Total hip replacement in younger patients

Survival rate after avascular necrosis of the femoral head

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Background **A high risk of loosening has been reported in replacements performed because of avascular necrosis.**

Patients and methods **To study cementless total hip replacement (THR) in younger patients with avascular necrosis (AVN), we analyzed retrospectively the outcome in 129 cases: 46 Mittelmeier monobloc ceramic hips (22 cases with AVN), and 83 Zweymüller total hip systems (35 cases with AVN) clinically and radiographically.**

Results **At follow-up, 17 Mittelmeier prostheses (10 AVN) and 4 Zweymüller prostheses (none with AVN) had been revised. The diagnosis did not affect the implant survival, but the Zweymüller THR fared better than the Mittelmeier system. The main reason for revision of Mittelmeier implants was aseptic loosening, 3 of 4 Zweymüller revisions were necessary due to polyethylene wear. This difference was confirmed by the radiographic evaluation of the still intact implants: Zweymüller THR showed better values for signs of osseointegration, radiolucent lines around the implants and migration, but more acetabular wear. None of these differences was affected by the AVN diagnosis.**

Interpretation **We could not confirm that AVN is a risk factor in total hip replacement.**

Avascular necrosis (AVN) of the femoral head mainly affect patients in the third to fifth decades of life. In advanced stages of the diseased joint, methods of preservation are not feasible. However, the risk of aseptic loosening of THR has been reported to be substantially higher in patients with AVN (Chandler et al. 1981, Saito et al. 1989, D'Antonio et al. 1997). Unfortunately, most of these studies compared various prosthetic designs and fixation techniques, different age groups, and small or heterogeneous samples.

Our retrospective study included only two designs of cementless total hip prostheses in patients less than 50 years of age. The aim was to determine the effect of the diagnosis on the survival rate, the radiographic signs of osseointegration or loosening, implant migration, heterotopic ossification and acetabular wear.

Patients and methods

We reviewed the records of all 4,920 patients who had received THR in our hospital between 1973 and 1991 to find all cementless total hip arthroplasties in patients less than 50 years of age at surgery. The two largest groups consisted of 46 patients (21 females) having cementless Mittelmeier monobloc ceramic hips (1978–1987) and 83 (35 females) with a cementless Zweymüller implant (1986 –1991).

The Mittelmeier group included 22 cases (3 females) with a diagnosis of AVN of the femoral head and 24 other diagnoses (18 females). The Mittelmeier total hip system has a monobloc screwed ceramic socket (Autophor, Osteo AG, Switzerland) and a Mark II metallic CoCr alloy femoral stem (Endocast, Krupp, Germany).

The Zweymüller group comprised 35 cases (5 women) with AVN and 48 (30 women) with other diagnoses. The Zweymüller system consisted of a

grit-blasted, threaded, self-cutting cup with polyethylene insert and a collarless grit-blasted, titanium alloy femoral component with a 32 mm alumina-ceramic head (AlloPro AG, Switzerland).

In addition to AVN, 26 were cases of primary osteoarthrosis (OA) and 46 secondary OA.

The mean follow-up of unrevised Mittelmeier implants was 14 years, and of unrevised Zweymüller implants 10 years. The mean follow-up of all Mittelmeier implants, including the revised hips (until their date of revision) was 9 years, and of Zweymüller implants 8 years.

Pre- and postoperative assessments included the Harris (1969) Hip Score and antero posterior and frogleg radiographs. In all revised patients, the date and indication for revision were recorded, and in patients who had died the date of death was noted as also was a check, that the implant was still in place at the time of death. To compensate for differences in follow-up periods and that patients had died, we did a Kaplan-Meier survivorship analysis of incomplete data with revision for any reason as endpoint. Log-rank tests were used to compare the Kaplan-Meier survival probability as regards the diagnosis and the type of implant. The preoperative radiographs were used to assess the stage of AVN (Ficat 1985), the postoperative radiographs were evaluated for loosening, migration of acetabular and femoral components and osseointegration of the implant (Engh et al. 1990), heterotopic ossification (Brooker et al. 1973), and acetabular wear (Kim and Kim 1993). In the comparisons of heterotopic ossification, radiolucent lines (DeLee and Charnley 1976, Gruen et al. 1979), migration of the implants and osseointegration in the two diagnostic groups in each prosthesis, we used the chi-square and Fisher's exact test. Comparison of decentralization due to acetabular wear was assessed with Wilcoxon's test.

