Failure of the Christiansen hip

Survival analysis of 265 cases

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Totally, 265 primary Christiansen total hip arthroplasties were followed clinically and radiographically for a median of 6 years. The operations were performed for arthrosis in 220 cases, failed fracture in 23, and rheumatoid arthritis in 13. The influence of 11 presumed determinants on the radiographic outcome was studied. In all, 96 hips were exchanged because of aseptic loosening, 35 stems were loose, and 210 sockets were definitely or probably loose at the last radiographic examination. The survivorship analyses revealed the probability of having a radiographically intact stem after 10 years as 67 percent and for the socket 0 percent. None of the 11 determinants influenced the radiographic outcome.

The long-term results of the Christiansen total hip replacement with a trunnion bearing and a socket made of polyoxymethylene (Delrin, DuPont) (Sundahl et al. 1974) have previously been reported to be poor (Josefsson et al. 1980, Ohlin et al. 1982, Sudman et al. 1983, Alho et al. 1984 Ahnfelt 1986). Various reasons for this high failure rate have been proposed, such as a poor geometric design (Alho et al. 1984), a high friction torque in the ball and socket articulation (Mathiesen et al. 1986), and a high socket wear rate with secondary tissue reactions (Ohlin and Kindblom 1988, Ohlin and Persson 1989).

In this report I have tried to identify presumptive determinants on the specific complications of the Christiansen hip.

Patients and methods

From December 1974 to February 1981, 332 primary Christiansen THRs were implanted in 274 patients at the Department of Orthopedics, Jönköping Hospital. Seven hips were excluded from this study because of deep infection, and 60 hips in 48 patients were excluded because the radiographs were missing. In the latter group several were known to have been revised because of aseptic loosening; there was no selection of the 265 hips and 219 patients remaining for the study. There were 115 men and 104 women with a median age of 67 (35–85) years. Their median body weight was 74 (48–130) kilograms. The diagnoses were arthrosis in 220, rheumatoid arthritis in 13, a failed femoral neck fracture in 23, and other diagnoses in 9 cases. No previous surgery had been performed on 227 hips; whereas nailing of a hip fracture had been performed in 23 cases; intertrochanteric osteotomy in 10 cases; and other operations in 5 cases.

Until 1978, the operations were performed in a standard operating theater, thereafter in a clean-air enclosure with vertical air flow. The prostheses were introduced using a posterolateral approach. The bone cement, either with or without gentamicin, was packed manually into the acetabulum and femur. Two thirds of the operations were performed by senior orthopedic surgeons and one third by residents. The patients were mobilized on the first or second postoperative day allowing full-weight bearing.

All the patients were examined clinically and radiographically after 6 and 12 months. Standardized anteroposterior films with the beam centered on the proximal part of the stem were obtained in every case. There was a magnification of 1.25 times, and all the values were corrected for this effect.

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Table I. Scores for pain and walking ability, respectively, (max. score 6) according to Charnley (1979) assessed at the follow-up investigation

Radiographic assessment	n	Pain			Walking Ability		
		Score	Range		Score	Range	
Intact socket and stem	65	5.34	3–6	-	4.92	2–6	-
Isolated socket loosening	67	4.37	2–6	***	4.21	2–6	**
Isolated stem loosening	5	3.20	3–4	***	2.80	2–4	**
Combined socket and stem loosening	14	4.29	2–6	**	4.07	2–6	*
	151						

*** $P < 0.001$; ** $P < 0.01$; * $P < 0.05$ compared with hips with radiographically intact socket and stem. (Mann-Whitney rank sum test).

Totally, 193 nonrevised hips in 151 patients were reexamined between January 1983 and July 1985. For 151 hips in 129 patients pain and walking ability were assessed according to Charnley (1979). The remaining cases (42 hips) were not scored because they were reexamined by surgeons not involved in the study. The entire series of radiographs for each hip was scrutinized by the author.

Figure 1. Eight years postoperatively. Osteolysis in the inferior part of the acetabulum.

