Abstract. – OBJECTIVE: Proximal periprosthetic femoral fractures (PPFFs) are gradually increasing and surgical management is often associated with high risk of complications, due to elderly population and associated comorbidities.

PATIENTS AND METHODS: We retrospectively assessed 39 patients at least at 2-years follow-up. We identified two study groups, similar for demographic data. Group A included patients surgically treated without involving prosthetic implants, whereas Group B included patients in which an implant revision was performed.

RESULTS: Data were recorded from January 2017 to February 2020, and 39 patients were included: 30 females (76.9%) and 9 males (23.1%), with a confirmed diagnosis of periprosthetic fracture of the proximal femur. 23 (58.9%) patients were treated with Open Reduction and Internal Fixation (ORIF), 12 (30.7%) with revision surgery and 4 (10.3%) were treated by modular megaprosthesis.

CONCLUSIONS: The treatment options considered in the study, revision arthroplasty and internal fixation had shown no significant differences as a matter of clinical outcomes and post-operative complications.

Key Words: Total Hip Arthroplasty, Periprosthetic fractures, Revision arthroplasty, Internal fixation, Proximal femur.

Introduction

Periprosthetic fractures are a well-documented, serious complications of joint arthroplasty, occurring in up to 11% of hip replacements. Proximal periprosthetic femoral fractures (PPFFs) are the second most common reason for hospital readmission within 30-days since the discharge in patients with total hip replacement (THR) and the third most common reason for reoperation after aseptic loosening and dislocation in patients who had THR. PPFFs are set to increase because of higher life expectancy age and the related estimated growing incidence of THR by 174% by 2030.

This complication is often related to higher mortality rate, higher costs of hospitalization and a huge social and economic burden due to incomplete functional recovery of the patient. The most used classification for PPFFs is the Vancouver classification, which describes the location of the fractures, stability of the stem and femoral bone quality. Periprosthetic fractures are usually associated with low energy trauma, often related to a higher risk of falls in elderly patients. For example, a fall from sitting or standing position or a “spontaneous” fracture, is commonly caused by bone osteolysis or loose prosthesis. Major trauma as the main cause is rare. Some of the grounds behind this problem are also determined by the predominantly cementless design of the modern implants because they may have higher early rates of periprosthetic fracture. This underlies the growing need for a comprehensive understanding of the potential outcomes and sequelae of PPFFs.

For the treatment, the surgical option is often the most indicated, due to the poor outcome of the conservative option, leading to a longer immobilization and related complication. Among the surgical treatments available for these conditions, only two are commonly used, according to fracture patterns, implants stability and bone stock: open reduction and internal fixation (ORIF) or...
total hip replacement, mainly stem revisions\textsuperscript{10-12}. Based on current indications, an ORIF can be performed only if the implants are stable and not loosened, otherwise a stem revision must be taken into account. Clearly, clinical outcomes are different between them, due to the late expected recovery in the ORIF group compared to the Implants revision. Anyway, the possibility of saving and sparing bone stock, avoiding a stem revision, still has to be considered when the surgery comes to mind. Hybrid solution can be the use of both options together, first performing an open reduction and internal fixation, and then revising the stem\textsuperscript{10}. Nowadays a different type of implants, more used in musculo-skeletal oncology rather than in traumatology, is often chosen, but it can also find an indication in this kind of condition\textsuperscript{13}.

The aim of this article is to compare clinical outcomes in patients with PPFFs surgically treated with or without implants revision and, as second endpoint, to analyze epidemiology and data of periprosthetic femoral fractures in a high volume first level trauma center.

Patients and Methods

The present study is a retrospective analysis of patients with PPFFs admitted in the Orthopedic Department in I level trauma center in Rome, Italy. An ethical approval was not requested for this retrospective analysis. All procedures were performed following written informed patient consent and in accordance with the ethical standards of the institutional and/or national research committee and the 1964 Declaration of Helsinki and its subsequent amendments or comparable ethical standards.

