Cementless Lord total hip arthroplasty

Cup loosening common after minimum 10-year follow-up of 103 hips

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ABSTRACT – We evaluated the clinical and radiographic results of 103 (88 patients) cementless Lord total hip arthroplasty after a mean follow-up period of 12.5 (10–16) years. 77 hips had arthrosis, 15 rheumatoid arthritis and 11 osteonecrosis. The preoperative mean Harris Hip Score improved from 47 (19–66) to 87 (62–99) at 5 years, but declined to 77 (56–97) at the final examination. The survivorship of the cup, using radiographically confirmed aseptic loosening as the end point, was 63% at 10 years and 45% at 15 years and the survivorship of the stem was 97% at 10 years and 96% at 15 years. The low figures of the cup may be due to insufficient contact between the smooth-surfaced threads of the cup and the acetabular bone. Thinner polyethylene, insufficient initial bone coverage, and larger femoral head diameter were significantly related to the occurrence of loosening. We can not recommend this smooth-surfaced threaded cup because of its high failure.

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Cementless total hip arthroplasty (THA) has become more common surgical technique since the early 1970s, but several problems have been pointed out (Jasty et al. 1997, Maloney et al. 1997, Joshi et al. 1998, Maloney et al. 1999, Sochart 1999). To improve the clinical outcome, various modifications in design of the cup have been made (Morscher 1992, Manley et al. 1998, Delaunary and Kapandji 1998). One of these was the threaded cup (Morscher 1992). This basic design can be divided into 3 groups, according to the surface coating, i.e., smooth-surfaced cup, grit-blasted cup, and hydroxyapatite-coated. The earliest designs with a smooth surface seemed promising (Lord et al. 1979, Lord and Bancel 1983). When poor results were reported in experimental and clinical studies (Pupparo ad Engh 1991, Fernández-González et al. 1997, Tooke et al. 1988), the use of smooth-threaded cups gradually declined until they were withdrawn from the market. On the other hand, the results with the grit-blasted threaded cup and hydroxyapatite-coated threaded cup have been good (Delaunay and Kapandji 1998, Manley et al. 1998). Delaunay et al. reported a 99% 10-year survivorship for the grit-blasted threaded cup, using radiographic loosening as the end point. Manley et al. found that 99% of the hydroxyapatite-coated threaded cups continued to show radiographic signs of a stable interface with osseous ingrowth, and only 1% had been revised because of aseptic loosening after a 5-year minimum follow-up period.

There has been only one mid-term (Fernández-González et al. 1997) and one long-term report (Malchau et al. 1996) on the Lord screw ring during the past decade. We report the long-term (10–16 years) clinical and radiographic results with the Lord THA.

Patients and methods

Between 1982 and 1988, 161 hips in 142 patients received a Lord THA. 18 patients (19 hips) had died and 36 patients (39 hips) could not be reached at the 10-year follow-up. Therefore, only 103 hips in 88 patients were available for review with a

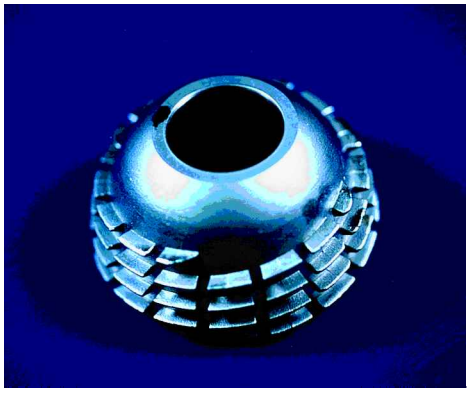


Figure 1. Lord smooth-surfaced threaded acetabular component.

