Factors predisposing to periprosthetic fracture after hip arthroplasty

A case (n = 31)-control study

Roope Sarvilinna[1,2], Heini SA Huhtala[3], Roope T Sovelius[1], Pekka J Halonen[4], Juha K Nevalainen[5] and K Jorma K Pajamäki[4]

[1]Medical School, University of Tampere, [2]Division of Orthopaedics, Department of Surgery, Tampere University Hospital, Tampere, [3]School of Public Health, University of Tampere, [4]COXA, Hospital for Joint Replacement, Tampere, [5]Medical Devices Centre, National Agency for Medicines, Helsinki, Finland
Correspondence: RS sarvilinna@yahoo.com
Submitted 03-01-13. Accepted 03-07-06

ABSTRACT We compared retrospectively 31 patients with a periprosthetic fracture to 31 patients in a control group. The Finnish Arthroplasty Register was used to count all periprosthetic fractures treated by revision arthroplasty in Finland and in Tampere University Hospital district during the years 1990–1999. We used the date of the previous operation to find the control group patients operated on at the same time in the same hospital district. No other selection or matching criteria were used. The type of prosthesis, complications, age, BMI, cementation and primary diagnosis were compared. We found that patients who had a fracture as the primary diagnosis ran a 4.4 (95%CI = 1.4–14) times higher risk of periprosthetic fracture than those operated on for other reasons.

5,900 total hip arthroplasties, including revision arthroplasties, were performed in Finland in 1999, and the number has been increasing (Puolakka et al. 2001). Consequently, the number of revision and re-revision arthroplasty is rising in Finland, meaning that we must treat more complications, including periprosthetic fractures (PF).

The reported incidence of PF varies between 0.1% and 18% (Schwartz et al. 1989, Beals and Tower 1996, Lewallen and Berry 1997, Tower and Beals 1999). The mortality rates and revisions for other reasons make the exact incidence of PF difficult to determine. The risk of intraoperative periprosthetic fracture is higher for uncemented prostheses, especially in revision operations (Scott et al. 1975, Christensen et al. 1989, Stuchin 1990, Mont et al. 1992). Schwartz et al. (1989) found a high incidence of PF in females and Löwenhielm et al. (1989) observed that the type of the prosthesis influenced the site of the fracture.

In this unmatched case-control study we compared 31 PF patients in the case group treated by a revision femoral prosthesis to 31 patients in the control group to find any factors predisposing to the PF after primary or revision arthroplasty.

Patients and methods

We used the Finnish Arthroplasty Register to calculate the absolute number of periprosthetic fractures in Finland and in the Tampere University Hospital district during the years 1990–2000. In Finland (population 5.1 million), the total number of periprosthetic fractures treated by revision rose from 18 a year in 1990 to 45 a year in 2000. In the Tampere University Hospital district (population 450,000), the total number rose also from 0 in 1990 to 9 in 2000 (Table 1). These numbers include the periprosthetic fractures which have been treated by revision operation and recorded in the Finnish Arthroplasty Register.

Table 1. Periprosthetic fractures in the Finnish Arthroplasty Register

Year	Finland	Tampere University Hospital district
1990	18	0
1991	18	2
1992	18	3
1993	23	1
1994	46	4
1995	38	6
1996	24	4
1997	34	3
1998	34	6
1999	41	10
2000	45	9
Total	339	48

In addition, we had permission from Tampere University Hospital and regional hospitals to do a more specific areal case-control study in patients operated on in the Tampere University Hospital district during the years 1990–1999. A unique personal identification number enabled us to examine the patient files in the hospitals where the operations were performed. An unmatched case-control study was done to find factors predisposing to the periprosthetic fracture. We estimated that the date of surgery was a factor without any bias which could be regarded as an unmatched design.

Patients for the case group were selected from the Finnish Arthroplasty Register. The register was the only way to find the patients revised after PF. Consequently this method excluded other treatment options for the PF from our study. The register includes all revision operations but not all primary operations. Therefore the absolute incidence of PF could not be calculated.

