The bridging nail in periprosthetic fractures of the hip. Incidence, biomechanics, histology and clinical outcomes
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CHAPTER 4

Periprosthetic femoral fractures in the Netherlands – an inventory of Dutch hospitals

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Abstract

Periprosthetic fractures of the femur are challenging injuries to treat. Not much is known about the incidence, the diversity of the performed techniques and the aftertreatment. Goal of this study was to document the amount of cases per hospital and to document the applied treatment modalities. A questionnaire was send to 88 Dutch orthopaedic departments concerning periprosthetic fractures in 2006. The response rate was 76%. The majority of units treated 1-5 cases a year, most of them by operative procedures. Ambulation was allowed by 94% of the respondents in patients treated with osteosynthesis. Opinions differ about the optimal choice of treatment. 58% of the respondents considered a periprosthetic femoral fracture a major health risk. Therefore these fractures deserve a thorough evaluation considering the high numbers of complications and mortality. A nationwide registry is beneficial for research, quality control and improvement of treatment.
Introduction

The incidence of periprosthetic femoral fractures (PPF) in the Netherlands is as yet unknown. As these fractures are not identified separately in the coding system, no information is available about epidemiology and treatment. Also, a nationwide register of implantations is lacking in the Netherlands. The Scandinavian registers, however, have started in the last few years to provide more clarity about the epidemiology and treatment of PPF. Before, only a few retrospective series had been reported by international centres that had adequate internal registration procedures.1-3

In addition to the complexity of analyzing the scope of this problem, it is apparent that treatment is difficult as well as prone to a high number of complications, with complication rates of 20% described in the literature.4 Moreover, mortality is high among PPF patients.5 This high complication rate stresses the need for in-depth research to identify problems and improve the quality of the therapy. Masri et al.6 have proposed a treatment algorithm in 1996. This algorithm was refined in 2004 by Parvizi et al.7 The application of these algorithms should bring more uniformity of treatment and facilitate evaluation of the outcome.

The present study aims to provide an overview of the current state of, and opinions on, the treatment of periprosthetic fractures in the Netherlands. We formulated the following research questions:

• What approximately is the yearly number of PPF cases seen in Dutch hospitals?
• What (surgical) techniques are applied?
• Do Dutch orthopaedic surgeons select treatment strategies in concordance with contemporary literature reports and algorithms?

Materials and Methods

Our data were obtained using a questionnaire (see appendix) that was sent to all Dutch units (practices and/or university departments) in orthopaedics. The questions related to all periprosthetic femoral fractures treated in the unit in 2006. In addition to general questions about preventing and treating these fractures, the questionnaire provided two specific cases and then asked about the proposed treatment. Of 88 questionnaires sent, 67 were completed and returned (response rate 76%).

Some questions allowed essentially equivalent responses to be formulated in different ways; such equivalent answers were lumped together in analysis. To answer the research question about the treatment algorithms, the responses to the specific case questions were compared to the preferred treatment according to the literature. Analyses were performed using SPSS 14.0 for Windows.
Results

General questions

Only 3 units (4%) out of 67 respondents [3 practices] did not treat any periprosthetic fractures in 2006; the majority (45%) treated 1-5 cases, and 11 units (16%) treated more than 10 PPF (Table 1).

<table>
<thead>
<tr>
<th>No. of PPF treated</th>
<th>No. of respondents</th>
<th>Percentage</th>
<th>Cumulative percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>3</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>1-5</td>
<td>30</td>
<td>44.8</td>
<td>49.3</td>
</tr>
<tr>
<td>5-10</td>
<td>23</td>
<td>34.3</td>
<td>83.6</td>
</tr>
<tr>
<td>&gt;10</td>
<td>11</td>
<td>16.4</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

More than half (53%) of the units treated all periprosthetic fractures surgically in 2006, while 23 units treated over 3/4 of PPF; only 9 units treated less than 3/4 of the fractures surgically. Fifty-one units (76.1%) used plate–cable fixation or plate-osteosynthesis. Forty-seven units (70.1%) performed one or more revision surgeries. Eighteen units (26.9%) said they had mostly used an allograft (Figure 1). Out of 67 respondents, 62 said they had accomplished an exercise-tolerant situation after osteosynthesis treatment. However, only 9 respondents reported a weight bearing capacity over 50%. Four clinics (6%) did not usually regard long stem revision surgery as exercise-tolerant. In contrast, 37% of clinics allow their patients to apply...
loads over 50%. The question whether periprosthetic femoral fractures are a major health problem in the Netherlands was answered in the affirmative by 58% of the respondents. The responses to this question are specified in Table 2 for units with different incidences of PPF.