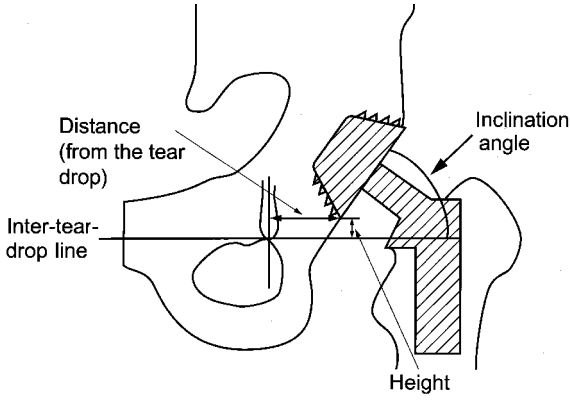


Figure 2. Measurement of the threaded cup position on the anteroposterior radiograph. Change was determined by measuring the inclination angle, height from the inter-teardrop line, and distance between the inferior edge of the threaded cup and the teardrop.

mean follow-up period of 12.5 (10–16) years. In the survival analysis, the 39 hips (36 patients) were also included.

Median age of the patients at surgery was 58 (36–79) years. There were 17 men (20 hips) and 71 women (83 hips). The preoperative diagnoses were osteoarthrosis in 77 hips (69 patients), rheumatoid arthritis in 15 hips (10 patients), and osteonecrosis of the femoral head in 11 hips (9 patients).

The smooth-surfaced threaded cup of the Lord total hip system is made of cobalt-chrome alloy, and ellipsoid-shaped, since it is cut out from a cone with 4 smooth threads (Figure 1). The diameter of the femoral head is 22.22 mm, when the outer diameter of the threaded cup is 42 mm (n 23) or 46 mm (n 37), and 32 mm, when the diameter of the threaded cup is 50 mm (n 24) or 54 mm (n 19). Mark I (Lord et al. 1979) femoral stem was used in 45 hips, and Mark II (Lord and Bancel 1983) stem in 58 hips. Both types are madreporique porous-coated cementless stems. The only difference is the smooth surface in the distal 1/3 of the stem in Mark II.

All surgical procedures were performed by two senior surgeons using a posterolateral approach. No trochanteric osteotomy was done. In 38 hips with severe acetabular dysplasia and insufficient bone stock, bone grafting was done to obtain sufficient coverage of the threaded cup. Postoperatively, partial weight bearing was started after 10 days. Full weight bearing with cane support was permitted in the 7th week. In patients with bone grafting, partial weight bearing was allowed in the 7th week, and full weight bearing was delayed until 3 months. We used the Harris Hip Score (HHS).

An independent radiologist, to whom clinical data were blinded, analyzed the consecutive pelvic views centered on the symphysis. The shape of the obturator foramen, was used to assess pelvic tilt. If inappropriate tilting was found, another radiograph was taken immediately.

We divided bone coverage of the threaded cup into 4 groups. Group A: cup entirely covered with original acetabular bone. Group B: cup partially covered with bone graft. Group C: cup fixed in a protruded position to obtain sufficient support of the thread in the dysplastic hip. Group D: lateral or anterior part of the cup not fully covered with bone.

To evaluate the stability of the threaded cup, changes in the inclination angle, height of the lowest point of the threaded cup from the inter-teardrop line, and distance between the medial edge of the threaded cup and the teardrop were measured on the anteroposterior radiographs (Figure 2). The location of radiolucent lines around the threaded cup was assessed using the 3 zones of DeLee and Charnley (1976). Aseptic loosening of the threaded cups was defined as (i) radiolucent lines on the entire circumference, (ii) 5° or larger change of inclination angle, or (iii) proximal or medial/lateral migration of 5 mm or more. Stem loosening was defined as a complete radiolucent line or ¶ 5 mm subsidence.

Kaplan-Meier survival analysis was done by setting the end-point at the time when revision surgery was performed or when radiographic loosen-

ing was confirmed. Statistical analysis was done using Cox regression analysis, the paired t-test, and χ^2-test. The relative risks (RR) and their 95% confidence limits were calculated (Statview 5.0). Results were considered statistically significant at $p < 0.05$.

Results

Clinical score

The mean HHS score improved from 47 (19–66) before surgery to 82 (47–96) at 1 year, 87 (62–99) at 5 years, and 84 (35–98) at 7 years. It declined significantly to 79 (23–96) at 10 years (paired t-test, between 7 and 10 years, p = 0.02), and 77 (56–97) at the final examination. 14 cups were revised because of aseptic loosening.

