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Socket loosening after hip arthroplasty

Radiographic observations in 241 cases up to 15 years

Serial radiographs of 241 consecutive, noninfected low friction arthroplasties performed between 1968 and 1972 were evaluated with respect to socket migration and the presence of radiolucencies, progressive or not. The number of intact sockets in 207 cases of arthrosis decreased slowly and, depending on their classification, approached 95–88 per cent about 10 years postoperatively. Contrary to previous reports, we could not observe any increase in the rate of loosening with time; half of the hips were observed for more than 10 years, and only a few cases of socket loosening were found beyond this point. In rheumatoid arthritis the number of intact sockets was significantly fewer – 23 of 34 – after about 10 years of service.

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The literature concerning cemented total hip replacements has mainly been focused on the femoral component. The factors responsible for failure have been fairly well identified, and this documentation has resulted in improved material, design, and, above all, operative techniques. By comparison, analyses of the acetabular component are sparse and difficult to evaluate. We have studied the long-term stability of Charnley total hip sockets from serial radiographs of hips operated on for arthrosis or rheumatoid disease.

Patients and methods

Between 1968 and 1972, 351 total hip replacements were performed in 310 patients in our hospital. The hips were operated on according to Charnley's (1979) original technique and approach by 18 surgeons with varying degrees of experience. Radiopaque acrylic cement was used for the fixation of the prosthetic components and was inserted into the acetabulum and the femoral canal by a digital technique.

One hundred and ten cases were excluded, six because the patients died within 1 year postoperatively, three because of insufficient radiographic information, 59 because of deep infections, 41 because of diagnoses other than arthrosis (OA) or rheumatoid disease (RA), and one because of early socket-cement separation. Thus, 207 cases operated on for OA and 34 for RA remained for this study. The age at the time of surgery averaged 67 ±7 years in the OA-patients and 61 ±8 in the RA patients.

Radiographs of all hips were made immediately and 1 or 2 weeks after the operation and thereafter at irregular intervals. However, in most cases a radiograph made 1 year post-operatively was available. These examinations had been performed with the beam centralized on the joint with the patient in the supine position. Both an anteroposterior and an oblique view – so-called frog view – were used.

In addition, at reexaminations in 1974, 1976 and 1977, and in 1982 through 1984, an AP view of the pelvis centered on the symphysis was almost always included. This allowed a more accurate evaluation of the socket. The time interval between the operation and the last radiographic examination was 104 ± 46 months in the OA group and 92 ± 52 months in the RA group.

The whole series of radiographs for each hip was scrutinized by at least one of the investigating orthopedic surgeons together with the radiologist. The acetabular area was divided into three zones according to DeLee & Charnley (1976). Any demarcation around the cemented socket or migration was recorded according to both Charnley's (1979) classification and Carlsson & Gentz (1984) (Figure 1, Table 1). To be included in Charnley's Grade I (perfect acceptance), we required absence of any demarcation of the cement-bone interface in the AP views centered on the hip and symphysis and in the oblique views.

From the national population records, it was possible to confirm whether or not the patients were alive in July 1984; for deceased patients, the date of

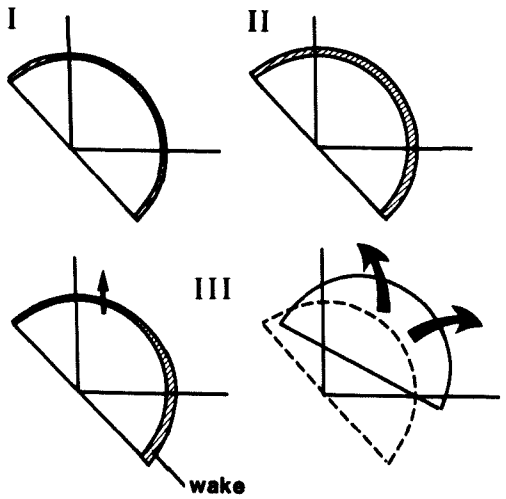

Figure 1. Schematic representation of radiographic bone-cement lucencies and migration of acetabular components according to Carlsson & Gentz (1984).
Grade I. Unchanged position of the socket; radiolucency of less than 2 mm in all 3 quadrants; no progress beyond 12 months after operation. Grade I also includes cases without any lucency, i.e., perfect acceptance.
Grade II. Unchanged position of the socket; radiolucency ≥ 2 mm in the 2 upper quadrants; radiolucency in the lower quadrant equal or less; progress beyond 12 months after operation.
Grade III. Change of position in any direction, including indirect signs of migration, e.g., the "wake phenomenon" – radiolucency more pronounced in the lower quadrant that in the 2 upper quadrants.

