International Orthopaedics (SICOT) (2003) 27:359–361
DOI 10.1007/s00264-003-0493-2

ORIGINAL PAPER

Roope Sarvilinna · Heini S. A. Huhtala
Timo J. S. Puolakka · Juha K. Nevalainen
K. Jorma J. Pajamäki

Periprosthetic fractures in total hip arthroplasty: an epidemiologic study

Accepted: 18 June 2003 / Published online: 30 July 2003

Abstract This study was based on data from the Finnish Arthroplasty Register. From 1990 to 1999, 33,154 primary hip arthroplasties were performed in Finland. Only periprosthetic fractures treated by a revision arthroplasty were registered. The six most used femoral components were compared using survival analysis and Cox's regression model. The incidence of periprosthetic fractures was calculated separately for the years 1990–1994 and 1995–1999. The incidence in the first period was greater than in the latter. Survival analysis and Cox's regression model showed that gender, prosthesis type and age were of no significance as risk factors for periprosthetic fractures.

Résumé Cette étude a été basée sur les données du Registre finlandais des Arthroplasties. De 1990 à 1999 33.154 arthroplasties totales de la hanche ont été exécutées en Finlande. Seulement les fractures periprothétiques traitées par une arthroplastie de révision ont été enregistrées. Les six composants fémoraux le plus utilisés ont été comparés en utilisant l' analyse de la survie et le modèle de régression de Cox. La fréquence des fractures périprothetiques a été calculée séparément pour les années 1990–1994 et 1995 –1999 et elle était plus élevée dans la première période que dans la deuxième. L'analyse de la survie et le modèle de Cox ont montré que le sexe, le type de prothèse et l'âge n'étaient d'aucune signification comme facteur de risque pour ces fractures périprotèthiques.

R. Sarvilinna
Medical School, University of Tampere,
Tampere, Finland

H. S. A. Huhtala
School of Public Health, University of Tampere,
Finland

T. J. S. Puolakka · K. J. J. Pajamäki (✉)
COXA, Hospital for Joint Replacement,
Lenkkeilijänkatu 6B, Tampere, Finland
e-mail: jorma.pajamaki@coxa.fi
Tel.: +358-3-31178031, Fax: +358-3-31178090

J. K. Nevalainen
Medical Devices Centre, National Agency for Medicines,
Helsinki, Finland

Introduction

The number of annually performed total hip arthroplasties (THA) is increasing in Finland [9]. This will probably be followed by and increase in THA-related complications, like periprosthetic fractures. Periprosthetic fractures, especially those treated by revision, are rather rare complications. However, in the light of the literature, it is uncertain whether the relative incidence of periprosthetic fractures as a complication of THA is increasing or not. The overall incidence seems to vary somewhere between 0.1 and 18% [1, 6, 11, 12]. As there are various operative protocols for the treatment, the incidence of fractures treated by revision arthroplasty has to be somewhat lower.

We studied the incidence of periprosthetic fractures treat by revision and the survival of the most used prostheses in Finland.

Materials and methods

From the Finnish Arthroplasty Register we collected information on all 33,154 primary hip arthroplasty operations performed in Finland from 1990 to 1999. The closing time of our study was 31 October 2002, which was the last date when deaths and revision operations were updated to the register.

First we selected all patients operated due to hip arthrosis. From this population, other parameters including gender, side of the prosthesis, cementation, date of the surgery, reason for the revision operation, date of the revision operation, and date of death were collected using the personal identification number that all Finnish citizens posses. All the information was collected from the register. Patients were not contacted, and no patient files were studied.

There were 19,886 (60%) women and 13,267 (40%) men in the group. Sixty-three percent (20,887) of prostheses were cemented and 37% (12,114) cementless. There were 199 different combinations of acetabular and femoral components.

