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Causes of failure in periprosthetic fractures of the hip at 1- to 14-year follow-up

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ABSTRACT

Introduction: The results and causes of failure for 61 patients undergoing surgery for femoral hip periprosthetic fracture are reported.
Materials and methods: Fractures were classified according to the Vancouver System. Osteosynthesis was performed in 88% of cases and prosthetic revision in 12% of cases. Clinical and functional outcomes were assessed according to the Harris Hip Score and radiological results were evaluated using Beals and Tower's criteria.
Results: At a mean follow-up of 32 months, the Harris Hip Score was 73.1 and the radiological results were excellent-to-good in 72.2% of patients after the first surgery. At the end of treatment, complete healing of the fracture and stability of the prosthesis was found in 87.3% of patients. The most relevant result was the recovery of walking in 73.8% of patients. Mortality after surgery was 1.6% at 3 months and 3.3% at 12 months. A higher mortality rate occurred when surgery was delayed more than 5 days after trauma.
Conclusions: The analysis of our cases shows that in Vancouver type B1 fractures treated with plating osteosynthesis, there were worse outcomes in total hip arthroplasty with cemented stems compared with uncemented stems. In Vancouver type B2 fractures with cementless straight stems, osteosynthesis with a plate can be a valid option. In Vancouver type C fractures, the stability of the stem must be carefully assessed.

Introduction

Periprosthetic femoral fracture after total hip arthroplasty is a severe postoperative complication, the treatment of which involves conservative treatment or complex, expensive and invasive surgical procedures in typically old patients with many comorbidities [1–4]. The surgical technique is generally an internal osteosynthesis or a prosthetic stem revision or a combination of both [5–7], and it is associated with a high rate of failure and need for further surgeries [8–10]. Lindahl et al. [8] had a failure rate of 12% and Springer et al. [10] had a rate of need for further surgeries of 17% due to prosthetic loosening, non-union, implant instability, new fractures and infections. Postoperative periprosthetic fractures are the third (9.5%) most common cause of prosthetic revision after aseptic loosening (60.1%) and instability (13.1%) [11]. Bhattacharyya et al. [12] reported a mortality rate of 11% one year after surgery, which is similar to hip fracture mortality rate (16.5%), but significantly higher than total hip arthroplasty mortality rate (2.9%). The Vancouver system is accepted worldwide for the classification of these fractures and their surgical treatment [13,14].

The aim of this study was to report our results and causes of failure after 1–14 years follow-up.

Materials and methods

A total of 71 patients were admitted to our Orthopaedic and Trauma Unit from June 1998 to August 2012 for postoperative hip periprosthetic femoral fracture. A review was conducted of 61 of these patients; 57 cases were fractures after primary hip prosthesis (93%) and four were after revision (7%). The clinical and radiological records for these patients were studied. Thirty patients were examined and the remaining 31 patients were interviewed by telephone to assess their current health status. The last X-ray was evaluated in all cases. Fifteen patients had died by the time of review. In these cases, the patient's relatives were interviewed. The

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data were collected and analysed in compliance with the procedures and policies of the Helsinki Declaration and all patients (or their relatives) gave their informed consent for use of the data. All the patients had undergone surgery. The study excluded patients whose periprosthetic fractures were treated conservatively. There were 51 females (83.6%) and 10 males (16.4%). Mean age at the time of fracture was 76.3 years (range 46–96 years); 54 patients at the time of fracture were aged over 65 years. The right hip was affected in 34 cases and the left in 27.

The following factors were considered: primary diagnosis for the arthroplasty (28 medial femoral neck fractures, 24 idiopathic osteoarthritis, 5 post-traumatic arthritis and 4 arthritis secondary to congenital dislocation of the hip [CDH]); implant types (31 cementless arthroplasty, 19 cemented arthroplasty, 5 hybrid arthroplasty and 6 hemiarthroplasty); stem design (25 anatomical and 36 straight); time between implant and fracture, and trauma dynamics.

Also considered were waiting time between trauma and surgery (mean 7.3 days, range 1–26 days); patient's general condition at trauma (2.3 comorbidities/patient); previous orthopaedic surgeries (from 1 to 4 per patient in 48% of the cases); the anaesthesiological risk according to the American Society of Anaesthesiologists Classification (ASA) (35 cases ASA $\geq$ 3), and the mortality rate. The Vancouver System was used for radiological classification of the fractures [15,16]. A highly debated issue in the literature is the preoperative diagnosis between Vancouver B1 and Vancouver B2 fractures, and the expected treatment [8].

Vancouver type B2 fractures are those in which the traumatic event causes the loss of the previous anatomical relationship between the stem and femur. The X-rays of the implant before and after the fracture were compared.

