Survivorship of hip prosthesis in primary arthrosis

Influence of bilaterality and interoperative time in 45,000 hip prostheses from the Finnish Endoprosthesis Register

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ABSTRACT – We studied the influence of bilaterality and interoperative time on survivorship of the hip prosthesis. The material consisted of 45,000 (3,153 bilateral) total hip arthroplasties and 38,000 patients operated on for primary osteoarthrosis, using data from the Finnish Endoprosthesis Register between 1980 and 1999. Cox regression analysis showed that male sex, young age, uncemented prosthesis and time of surgery (first 10-year period) were significant risk factors for aseptic loosening. We found no difference between the survivorship of the first bilateral and that of unilaterals, but second bilaterals survived better than the unilaterals.

Bilateral prostheses survived better when the second prosthesis was implanted during the first postoperative year. The risk of loosening of a bilateral prosthesis increased when the second prosthesis was implanted a few years later. Survivorship of bilateral prostheses in a 1-stage bilateral operation was about the same as in those operated on within the first postoperative year.

Better survivorship of the second bilateral can cause bias in per hip survivorship analyses. In bilateral cases, the second hip should be operated on as soon as possible or be considered for a 1-stage bilateral procedure.

■

The need for bilateral THAs is great. The prevalence of bilateral primary coxarthrosis is 33% (Danielsson and Lindberg 1997). Walking involves symmetric and interactive use of both hips. Thus the function of one hip is dependent on that of the other. Per prosthesis total hip arthroplasty (THA) analysis may cause a bias compared to per patient analysis. This has been studied in only four previous series of THA. Heinert (1982) reported an almost 7% better survivorship per prosthesis analysis than per patient in a THA series with 45% bilateral cases. Similarly, Turula (1989) found a 3% better survivorship at 15 years' follow-up in a series of patients with 20% bilateral THAs. On the other hand, in a series of 6304 patients with unilateral and 1618 with bilateral Charnley prostheses from the Norwegian Arthoplasty Register, the survivorship of the unilateral prostheses did not differ from that of bilaterals (Havelin et al. 1995). In bilateral cases the right and left prostheses affected each other as regards loosening (Bucholz et al. 1985). Möllenhoff et al. (1994) obtained the best results for survivorship of the first THA when the second hip was operated on within 1–3 years after the first THA.

The role of bilaterality in the survivorship of the prosthesis has not been taken into account in large Nordic endoprosthesis registers (Havelin et al. 2000, Malchau et al. 2000, Nevalainen et al. 2000).

We analyzed the effects of the interoperative time on the survivorship of bilateral prostheses and compared the survivorship of the first and second bilateral THAs to that of unilaterals, using data from the Finnish national endoprosthesis register (Nevalainen et al. 2000).

Patients and methods

All data were collected from the Finnish Endoprosthesis Register from 1980 to the end of 1999.

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Table 1. Cox analysis of factors related to aseptic loosening of THAs in 38,010 patients

Factor	No of patients	RR	95%CI	P-value
Age: ≥ 75 (reference)	8,917	1		
65–75	16,483	1.50	1.34–1.67	<0.001
55–65	9,613	2.29	2.04–2.57	<0.001
< 55	2,997	2.95	2.58–3.39	<0.001
Women (ref.)	23,026	1		
Men	14,984	1.06	1.00–1.13	0.07
Time of surgery:				
1990–1999 (ref.)	26,344	1		
1980–1989	11,666	1.25	1.16–1.29	<0.001
Cemented (ref.)	21,698	1		
Uncemented	16,312	1.20	1.12–1.29	<0.001

Prostheses were followed from the insertion of the implant to the first revision, to the death of the patient or to 31.12. 1999.

All patients were operated on for primary osteoarthrosis. The total number of primary THAs was 44,585 of which 60% were performed on women. 66% (29,440) of the prostheses were implanted in patients over 65 years of age. 19% (7,211) of the patients with the implant in situ died before the end of 1999. 10% (4,564) of the prostheses were revised because of loosening.

We divided the material into 4 study groups: unilateral, first and second bilateral and 1-staged bilateral THA. The total number of unilateral prostheses was 31,432 (71%), staged bilateral 12,701 (28%) and 1-staged bilateral 452 (0.001%). The number of first bilaterals was 6,356 and that of second bilaterals 6345. The lower number of the second bilaterals was due to operative failure or death of the patient

General confounding factors for aseptic loosening of the prostheses were calculated and included sex, 4 age groups, first (1.1. 80–31.12. 89) and second 10-year period (1.1. 90–31.12. 99) of surgery and mode of fixation of the prosthesis (cemented, uncemented) (Table 1).

Cox multivariate regression analysis was used:

a) to find general confounding factors, in this case material of unilaterals and one randomly selected bilateral per patient (n = 38,010).

b) to calculate relative risks for staged and 1-staged bilaterals, as compared to unilaterals and adjusted for confounding factors. In this case, 1 randomly selected 1-staged bilateral per patient was employed and analyses were made pairwise: unilaterals vs. 1-staged bilaterals, unilaterals vs. first bilaterals and unilaterals vs. second bilaterals.

c) to estimate the effect of interoperative time between bilaterals to survival of the prosthesis adjusted for confounding factors. In this case, unilaterals and first bilaterals were used, but the failure of the prosthesis was determined as the first failure of either bilateral. In every case, only one prosthesis per patient was used in the analyses.

Risk ratios and their 95% confidence intervals (Cl) and their p-values were calculated for all the parameters.