### Table 2. Responses to “PPF is a major health problem in the Netherlands”

<table>
<thead>
<tr>
<th>No. of PPF seen</th>
<th>Major health problem in the Netherlands?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>None</td>
<td>3</td>
</tr>
<tr>
<td>1-5</td>
<td>11</td>
</tr>
<tr>
<td>5-10</td>
<td>9</td>
</tr>
<tr>
<td>&gt;10</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
</tr>
</tbody>
</table>

### Box 1

Case A. 85-year-old female, walks indoor only, uses a walking aid. THA Right cemented 12 years in situ. ASA class IV, X-ray evidence of loosening. What is your preferred method of treatment?

- [ ] Conservative
- [ ] Stem revision
- [ ] Plate–(screw)–cable construct
- [ ] Plate and screws
- [ ] Allograft
- [ ] Other: ____________________________

### Box 2

Case B. 65-year-old male, no mobility aid. Cemented THA Left, 5 years in situ without symptoms. ASA class I. What is your preferred method of treatment?

- [ ] Conservative
- [ ] Stem revision
- [ ] Plate–(screw)–cable construct
- [ ] Plate and screws
- [ ] Allograft
- [ ] Other: ____________________________

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Periprosthetic femoral fractures in the Netherlands
Case-specific questions
The cases presented in the questionnaire are described in Boxes 1 and 2. Responses are collected in Tables 3 and 4 correspondingly. Several respondents indicated multiple answers to case questions.

In both cases a distinct preference towards plate osteosynthesis is apparent, with or without a cable component (64.2% and 68.7%).

<table>
<thead>
<tr>
<th>Table 3. Preferred treatment for Case A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>Revision</td>
</tr>
<tr>
<td>Plate–screw–cable</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Revision/Plate</td>
</tr>
<tr>
<td>Total completed</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 4. Preferred treatment for Case B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>Revision</td>
</tr>
<tr>
<td>Plate–screw–cable</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Revision/Plate</td>
</tr>
<tr>
<td>Total completed</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Discussion
General questions
The incidence of these fractures varies considerably among the respondents (76%). All units together saw 350 PPF in 2006, most of them treated 1-5 PPF in one year. It is remarkable that 11 clinics each treated more than 10 PPF. These could possibly be departments with a high volume of hip prosthetic surgeries. Another explanation could be that a concentration of patients occurs in certain centres.

Several authors have reported an increasing incidence of PPF. As the Dutch situation has not been previously described, no conclusions can be
based on the existing data. The incidence of PPF has been reported to be elevated for uncemented stems. Van der Wal and colleagues reported 2.3% PPF after an average of 6.9 years follow-up in a large cohort of uncemented ABG prosthesis.\textsuperscript{10} While the average age of this cohort was 67.6 years, the PPF patients were, on average, 79.0 years old at the time of PPF (on average 72.2 years old during surgery). This suggests PPF to have a higher incidence when uncemented THP is used at higher age. Whether this phenomenon is general or related to this specific implant has not been entirely clarified. Moreover, (micro)fissures created perioperatively could be overlooked, and lead to a full fracture at a later point in time.

In 86% of the clinics 75-100% of all cases underwent surgery. A small group of patients was treated conservatively. In cases of high co-morbidity or limited health benefit of surgery, treatment could be palliation with bed rest, traction or plaster of Paris. Complications to be expected with this therapy are comparable to those for conservatively treated fractures of the proximal femur.\textsuperscript{5} It is also possible that the Vancouver A fractures, namely those of the trochanter major, were included in the responses, thereby distorting the image. 94% of the responding surgeons indicated that in most cases they created safe mobilisation conditions with osteosynthesis. However with revision rates of 25% reported in the literature\textsuperscript{11}, this generally advocated postoperative regime might be overconfident. Of the 55 respondents who performed a long stem revision in 2006, 55% advised the patient not to apply load to this construct.

The question whether periprosthetic femoral fractures are a major health risk in the Netherlands was answered in the affirmative by 58% of the respondents, implying that further research and development on the treatment of these fractures is needed. An adequate registration system is vital in this respect. As the current registration (DBC, LMR) in the Netherlands does not provide insight in incidence and clinical outcome of PPF, the new nationwide prosthetic registration should include a separate coding mechanism for this type of fracture.

