

## C A S E R E P O R T

# Intraoperative complications during total hip arthroplasty: A very uncommon intraoperative femur fracture occurred in a malnourished osteoporotic patient

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**Abstract.** Intraoperative femoral fracture is a rare but growing complication of primary total hip arthroplasty. We aimed to present an uncommon related case, assessing also the role of malnutrition and osteoporosis. We discuss the case of a 49 years old male patient, malnourished and osteoporotic, with an intertrochanteric, multifragmentary, inveterate fracture, that happened three months before. During the prosthetic surgery, a supracondylar fracture occurred. We synthesized it with a 13 holes LISS plate, 7 distal screws and 3 proximal cerclage wires. The leg was immobilized to 0° for 3 weeks and the load forbidden for 3 months. Calcium, Albumine, Total Proteins, Osteocalcin and Vitamin-D levels were below the normal range. Teriparatide was administered for 6 months. Global investigation of the patient's nutritional status is recommended before joint replacement and preoperative planning is mandatory to choose the adequate implant. Osteoanabolic therapy could be advisable to favor fracture healing. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** intraoperative femur fracture, supracondylar fracture, plate, malnutrition, osteoporosis

## Introduction

Total hip arthroplasty (THA) is one of the most common reconstructive procedures in adults and its use is expected to increase in the coming years (1-5). Sloan et al. supposed that in the USA THA procedure will have a linear or slowed growth at least until the next decade, reaching 635,000 procedures in 2030 (6). The main indication for this procedure is end-stage and symptomatic hip osteoarthritis (OA), but it is widely used also for other pathologies such as osteonecrosis, dysplasia and inflammatory arthritic conditions (7).

Intraoperative femoral fracture (IFF) is a rare complication of primary THA which occurs in 2% of cases (8). On the other hand, its incidence in revision surgery is much more frequent, reaching up to 7.8% (8). Many risks factors are related to the patient, such as osteoporosis, older age, female sex, previous hip surgery,

BMI > 40kg/m<sup>2</sup>, metaphyseal-diaphyseal index, hip dysplasia, rheumatoid arthritis, ostemalacia and morbus Paget (9,10). Implant-related and surgeon-related are other possible risk factors. About the implant, from the literature we know that cementless THA are more prone to IFF, that may happen during the broaching of the femoral canal or during implant insertion, because of the surgeon's attempt to obtain an adequate press-fit (10). Moreover, also mini-invasive approaches, such the direct anterior one, have higher IFF incidence (9). Usually, this adverse event affects the calcar portion of the femur, with an incidence of 70%; in the 25% it affects the greater trochanter and in the 5% the diaphysis (9). Currently, IFF are classified according to Duncan and Masri, who proposed a modified version of the Vancouver classification to describe this pattern of fracture (11). Conservative treatment of these fractures is not recommended, particularly in case of

uncemented THA, due to the possible displacement of the fracture or the risk of crack propagation (12).

The aim of the study is to bring to the attention an uncommon type of IFF, occurred during cementless THA, and present our surgical solution. Second endpoint is to assess whether malnutrition and osteoporosis may play a main role in IFF.

## Case presentation

We discuss the case of a 49 years old male patient, who accessed our Emergency Room Department. He complained of pain and total functional impairment to his left lower limb, which started three months before, after a fall. Since then, the patient no longer walked or loaded on the affected leg. He appeared asthenic, thin and malnourished. The limb was extra-rotated, shortened and abducted. In anamnesis there was a history of alcohol addiction (still active) and a previous right proximal femur fracture treated with nailing. X-Rays examination diagnosed a left intertrochanteric, multifragmentary, displaced, impacted inveterate fracture, along with the presence of radiological signs of osteoporosis (Figure 1).

In fact, in the anteroposterior view the morphology of the femur had the peculiar stovepipe shape with an extremely thin bone cortex, loss of trabeculae and increased Canal Bone Ratio (CBR). On the other hand, in lateral view is observable a widened medullary cavity and indistinct cortical bone. Consequently, according to Dorr classification, the femur could be identified as type C (13). In accordance with current protocols, after obtaining a negative result with the nasopharyngeal swab for Covid-19, the patient was then admitted to our ward (14,15). During the hospitalization, blood chemistry tests pointed out values at the lower limit or insufficient for red blood cells (RBC), red cell distribution width (RDW), calcium, vitamin D, vitamin B12, folate, total proteins and albumin.