Results

Preoperative data

The Mittelmeier group had a mean hip score of 51 (14–68) points and the Zweymüller group 48 (14–70). The scores were similar in the AVN Mittelmeier and Zweymüller subgroups, 55 (14–68) and 48 (14-70), and in patients with other diagnoses—i.e., 48 (26–68) and 48 (23–69) points. All AVN hips had Ficat stages III or IV.

Early complications

1 deep and 1 superficial bacterial infection required antibiotic treatment, but no revision. 1 deep infection, 8 days after surgery, was revised with debridement but the prosthesis was not removed. 1 immediate postoperative luxation needed a change in the modular femoral head to increase the length of the neck. These 2 revisions were not defined as the endpoint for the Kaplan-Meier calculations.

Revision

At follow-up, 19 hips had had a revision arthroplasty and 2 prostheses had been removed: 17 Mittelmeier (10 AVN) and 4 Zweymüller prostheses (no AVN). The survival rates after AVN and other diagnoses were similar (Figure 1). Zweymüller arthroplasties had a higher survival rate than Mittelmeier arthroplasties ($p < 0.001$). The survival probability of Zweymüller implants, according to Kaplan and Meier, was 0.93 (95% CI 0.86–1.0) after 10 years, and of Mittelmeier implants 0.68 (CI 0.53–0.84). Zweymüller arthroplasties needed revision for 1 aseptic loosening and 3 cases of polyethylene wear. Mittelmeier implants were revised for aseptic loosening in 15 cases, for 1 late deep infection and 1 breakage of the acetabular component.

Clinical outcome

The Harris Hip Scores were 90 (45–100) points for unrevised Mittelmeier THR at follow-up, 87 (45–100) for the AVN subgroup and 92 (75–100) for other diagnoses. The scores were 96 (65-100) for unrevised Zweymüller THR, 96 (67–100) for the AVN subgroup and 95 (65–100) for other diagnoses.

Radiographic outcome

At follow-up, the Mittelmeier stems showed a high incidence of radiolucencies at the bone-prosthesis interface in zones 1–7 (Gruen et al. 1979) (Figure 2). The Zweymüller stems developed radiolucencies mainly in the proximal third (Gruen zones 1 and 7). The diagnosis had no effect on the development of radiolucencies.

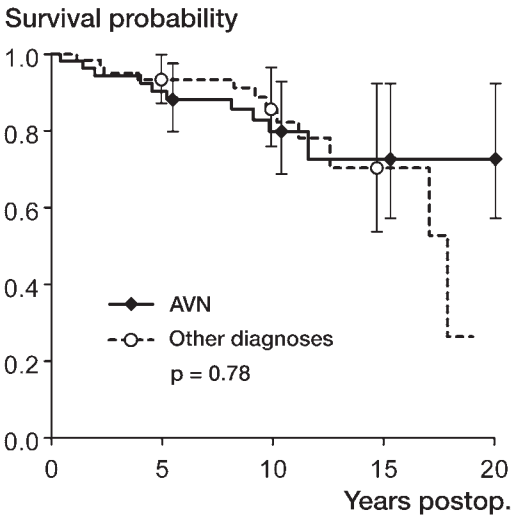

Figure 1. Kaplan-Meier survivorship curves comparing total hip arthroplasties after AVN and other diagnoses. Error bars show 95% CI 5, 10, 15 and 20 years following surgery.

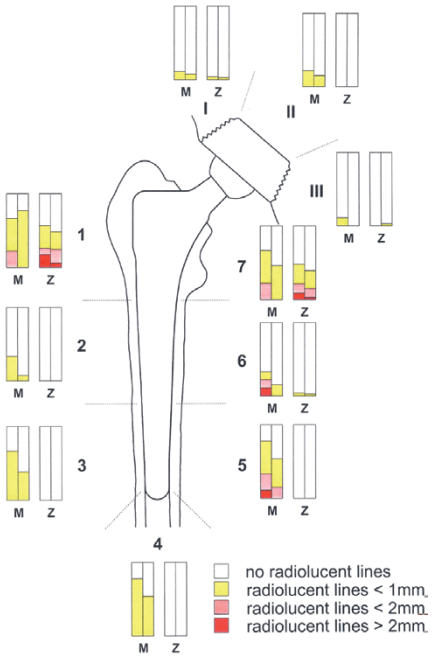

Figure 2. Radiolucent lines at the bone-prosthesis interface, using the classifications of Gruen et al. (1–7) and DeLee and Charnley (I–III). Left double-bars are Mittelmeier results, right double-bars Zweymüller results. The left hemi-bars show the results in patients after AVN, and the right hemi-bars those in patients with other diagnoses.