The patients in the case group had been reoperated on for a periprosthetic fracture, using a new femoral prosthesis during the years. 1990–1999. Data were collected from all four units in the Tampere University Hospital district. Eight patients incorrectly reported as PF to the Arthroplasty Register were excluded. No other selection criteria were used, which left 31 patients with 31 fractures in the case group. According to this information, the previous date of operation was obtained from the patient files. There were 27 primary and 4 reoperations. 2 of the latter were done after aseptic loosening of a prosthesis and 2 after secondary arthrosis caused by complications of internal fixation. The median time (quartiles) from the primary operation to PF was 5.8 (Q_1–Q_3 = 1.3–11) years and from re-operation to PF 5.6 years (Q_1–Q_3 = 1.4–11).

The control group was selected from the University Hospital register. The date of a patients index operation in the case group was used to select the control group patient, who was defined as the next patient operated on in the same hospital district. 24 of these were primary and 7 were reoperations. 2 reoperations were done after aseptic loosening of the prosthesis, 5 after secondary arthrosis caused by complications of internal fixation. No other selection or matching criteria were used.

The index and the revision operations were performed on all patients in each group in the Tampere University Hospital district, all data on them were obtained from the patient files. The date of surgery was rechecked.

The median age at the time of the index operation was 71 (53–89, Q_1-Q_3 = 62–76) years in the case group and 65 (37–93, Q_1-Q_3 = 59–75) years in the control group. 22 were females in the case group and 20 were females in the control group. 17 patients in the case group were over 70 years of age, as compared to 12 patients in the control group and 5 patients in the case group were over 80 years of age, as compared to 2 patients in the control group.

A power analysis showed that a BMI difference of > 3.6 with a dSD of 5 would result in a statistically significant difference (80% probability) with our sample size. As regards age (SD = 11, difference over 8 years), primary diagnosis and cementation the sample size was large enough to show statistically significant differences (80% probability), but for the 10 different types of prostheses, it was too small.

Risk ratios (RR) were estimated by ORs with 95% CI. Odds ratios with 95% CI were calculated for categoric variables using 2 × 2 tables. Age was divided into three groups (< 70, > 70 and > 80). Logistic regression analysis was used to analyze the effect of BMI on PF. On the basis of the values, the patients were divided into four groups (BMI = < 22.6, 22.6–26.0, 26.0–28.7 and > 28.7). A P-value below 0.05 was considered significant.

Table 2. The Odds ratio for prostheses

	Case group n = 31	Control group n = 31	Risk ratio	95% CI
Exeter	8	5	1.8	0.52–6.3
Thompson	5	1	5.8	0.63–52
Lubinus	9	9	1.0	0.33–3.0
Biomet	4	10	0.31	0.09–1.1
Lord	2	3	–	–
ABG	2	0	–	–
Omnifit	1	0	–	–
S–ROM	0	1	–	–
Euro	0	1	–	–
Link RS	0	1	–	–

Median and quartiles (Q1–Q3) were calculated for time variables. The statistical analyses were done using SPSS version 10.1 for Windows (SPSS Inc, Chicago, Illinois, USA).

Results

The patients' sex (RR = 1.3, CI = 0.5–3.9), age more than 70 vs. less than 70 years (RR = 1.9, CI = 0.7–5.3), or 80 vs. less than 80 years (RR = 2.8, CI = 0.5–15.6) were not significantly associated with an increased in the risk of PF.

The prosthesis was cemented in 24 and uncemented in 7 patients in the case group and cemented or uncemented in 21 and 10 patients in the control group. In patients operated on with the cementless prosthesis, the risk of PF was about the same as in patients operated on with the cemented prosthesis (RR = 0.6, CI = 0.2–1.9). A high BMI (> 28.7) had no association with the incidence of PF (p = 0.7).

