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Long-Term Results of Total Hip Arthroplasty with an Extensively Porous Coated Stem in Patients Younger than 45 Years Old

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Purpose: This study analyzed the long-term results of cementless total hip arthroplasty using an extensively porous coated stem in patients younger than 45 years old. **Materials and Methods:** The clinical and radiographic results of 45 hips from 38 patients who underwent cementless total hip replacement arthroplasty with an AML prosthesis were reviewed retrospectively. The average follow-up was 12 years (range, 10-15 years). **Results:** The average Harris hip score at the time of final follow-up was 87.3 (range 77-94) points. Forty two hips (93.3%) showed excellent and good clinical results. Osteolysis occurred around the stem in 20 hips (44.4%) and around the cup in 26 hips (57.8%). Stress-mediated femoral resorption was observed in 33 hips (73.3%) at 10 years. There was no incidence of resorption progressing after 5 years postoperatively. There was no stem loosening. Five hips were revised for osteolysis, cup loosening and polyethylene wear. **Conclusion:** The long term results of total hip arthroplasty using an extensively porous coated stem were acceptable, and there was no case involving the progression of proximal bone resorption.

Key Words: Cementless total hip arthroplasty, extensively porous coated, polyethylene wear, osteolysis

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INTRODUCTION

Uncemented total hip arthroplasty (THA) was developed in order to achieve biological fixation of the prosthesis through the integration of the cementless hip components into prepared bone, thereby increasing the longevity of the implant. The principal aim of uncemented THA is to prevent movement at the implant-bone interface. Cementless stems require a high degree of initial stability, proximal stress transfer and permanent bonding of the implant to the bone.

Most studies on cementless total hip arthroplasty have reported satisfactory results after a medium-term follow-up.[1-5] However, there are still unsolved problems, such as thigh pain, polyethylene wear, osteolysis and bone remodeling.[6-10] This study presents the results of a total hip arthroplasty with an Anatomic Medullary Locking (AML, DePuy, Warsaw, IN, USA) hip prosthesis, which were observed clinically and radiographically for a minimum of 10 years (range 10 to 15 years).

MATERIALS AND METHODS

A retrospective study was carried on 52 younger than 45 years-old THA patients (64 hips) who received an AML prosthesis. Of these patients, 19 hips were lost to

follow-up, leaving a final 38 patients (45 hips) enrolled in this study. There were 35 men and 10 women with an average age of 41 years (range, 28-45) at the time of surgery. There were 31 hips (68.9%) with a diagnosis of osteonecrosis, 8 hips with a femoral neck fracture and 6 hips with osteoarthritis. The postoperative evaluation included an assessment using the recently validated Harris hip score.[11] Excellent, good, fair and poor results were considered if there was a Harris score of 90-100, 80-89, 70-79, and 69 points and below, respectively.

For the purpose of data analysis, the preoperative radiograph was compared with the post operative radiographs done immediately, 6 months, 1 year after surgery and each year thereafter. Standardized simple supine anteroposterior radiographs of the pelvis, including femur and lateral projection of hip, were made. The acetabular component was assessed for any vertical and horizontal migration, the presence of a sclerotic radiolucent line around the implants, the average polyethylene wear and the annual rate of wear. Radiological measurement was done by a single observer.

The femoral component was assessed for femoral stem migration, osteolysis and stress shielding. The level of osteolysis was assessed using the Gruen zone.[12]

An unstable cup was defined as migration more than 2 mm or a change in the inclination more than 5°. The average wear of polyethylene was measured using the method described by Livermore, et al.[13] The status of biological fixation of the femoral component was defined according to the classification by Engh and Bobyn.[1]

The ratio of the width of the femoral component to the width of the femoral canal was measured and assessed at the upper border of the lesser trochanter, and was defined as being good if the amount of fill achieved by the femoral component at the metaphyseal level exceeded 80% and there was less than 1 mm of metal to bone contact.[14]

The stability of the femoral component was classified in terms of the level of bone ingrowth, stable fibrous ingrowth and unstable fixation.[15] Loosening of the femoral component was determined by measuring a perpendicular line from the proximal portion of the stem to the lesser trochanter, and progressive axial subsidence was diagnosed as a change in excess of 5 mm. The location of the osteolysis of the acetabular component was recorded using the DeLee and Charnley[16] method.