Radiographic evaluation

Among the 103 cups followed for 10 years or longer, 32 cups were completely covered with host bone, 38 were partially resting on graft, 16 were fixed in a protruded position, and 17 were not completely covered with bone. The mean inclination angle was 46° (29°–63°) immediately after surgery, 45° (24°–61°) at 5 years, 45° (21°–72°) at 10 years, and declined to 43° (31°–64°) at the last examination. 31 hips had a 5°or more change in inclination angle. The height from the inter-teardrop line gradually increased from 1.3 (–20–18) mm immediately after surgery to 3.2 (–20–15) mm at 5 years, 4.9 (–15–21) mm at 10 years, and 6.9 (–10–20) mm at the final examination (mean increase: 5.6 mm). There were 37 hips with more than a 5 mm increase in height at the final examination. The distance between the medial edge of the threaded cup and the teardrop decreased from 3.5 (–4–17) mm immediately after surgery to 2.7 (–4–17) at 5 years, 1.3 (–11–17) mm at 10 years, and 0.7 (–10–16) mm at the final examination (mean change in distance change: 2.8 mm). 6 hips (6%) showed a change in distance of 5 mm or more at the final examination.

60 of the 103 cups had radiolucent lines at the final follow-up examination. At the 10-year follow-up, a radiolucent line was found in zone I in 33 hips, zone II in 24 hips, and zone III in 34 hips. 12 cups had complete radiolucency. The distribution of radiolucent lines between the 3 regions did not differ (p = 0.2).

Radiographic loosening of the cup was found in 49 of the 103 hips at the final examination. In 6, we also found localized osteolysis. Loosening occurred in 35 of 77 hips with osteoarthrosis, 8/15 with rheumatoid arthritis and 6/11 with osteonecrosis with no difference between osteoarthrosis and rheumatoid arthritis: RR = 1.4 (0.6–2.9), p = 0.5; osteoarthrosis vs. osteonecrosis: RR = 0.8 (0.3–2.0), p = 0.6.

Aseptic loosening was seen in 13 of 32 cups in group A, 20/38 in group B, 5/16 in group C and 11/17 in group D. A Cox regression analysis including gender, diagnosis and bone coverage of the cup (groups A–D) showed that the aseptic loosening rate was higher in groups B and D (RR = 2.0 (1.1–3.9), p = 0.03) in which the cup was not covered enough with original acetabular bone (Figure 3).

The regression analysis also showed an increasing loosening rate in cases with thin liners (RR = 1.9 (1.1–3.5), p = 0.03). 29 of 47 with a thickness of 7 mm or less loosened, while the corresponding loosening rate was 20 of 56 when liners at least 9 mm thick had been used. A corresponding analysis including only the 60 cases with a femoral head diameter of 22.22 mm gave the same results (RR = 2.2 (1.0–4.9), p = 0.04).

Loosening occurred in 23 of 60 hips with 22.22 mm heads and in 26 of 43 hips with 32 mm heads. The loosening rate of the cups with 32 mm heads was higher than that with 22 mm heads in the group with linear thicknesses of 9 mm or more (n 56) (RR = 2.5 (1.0–6.2), p = 0.04). In the group with linear thicknesses of 7 mm or less, the head diameter had no effect on the loosening rate (n 47) (RR = 1.0 (0.5–2.2), p = 0.9).

Overall, 4 (4%) femoral stems were classified as loose because of at least 5 mm subsidence. In these cases, no simultaneous instability of the threaded cup was detected. None of the stems had a complete radiolucent line.