The Kaplan-Meier method was used for analysis of survival. Revision operation of the femoral or both components due to peri-

Table 1 Types of prostheses and causes of revision

Prosthesis (number)	Revision caused by								
	Loosening of both components	Loosening of acetabular component	Loosening of femoral component	Infection	Dislocation	Prosthesis in incorrect position	Bone fracture	Other reason	Total
ABG cemented (558)	2	3	7	1	6	1	1	0	21
ABG cementless (2,001)	1	5	1	3	6	1	1	9	27
Biomet cemented (1,151)	11	8	39	5	4	2	2	5	76
Biomet cementless (5,556)	10	61	20	12	47	13	7	79	249
Elite Plus (1,050)	12	3	40	6	1	3	0	0	65
Exeter (4,798)	8	16	15	18	22	6	5	0	90
Lubinus (SP I and SP II) (7,588)	91	46	153	23	23	6	9	11	362
Müller (3,025)	14	9	55	15	2	4	4	6	109
Other cemented (2,717)	25	17	81	14	14	2	4	9	166
Other cementless (4,557)	52	84	157	16	21	12	7	41	390

prosthetic fracture was recorded as revision. Death of a patient, the closing date of our study, and revision for other causes than periprosthetic fracture, were recorded as withdrawals. The observation time for the individual prosthesis was the period from the surgery date to revision or withdrawal. Survival analysis concerning revision due to periprosthetic fractures was calculated for the six most used total hip arthroplasties (Table 1). Prostheses classification was based on the femoral component. The remaining cases were divided into a cemented (2,717) and a cementless (4,557) group. Survival analysis was also calculated for gender and age cohorts. Cox's regression model was used, including the studied risk factors: age, gender, and prosthesis type.

The incidence of periprosthetic fractures was calculated for the whole period and separately for patients primarily operated during the years 1990–1994 and 1995–1999. Kaplan-Meier survival and Cox regression analysis were calculated using SPSS version 9.0 for Windows (SPSS Inc., Chicago, IL, USA). A p value under 0.05 was considered statistically significant. STATA (Stata Corporation, TX, USA) program version 7.0 was used to calculate the incidence. Median and quartiles (Q_1–Q_3) are shown for time variables.

Results

We found 40 revisions due to periprosthetic fractures (Table 1); 1,515 patients were revised for other reasons. The overall incidence for periprosthetic fractures was 18.36 (CI=13.47–25.03) per 100,000 person years. For patients operated primarily between 1990–1994, the incidence was 20.45 (CI=13.93–30.04) per 100,000 person years, and for patients operated primarily between 1995–999, the incidence was 15.43 (CI=9.14–26.05) per 100,000 person years.

Median age at the time of the primary operation was 69 (Q_1–Q_3 =62–74) years. For female patients the median age was 70 (Q_1–Q_3=64–75) years and for male patients 66 (Q_1–Q_3=60–72) years. The survival analysis showed no difference between prosthesis types (p=0.99). Survival analysis between genders showed that male patients had more revisions after periprosthetic fractures (p= 0.08). In Cox regression model the age-standardized male gender showed a tendency for a higher risk of periprosthetic fractures (p=0.053, RR= .86, CI=0.99–3.5).

Discussion

Periprosthetic fracture is a rare complication of THA, especially the cases requiring a revision. However, in the light of the literature, is has not been clear if the incidence of periprosthetic fracture as a complication of THA is increasing. The overall incidence varies somewhere between 0.1 and 18% [1, 6, 11, 12]. There prevails many options to treat periprosthetic fractures [7], revision operation being only one, and thus the incidence of revision-operated fractures has to be somewhat lower. The incidence revealed by our register-based study was very low—only 18.36 per 100,000 person years.

In Finland all the prostheses after the operation of primary hip arthrosis are recorded in the Finnish Arthroplasty Register [8]. The coverage of the Finnish Arthroplasty Register has varied from 90% in 1995 to over 95% in 1999, and thus a portion of patients always remain excluded from the register [9, 10]. In some studies it has been difficult to perform detailed analyses of the data in the register, mainly because acetabular and femoral components, as well as the material and size of the femoral heads, have been recorded separately only since 1996 [10]. These limitations must be kept in mind also when the results of our study are evaluated. However, the factors needed in our study were easily found from the register.