The qualitative resorptive bone changes in the proximal femur were categorized into the degrees of severity using the system reported by Engh, et al.[9] (First degree, only the most proximal medial edge of the femoral neck was rounded off slightly; second degree, rounding off or the proximal medial femoral neck is combined with a loss of medial cortical density; third degree, more extensive resorption of the cortical bone involving both the medial and anterior cortical regions; and fourth degree, cortical resorption extending below 1 and 2 into the diaphysis).

SPSS statistical software was used to analyze the data (SPSS, Inc, Chicago, IL, USA). The chi-square test was used for statistical comparison of bone remodeling and patient's factor (age, weight and stem size).

RESULTS

Clinical results

The average Harris hip score was 87.3 (range 77-94) points at the final follow-up. Hip scores at the last follow-up were; excellent in 32 out of 45 hips (71.1%), good in 10 (22.2%) hips and fair in 3 (6.7%) hips. The prevalence of thigh pain was initially 15.6% (7 hips) and the pain in all hips disappeared 3 years after surgery.

Radiographic results

Thirty-eight (84.4%) stems had good canal fill; 37 hips of these showed bone ingrowth and one hip had stable fibrous ingrowth. Seven (15.6%) hips had a poor canal fill. Four of these showed bone ingrowth, and 3 hips showed stable fibrous ingrowth. There was no unstable stem.

Osteolysis was observed around the stem in 20 hips (44.4%) and around the cup in 26 hips (57.8%). Most of the osteolysis in the femoral side was in zones I and VII.

The average amount of polyethylene wear was 2.3 mm (range 1.5-4.8 mm, standard deviation 0.5 mm), and the wear rate per year was 0.19 mm/yr.

Stress-mediated femoral resorption was observed in 30 hips at 3 years after surgery, 32 hips at 5 years after surgery and 33 hips (73.3%) at 10 years after surgery: first degree in 15 hips (33.3%), second degree in 11 hips (24.4%) and third degree in 7 hips (15.6%), respectively. The demographic data (age, weight and stem size) of the 35 hips showing evidence of stress shielding were compared with the group not showing stress shielding. There was no apparent difference between the two groups. The resorption did not progress to the third degree from either the first or second degree after 5 years postoperatively.

There was no stem loosening. Four hips were revised. One hip was revised at 5 years after surgery because of an unstable fixation of the acetabular component. Three hips were revised due to osteolysis around the cup and excessive polyethylene wear (Fig. 1); posteoperative 10 years in two hips and 11 years in one hip. The last follow-up radiography showed osteolysis around the cup with excessive polyethylene wear. Cup revision arthroplasty with an allograft was carried out for an osteolytic lesion.

Intraoperative periprosthetic femoral fracture developed

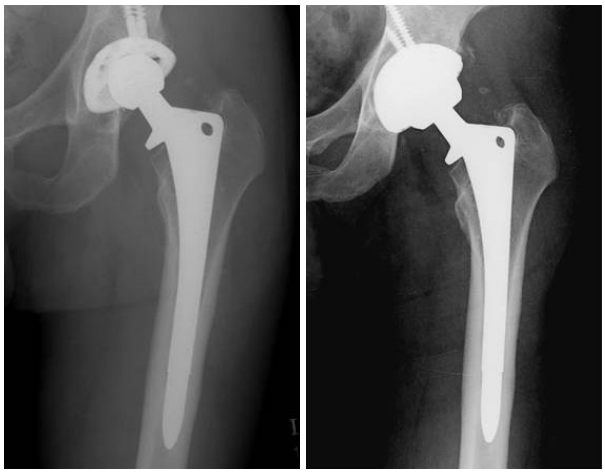

Fig. 1. Radiography taken at postoperative 11 years shows osteolysis around cup with excessive polyethylene wear. Revision arthroplasty with an allograft was carried out for an osteolytic lesion.

in one hip, which was managed successfully with cerclage wiring. Two patients had a dislocation of the hip, which was treated by a closed reduction.