Radiographic signs of osseointegration were seen in only 8/22 of Mittelmeier stems and 4/22 of Mittelmeier cups. However, 98% of both stems and acetabular cups of Zweymüller implants had radiographic signs of osseointegration. The diagnosis had no effect on the development of radiographic osteointegration.

Radiographic migration occurred in 2/57 of Zweymüller acetabular cups, without migration at all of femoral stems. Mittelmeier cups showed migration in 9/22 cases, and femoral stems in 18/22. No statistically significant differences could be ascribed to a particular diagnosis with both types of implants ($p = 0.2$ for Zweymüller cups, $p = 1.0$ for Zweymüller stems, $p = 0.7$ for Mittelmeier cups), except for migration of Mittelmeier stems in patients after AVN in whom the rate of migration was 95%, as compared to 60% after other diagnoses ($p = 0.001$).

As regards heterotopic ossification we found no statistically significant differences in patients after AVN and other diagnoses, or in patients with Mittelmeier or Zweymüller prostheses.

The acetabular wear of the unrevised total hip replacements was a mean of 0.39 (0.0–2.1) mm after a mean of 14 years with the ceramic/ceramic Mittelmeier system, as compared to a mean of 0.83 (0.0–3.8) mm after 10 years with the ceramic/polyethylene Zweymüller system. The wear rates of the AVN-subgroup and the group of other diagnoses with each type of implant were not statistically significant ($p = 0.07$ for Mittelmeier and $p = 0.2$ for Zweymüller).

Discussion

The results of our study confirmed our view that AVN is not a risk in total hip replacement, and unlike other studies showing that the risk of loosening after total hip arthroplasty is higher in patients with AVN than in those with other diagnoses (Chandler et al. 1981, D'Antonio et al. 1997, Saito et al. 1989). Unfortunately, they only compared their findings in osteonecrotic hips to those in the literature. Other authors have had similar results in total hip arthroplasty with AVN of the femoral head, and other diagnoses (Ritter and Meding 1986, Dorr et al. 1990, Cheng et al. 1995, Lombardi et al. 1995, Chiu et al. 1997, Xenakis et al. 1997).

In the present study, as expected, the overall survival rate after Mittelmeier total hip arthroplasty was significantly lower than the excellent long-term survival rate after Zweymüller total hip replacement. With an increase in the follow-up period, the risk of revision declined after Mittelmeier implants and the risk of revision increased after the Zweymüller system, due to polyethylene wear.

The radiographic analysis showed no significant differences as regards radiolucent lines at the bone-prosthesis interface, osseointegration and heterotopic ossification in patients with AVN and those with other diagnoses. The only statistically significant difference that was related to the diagnosis concerned migration of Mittelmeier femoral stems—i.e., after AVN, the risk of migration of the stem seemed to be significantly higher with this implant. This may explain the discrepancies in the literature as regards aseptic loosening after AVN of the femoral head: implants with excellent osseointegration are at no higher risk of loosening, even in cases of critical bone stock in patients with AVN. Implants with poor osseointegration run a higher risk of aseptic loosening in osteonecrotic hips.

We could not confirm a previously discussed higher acetabular wear in patients with the diagnosis of AVN of the femoral head (Hirakawa et al. 1996). The difference in wear apparently is linked only to other factors, such as duration of implantation or the type of implant.

Although this is a retrospective study of two sequentially-operated groups, our data showed no higher risk of loosening after total hip replacement in patients with AVN of the femoral head, but emphasize the influence of the implant's design. Our patients with AVN given the Zweymüller hip had the same excellent follow-up results as in other studies (Havelin et al. 1995, Delaunay and Kapandji 1998).

No competing interests declared.

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