ABSTRACT

Purpose. To evaluate long-term outcomes of total hip arthroplasty (THA) using the Perfecta cementless system.

Methods. 73 men and 76 women aged 65 to 88 (mean, 71) years underwent 168 THAs using the Perfecta cementless system and were followed up for a mean of 13 (10 to 15) years. 19 patients had bilateral THA. The diagnoses were idiopathic osteoarthritis (n=121), osteonecrosis of the femoral head (n=25), rheumatoid arthritis (n=14), and post-traumatic osteoarthritis (n=8). Patients were evaluated clinically and radiographically before and after THA.

Results. The mean Harris hip score improved from 40 to 84 (p<0.001); the score was excellent or good in 130 hips, fair in 17, and poor in 21. The mean Merle D’Aubigne score improved from 4 to 10 (p<0.001); the score was excellent or good in 138 hips, fair in 9, and poor in 21. Poor results were due to aseptic revision of the cup (n=16) or stem (n=3) or deep infection (n=2). Thigh pain that limited activities of daily living was noted in 3 hips. 142 patients could walk without a limp, 5 had a slight limp, and 3 had a moderate limp and used a cane. The mean Short Form-12 score for the physical function was 49 and for the mental health was 56; the mean Western Ontario and McMaster Universities Osteoarthritis Index was 39; the mean visual analogue scale score for satisfaction was 8. Two patients developed deep infection at postoperative months 8 and 50 and were treated with 2-staged revision. Five patients had hip dislocation within 2 months; 3 of whom endured recurrent dislocation and underwent revision surgery; they had acetabular malposition with excessive anteverision despite a correct acetabular angle. 13 other cups were revised because of loosening or extensive osteolysis (n=10) and polyethylene wear (n=3) after a mean interval of 6 (range, 4–10) years. Three stems were revised because of aseptic loosening after a mean interval of 7 (range, 6–9) years. The survivorship at 14 years was 99% for stems and 91% for cups.

Conclusion. The long-term outcome of the Perfecta cementless stem was good; most major complications occurred in the cup.

Key words: arthroplasty, replacement, hip; titanium; treatment outcome

Cementless total hip arthroplasty using titanium, plasma-sprayed implants: a study with 10 to 15 years of follow-up

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INTRODUCTION

Cementless total hip arthroplasty (THA) minimises prosthetic loosening, particularly in young patients with high activity demands. The cementless, titanium, plasma-sprayed, proximally coated, tapered stems are increasingly popular in Europe, as they improve bone ingrowth into the porous surface. Only few studies with at least 10 years of follow-up in patients aged ≥65 years have been reported. We evaluated long-term outcomes of THA using the Perfecta cementless system in patients aged ≥65 years.

MATERIALS AND METHODS

Between May 1992 and January 1998, 188 consecutive patients aged ≥65 years underwent primary THA using the Perfecta cementless system (Orthomet, Wright Medical, Arlington [TN], USA). 34 of the patients had died (within postoperative years 3 to 9) from causes unrelated to their THA, 2 refused to be examined, and 3 could not be contacted. The remaining 73 men and 76 women (168 hips) aged 65 to 88 (mean, 71) years were followed up for a mean of 13 (10 to 15) years. 19 patients had bilateral THAs. The mean patient weight, height, and body mass index were 80 (range, 66–103) kg, 168 (range, 160–188) cm, and 28 (range, 24–38) kg/m², respectively. The diagnoses were idiopathic osteoarthritis (n=121), osteonecrosis of the femoral head (n=25), rheumatoid arthritis (n=14), and post-traumatic osteoarthritis (n=8). This study was approved by our institutional review board, and informed consent was obtained from each patient.

All THAs were performed under epidural anaesthesia through the Hardinge lateral approach by 2 senior surgeons. The cementless, modular, collarless, tapered, titanium stem had proximal triplanar wedge geometry. The proximal third of the stem had a rough, closed pore structure with a circumferential porous-coated plasma spray. The roughness of the plasma-spray coating increased as its thickness increased. The distal conical portion had a 3º proximal-to-distal taper and was matte-finished. The stem had a 130º neck angle that lateralised the prosthesis to improve joint mechanics and reduce wear (Fig. 1). Seven different diameter sizes were available (range, 9–18 mm). Sequential metaphyseal reaming was performed, until a tight press-fit was obtained. The size of the stem matched that of the last reamer used. The median stem size was 13.5 mm. Stems were fixed at 10º to 15º anteversion. The femoral head was 28 mm in diameter for all cup sizes; larger heads were used only in cases at risk of instability.

