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Functional and radiological outcome of periprosthetic femoral fractures after hip arthroplasty

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ABSTRACT

Background: The aim of this study was to determine the functional and radiological results of the treatment of periprosthetic femoral fractures.
Materials and methods: A review was performed of all periprosthetic femur fractures after a total hip arthroplasty (THA) or hemiarthroplasty (HA) treated at our institution from 1995 to 2011. Functional outcome was assessed in terms of the Harris Hip Score and ambulatory status. Radiological findings were classified using Beals and Tower's criteria.
Results: A total of 59 periprosthetic fractures were identified in 58 patients. The mean age of patients was 79 years old and the mean follow-up time was 33.6 months. Local risk factors were identified in 71% of the patients, principally osteoporosis (59%), followed by osteolysis (24%) and loosening of the stem (19%). In the multivariable analysis, the presence of local risk factors was associated with worsening of patients' ambulatory status. According to the Vancouver classification, there were 8 type A, 46 type B and 5 type C fractures. Of the type B fractures 24 were B1, 14 were B2 and 8 were B3.

Fracture union was achieved in 54 fractures, with a mean union time of 6 months. Applying Beals and Tower's criteria, radiological results were excellent in 20 patients (34%), good in 22 (37%), and poor in 17 (29%). None of the patients improved their ability to walk after these fractures and 31 patients (52%) did not regain their prefracture walking status. The mean Harris Hip Score postoperatively was 67.9.

There were major or minor complications in 33 patients (56%) and 11 patients (19%) required further operations.
Conclusion: Although this study shows good radiological results following methods of treatment in accordance with the Vancouver classification, there was marked functional deterioration in many patients and a high rate of complications. Local risk factors were associated with poorer ambulatory status.

Introduction

Periprosthetic femoral fractures after hip arthroplasty are a severe complication and their treatment is a difficult challenge; it is technically demanding, and is associated with several serious complications. In elderly patients, the surgical procedure may be particularly complicated due to poor bone quality, and also these patients have higher prevalence of medical comorbidities, which could worsen the prognosis.

The true incidence of periprosthetic fractures is uncertain, with estimates ranging from 0.1 to 2.1%, and in revision procedures incidences reported have been even higher (2.8% and 4%) [1,2]. Moreover, the absolute number of periprosthetic fractures can be expected to increase, due to a worldwide rise in the elderly population and the increasing prevalence of primary and revision hip arthroplasties [3,4]. Several local risk factors have been described, including osteoporosis, rheumatoid arthritis and Paget's disease, which affect the quality and mechanical strength of the host bone. Cementless implants, malposition of the components, osteolysis and loosening, and cortical stress risers also may lead to a fracture [5,6]. In addition to these, general factors such as female gender, higher comorbidity, and higher ASA score were associated with a higher risk of periprosthetic fractures [6].

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Our objective was to identify local risk factors and medical comorbidities, and to examine our experience with the treatment of postoperative periprosthetic fractures to corroborate the recommendations of the Vancouver group [7]. Additionally, we analysed functional outcome and ambulatory status after the fracture and whether they were influenced by any of the factors studied.

Materials and methods

A retrospective review was performed of all periprosthetic femur fractures after a total hip arthroplasty (THA) or hemiarthroplasty (HA) treated at our institution from 1995 to 2011. We only included patients with complete medical records and radiographs. Intraoperative fractures, concomitant infection and fractures related to cancerous lesions were excluded. To analyse the functional and radiological outcome, patients followed-up for less than 10 months were also excluded. Comorbidity was measured using the Deyo-Index and the ASA score [8]. Minor diseases such as high blood pressure or dyslipidaemia were not included.

Local risk factors were assessed on the basis of previous radiographs: periprosthetic osteolysis, loosening, malposition of the stem or considerable heterotopic ossifications (Brooker grades 3 and 4) [9]. Osteoporosis was considered to be present if there was low bone density demonstrated by densitometry (T-Score ≤ -2.5); previous osteoporotic fractures (distal radius, vertebral, or hip); or cortical thickness index <0.40 (measured on both anteroposterior and lateral radiographs of the hip) [10].

Radiographs and medical records were reviewed to ascertain the primary diagnosis (osteoarthritis, osteonecrosis, inflammatory arthropathy or a fracture), type of procedure performed (hemiarthroplasty, THA or revision THA), and type of fixation used (cemented or cementless). The fracture mechanism was categorised as low-energy trauma, high-energy trauma or spontaneous fracture.