DISCUSSION

The AML prosthesis occupies the proximal area of a stem in a wide triangular shape to achieve early torsional stability in the postoperative period, and late postoperative stability. Its components are made from porous-coated cobalt chromium beads, ranging from 187 to 200 μm in diameter, which comprise proximal 2/3 of the stem.

Most studies have shown satisfactory results in terms of the long-term follow-up over a minimum 10 years for AML prostheses. However, there are still unresolved problems such as thigh pain, polyethylene wear, osteolysis and resorption of the femur due to stress shielding.

After a follow-up of more than 10 years, Engh and Bobyn,[2] reported better than good results in 93% of cases, Kim and Kim,[5] reported better than good in 84.0% of cases and Hwang, et al.[4] reported the same in 88.9% of cases. Our series showed good results in 92% of hips. Patients whose recent radiographs were not available were excluded. This means that there was a relative high percentage of those lost to follow up, which would be a limitation to this study.

A consequence of early proximal porous coated bone ingrowth fixation designs was thigh pain, which occurred for two reasons: inadequate fixation and the stiffness ratio between the stem and bone.[6] There are two patterns of pain. One is from the distal end of the stem due to firm distal fill with a rigid stem, which usually occurs after exercise but does not cause significant lifestyle problems. The other is from a loss of fitting or due to fibrous fixation, which usually occurs immediately after weight-bearing exercises. However, most pains improve within 2 years. The pain may be associated with loosening if it persists for more than two years. After a follow up of more than 10 years, Engh and Bobyn[2] reported a prevalence of thigh pain of 8%, and Hwang, et al.[4] reported 5.6%. In this study, the prevalence of pain was 11.5% but the symptoms disappeared within 3 years, possibly due to stable fibrous ingrowth fixation of the stem.

Schulte, et al.[17] reported after a minimum 20-year follow-up that the annual rate of polyethylene wear was 0.074 mm/yr in the Charnley hip system, and Livermore, et al.[13] reported that the annual polyethylene wear rate of 22 mm and 28 mm-sized femoral heads which were made from a cobalt-chromium substrate were 0.13 mm/yr and 0.10 mm/yr, respectively. In the present study, the rate was 0.19 mm/yr: Three hips were revised due to polyethylene wear but their age when they underwent revision surgery was less than 45 years old. This is similar to the result of Engh and Bobyn[2] that the polyethylene wear rate was higher in relatively active young patients with cementless total hip arthroplasty than in older patients.

It is known that osteolysis of the acetabular component begins at the sclerotic line in zone II of DeLee & Charnley. The prevalence was 30.8% according to Kim and Kim[5] In this study, the prevalence was 40.4% and it occurred frequently in zones I and II. As for the osteolysis of the femoral side, Kim and Kim[5] reported a prevalence of 25.0%. The present series showed a prevalence of 23.1%, which is believed to be associated with a relatively young age, a long-term follow-up, and a high rate of polyethylene wear.

Engh, et al.[8] reported that bone resorption due to stress shielding is related to the size of the femoral stem and the condition of the sintered porous coating. In this study, femoral resorption was observed in 31 hips 3 years after surgery, 34 hips 5 years after surgery and 35 hips (67.3%) 10 years after surgery. No significant difference was observed at the long-term follow-up. In addition, there was no apparent difference in age, weight, Charnley activity, and stem size between the two groups (stress shielding and non stress shielding). Most bone resorption was first or second degree, and none progressed from a low grade to a high grade 5 years after surgery.

Engh, et al.[18] reported that there was no significant difference in the fracture rate due to osteolysis and bone resorption. They also reported that bone resorption due to stress shielding did not appear to cause significant problems in cementless THAs. In the present study, there was only one greater trochanter fracture, which was induced by osteolysis. Conservative treatment for a trochanteric fracture leads to a satisfying result, nevertheless, consistent observations are required because of the potential of progressing to osteolysis.

Engh and Bobyn[2] analyzed 174 hips of an AML series for a minimum 12 years follow-up, and found that the rate of survival was 94.8% for the cup and 98.3% for the stem. In the present study, the rate was 88.9% for the cup and 100% for the stem.

In conclusion, the long-term results of total hip arthroplasty, using an extensively porous coated stem, in young patients were acceptable and there was no significant proximal bone resorption. However, polyethylene wear and osteolysis should carefully be followed over the long term.

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