Kaplan-Meier survivorship

The survival analysis was done on 142 hips which included the 103 hips with a follow-up period of 10 years or more and the 39 hips which had not been followed more than 10 years. As a result, survivorship, when revision was set as the end point was 91

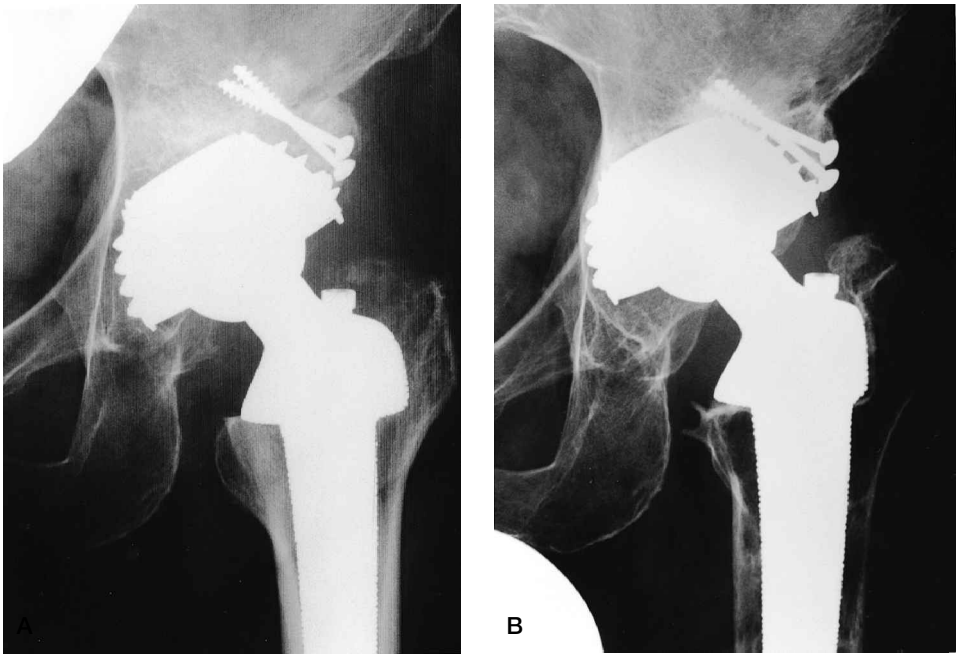


Figure 3. A 60-year-old female. A. Immediately after surgery. The cup was covered with bone graft. B. 8 years after surgery. Marked increases occurred in the height from the inter-teardrop line and the inclination angle.

(95%CI = 86–96)% at 10 years and 79 (67–90)% at 15 years (Figure 4). When the end point was set at the time when aseptic loosening was radiographically confirmed, survivorship was 63 (54–72)% at 10 years and 45 (34–56)% at 15 years (Figure 4). The survival of the stem based on aseptic loosening as the end point was 97 (94–100)% at 10 years and 96 (92–100)% at 15 years (Figure 4).

Complications

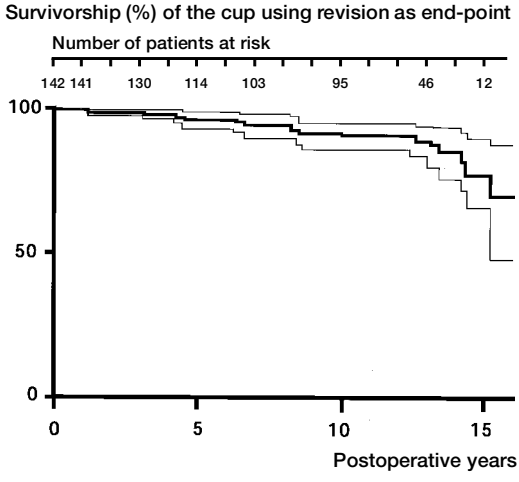
There was a superficial infection in 1 hip and dislocation in 4 hips. Ectopic ossification was noted in 4 hips (2 grade 2 and 2 grade 3, according to the classification of Brooker et al. 1973).