Dobbs introduced the Kaplan-Meier univariate analysis for hip prostheses in 1980, and it has been used ever since to evaluate the survivorship of endoprostheses [2]. It has been regarded as a valid technique for long-term evaluation of joint prostheses, although many patients are lost to follow-up, assumptions on the outcome of lost patients are done, and the interpretations are increasingly uncertain at the tail-end of curves [3, 5]. On the contrary, Johnsson et al. [4] found Cox's multiple regression analysis more accurate for the analysis of the true risk factors for revision arthroplasty. Still, most authors prefer to use only the survival analysis in their studies. We used both Kaplan-Meier analysis and Cox's regression model. Patients with a single primary diagnosis and patients with

revisions only for fracture must increase the accuracy of the findings in survival analysis, although some patients were lost to follow-up.

Our special interest was in revision-operated periprosthetic fractures, and it seemed that the survival of the six most used as well as other cemented or cementless prostheses was the same, with no significant difference.

We found only 40 periprosthetic fractures that required femoral revision operation in a population of 33,154 patients. The incidence was lower for patients primarily operated during years 1990–1994 than for patients operated during years 1995–1999, even though authors presume that the trend has been towards more aggressive revision procedure during the same period. Thus, the revision-operated periprosthetic fracture seems to be a very rare complication for patients with primary arthrosis. However, periprosthetic fractures treated differently were excluded from our study. The follow-up in our study varied from 3 to 12 years, and a longer follow-up is needed to see the incidences of a late complication. The differences in prevailing practice of treatment between the countries and the variety of registers thorough the world makes it difficult to compare these results with other studies.

The incidence of the most serious, revision-operated fractures has declined during the years 1990–1999, even though the indications for THA have changed at the same time.

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

References

1. Beals RK, Tower SS (1996) Periprosthetic fractures of the femur. Clin Orthop 327:238–246
2. Dobbs HS (1980) Survivorship of total hip replacements. J Bone Joint Surg [Br] 62:168–173
3. Dorey F, Amtutz H (1989) Validity of survivorship analysis in total joint arthroplasty. J Bone Joint Surg [Am] 71:544–548
4. Johnsson R, Franzen H, Nilsson LT (1994) Combined survivorship and multivariate analyses of revisions in 799 hip prostheses. A 10–20 year review of mechanical loosening. J Bone Joint Surg [Br] 76:439–443
5. Kaplan EL, Meier P (1958) Nonparametric estimation from incomplete obsevations. J Am Assoc 53:457–481
6. Lewallen DG, Berry DJ (1997) Periprosthetic fracture of the femur after total hip arthroplasty. J Bone Joint Surg [Am] 79:1881–1890
7. McLauchlan GJ, Robinson CM, Singer BR, Christie J (1997) Results of an operative policy in the treatment of periprosthetic femoral fracture. J Orthop Trauma 11:170–179
8. Nevalainen J, Hirvonen A, Pulkkinen P (1997) The implant yearbook on orthopedic prostheses. Publication of the National Agency for Medicines, Helsinki
9. Puolakka TJS, Pajamäki J, Pulkkinen P, Nevalainen J (1997) Cementless Biomet total hip prosthesis in the treatment of osteoarthrosis. Publication of the Finnish National Agency for Medicines, Helsinki
10. Puolakka TJS, Pajamäki KJJ, Halonen PJ, Pulkkinen PO, Paavolainen P, Nevalainen JK (2001) The Finnish Arthroplasty Register. Report of the hip register. Acta Orthop Scand 72:433–441
11. Schwartz JT Jr, Mayer JG, Engh CA (1989) Femoral fracture during non-cemented total hip arthroplasty. J Bone Joint Surg [Am] 71:1135–1142
12. Tower SS, Beals RK (1999) Fractures of the femur after hip replacement. Orthop Clin North Am 30:235–247