Case-specific questions

There is no single optimal treatment for femoral fractures in connection with hip prostheses. Treatment depends on fracture type, general patient-related factors, implant factors (loosening), bone quality and the experience of the physician. These considerations have been incorporated in the treatment strategies proposed by Parvizi et al. and Masri et al.\textsuperscript{7,12}

The treatments suggested for the two cases presented in the questionnaire did not vary significantly with the number of PPF treated in the clinic. The results of the questionnaire show that 3/4 of the clinics usually treat PPF using plate–cable osteosynthesis. Cortical allograft is applied routinely in only 27% of the clinics, although good biomechanical stability and treatment results have recently been published.\textsuperscript{13-15} This could possibly be
due to limited availability of donor material, high cost, and the experience of the treating physician with bone allografts.

The two cases presented in the questionnaire were deliberately chosen very differently. According to modern treatment algorithms, loosening is an indication for long stem revision; an advantage this procedure is the rapid restoration of load capacity. In 2005 Lindahl and colleagues reported that, for a PPF after a first THP, 70% of stems had loosened [23% known before PPF; 47% unknown until PPF]. These percentages were 21% and 23%, respectively, for a PPF after revision. For Case A, the co-morbid ASA IV patient, 64% would choose a plate construction with or without cable, while only 22% suggest a revision procedure. Thus the majority does not perform the treatment preferred in the proposed algorithm. Both the plate construction and the revision procedure place a heavy burden on this type of patients in terms of tissue damage, surgical trauma, blood loss and cardiopulmonary stress. Only a few respondents chose the recently reported option of a minimally invasive inserted retrograde pen for stabilisation. For Case B, a considerable number of respondents (19%) would choose revision, although the stem in this case is well fixated in the femoral shaft. According to the algorithm osteosynthesis is the preferred treatment here, and indeed the majority of respondents concurs. However there is no clear uniformity among the respondents as the underlying rationale of these two treatment modalities differ greatly.

In the treatment of PPF a tailored strategy is preferable. Moreover, new ideas and implants may provide novel solutions for specific problems. Almost all treatment propositions in the literature ignore the general condition of the patient, although that condition may strongly affect the balance between the risks of surgery and the fracture-technical advantages of a certain technique. A treatment proposition should therefore take account of the general characteristics of the patient, for instance, in the form of a clinical vitality score. This suggests an interesting research question for a multi-centre prospective study.

In conclusion, it has become apparent that opinions differ about the clinical problem of periprosthetic fractures and their treatment. The relatively small number of patients treated in each hospital, combined with the differing approaches, underscores the need for an implant registration system in the Netherlands.
Query periprosthetic fractures of the femur.
(translated from Dutch)

1. Could you estimate the amount of patients with a periprosthetic fracture treated in your hospital in 2006?
   (please tick one)
   □ None → continue with question 8
   □ 1-5
   □ 5-10
   □ More than 10

2. How many patients with unstable fractures did you treat operatively?
   □ All
   □ More than ¾ of the cases
   □ More than ½ of the cases
   □ Less than ½ of the cases

3. Which kind of treatment did you perform in 2006 (multiple answers possible)
   □ Conservative
   □ Stem revision
   □ Plate(-screw)-cable construction
   □ Plate screw
   □ Allograft
   □ Other (retrograde nail) __________________________

4. Patients were able to exercise after a performed osteosynthesis in most cases. (Yes/No)

5. Load bearing (>50%) was allowed after a performed osteosynthesis in most cases (Yes/No)

6. Patients were able to exercise after a performed revision arthroplasty in most cases. (Yes/No)

7. Load bearing (>50%) was allowed after a performed revision arthroplasty in most cases (Yes/No)

8. The treatment and complications of a periprosthetic fracture account for a large health problem in The Netherlands. (Yes/No)
We kindly ask you to answer the following case specific questions:

**Box 1**

Case A. 85-year-old female, walks indoor only, uses a walking aid. THA Right cemented 12 years in situ. ASA class IV, X-ray evidence of loosening. What is your preferred method of treatment?

- [ ] Conservative
- [ ] Stem revision
- [ ] Plate–(screw)–cable construct
- [ ] Plate and screws
- [ ] Allograft
- [ ] Other: ________________________________

**Case B**

Case B. 65-year-old male, no mobility aid. Cemented THA Left, 5 years in situ without symptoms. ASA class I. What is your preferred method of treatment?

- [ ] Conservative
- [ ] Stem revision
- [ ] Plate–(screw)–cable construct
- [ ] Plate and screws
- [ ] Allograft
- [ ] Other: ________________________________
Periprosthetic femoral fractures in the Netherlands

Reference List