Survival of the Charnley hip in coxarthrosis

A 10–15-year follow-up of 629 cases

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We present a 10–15-year follow-up of 629 hips in 555 patients operated on with a Charnley arthroplasty for coxarthrosis. Survivorship analysis showed a 92 percent prosthesis survival after 13 years, with results better in women and in higher age groups.

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Survivorship analysis (Cox and Oakes 1984) for long-term evaluation of total hip replacement is based on the time from insertion to removal of all or part of the prosthesis, except removal of irritating steel wires.

We report a survivorship analysis of Charnley's low-friction arthroplasty for coxarthrosis.

Patients and methods

Between November 1973 and December 1978, a total of 701 primary Charnley arthroplasties were performed at our hospital, with 629 for coxarthrosis in 555 patients. The female:male ratio was 2.2:1, with 381 females and 174 males. The mean age at the operation was 66 (23–88) years.

We followed the standard Charnley/Wroblewski procedure (Charnley 1979). Since August 1974, all the operations have been performed in a greenhouse with glass walls incorporating a body-exhaust system. Prophylactic antibiotics were not administered. Twelve surgeons performed the arthroplasties, and the number of operations performed by each surgeon ranged from 18 to 221. The patients were examined 3 months after surgery and then once yearly for 5 to 10 years.

A questionnaire was sent to all the surviving patients in September 1988 (437 patients). The questionnaire was answered by all the patients, either by themselves or through close relatives or nursing personnel. For the 186 patients who died during the follow-up period, information from the last chart entry or from relatives about the condition before death was used. No patient was lost to follow-up.

The median follow-up period for the total patient material was 11 (0.1–15) years, whereas the median follow-up period was 12 (10–15) years for the survivors.

The survivorship tables were constructed as standard actuarial life tables (Cutler and Ederer 1958) with 1-year intervals (Table 1). There were two possible designations for each hip: removal of the prosthesis or death of the patient. Confidence intervals for the estimates of prosthesis survival were based on the Greenwood variance estimator. A two-sided log rank test was used to determine if differences in survivorship between subgroups were significant (Mantel 1966). Estimates of the relative rate of prosthesis failure between groups were based on a proportional hazards model, where the parameter estimate corresponding to a binary variable is the logarithm of the relative failure rate between the two levels of the variable (Cox 1972). The model assumes that the relative failure rate between subjects is constant during the follow-up period.

As regards age at the operation, six subgroups were also used and entered as binary categories of five dummy variables, using the oldest age group as a reference. The survivorship analyses were performed using the 1L and 2L programs of the BMDP statistical package (Dixon 1985). The relative failure rates were estimated with the proportional hazards model. All the groups were compared with hips replaced in patients that were more than aged 74 years.

Results

Survivorship

The estimated probability of prosthesis survival in all the 629 arthrotic hips 13 years after surgery was

Table 1. Actuarial survivorship of 629 arthroplasties in patients with coxarthrosis

Interval (years)	Hips at start of interval	Prosthesis failures	Patients died or reached end of follow-up	Cumulative proportion surviving at start of interval
0–1	629	2	12	1
1–2	615	4	3	1
2–3	608	4	11	0.99
3–4	593	4	9	0.98
4–5	580	5	11	0.98
5–6	564	4	15	0.97
6–7	545	4	17	0.96
7–8	524	5	18	0.95
8–9	501	1	20	0.95
9–10	480	3	37	0.94
10–11	440	3	140	0.94
11–12	297	0	109	0.93
12–13	188	2	77	0.93
13–14	109	3	71	0.92
14–15	35	0	34	0.88
15–16	1	0	1	0.88