The patient underwent a CT scan examination which permitted us to perform adequate pre-operative planning (Figure 1). Given the great loss of substance in the intertrochanteric region and the soft tissue degeneration, we opted for a total hip arthroplasty. The surgery was scheduled after two days.

## Surgical procedure

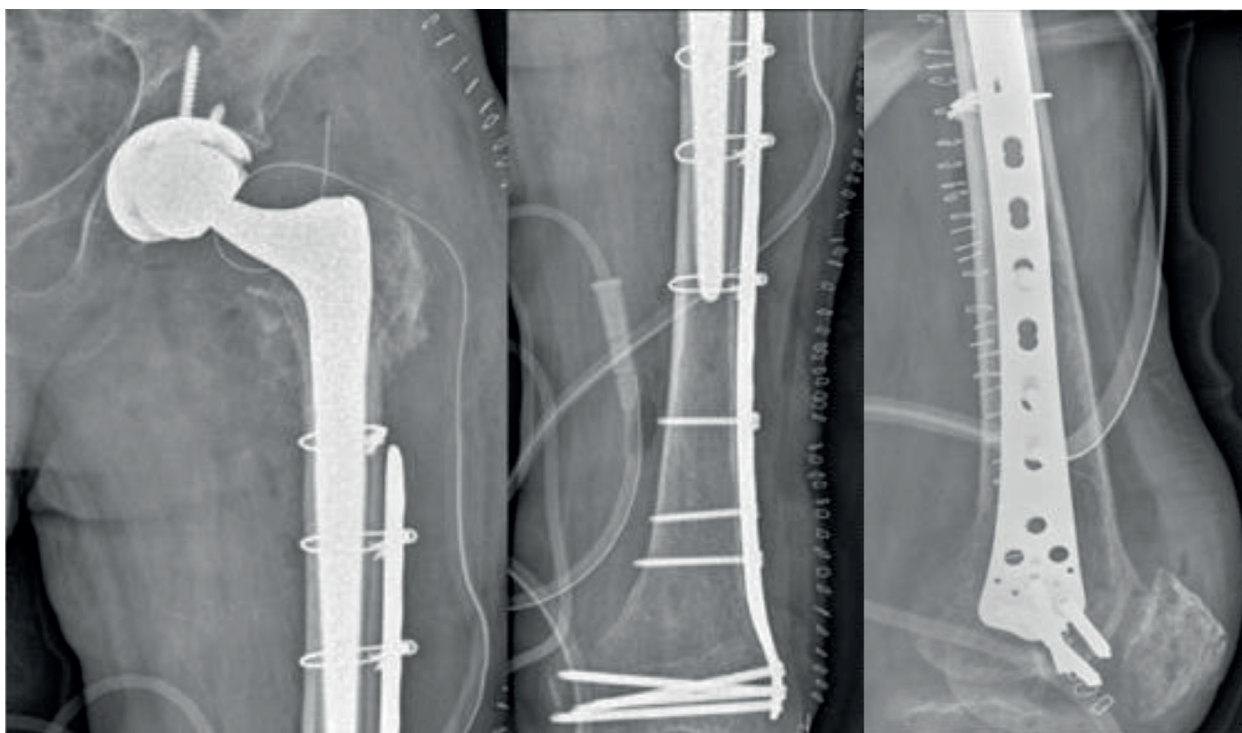
The patient was positioned in lateral decubitus, under locoregional anesthesia and in sterile field; 2g Cefazolin were administered as antibiotic prophylaxis. The procedure was developed through a posterolateral approach. Intraoperatively, we observed severe nonunion and wide bone resorption. We started from the acetabular side, where we implanted a 52mm R3 Acetabular System (Smith & Nephew, London UK), stabilized with 2 cancellous screws (6.5 x 35mm, 6.5 x 20mm), and a constrained polyethylene liner. Due to the poor bone quality, prior to the preparation of the femoral canal, we decided to apply a cerclage a 1.7mm Cobalt-Chrome alloy wire. With rasps of increasing size, we were preparing the femoral canal when we noticed a preternatural movement of the most distal part of the left femur, at the height of the condyles. None of the three operators heard any sound or perceived any feeling of fracture. The image intensifier highlighted a complete supracondylar transverse fracture of the femur, classifiable as 33A2.3 according to AO/OTA classification (16). Consequently, we decided to perform an open reduction and internal fixation (ORIF) with a 13 holes LISS plate, stabilized with 4 distal angle stable interlocking screws (70 - 80 - 85 - 85 mm), 3 compression screws (40 - 38 - 36 mm) and 3 proximal cerclage wires (each 1.7mm). After verifying the correct positioning of the osteosynthesis devices with the image intensifier and the achievement of a good stability, we finalized the procedure implanting the definitive cementless femoral component: a titanium monoblock tapered fluted lateralized stem 18 x 240 mm (Redapt, Smith & Nephew, London UK) and a 36mm oxinium head (Smith & Nephew, London UK) (Figure 2).