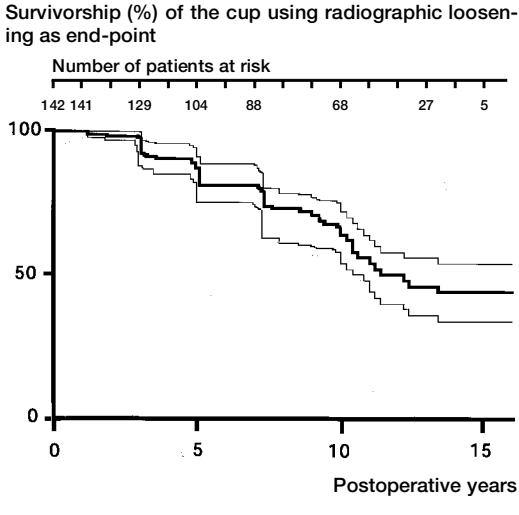
Discussion

The uncemented threaded cup has gained popularity as a primary and revision implant during the last 2 decades. In a recent study, Pandit et al. (1999) showed that the self-tapping smooth-threaded acetabular cup functioned well in 41 hips 6 years after surgery, and none of these patients had needed revision for aseptic loosening. A similar result was reported by Effenberger et al. (1997) on the Hofer-Imhof smooth-threaded cup in 143 hips 5 years after surgery. However, at the same time, several authors reported discouraging results at the mid-term follow-up (Fox et al. 1994, Yahiro et al. 1995, Malchau et al. 1996, Lim and Hunt 1997).

Manley et al. (1998) stated that physical interlocking between the cup and the acetabular bone may be a prerequisite for long-term stability. Finite element analysis showed that the threads of the Lord cup have a minimal contact area against the acetabular bone and therefore unfavorable load transfer (Huiskes 1987, Schimmel and Huiskes 1988). These mechanical disadvantages may cause loosening, as evidenced by the high frequency of radiolucent lines in our patients.

Later designs of porous-coated press-fit cups have shown 10–11 year survival rates of 97–99% (Dorr et al. 1997, Tompkins et al. 1997, Bohm and Bosche 1998), which is far better than our results. In a meta-analysis, Yahiro et al. (1995) compared the results of 1,269 smooth-surfaced threaded cups with 1,979 porous-coated press-fit and 10,230 cemented cups. The smooth-surfaced threaded cup was statistically significantly higher rates of revision, migration, radiolucencies and clinical failures.





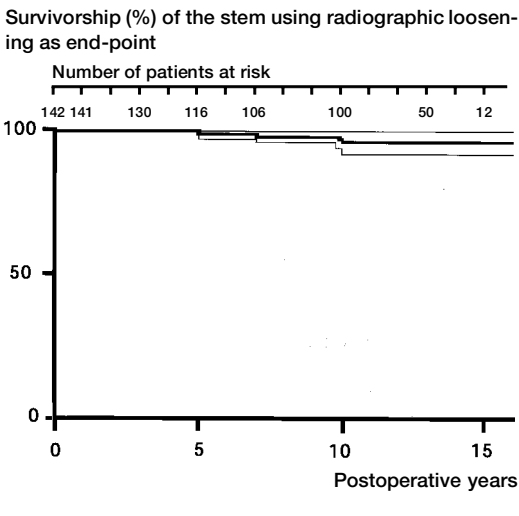


Figure 4. Kaplan-Meier survivorship analysis. Bold line: survivorship curve. Thin lines: 95% confidence limits.

Our loosening rate was affected by poor bony coverage. As in previous studies, liner thickness (Bartel et al. 1986, Calton et al. 1998) and femoral head diameter (Bartel et al. 1986, Hirakawa et al. 1997) also proved to be important. Thicker UHMWPE and small femoral head were considered to favor longer survivorship of the smooth-surfaced threaded cup (Hirakawa et al. 1997, Maloney et al. 1999).

As regards the stem component, good clinical outcome for long-term use is reported for the fully-coated porous stem. A 97% 12-year-survival has been reported for the anatomic medullary locking type stem and 85% 10-year-survival for the Lord stem (Malchau et al. 1996, Engh et al. 1997). In our study, the survival rate seemd to be better than that in the only previously published intermediate long-term study on this design.

Our findings suggest that patients with a smooth-surfaced threaded acetabular component must be carefully watched for signs of radiolucency and migration. Because of the high rate of failure, this type of cup can not be recommended for use in total hip arthroplasty.

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