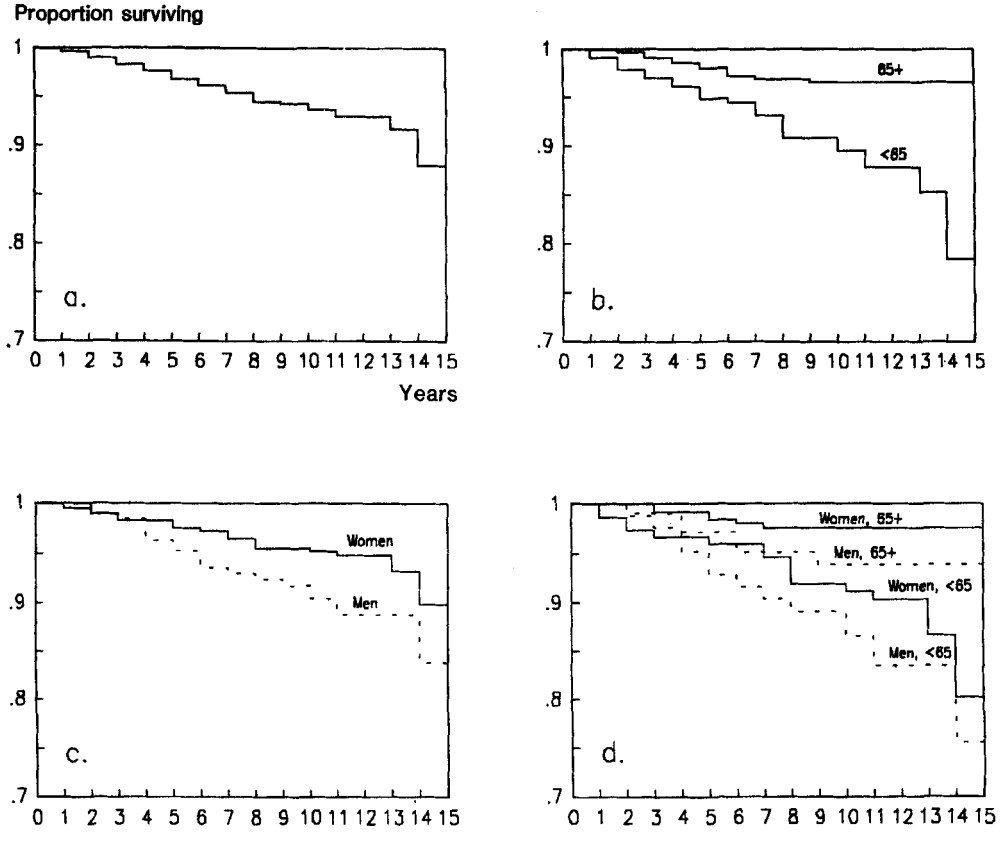

Figure 1. Life tables showing prosthesis survival in patients with coxarthrosis.
a. Overall survivorship.
b. Survivorship related to two age groups.
c. Survivorship related to sex.
d. Survivorship by age and sex.

92 percent (Table 1). For the last 2 years of follow-up, the survival dropped to 88 percent. This was due solely to patients' deaths, for there were no revisions during this period. However, the number of patients was small, and the accuracy was limited (95 percent confidence interval: 83–93).

Hip survivorship in patients more than 65 years of age was compared with survivorship in patients under 65 years of age. The estimated 13 years' survivorship was 97 percent after aged 65 years, and 85 percent among the younger (under aged 65 years) patients (log rank test $P < 0.0001$; Figure 1). The failure rate was estimated by the proportional hazards model as being 3.9 times higher in the younger patients. Further, a linear trend indicated that the rate of failure was increasingly higher in the younger patients ($P = 0.0002$; Figure 2). However, at both extremes of the age distribution, i.e., < 55 years and > 74 years, the relative failure rates were slightly lower and higher, respectively, than indicated by the linear trend. Adjustment for sex gave only negligible changes in our estimates of the age effect. The failure rate was found to be twice as high in the men as in the women. The survivorship of the 629 hips with arthrosis was compared with the other 72 hips that were operated on during the same period, mostly for a hip fracture. No difference was found (log rank test $P = 0.22$).