death was available. This information was necessary for the construction of the corrected loosening curves (Figures 2 and 3). The midpoint of each line was assumed to be the time when loosening occurred. To obtain the percentage of intact hips within each year, the accumulated number of loosened hips was divided by the number of survivors in the previous years minus deaths within the actual year and the figure multiplied by 100.

Results

In the 207 OA hips, 10 sockets had migrated and in 10 sockets a progressive bone-cement lucency was observed, implying uncorrected loosening rates of 5 and 10 per cent, respectively. In the 34 RA hips, nine sockets had migrated, and another two cases had progressive widening >2 mm, implying uncorrected loosening rates of 26 and 34 per cent, respectively. The difference between arthrosis and RA cases was significant ($p < 0.001$, X^2).

When the data were corrected for withdrawals because of deaths and revisions (Figures 2 and 3), the loosening rate for migration in OA was estimated to be 5 per cent after about 10 years. If progressive radiolucency (Grade II) was included, the figure rose to about 12 per cent. The corrected loosening rate in rheumatoid disease was estimated to be about 40 per cent.

About half of the hips were observed for more than 10 years Table 1. Migration might have started after that period in two cases of RA, but this was not observed in OA. Progression of the lucencies from Grade I to II after 10 years occurred in one case of arthrosis, but might have done so in further two cases (Figures 2 and 3).

Absence of any radiolucency in both the AP and the oblique views, i.e., perfect acceptance according to Charnley (1979), was observed in 16/207 (8 per cent) of the OA hips and in 1/34 of the RA hips. The difference was not significant. The time of observation in the OA cases with perfect acceptance was 128 ± 42 months,

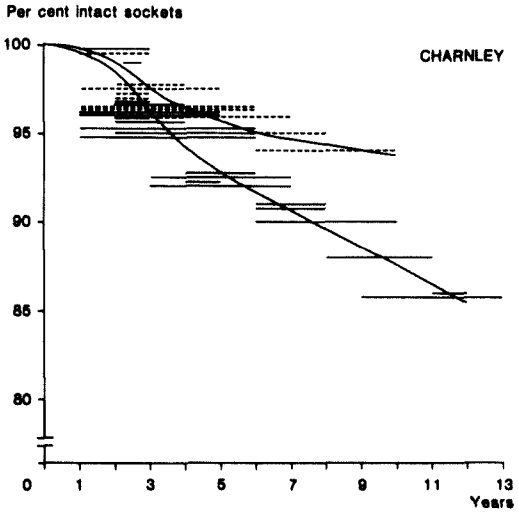

Figure 2. Best fit curves showing the rate of intact sockets in osteoarthrosis observed for each year of the follow-up period. The right end of each horisontal line (one case) represents the time when migration or progression from Grade I to Grade II according to Carlsson & Gentz (1984) was definitely established. The left end shows the earliest possible time when this radiographic loosening could have occurred. The upper curve is based on 10 cases (dotted lines) of migration. The lower curve is based on the same 10 cases plus 10 Grade II cases (solid lines). The true curve is supposed to lie in the area outlined by these two curves.

Table 1. The number and time of observation in cases operated on because of arthrosis (OA) and rheumatoid arthritis (RA)

Time of observation (years)	Number of cases OA	RA	Total
0–1	5	0	5
1–2	10	3	13
2–3	9	4	13
3–4	8	3	11
4–5	11	2	13
5–6	9	3	12
6–7	18	1	19
7–8	9	–	9
8–9	12	–	12
9–10	11	2	13
10–11	25	2	27
11–12	35	6	41
12–13	24	6	30
13–14	19	2	21
14–15	1	–	1
15–16	1	–	1
Total	207	34	241

and averaged 2 years longer than in the rest of the cases classified as Grade I according to Carlsson & Gentz (1984).

No correlation between socket loosening and the age of the patients was observed. Neither in arthrosis nor in RA could any correlation be demonstrated between mechanical stem loosening (Carlsson & Gentz 1980) and socket migration/progressive lucencies.