The cementless, titanium, plasma-sprayed, hemispherical, press-fit cup has 4 holes for screws (Fig. 1). Nine cup sizes (in diameter) were available (range, 46–62 mm). The acetabulum was prepared by reaming. The cup was then inserted; the diameter of the implant matched that of the last reamer. The median cup size used was 50 mm. In 144 hips, cups were supplemented with 2 divergent screws into the superior quadrant. The ultra-high-molecular weight polyethylene insert with a 10º lip and an inner diameter of 28 mm was used.

Prophylactic antibiotics (intravenous cefazolin) and antithrombotics (subcutaneous low-molecular weight heparin) were given on the night after surgery and continued for 6 weeks. Full weight-bearing with the aid of a walker or crutches was allowed on day 2.

Patients were evaluated preoperatively and postoperatively at 3 and 6 months, one year, and yearly thereafter. The Harris hip score⁸ and the modified Merle D’Aubigne score⁹ were evaluated. Thigh pain was rated as none, slight, mild, moderate, or severe. The short form-12 (SF-12) Health Survey, the reduced Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the level of satisfaction using a 10-point visual analogue scale (VAS) were completed by the patients.

Anteroposterior and true lateral radiographs were evaluated by a single independent orthopaedic surgeon. The latest and postoperative month 3 radiographs were compared. The femoral bone quality on preoperative radiographs was analysed according to the Dorr’s criteria.¹³
Stem orientation was defined as the position of the stem relative to the long axis of the femoral shaft on anteroposterior radiographs; varus or valgus of >3° were recorded. Proximal femoral filling was defined as the ratio of the stem width to the medullary canal width at the upper border of the lesser trochanter. Filling was deemed satisfactory when >80% in the anteroposterior plane and >70% in the lateral plane. Stem subsidence was defined as a ≥5 mm change in distance between the top of the stem and the greater trochanter. Radiographic analysis of femoral loosening based on the Gruen zones was defined as a progressive subsidence of >5 mm, a progressive change of position of ≥3°, or a continuous radiolucent line of >2 mm. Femoral fixation and stability were classified as bone ingrown, stable fibrous ingrown, or unstable, according to the Engh criteria. Osseointegration was determined by the presence of spot welds. Remodelling of the femur (calcar resorption, cortical hypertrophy, or pedestal formation) was recorded, as were bone apposition, spot welds, radiolucent lines, and osteolysis. Ectopic ossification was defined using the Brooker criteria.

The acetabular angle was classified as neutral (40°–50°), horizontal (<40°), or vertical (>50°). Radiolucent lines, osteolysis, or migration of the cup was assessed at the zones of DeLee and Charnley. Loosening of the cup was defined as migration of >2 mm, change in component inclination of >5°, or the presence of a complete radiolucent line of >2 mm. Linear wear was measured according to the McCalden method and defined as the linear displacement of >2 mm off the centre of the femoral head in relation to the centre of the acetabular cup.

The paired t-test was used to compare measurements at 2 time points. The survival probability of the femoral component was estimated using the Kaplan-Meier survivorship analysis; the end point was defined as revision of the component. A p value of <0.05 was considered statistically significant.

RESULTS

From preoperation to the latest follow-up, the mean Harris hip score improved from 40 (range, 12–67) to 84 (range, 31–100) [p<0.001]; the score was excellent or good (80–100) in 130 hips, fair (70–79) in 17, and poor (<70) in 21. The mean Merle D’Aubigné score improved from 4 (range, 2–8) to 10 (range, 4–12) [p<0.001]; the score was excellent or good (10–12) in 138 hips, fair (8) in 9, and poor (<8) in 21. Poor results were due to aseptic revision of the cup (n=16) or stem (n=3) or deep infection (n=2). Thigh pain was absent in 160 hips, slight in 5 hips, and moderate in 3 hips. 142 patients could walk without a limp, 5 had a slight limp, and 3 had a moderate limp and used a cane.

The mean SF-12 score for the physical function was 49 (95% confidence interval [CI], 46–50) and for the mental health was 56 (95% CI, 54–56); the mean WOMAC was 39 (95% CI, 37–40); the mean VAS score for satisfaction was 8 (95% CI, 7–8).