The effect of the surgeon's experience on prosthesis survivorship was studied. All the hips were grouped according to the total number of operations in the series performed by each surgeon, i.e., < 24, 25–49, 50–99 and > 100 operations. No difference was found ($P = 0.32$).

Revisions

During the observation period, 51 hips (7 percent) were revised. Of these, 11 hips were revised twice and three hips thrice. Among the primary revisions, aseptic loosening accounted for 4.4 percent. This included 5 patients with a loose femoral stem, 10 patients with a broken femoral stem, and 16 patients in whom both components were loose. There was an overall deep-infection rate of 1.9 percent. Before the introduction of the greenhouse, 4/38 hips were infected and 5/663 after its introduction (0.8 percent; $P = 0.002$, Fisher's exact test).

Eight of nine infections occurred within the first 7 years after surgery, and there were no infections after the 10th year. Nine of 10 stem fractures occurred 8 years or later after surgery. There were no stem fractures before the 6th year after surgery.

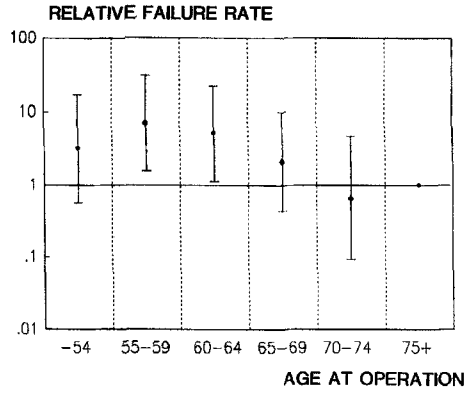

Figure 2. The relative failure rate of a hip prosthesis in patients with coxarthrosis in different age groups as estimated under the Cox model. Each estimate is bounded by a 95 percent confidence interval.

Patients' response

The subjective response of the total material of surviving patients according to the answers of the questionnaires was that 86 percent described the result as good, 12 percent as satisfactory, and 2 percent as poor.

Discussion

Our study confirms recent long-term studies of the durability of the hip arthroplasty, albeit with earlier failure in males vs. females and in young vs. elderly. Dobbs (1980) reported 88 percent survival of the Stanmore prosthesis after 9 years. Ahnfelt (1986) and Ahnfelt et al. (1990) reviewed national revision rates in Sweden, comparing survival of the various prostheses in use. In Visuri's (1987) long-term study of the McKee-Farrar prosthesis, the survival rate after 12 years was 72 percent. Sarmiento et al. (1988), using progressive loosening as a criterion, found survival rates after 11 years ranging from 92 percent for the Charnley prosthesis to 96 percent for the STH-straight prosthesis. Johnsson et al. (1988) reported a 19 percent cumulative revision rate 14 years after primary surgery.

In studies of long-term results of hip arthroplasties, patients lost to follow-up cause an unknown effect on the statistical estimates. We have been able to eliminate this by tracing all the patients included in the study. Their number permits reliable estimates of prosthesis survival.

To obtain a patient group as homogeneous as possible, we studied all the patients with coxarthrosis separately. This permitted us to compare various risk factors within this group. The survivorship of the prosthesis was better among women than among men, and better the higher the age group. All the revisions done 10 years or more after the primary surgery were performed because of mechanical loosening. This indicates that long-term mechanical strain and activity are important risk factors.

Prosthesis survivorship tells us nothing about the patient's level of function or pain, and one can therefore assume that this statistical method gives an impression of the patient's satisfaction that is too flattering. However, the response from the surviving patients, with their subjective evaluations, showed that 98 percent were satisfied. These results correlate well with the results obtained using survivorship analysis.

In closing, again, it should be noted that we found no effect of the surgeons' experience on the long-term results. This would seem to indicate that the surgical procedure of inserting Charnley's LFA, being highly standardized, has a fairly wide margin of safety.

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