It was possible to evaluate pain in 23 of the 31 cases with migrated or Grade II sockets. Sixteen of these 23 hips were painless, whereas mild or moderate pain was reported by seven patients, one of which also had a loose stem prosthesis. None of the 31 hips have, to date, been revised because of socket problems.

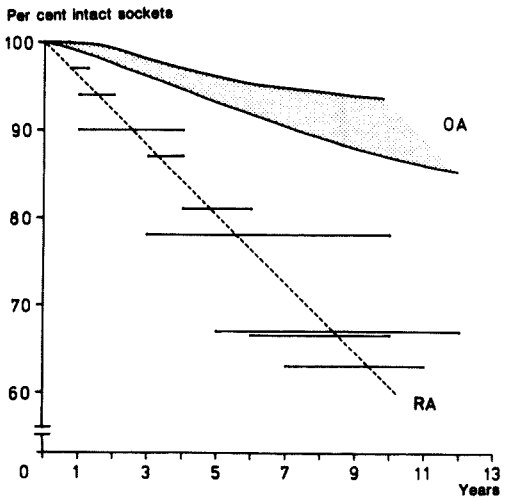

Figure 3. The upper two curves and enclosed area represent the cases with arthrosis and are the same as in Figure 2. The horizontal lines and the corresponding best fit curve represent socket migration in rheumatoid arthritis. The two RA cases with lucency Grade II are not included in this figure.

Discussion

In a 10-year follow-up of 231 Charnley hips, Stauffer (1982) defined socket loosening as migration or a bone – cement lucency exceeding 1 mm around the whole circumference of the acetabulum. By these criteria he reported 6.5 per cent loosening of the socket 5 years postoperatively and 11 per cent 10 years postoperatively. Salvati et al. (1981), using similar criteria in a 10-year follow-up of 54 Charnley prostheses, found 11 per cent socket loosening.

Sutherland et al. (1982) reported 24 per cent socket migration after 10 years in 54 curved stem Müller prostheses with a head diameter of 35 mm compared with 22.2 mm in the Charnley prostheses; the use of radiolucent cement presumably made evaluation of the radiographs more difficult.

Charnley (1979) did not define exact criteria for socket loosening. His Grade III ("severe demarcation") "involves the whole circumference of the socket and the gap need not be wider than 1 mm". By including Grade III and migration, he reported 4.5 per cent socket loosening in 131 hips followed for 5–10 years and 24 per cent in 133 hips followed for 11–15 years. Using the same criteria, Charnley (1979) reported 21 per cent socket loosening in 80 cases of RA and 11 per cent in 184 cases of arthrosis 5–15 years postoperatively ($p < 0.05$). Stauffer (1982) reported 35 per cent socket loosening in RA and 7 per cent in OA ($p < 0.001$).

The higher incidence of loosened sockets in RA when compared with OA in our study confirms the findings by Charnley (1979) and Stauffer (1982). Both of these authors and also Sutherland et al. (1982) postulated an increased rate of socket loosening with time. This could not be confirmed by our study. On the

contrary, we found that most acetabular loosenings in arthrosis occurred relatively early and that there was a tendency for the curve to level off (Figures 2 and 3). In a previous study (Carlsson & Gentz 1984), 31 per cent of sockets Grade II were found to be loose at revision. Therefore, we presume that the true rate of socket loosening in OA follows a course corresponding to the middle or upper part of the area enclosed by the two OA-curves in Figures 2 and 3. However, in RA the proportion of loose sockets seems to increase linearily with time.

Absence of any radiolucency around the circumference of the socket – perfect acceptance – was observed by Charley (1979) in 42 per cent of 112 hips followed for 12–15 years; only AP views of the hip were evaluated. Stauffer (1982) found 28 per cent of 231 sockets without any lucency 5–11 years postoperatively, likewise without evaluating oblique views of the hip.

In our investigation absence of radiolucency both in the AP and the oblique view of the hip was required for perfect acceptance. We observed 16/207 such cases (7.7 per cent) 128 ± 42 months postoperatively in arthrosis patients. One case of perfect acceptance was observed in the 34 RA cases.

Obviously, rheumatoid arthritis implies a higher risk of socket loosening compared with arthrosis. Special attention should probably be paid to careful preparation of the acetabulum in patients with rheumatoid disease.

Acknowledgements

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