From records and radiographs, data were obtained regarding the stem size, femoral neck length, and cup size. The position of the stem in terms of varus or valgus was determined. From the immediate postoperative films, it was determined whether the socket was fully contained. Socket demarcation or migration were recorded according to Carlsson and Gentz (1984). However, for definite socket loosening (Carlsson and Gentz Grade III), migration exceeding 2 mm or other such obvious change of position were required. Any osteolytic changes in the inferior part of the acetabulum of the type previously described (Ohlin and Persson 1989) were recorded (Figure 1). Socket wear was calculated from the radiographs according to Charnley and Halley (1975), but only values of 1 mm or more were considered. Radiographic stem loosening was defined as subsidence of 2 mm or more with or within the cement, or as varus tilt, substantiated by a zone between the stem and bone cement exceeding 1 mm (Charnley 1979, Tapadiya et al. 1984). Bone resorption of the resected neck and proximal femur was measured.

National population records were used to confirm whether patients were still alive on December 31, 1985. For deceased patients the date of death was noted. The clinical hip survival, i.e., the probability of not having the hip exchanged, was determined by the date of revision, death, or termination of the study. From these data, a clinical survivorship curve was constructed.

The date when loosening of either component was first observed was the termination point of the radiographic survivorship analysis. At this time the actual component was censored. The radiographically intact components were censored on the date of the last radiographic examination. Separate survival curves were constructed for each component showing the probability of not having the actual compo-

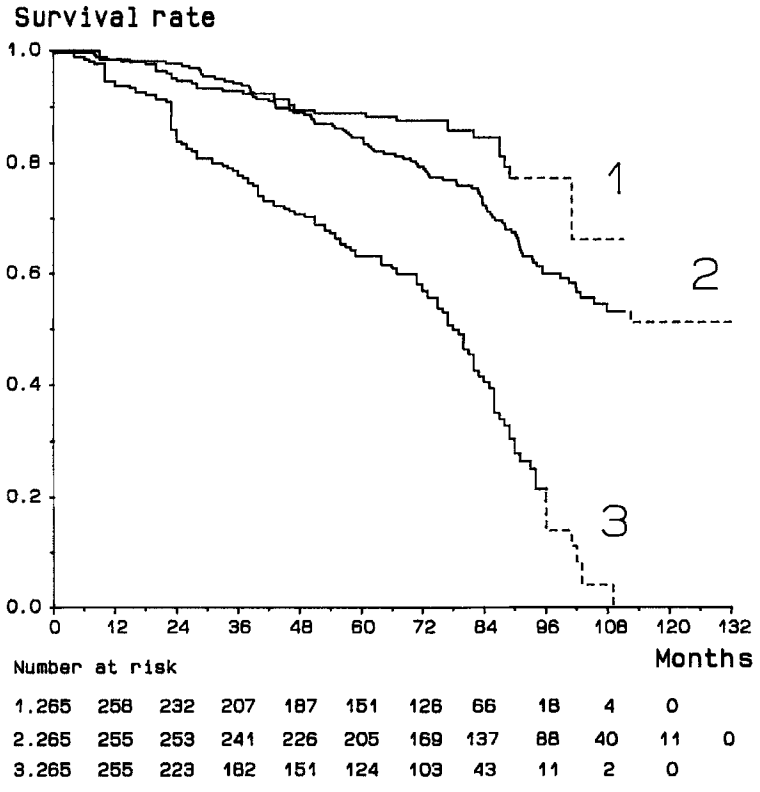

Figure 2. Kaplan-Meier curves.

1. Radiographic survival of the stem. SE < 0.05 until 90 months.
2. Clinical survival. SE < 0.05 until 110 months.
3. Radiographic survival of the socket. SE < 0.05 at 95 months.

nent radiographically loose at different postoperative periods.

A covariate analysis was performed to elucidate any influence of probable determinants on the radiographic outcome. The following data were analyzed: age, sex, body weight, index diagnosis, function, socket size, neck length of the femoral component, and socket wear. To reveal any influence of component positioning on the result, the socket containment and stem position were included in the analysis. Also, the role of surgical experience was considered, the surgeons being classified as seniors or residents.

Statistical methods

Kaplan-Meier analysis (BMDP Software Inc. 1964), Cox stepwise covariate analysis (BMDP Software Inc. 1964), correlation analysis, Mann-Whitney rank sum test.

Results

One third of the hips were revised owing to aseptic loosening. In 13 cases, only the socket was exchanged; and in 83 cases both components were exchanged. Further, one hip was revised because of subluxations. However, radiographic stem loosening had been observed in only 13 of the 97 revised cases. From the records, it was not possible to decide whether or not the components had been stable at the time of the exchange operation.