Table 2. Cox analysis of adjusted relative risks of first and second bilateral and one-staged bilateral THAs compared to unilaterals for revision

Variable	N (prostheses)	RR	95%CI	P-value
Unilaterals (ref.)	31,432	1		
First bilaterals	6,356	0.95	0.88–1.02	0.2
Second bilaterals	6,345	0.89	0.81–0.97	0.009
One-staged bilaterals	226	0.49	0.24–1.04	0.06

Results

Low age, male sex, uncemented prosthesis and first 10-year period of surgery were statistically significant risk factors for loosening of the prostheses (Table 1). After adjustment for general confounding factors, survivorship of the first bilateral prosthesis did not differ from that of the unilaterals. The second bilaterals survived significantly longer than the unilaterals (Table 2).

An increase in the interoperative time increased the risk of revision of either bilateral prosthesis (Table 3).

The survivorship of 1-staged bilateral prostheses was better (RR 0.66) than in those patients whose second prosthesis was inserted during the first postoperative year, but the difference was not statistically significant (Table 4).

Discussion

The deterioration or development of osteoarthrosis

Table 3. Cox analysis of adjusted relative risks of interoperative time for the revision of either bilateral prosthesis implanted within 5 postoperative years compared to unilaterals

Interoperative time, years	N (patients)	RR	95% CI	P-value
0–1	2,626	0.90	0.80–1.02	0.1
1–2	1,923	0.93	0.81–1.06	0.3
2–3	839	1.03	0.86–1.23	0.7
3–4	642	1.16	0.97–1.39	0.1
4–5	548	1.30	1.09–1.56	0.004

Table 4. Cox analysis of adjusted 1-staged bilateral implantation and staged implantation in the first postoperative year for revisions

Variable	N (patients)	RR	95%CI	P-value
Staged bilaterals (ref.)	2,628	1		
One-staged	226	0.66	0.37–1.19	0.2

of the unoperated hip after THA is noteworthy. The probability of progression of osteoarthrosis in the second hip after THA is 79% at 10 years, the likelihood of having an arthroplasty being 54%. The probability of a hip diagnosed as normal developing osteoarthrosis is 37%, with an 8% likelihood of requiring a total hip arthroplasty (Ritter et al. 1996). The cumulative risk is 0.15 for replacement of the contralateral hip 1 year after replacement of the first hip, increasing to 0.47 after 10 years (Husted et al. 1996).

Kaplan-Meier univariate survival analysis has been widely used to evaluate the survivorship of endoprostheses, since Dobbs introduced it in 1980. It has been regarded as a valid technique for long-term evaluation of joint prostheses, although many patients are lost to follow-up (Dorey and Amstutz 1989). Practically all survivorship analyses for THAs with this method have been done on a per hip basis. True risk factors for revision, however, can be determined accurately with Cox multiple regression analysis (Johnsson et al. 1994).

Statistical handling of data includes factors that are not independent. Since both hips are dependent on each other, this introduces a bias in estimating the risk factors and statistical significance of revisions. Considerable "double sampling" occurs if the series contains bilateral prostheses. Risk factors are "doubled" and valid comparability is inevitably lost (Niemcryk et al. 1990). Better survivorship of the second bilateral results in too favorable a prognosis in series having many bilateral prostheses versus those having only a few. The influence of bilaterality should be estimated in reporting survivorships of the endoprostheses. Turula (1989) avoided the problem by selecting at random the other implant in bilateral cases.

In our material, the delay in the second operation played a significant role in loosening of the prosthesis. Patients with bilateral coxarthrosis strain the painless prosthetic hip, which can cause loosening of the prosthesis after a long interoperative interval (Möllenhoff 1994).

Replacement of both hips allows more symmetric use of both hips when walking. Patients with bilateral hip disease do not gain optimal function, even on the first side, until both hips have been replaced (Wykman and Olsson 1992). Recovery of walking after THA depends on the severity of the osteoarthrosis in the unoperated hip (Berman et al. 1991).

In our study, unilateral prostheses had a worse survivorship than the second bilateral ones. Patients with unilateral prostheses and a healthy other hip may be more active than those with bilateral prostheses. Unilateral replacement gives better gait analysis than does either side after bilateral procedures (Wykman and Olsson 1992). The walking ability of patients with unilateral hip disease improves to a greater extent than in those with bilateral disease after arthroplasty (Berman et al. 1991).

High survivorship of the prosthesis reduces the effect of bilaterality. In the Norwegian series of Charnley prostheses with a 94–98% survivorship, depending on the type of cement, at 5.5 years, no difference was found between the outcome of unilateral and bilateral prostheses (Havelin et al. 1995). The survivorship was 92% of the three most used uncemented prostheses in our series at 5.5 years and 94% of the three most used cemented prostheses for primary osteoarthrosis (Nevalainen et al. 2000), which caused a difference between patients with unilateral and bilateral prostheses. In these circumstances, clinical dependence of both

hips also results in statistical dependence, but the effect is small.

Our series showed that survivorship of the prostheses after a 1-stage bilateral operation seems to be at least equal to that of the second implantation during the first postoperative year.

One-stage arthroplasty has proved to be equally safe and more economic than staged procedures (Eggli et al. 1996, Reuben et al. 1998, Alfaro-Adrian et al. 1999). The outcome of 1-staged operations is also comparable with that of staged ones (Ritter et al. 1995, Eggli et al. 1996, Alfaro-Adrian et al. 1999).

Bilaterality should be reported in the results of THA. The second coxarthrotic hip may be operated on in a 1-staged bilateral procedure or the interoperative time should be as short as possible.

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