Although the Vancouver System was used as reference for fracture classification, the choice of surgical treatment was affected by the nature of the fracture, the stability of the prosthetic implant, the quality of the bone stock, the patient's age and the experience of the surgeon [13]. The surgical procedures were associated with a significant blood loss: 72.5% of the patients in the perioperative period needed blood transfusions with a mean of 3.8 blood units/patient (hip revision: 5 units/patient; osteosynthesis: 3.6 units/patient). The postoperative rehabilitation programme differed according to the type of surgery: rehabilitation was more aggressive for hip revision, with early mobilisation and weight-bearing a mean of 15 days after surgery, and more cautious for osteosynthesis, with assisted and delayed weight-bearing a mean of 40 days after surgery.

Radiographic results were evaluated using the Beals and Tower's criteria [17,18] (Table 1). The radiographic consolidation of the fracture and the stability of the prosthetic implant at the end of treatment were examined in those patients who required further surgery. The clinical and functional outcomes were assessed using the Harris Hip Score (HHS) [19]. The most important clinical parameters analysed were pain and recovery of walking ability. As the HHS before the trauma was not available, the patients (or their relatives) were asked to complete a self-evaluation survey for before and after the trauma with a score from 1 (poor) to 10 (excellent) to enable changes in quality of life to be assessed.

Results

The time between implant of the prosthesis and fracture was less than one year in 17 cases (27.8%), with a slight prevalence in cementless stems (10 cases, compared with 7 cases with cemented stems) (Fig. 1). Twelve of the 17 patients (70.6%) had undergone a hip arthroplasty for hip fracture and for 15 of the 17 patients (88.2%), the cause of the periprosthetic fracture was a low-energy trauma (accidental fall or limb loss of support). In the cases involving a hemiarthroplasty, the fracture occurred within the first year in 33% of patients (2/6 cases).

The cases were divided according to the Vancouver classification: 1 type AG (1.6%), 30 B1 (49.2%), 7 B2 (11.5%), 11 B3 (18%) and 12 C (19.7%).

The first surgical procedure was as follows: 52 (85%) plate fixations (43 Cable Ready, 7 locking compression plate [LCP], 1 Mennen, 1 AO); 7 (12%) prosthetic revisions (all Wagner stems); 1 retrograde intramedullary nail and 1 with simple cerclages. Bone graft was used in only two reoperations. The mean clinical follow-up was 32 months (range 1–130 months). The clinical outcome with HHS was 73.1 (range 17–100). In the absence of data before the trauma, at follow-up an excellent mean passive range of motion was obtained (flexion 87°, extension 6°, E-rotation 21°, abduction 33°, I-rotation 7°, adduction 18°) and a leg length discrepancy was found in 37 cases (61%): in 30 patients a shortening of the limb (average −1.6 cm) and in 7 patients a lengthening (average +2.3 cm). Pain was present in 21 cases (34%), including 15 with chronic pain.

The most relevant element that was considered in this study was the recovery of walking ability (Table 2): 73.8% of patients were able to walk without support or with the aid of a cane, while 26.2% were disabled; 55.7% of the patients were able to climb stairs and 47.5% were able to walk two or three blocks.

Mean radiographic follow-up was 32.2 months (range 1–130 months). The radiographic findings, according to Beals and Tower's criteria, were: 31 excellent (56.4%), 9 good (16.4%) and 15 poor (27.3%); 6 cases were not evaluated because of short-term follow-up. Fracture consolidation with a stable prosthetic implant was achieved in almost 73% of cases after the first treatment. Eleven patients required further surgery. At the end of the treatment, including these 11 patients, there was complete radiographic healing of the fracture with stability of the prosthetic implant in 48 cases (87.3%).

There were 17 postoperative complications: 2 new fractures; 4 failures of the fixation, system (1 septic); 3 periprosthetic heterotypic ossifications; 3 prosthesis stem loosening; 2 dislocations (1 recurrent); 1 septic non-union; 1 superficial infection, and 1 loss of reduction of the fracture (Mennen Plate). New surgical procedures were required 15 times in 11 patients: 5 new osteosynthesis, 4 arthroplasty revisions, 3 synthesis device removal, 2 surgical wound revisions and 1 prosthetic head replacement. The average score in the self-evaluation survey of the quality of life before and after the fracture was 7.3 preoperatively and 5.7 postoperatively in the 45 patients who regained walking ability, while in the 16 disabled patients it was 5.9 preoperatively and 2.7 postoperatively. The mortality rate at 3 months, 1 year and 2 years after surgery was 1.6%, 3.3% and 11.5%, respectively, and was higher in patients whose surgery was delayed more than 5 days after trauma (Table 3).

Table 1
Beals and Tower's criteria for radiological evaluation.

Outcome	Arthroplasty		Fracture
Excellent	Stable	And	Healed with minimal deformity without shortening
Good	Stable Subsidence	Or	Healed with moderate deformity and shortening
Poor	Loose	Or	Non-union, sepsis, or new fracture with severe deformity and shortening

Modified from Beals and Tower [13].