In 151 cases assessed a median of 7 (3–9) years postoperatively, radiographic loosening of the components was correlated with pain and decreased walking ability (Table 1). Definitive socket loosening (Grade III) was found in 139 cases; in 128 of them, the socket had migrated on an average 7 (2–30) mm upwards. Severe socket demarcation, but unchanged cup position, considered as probable loosening (Grade II) was observed in 71 cases; and in only 55 cases the socket had an unchanged position in conjunction with radiolucency less than 2 mm in all three quadrants (Grade I).

Socket wear, determined as ball penetration into the socket, was measurable in 181 hips. Wear corre-

lated positively with socket migration ($P < 0.01$). In 66 of the 265 hips, obvious cystic bone resorption was observed in the ischium just inferior to the acetabulum (Figure 1).

Thirteen percent of the cases had radiographic stem loosening. Resorption of the medial aspect of the femur beneath the collar averaged 7 (0–30) mm. There was a difference ($P < 0.001$, Mann-Whitney rank-sum test) as regards the degree of neck resorption among patients with and without cystic formation distally in the acetabulum.

In the covariate analysis none of the presumed determinants influenced the survival of the Christiansen hips (Figure 2).

Discussion

In this series the failure rate was even higher than reported previously with the Christiansen hip (Ahnfelt 1986, Alho et al. 1984, Sudmann et al. 1983), probably due to a longer follow-up period. The radiographic observation that 79 percent of the sockets were definitely or probably loose is in sharp contrast to the results in metal-to-polyethylene hips, where the socket loosening rate, admittedly with varying definitions, ranges from 4 to 25 percent 10 years postoperatively (Salvati et al. 1981, Stauffer 1982, Sutherland et al. 1982, Carlsson et al. 1988). Radiographic stem loosening was observed much less frequently (13 percent), a number comparable to or less than observed for metal-to-polyethylene hips implanted using contemporary techniques (Salvati et al. 1981, Stauffer 1982, Sutherland et al. 1982, Sudmann et al. 1983.) According to the radiographic survivorship analysis, no sockets were likely to be intact after 10 years, in contrast to 67 percent of the stems. Also, isolated socket loosening resulted in hip pain and reduced walking ability. This, again, is in contrast to reports on other designs in which isolated socket loosening was found to cause only slight symptoms (Charnley 1979, Johnston and Crowninshield 1983, Carlsson et al. 1988). The difference may be explained by the extensive osteolysis permitting the loose socket some play in the enlarged acetabular cavity. The strong correlation between bone resorption in the ischium inferior to the acetabulum and in the proximal part of femur has not been described previously. However, a correlation between socket loosening and calcar bone resorption was reported by Johnston and Crowninshield (1983).

The probable determinant factors age, sex, body weight, index diagnosis, functional class, size of prosthetic components, socket containment or wear, stem positioning, or experience of the surgeon could not be demonstrated to influence the outcome, because the inherent loosening factor of the Christiansen hip probably overrides these factors.

Our increased awareness of the frequent and aggressive bone resorption following the implantation of the Christiansen THR resulted in more liberal indications for revision as time went by. This explains the extremely high revision rate and the steep slope of the clinical survival curve (Figure 2).

In most cases, both components were exchanged, although the stem was more rarely radiographically loose. The aim was to avoid further progression of bone resorption by removing debris and by cleaning the joint. The socket loosening in a high proportion of the cases, severe socket wear rate, and periprosthetic bone resorption indicate that release of wear products was the cause of this large scale failure. Other factors that have been considered disadvantageous in the Christiansen hip are stem design, with an increased offset distance considered unfavorable (Alho et al. 1984) and high friction torque generated in the articulation (Mathiesen et al. 1986). The main problem is obviously not with the femoral component; the stem design is therefore not a probable cause of the numerous failures. Also, the offset, here expressed as different neck lengths, did not influence the result. Even if the friction torque in the Christiansen prosthesis was higher than in other designs, it is not of the magnitude required to loosen a socket (Andersson et al. 1972, Volz et al. 1977).

The Judet and Christiansen hips are now history; before the introduction of new biomaterials or designs careful studies must be performed to avoid large-scale failures—in Sweden, alone, over 5,000 Christiansen hips were implanted (Ahnfelt 1986).

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