We found no intraoperative or immediate postoperative PFs in the case group. The median time from the index operation to the revision operation due to a fracture was 70 (range 1–174, Q_1–Q_3 = 15–128) months. The etiology of PF was trauma in all 31 cases. 29 patients had fallen and 2 reported some kind of distortion. The prevalence of reoperated patients was higher in the control group than in the case group, but the risk of PF was no higher than in reoperated patients; RR = 0.51 (0.1–2.0).

10 types of prostheses had been used in these two groups. A reliable statistical evaluation could not be done because of the small number of cases in each group (Table 2).

Table 3. Complications after previous operation

	Case group n = 31	Control group n = 31
Aseptic loosening	4	1
Dislocation	0	2
Wound infection	0	1
Myositis ossificans	2	0
Invalidizing pain	2	0
Postoperative thrombosis	0	2

Table 4. Primary diagnoses

	Case group n = 31	Control group n = 31	Risk ratio	95% CI
Fracture	16	6	4.4	1.4–14
Primary arthrosis	11	18	0.35	0.12–0.97
Rheumatoid arthritis	2	1	2.1	0.18–24
Congenital dysplasia	0	4	–	–
Caput necrosis	1	0	–	–
Congenital hip luxation	1	0	–	–
Legg–Perthes'	0	1	–	–

At the time of the periprosthetic fracture, 4 patients in the case group were waiting for the revision operation, because of aseptic loosening, noticed at routine clinical follow-up and radiographic examinations (Table 3). More late complications occurred after the index operation in the case group than in the control group, but the difference was not statistically significant; (RR =1.62 0.4–6.4).

The prevalence of fracture as the indication for primary operation was higher in the case (16/31) than in the control group (6/31) (p = 0.02). The prevalence of arthrosis as a primary diagnosis was lower in the case (11/31) than in the control (18/31) group (p = 0.074) (Table 4).

Discussion

In this study, the patients treated with a new femoral prosthesis after PF were included in the case group, but not those treated by other means like plate fixation. Patients operated on by internal fixation are

not included in the Finnish Arthroplasty Register and could be found in the hospital records. None of the patients in the case group had had intraoperative fractures. The treatment of intraoperative femoral fractures depended om the severity of the fracture, and in many cases these were treated with wire and/or plate fixation (Schwartz et al. 1989, Berry 2002) rather than with a new prosthesis, which may have reduced the number of uncemented prostheses in the case group. This makes a relevant comparison of our study and those of others difficult. It should also be noted that the number of prostheses included in the Finnish Arthroplasty Register has varied from almost 90% in 1995 to 95% in 1999 (Puolakka et al. 1997, 1999).

Trauma, especially a fall, is the most common etiology of late PF. Beals and Tower (1996) stated that 84% of periprosthetic fractures had been caused by a fall, 8% by some other kind of trauma and 8% were spontaneous. Known risk factors for PF include component loosening, osteolysis and proximal femoral bone loss (Johansson et al. 1981, Christensen et al. 1989, Astion et al. 1996, Radl et al. 2000). In our study all periprosthetic fractures resulted from a trauma (28/30 from a fall) long after the operation. It should also be noted that 4 patients in the case group were waiting for a revision operation because of aseptic loosening of the femoral (2 patients) or both components at the time of the PF. McLaughlan et al. (1997) reported that 5 of their 45 patients had loose prostheses before they developed PF.

Schwartz (1989) found that female patients had a higher incidence of intraoperative PFs than males. We found no correlation with the patients' sex and the incidence of PFs. Half of the patients in the case group had had a previous arthroplasty due to fracture and consequently, a previous fracture seems to have affected the later development of PFs. On the other hand Löwenhielm et al. (1989) found no such correlation.

All registers are subject to a certain frequency of errors and incompleteness. The number of prostheses and patients included in the Finnish Arthroplasty Register have varied during the years. Incorrect classification of diagnoses in this Register may have reduced the number of patients in the case group. However, the data on patients were collected from the same database.

The authors thank Anu Hirvonen, secretary of the Arthroplasty Register and Kirsti Kotaniemi, lawyer of the National Agency for Medicines.

No competing interests declared.

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