The preoperative femoral bone quality was Dorr type-A in 115 femurs, type-B in 47, and type-C in 6. Postoperatively, proximal filling was satisfactory in 138 femurs. Alignment was neutral in 129 stems, varus in 37, and valgus in 2; 4 stems changed position but remained well-fixed. This positional change was related to unsatisfactory femoral filling (p<0.01, Chi squared test). Excluding the 2 deep infection, 163 stems showed stable fixation with bone ingrowth (Fig. 2) and 3 stems showed unstable fixation. Subsidence occurred in 3 stems. Radiolucent lines were noted in 6 stems; 5 had them in zone I, one in zone II, 3 in zone III, 2 in zone IV, 2 in zone V, 2 in zone VI, and 3 in zone VII. 18 femurs had trochanteric osteolysis in the femoral periprosthetic bone that did not affect the structure. No femur had distal osteolysis, 27 femurs had calcar atrophy, 102 stems had spot welds. 14 femurs had an incomplete pedestal at the tip of the well-fixed stem. 12 femurs had femoral cortical hypertrophy; 7 in zone III and 5 in zone V. 26 hips had heterotopic ossification (15 grade-I, 8 grade-II, and 3 grade-III).

The mean acetabular angle was 43° (standard deviation [SD], 4°; range, 28°–58°); the angle was neutral in 163 cups, horizontal in 2, and vertical in 3. 153 cups had stable fixation with bone ingrowth (Fig. 2). The global linear rate of polyethylene wear was 0.21 mm per year (range, 0.02–0.94). 11 polyethylene inserts had wear of >2 mm. Two patients sustained non-displaced longitudinal fractures at the femoral calcar during insertion of the femoral component and were treated with cerclage wiring; none developed postoperative femoral subsidence. Two patients developed deep infection at postoperative months 8 and 50 and were treated with 2-staged revision. Five patients had hip dislocation within 2 months. Their acetabular angle was between 40° and 50°. Two of these patients were treated with closed reduction and had satisfactory results at the final follow-up (Harris hip score, 84 and 94). The remaining 3 patients had recurrent dislocations and underwent revision surgery; they had acetabular malposition with excessive anteversion (despite a correct acetabular angle) and
were attributed to technical error. 13 other cups were revised because of loosening or extensive osteolysis (n=10) and polyethylene wear (n=3) after a mean interval of 6 (range, 4–10) years. Three stems were revised because of aseptic loosening after a mean interval of 7 (range, 6–9) years.

The Kaplan Meier survival at 14 years was 99% (95% confidence interval [CI], 97–100) for stems and 91% (95% CI, 86–95) for cups (Fig. 3).

**DISCUSSION**

Proximally coated stems have demonstrated long-term durability and lower likelihood of thigh pain and distal osteolysis, despite variable rates of migration and femoral remodelling. It has been postulated that tapered femoral components optimise the stress transfer from implant to bone, and result in less proximal femoral atrophy and thigh pain. In mid- and long-term studies, cementless tapered stems achieved stable bone ingrowth in 98 to 100% of cases, with satisfactory clinical and radiographic results. The performance of the Perfecta stem is comparable.

Thigh pain is a recognised problem after cementless primary THA. It may be associated with stem instability and fixation failure. In well-fixed cementless stems, thigh pain is most likely to be caused by a mismatch in flexural rigidity between the bone and the stem. In our study, only 3 hips developed continuous thigh pain secondary to stem loosening owing to insufficient filling of the femoral canal.

In our study, 98% of stems had signs of stability (endosteal bone formation and proximal adaptive bone remodelling), and 61% had endosteal spot welds indicative of bony fixation. Proximal circumferential plasma spray does indeed protect against distal migration of particulate debris at long-term follow-up, as osteolysis was found exclusively in the proximal femur. 7% of femurs had cortical hypertrophy, owing to the concentration of focal stress in the transitional zone between the stiff area around the stem and the elastic area distal to the implant. This is not related to stem loosening. 8% of femurs had an incomplete pedestal at the tip of the stem indicative of adaptive remodelling response.

In a series of 307 Mallory Head cementless femoral components with 10 to 13 years of follow-up, no revision for aseptic loosening was reported. In a series of 92 porous-coated anatomic hips, a 100% survival rate at 10 years was reported. With the Omnifit stems, a 3.9% revision rate for stems after a mean follow-up period of 10 years was reported; 7.1% of stems had cortical hypertrophy and 2 stems exhibited early migration with later stabilisation. In our series, most major problems were from the cups, which was consistent with other studies.
REFERENCES