The bridging nail in periprosthetic fractures of the hip. Incidence, biomechanics, histology and clinical outcomes
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CHAPTER 3

Incidence of periprosthetic femoral fractures in The Netherlands; a survey of Hospital admissions

RG Zuurmond, P Pilot, SK Bulstra, AD Verburg
Abstract

Introduction
The incidence of periprosthetic femoral fractures is incidentally reported in literature and more often estimated from hospital figures. Monitoring the incidence is important regarding treatment strategies, research and health costs.

Purpose
The purpose of this study is to determine the incidence of periprosthetic femoral fractures in The Netherlands.

Materials and Methods
Hospital admission data from the Prismant Institution register were used to determine total hip arthroplasty patients. All data from patients who underwent total hip arthroplasty (THA) in 1991 and 1992 were collected and two cohorts were defined. All re-admissions in the following ten registration years were obtained and analysed. Acute readmissions for a suspected periprosthetic fracture were counted and analysed using SPSS 14.0.

Results
13,086 THA procedures were performed in 1991. In the next 10 registration years 106 (0.81%) periprosthetic fractures were noted from this cohort. Mean age at time of fracture was 76.1 years. Mean hospital stay was 30.8 days.

14,652 THA procedures were recorded in 1992. 124 (0.86%) patients were treated in the next 10 registration years for a periprosthetic fracture. Mean age at fracture was 74.9 years. Mean hospital stay 34.6 days. Mean overall time from initial operation to fracture development was 52.5 months. The fractures were distributed among 51-53 hospitals in The Netherlands.

Conclusion
The incidence of periprosthetic femoral fractures of a cohort of THA patients lies between 0.81% and 0.85%. These figures are the first reported in The Netherlands derived from a nationwide register. The numbers are consistent with the scarce international reports concerning the incidence of these fractures.
Introduction

Periprosthetic fractures (PPF) of the femur often demand an extended form of treatment. Revision arthroplasty or fracture treatment in older patients with extensive surgery cost quality of life and financial resources as well. It is important to know the incidence of these fractures and to observe if there is an increasing frequency regarding future health management.

A wide range of data have been reported the passed years in recent literature reports (Table 1). Some authors show an increased incidence of PPF during consecutive years. The most convincing data are generated from a Scandinavian report and from the Mayo clinic register. The National Hip Register is a well organised database in Sweden. Finland having a similar comprehensive registration system, enabled Sarvanlinna et al. to show an increase in incidence during several consecutive years. Other reports estimate the incidence from clinical registrations in relation to the numbers of implant surgical procedures in one or more hospitals. Those data are retrieved from internal hospital registration.

To determine the size of the problem of PPF in the Netherlands, we posed the following research questions: What is the incidence of periprosthetic hip fractures in the Netherlands? And is there an increase of the incidence over the years?

Table 1. Reported incidence in literature †=reported cumulative incidence

<table>
<thead>
<tr>
<th>Author</th>
<th>Year of report</th>
<th>Sample size</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fredin</td>
<td>1987</td>
<td>1,961</td>
<td>0.56%</td>
</tr>
<tr>
<td>Lewallen</td>
<td>1998</td>
<td>17,579</td>
<td>0.6%</td>
</tr>
<tr>
<td>Berry</td>
<td>1999</td>
<td>20,859</td>
<td>0.3%</td>
</tr>
<tr>
<td>Lindahl</td>
<td>2006</td>
<td>242,393</td>
<td>0.4%†</td>
</tr>
</tbody>
</table>

Recently a centralised registration system for implant surgery in the Netherlands was introduced. Efforts in the past did not offer comprehensive databases for research and were abandoned. However, a centralised admission registration (Prismant Institution, Utrecht, The Netherlands) with ICD-9 codes is available and offers an opportunity to study medical conditions and treatment. The records of the Prismant institution provide data for an analysis of the admissions for periprosthetic fractures.

To determine the size of the problem of PPF in the Netherlands, we posed the following research questions: What is the incidence of periprosthetic hip fractures in the Netherlands? And is there an increase of the incidence over the years?

Materials and Methods

At the hospital registration agency, Prismant, records were obtained of all patients in the Netherlands operated for total hip arthroplasty in the years
1991 and 1992. In the consecutive 10 years, hospital admissions of these patients for a fractured femur or revision arthroplasty were retrieved. The medical conditions were diagnosed by the ICD-9 system. The records were judged on the treatment that was given by the individual Dutch hospitals. The treatment was coded by universal codes according to the ICD-9. Unfortunately the code for a periprosthetic fracture is not used by hospitals in the Netherlands. An indirect method that consists of elimination of other diagnoses had to be performed. Several assumptions had to be made to eliminate re-admissions for other reasons than PPF. One of these key assumptions was that patients stayed loyal to their initial hospital of treatment. The analysis was performed twice. A first analysis was done without the possibility of a patient moving outside their postal code area. The second analysis was performed with the assumption that patients stayed within the same hospital area. Since the initial record consisted of 13,086 patients with total hip arthroplasty in 1991 and all re-admissions afterwards, the records were matched limiting acute admissions (since a PPF is expected to be a sudden event). Besides hip dislocations, other complications as infections and acetabular revision arthroplasty were ruled out. Then the entire record was evaluated for periprosthetic fractures according to the diagnosis and performed treatment. Since the 1991 cohort was the first registration year in The Netherlands, for 1992 more precise data were available, however a small group stayed multi-interpretable (0.2%). The statistical analyses were performed on a personal computer using SPSS for Windows XP (version 14.0).

