs. Probable loosening was characterized by the presence of a continuous radiolucent line along the entire bone–cement interface. Possible loosening was indicated by a radiolucent line at the bone–cement interface that encompasses more than 50% but less than 100% of the circumference of the stem on the anteroposterior radiograph. Subsidence of the femoral component, determined with use of the method of Loudon and Charnley [20], was defined as an increase of at least five millimeters (with magnification taken into account), between the initial postoperative radiographs and those made at the latest follow-up evaluation, in the distance from a line drawn perpendicular to the central axis of the femoral stem and intersecting the tip of the stem, and a line drawn perpendicular to the central axis and intersecting the point where the trochanteric wire passes through the lesser trochanter.

Assessment of femoral bone stock deficiency was determined on pre-revision radiographs according to the classification system developed by Paprosky and Burnett [22]. Type I defects contained no structural defects, type II defects are isolated to the metaphysis, type IIIA defects involve the metaphysis and junction with the diaphysis, type IIIB defects extend further into the diaphysis and type IV defects represent extensive femoral metadiaphyseal damage.

Cementing quality was evaluated on postoperative radiographs using the criteria of Barrack et al [12] and Schmalzried and Harris [23]. A grade-A result was complete filling of the intramedullary canal with cement, grade-B was complete filling of the canal with a cancellous bone lucency between cement and cortical bone, grade-C_1 had voids in the canal, grade-C_2 had an incomplete cement mantle at some point along the prosthesis, and grade-D was 100% radiolucency at the cement-bone interface or failure to fill the distal canal with cement.

Loosening of the acetabular component was classified according to the criteria of Hodgkinson et al [24] with the zones demarcated by DeLee and Charnley [25]. Migration of the component was defined as a vertical or horizontal movement of the cup (of at least 5 mm after correction for magnification) using a horizontal and vertical line drawn through the teardrop, as described by Massin et al [26].

Assessment of acetabular bone stock deficiency was determined on prerevision radiographs according to Paprosky and Burnett [22]. Type I defect is complete bony rim support and no component migration; type II defects have mild teardrop and ischial lysis and greater than 70% host-bone coverage is anticipated after acetabular preparation; type IIIA defects involve greater than 3 cm superior migration with moderate teardrop and ischial lysis; type IIIB defects involve greater the 3 cm superior migration with severe teardrop and ischial lysis, as well as medial migration.

Heterotopic ossification was graded using the criteria of Brooker et al [27].

Statistical Analysis

The Kaplan–Meier [28] method was used to evaluate survival of the implant with regard to revision or loosening, or both [29,30]. Survivorship curves with corresponding 95% confidence intervals were generated, with failure defined according to the six standard end points: (1) revision for any reason of the femoral and/or the acetabular component; (2) revision for aseptic loosening of the femoral and/or the acetabular component; (3) revision for aseptic loosening of the femoral component; (4) radiographic loosening of the femoral component, defined as definite or probable radiographic loosening or revision because of aseptic loosening; (5) revision of the acetabular component for aseptic loosening; and (6) radiographic acetabular loosening, defined as definite or probable radiographic loosening or revision because of aseptic loosening. Bone stock at the time of revision was compared to re-revision for aseptic loosening and with radiographic loosening by chi-square test with Yates' correction when both variables were categorical, and by one-way analysis of variance and the two-tailed Student's *t*-test when one variable was continuous.

Results

At the time of review, a total of 22 hips (26.5%) had been reoperated on (Table 1). Eighteen (21.7%) were for aseptic loosening, 3 (3.6%) for femoral prosthesis fracture and 1 (1.2%) for dislocation. Fifteen (21.7%) acetabular components and six (7.5%) femoral components were revised for aseptic loosening (Table 2). One of 34 polished Charnley components was revised and five of 39 Iowa matte finish components were revised. Eleven (47.8% of living hips) of the acetabular revisions and three (13.0% of living hips) of the femoral revisions were in the group of patients still living at the twenty-year clinical and radiographic follow-up interval.

Of all 83 hips, 61 (73.5%) were functioning at the latest follow-up or the patients had died without re-revision, 17 (20.5%) had required one additional revision and 5 (6.0%) had required two or more revisions. Of the hips reviewed at twenty-years, 12 (48.0%) were functioning with their index revision, 8 (32.0%) had required one additional revision and 5 (20.0%) had required two or more revisions.

Of those living at the twenty-year follow-up interval, 17 patients (81%) were retired. Four patients (19%) were semi-sedentary, 7 (33%) were sedentary and 1 (4.7%) was bedridden. Ten patients (48%) had no pain, 9 (43%) had mild pain, 1 (4.7%) moderate pain and 1 (4.7%) had severe pain. Eleven patients (52%) walked without support, 1 (4.7%) required occasional use of a cane and 7 (33%) needed the full-time use of supports.

At the final follow-up 5 (24%) had unlimited walking capacity, 4 (19%) could walk for eleven to thirty minutes, 3 (14%) could walk for two to ten minutes, 4 (19%) could walk only indoors, and 5 (24%) had very limited walking. Of the living patients all 21 (100%) stated that