All patients older than 65 years with PPFFs were identified from trauma databases and included in the present investigation if surgically treated. Patients were excluded in case of incomplete radiological or clinical data, pathological fractures, and a follow up shorter than two years. Moreover, patients with previous fixation of PPFFs did not enter the study.

Clinical notes and hospital records were reviewed in order to collect patient demographics, Vancouver Grade fracture classification, surgical treatment, type of implants, hospitalization, peri and post-operative complications.

Clinical outcomes were recorded with Patients Reported Outcomes Measures (PROMs) and Clinical completed scores. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Hip disability and Osteoarthritis Outcome Score (HOOS), Activities of Daily Living (ADLs) score and Brody Instrumental Activities of Daily Living Scale (IADL) were performed. Radiological assessments were made through plain radiographs of the pelvis in Antero-posterior view to analyze before the surgery the fracture type and the eventual loosening, and during the follow-up after surgery, to examine bone healing and the radiological outcome. Vancouver classification was used to identify the diagnosis.

As already stated, the treatment choice included two alternatives: open reduction and internal fixation (ORIF) or total hip replacement, mainly stem revisions. Therefore, we identified two study groups, similar for demographic data. Group A included patients surgically treated without involving prosthetic implants, whereas Group B included patients in which an implant revision was performed.

During hospitalization, all patients received continuous multidisciplinary team care from the trauma team, the geriatric team and the physiotherapists throughout their inpatient stay. Post-operative indications for group A were no weight bearing for 45 days, then progressive weight bearing through uses of crutches. During this period, active and passive mobilization of the hip on the bed were suggested. For group B, an earlier weight bearing was achieved and strongly encouraged. Each clinical and radiological follow-up was planned at 1, 3, 6 and 12 months, then yearly for both groups, with clinical examination and X-rays of the Pelvis in Antero-posterior view.

Statistical Analysis

Data were analyzed for descriptive statistics as mean or median for continuous variables and frequency distribution (%) for categorical variables. Further inferential analysis was not possible because data were not homogeneous.

Results

Data were recorded from January 2017 to February 2020, before the SARS-CoV-2 pandemic in Italy significantly changed the trauma department in our hospital\textsuperscript{14}. A retrospective analysis of the Hospital database was performed, the demographic data were recorded and are shown in Table I. 39 patients were included: 30 females
(76.9%) and 9 males (23.1%), with a confirmed diagnosis of periprosthetic fracture of the proximal femur, more specifically 15 involving the right femur (38.5%) and 24 (61.5%) the left one. The mean age was 84.4 ± 7.9 years, the mean BMI value was 21.7 ± 8.4.

Among these patients, 36 (92.3%) had direct trauma to the hip, in 35 cases (97.2%) the cause was a low energy trauma. One patient had a PPFF during a primary total hip replacement surgery. 7 (17.9%) patients had only one comorbidity, 32 (82.1%) have more than one comorbidity.

According to the Vancouver classification of periprosthetic femoral fractures, we found 6 (15.4%) type AG fractures; 17 (43.6%) type B1; 12 (30.7%) type B2; 4 (10.3%) type B3 (Table II).

Chosen surgical options and therefore the two groups, A and B, are detailed in Table III, 23 (58.9%) patients were treated with Open Reduction and Internal Fixation (ORIF); 12 (30.7%) with revision surgery and 4 (10.3%) were treated by modular megaprosthesis. Posterolateral approach was used in 22 (56.4%) patients, while lateral approach in 17 (43.6%). Average total length of hospitalization was 16.8 ± 8.8 days.

Patients were evaluated using 5 scales: HOOS and WOMAC scales to assess pain, hip function, and quality of life; ADL, IADL and Clinical frailty score to assess the degree of autonomy in the activities of daily life. These scores were assessed at the last follow-up for each patient. Mean follow-up was 26.3 months. The results are shown in Table IV. No significant differences between the two groups were recorded. Most of the clinical scores were similar in Group A and B, with a mild superiority in the HOOS score and a better result in the WOMAC score for Group B. Radiological evaluation showed a good bone healing at last follow-up X-rays without loosening of the implants for all the patients from both groups.