Results

Cohort 1991

In 1991 13,086 primary hip arthroplasties were performed in The Netherlands. Mean age was 69.3 years (17-99) and 25.2% was male. Mean duration of hospital stay was 20 days.

105 patients died during the postoperative period in the hospital. 1,143 patients were referred to an institution for rehabilitation. The rest of the patients were discharged to their own home environment.

From 1991 to 2002, 91 patients were extracted from the database with a periprosthetic fracture (0.71%). Mean age at time of fracture was 76.3 years (50-93). These fractures occurred after a mean period of 48 months (range 0-126 months). 18 male patients (19.8%) were observed. Mean hospital stay was 38 days (1-222 days) with a median of 30 days. Five patients had a stay longer than 100 days. Three patients died during the postoperative stay (3.3%). 28 patients were discharged to a nursing home facility (32.5%). The fractures were spread among 50 hospitals. On average 1.8 PPF per hospital was seen. One hospital treated 7 fractures from the cohort of 1991.

In the 1991 cohort several codes were multi-interpretable. After record analysis an additional number of 15 patients were identified as likely to have
suffered from a periprosthetic fracture. The ICD-9 diagnosis code and the recorded therapeutic intervention strongly raised the suspicion for an admission for a periprosthetic fracture. These combined codes included for example an acute admission for mechanical failure of an implant and a performed femoral osteosynthesis. When the two groups are combined 106 patients with periprosthetic fractures are isolated from the cohort (0.81%). Mean age at time of fracture was 76.12 years (50-93) (Table 3).

In summary the number of periprosthetic fractures is estimated between 0.71% and 0.81% in ten years time for a cohort of total hip arthroplasty patients operated in 1991.

**Cohort 1992**

In 1992 14,651 primary total hip arthroplasties were performed. Mean age was 69.3 years (16-101) and 26.2% were male patients. Mean duration of hospital stay was 19.7 days (1-464) with a SD of 13.9. Ten patients had a hospital stay longer than 100 days. 325 patients died during their hospital stay (2.2%). 5,038 patients were transferred for rehabilitation to an external facility. The rest of the patients were discharged to their home environment.

| Table 2. Overview of cohorts and found periprosthetic fractures with combined numbers form cohort 1991 and 1992. |
|---|---|---|
| **Cohort size** | **1991** | **1992** | **Combined** |
| **Primary indication** | | | |
| 1. Primary OA | 10116 (77.3%) | 11039 (0.75%) | 21155 (0.76%) |
| 2. Secondary OA | 950 (7.3%) | 933 (6.4%) | 1883 (6.8%) |
| 3. Prox Fem Fracture | 932 (7.1%) | 922 (6.3%) | 1854 (0.69%) |
| 4. AVN | 190 (1.5%) | 241 (1.6%) | 431 (1.6%) |
| 5. Other | 898 (6.9%) | 1517 (10.4%) | 2415 (8.7%) |
| **Return to home environment** | | | |
| | 11,943 | 13,192 | 25,135 |
| | (91.2%) | (90.0%) | (90.6%) |
| **Mean hospital stay (days) ± SD** | 20.0±18.4 | 19.7±13.9 |
| **Periprosthetic fractures** | | | |
| 106 (0.81%) | 124 (0.85%) | 230 (0.83%) |
| • Certain fractures | 91 | 94 | 185 (0.67%) |
| • Suspected fractures | 15 | 30 | 45 (0.16%) |

OA = osteo arthritis, Prox Fem Fracture= proximal femoral fracture, AVN = avascular necrosis of the femoral head, Other = other indications for total hip arthroplasty, e.g. pseudarthrosis, malignancy. SD = standard deviation of the mean.
From 1992 to 2003, 94 patients were retrieved from the database with a periprosthetic fracture. Mean age at time of fracture was 74.9 years (53-96). 19 male patients (20.2%) were observed. The occurrence of fracture was after a mean period of 57.2 months with a SD of 41.3 months. Mean hospital stay was 34.6 days (4-214, SD=30.1). 2 patients died during the postoperative in-hospital period. 25 patients were discharged to a nursing home institution. The fractures were spread among 53 hospitals. One hospital treated 5 periprosthetic fractures of the 1992 cohort, and was another hospital than for the 1991 cohort.