Fractures were classified by the authors according to the Vancouver classification system [7]. Type A fractures are those located in the proximal metaphysis, further subdivided into those involving the greater trochanter (AG) or lesser trochanter (AL). Fractures around the stem or just below it are defined as type B, which is subdivided into those adjacent to a stable stem (B1), to a loose stem but with adequate bone stock (B2) or to a loose stem with poor bone stock (B3). Type C fractures are located well below the stem tip. The choice of treatment is based upon the type of fracture, the integrity and quality of the remaining bone stock, and the stability of the implant. The treatment was classified as non-operative, revision, or open reduction and internal fixation (ORIF). The length of hospital stay and requirement for blood transfusion were also recorded. Bone-related complications were classified as dislocation, nonunion or refracture. The destination after discharge was a nursing home (or chronic care hospital) or the prior home address.

The time to union was recorded. This variable was defined radiologically as callus formation on both anteroposterior and lateral radiographs, and clinically as weight bearing with no more than baseline levels of pain. Radiological findings were classified using the criteria proposed by Beals and Tower [11]. According to this classification, outcomes were graded as excellent (stable arthroplasty with minimal deformity), good (stable arthroplasty or with minimal subsidence and fracture healed with moderate deformity) or poor (loosening, nonunion, sepsis, severe deformity or new fracture). An implant was described as stable if there was an absence of radiolucent lines around the stem or progressive implant migration or subsidence [12].

The clinical outcome was assessed on the basis of patient mobility. The mobility in the period prior to the fracture and after fracture healing was assessed using the following categories (from best to worst): able to walk without help, able to walk with a walking stick, able to walk with a walking frame or two crutches, and unable to walk. In addition, the Harris Hip Score (HHS) was used to evaluate the functional outcome [13]. Where patients were unable to attend the hospital for follow-up due to frailty, then HHS was assessed via a telephone interview. Local and systemic complications were sub-categorised as in Parvizi et al. [14].

Statistical analysis

Initially, an exploratory data analysis of the studied sample was performed. Mean and standard deviation were calculated for the age of patients and frequencies and percentages for qualitative data. Differences in sociodemographic and clinical characteristics between the fracture types according to the Vancouver classification were assessed. To this end, the Kruskal–Wallis non-parametric test for independent samples was used for continuous variables and the Chi-square test (with Fisher's Exact test if required) for categorical variables.

Furthermore, McNemar's test was used to assess the percentage difference between the pre- and post-fracture ambulatory status in each category. Walking recovery after the fracture healing was the main outcome of the study. Patients were considered to have recovered when they regained their previous mobility (i.e., any change to a similar or better status). Otherwise, there was considered to have been no recovery. To determine the potential predictors of walking recovery, a univariate analysis was performed, using the Chi-square test or Fisher's Exact test (if necessary). Subsequently, a multivariable logistic regression analysis was performed, with recovery as the dependent variable and all variables with a p-value <0.20 in the univariate analysis as independent variables.

All the statistical analyses were performed using SAS System v 9.2 and p-values were deemed to be significant when <0.05.

Results

A total of 71 patients were identified, of which 58 patients (59 fractures) fulfilled the inclusion criteria. Six of the patients excluded were lost to follow-up, and the other seven died after less than 10 months of follow-up. Among those included in the analysis, the mean age at the time of presentation was 79 years old (range, 57–97), 24 of the fractures were in men (35 in women), and the left hip was the most commonly involved (63%). The mean follow-up time was 33.6 months (range, 11–133 months).

As for comorbidities, 16 patients (28%) had a Deyo–Charlson index score of 3, 9 patients (16%) a score of 2, and 13 patients (22%) a score of 1. Only 20 patients (34%) had no comorbidities. Nearly three-quarters of patients (43, 73%) had an ASA class of 3 or higher. Local risk factors were identified in 71% of the fractures, principally osteoporosis (59.3%), followed by osteolysis (24%) and loosening of the stem (19%). Heterotopic ossifications classified as Brooker grade 3 or 4 were found in 4 patients.

Reasons for initial THR surgery were osteoarthritis (48%), fracture (39%), inflammatory arthritis (4%) and avascular necrosis of the femoral head (10%). The periprosthetic fracture involved a primary THA in 38 cases, a revision THA in 5 cases, and a hemiarthroplasty in 16 cases. The mean time from primary procedure to fracture was 85 months (SD = 77 months). The type of fixation was cementless in most cases (53 patients, 91%). Eighty per cent of the patients were community ambulators without help or able to walk with only a walking stick. The great majority of fractures were caused by falls (85%), followed by spontaneous