About the intraoperative complications, one case suffered from periprosthetic damage during surgery: a patient with B1 fracture, during surgery for open reduction and internal fixation, had intraoperative complications, resulting in a B2 fracture. For this reason, the patient was treated through stem revision surgery and ORIF.

Postoperative complications were similar in both groups, with a total of 2 (5.12%) surgical wound infections, 10 (25.6%) postoperative anemia (they both received blood transfusions during hospitalization), 1 (2.56%) acute intestinal ischemia. 10 patients (25.6 %) died within less than 3 years from surgery. Results for different group are shown in Table V.
Discussion

PPFFs occurring in up to 11% of Total Hip Replacements (THR) and in 7% of hip hemiarthroplasties. The number of PPFFs is enhanced due to the increased quantity of hip replacements. Risk factors of PPFFs, as reported in actual literature, include old age, rheumatoid arthritis, osteoporosis, and low energy falls. Using a cementless stem can increase the risk of PPFFs of up to 14 times. The risk of patient falling is also associated with some neuromuscular diseases, such as Alzheimer, Parkinson and Dementia, but there is not a direct correlation with the risk of PPFFs. Füchtmeier et al found an association between higher mortality and old age, higher ASA grades and dementia. In another study, Drew et al confirmed the higher mortality rates at 1 year in elderly patients with high BMI. PPFFs have poor clinical outcomes and generally involve unwell, frail, and elderly patients. They do not return to their pre-injury functional level and bed rest, and that is associated with the onset of systemic complications and further limited mobilization. Females are 40% more likely to have a PPFF. 76.9% of our patients was female.

The treatment of PPFFs is influenced by the Vancouver classification. As shown in the review of Stoffel et al, there are no significant differences between revision and fixation, as also reported in our study, and the most significant indication toward one or the other is given by fracture type, stem stability and bone stock. Scalfici et al made a comparison similar to ours, with a larger population size but a lower minimum follow-up (12 vs. 24 months). Their conclusion has shown a possible advantage for revision arthroplasty (RA), even if some limitations of the study made the statement less evident. Even in this case, the main indication toward ORIF or RA was not on the surgeon, but on the fracture type and implants loosening.

In the present study, we had fair clinical results at least at 2-years follow-up after surgical management of PPFFs (Table IV). We also considered the number of comorbidities of the patients, which also affects the length of stay; in fact, patients with more than 5 comorbidities are more likely to have a longer length of stay than those with 0 to 2 comorbidities with a higher total cost.

Limitations and Strengths

A main limitation in our study is the population size; in fact, patients with PPFFs diagnosis came to our attention are not enough to do any proper statement about epidemiology and treatment options. Moreover, multiple methods of fracture fixation were used, such as plates, cerclage, and screws, according to the fracture patterns and surgeon experience; therefore, it is hard to generalize about the ORIF outcome without considering a single-implant evaluation. In the end, retrospective designed study and midterm follow-up are correct, but they do not allow strong evidence for our findings.

However, this study presents strong findings taking into account that the experience of a high-volume center is precious when a particular condition has to be investigated, representative of the regional population. Surgical techniques were performed by high-experienced and high-skilled surgeons, reducing the surgeon-related bias. Our experience with a multidisciplinary team, involving specialized doctors with ortho-geriatrics curricula, is a strength of our study, because it is still a rare occurrence, despite the high level of evidence linking better outcomes in elderly patients and ortho-geriatric approach.

Conclusions

The current study shows that PPFFs are a devastating event for the patient and may be challenging for the surgeon. The treatment options considered in the study, revision arthroplasty and internal fixation had shown no significant differences as a matter of clinical outcomes and post-operative complications, confirming evidence already present in literature. The main indications for the surgical choice are: fracture type, implant stability and bone stock. Further and larger studies are needed to better evaluate these treatments and to produce stronger evidence.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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