After studying all cases and interventions, 30 additional cases were classified as to have suffered from a periprosthetic fracture. When added to the certain cases, a total of 124 fractures is noted in 10 registration years for the cohort of 1992. (Table 2)

The number of cases that develop a periprosthetic fractures in ten years for a cohort of total hip arthroplasty patients operated in 1992 lies between 0.64% and 0.85%.

Discussion

The incidence of periprosthetic fractures in The Netherlands was derived from an analysis of hospital admission data. The incidence of a periprosthetic fracture for patient operated between 1991 and 1993 in ten years time is between 6.4 and 8.5 per thousand. No increase in incidence was observed in two consecutive cohorts (1991 and 1992). The number of patients who underwent primary hip arthroplasty increased from 13,086 in 1991 to 14,865 in 1992. As a result an increase in absolute numbers of patients needing treatment for a periprosthetic fracture was noted. As the number of primary hip arthroplasties continues to rise, a similar increase in the amount of adverse events is to be expected. For example in 2006, approximately 25,000 total hip arthroplasties were performed in The Netherlands. This development has to be taken into account, as the treatment of periprosthetic fractures often involves high complication and mortality rates. These complications have their negative influence on quality of life and health costs as well. In our cohort, the mean hospital stay for a periprosthetic fracture is 34.3 days. To oversee the impact of these fractures on health services and costs, monitoring of the incidence is important.

A number of authors report a higher incidence of periprosthetic fractures after uncemented total hip arthroplasties. Our database did not contain implant-specific data. Therefore we were unable to analyse differences between various (types of) implants. Furthermore periprosthetic fractures occur more often after a revision arthroplasty. Unfortunately we were unable to evaluate these cases in our study. The cohorts contained only primary total hip arthroplasty procedures. The cohort could contain cases with a revision arthroplasty between primary total hip surgery and fracture. These possible interventions were filtered out during the study. The analysis
of fractures after revision procedures is a subject of further research, demanding new databases.

Several assumptions had to be made to perform the analysis of the data. This was needed to filter out the cases in the hospital admission database. First of all, the cases had no unique number due to privacy regulations. Selection of duplicates was performed using date of birth, postal code area and hospital number. We had to assume that patients stayed loyal to their initial hospital of treatment. In this particular time-frame (1991 and 1992) no stringent (commercial) competition existed in the Dutch medical care system. Secondly, the postal code area was assumed large enough for people with a mean age of 69.3 years not to migrate out of the adherence area. This assumption was validated by running an additional data-analysis without the postal code area parameter, leaving the same amount of periprosthetic fractures in one cohort. Thirdly, the assumption was made that an acute hospital admission was coded for a fracture (infection and dislocation were excluded). Hypothetically non acute transferrals could be missed from nursing home institutions. However, after contacting coding personnel of academic and community hospitals the chance of missing fractures seemed very small. Finally, the selected cases were individually checked to sort out the periprosthetic fractures. Additionally some codes could resemble a periprosthetic fracture. For example a case of a patient with an acute admission for mechanical problems with the implant, needing an osteosynthesis procedure. These cases are separately mentioned in the results. With the assumptions chosen, care was taken that no exaggeration of the amount of fractures could occur. The incidences found therefore represent minimum figures.

However, these assumptions would not be necessary if an adequate coding system for orthopaedic implants had existed in The Netherlands. The Swedish Hip Register is a great example. Recent efforts to organize a new implant registration system in the Netherlands (LROI) will facilitate implant related research. It is essential that a separate code for periprosthetic fractures is embedded in the new registration. Besides, a unique citizen service number will eliminate confounding factors.

To observe the expected increase in incidence this study could be repeated for a cohort with a five or ten year interval. The more frequent use of uncemented implants, in The Netherlands, could increase the incidence. Nowadays more (hemi-)arthroplasties are performed for proximal femoral fractures. Poor bone stock and high risks of recurrent falls in this specific patient group could affect the incidence. At this time, however, in our cohorts no difference was seen between the development of a periprosthetic fracture and proximal femoral fracture as primary indication for arthroplasty. With the expected increase in proximal femoral fractures, the effect might be measured in a future cohort.

The study we performed is the first attempt in The Netherlands to evaluate the incidence of periprosthetic femoral fractures. The Prismant Institution hospital admission data were used to retrieve the amount of periprosthetic fractures.
fractures of a cohort of primary hip arthroplasties. The analysis revealed that the admission database is a cumbersome system to use for implant evaluation regarding the assumptions that have to be made.

In conclusion, the incidence of periprosthetic femoral fractures in The Netherlands lies between 0.65% and 0.85%. These figures are comparable to reported numbers in literature. These figures represent minimal values. The obvious need for more precise coding of implant surgery and the implants used cannot be overemphasized. The implementation of a separate code for periprosthetic fractures is essential.
Reference List