## Postoperative course

Despite the X-ray images showed a good position of the implant, the load was forbidden for 3 months, due to the poor condition of the surrounding bone. Furthermore, in the first 3 weeks also the flexion-extension of the knee wasn't allowed and the joint was immobilized to 0° with a posterior splint. The blood count after surgery was characterized by an important acute anaemia, with hemoglobin (Hb) 7.9 g/dL and RBC 2.52 million/mm<sup>3</sup>,



**Figure 1.** Preoperative X-rays and CT scan.



**Figure 2.** Postoperative X-rays, anteroposterior and lateral view.

that was managed with an immediate transfusion of one packed RBC. The persistence of anaemia (Hb minimum 6.6 g/dL) made necessary the transfusion of two other packed RBCs in the subsequent days. We registered also low levels of Calcium (7.2 mg/dL), Sodium (129 mmol/L), Albumine (2.2 g/dL), Total Proteins (4.5 g/dL) and 25 OH Vitamin D (6 ng/mL), with an Osteocalcin value of 102.1 µg/mL.

To cope with osteoporosis, on the first postoperative day we started a therapy with Teriparatide, administering 20 µg per day with subcutaneous injections and recommending its intake for 6 months. On the other hand, dietician colleagues suggested how to deal with malnutrition, establishing a therapy with electrolytes, vitamins (B-D), minerals, amino acids and proteins.

3 weeks after surgery we changed the splint with an articulated knee brace, permitting an initial flexion-extension of 0°-90°. At 6 weeks we allowed a free flexion-extension. Following a partial physical recovery and viewing a good 3-month x-ray, with the use of 2 crutches or walkers, a partial load was allowed at 3 months from surgery (Figure 3).

The full load was compromised by the patient's poor compliance; indeed he did not perform the physiotherapy program indicated, he decided an autonomous suspension of the osteoporotic therapy prescribed to him and he did not show up at several orthopedic checks. Nevertheless, at 1 year from surgery, the patient returned to his normal activities, but he still needs the use of walkers during long journeys outside his home (Figure 4).

## Discussion

The pattern of fracture verified during our surgery could be defined as supracondylar intraoperative femoral fracture (SIFF). The absence of a similar event in the Literature, attests the singularity of this fracture. In fact, usually the IFFs affect the proximal part of the femur or the subtrochanteric area (9). Abdel et al. in a study on 32644 THAs, found that the 1.7% had an IFF (564 cases) and they affirmed that 69.7% of IFFs occur at the calcar, the 24.7% at the greater trochanter and only the 5.6% are diaphyseal fractures,



**Figure 3.** 3 months follow-up.

not mentioning any distal IFF (17). Given the fact that we don't know the exact time when the fracture occurred, our hypothesis is that the event happened during the femoral canal preparation. As a matter of fact, diaphyseal IFF are usually identified during this passage of the procedure (17).

We assumed our complete supracondylar transverse fracture of the femur as a C3 Vancouver



**Figure 4.** 1 year follow-up.

intraoperative fracture. As reported in Literature, if the stem is stable and bone stock is adequate, plating is an optimal solution, as long as the plate length is enough to overlap the distal part of the stem (18,19). In addition, Siddiqi et al. proposed an algorithm for femoral periprosthetic fractures, suggesting to manage type C3 IFFs with cerclages, ORIF and platelet rich fibrin in bone deficiency (20).

This peculiar pattern of IFF could not be explained without taking into account the condition of

the patient's bones. Blood tests recorded a deficiency of many nutritional status indicators, such as albumin, total proteins, calcium and vitamin D. Moreover, X-rays highlighted the poor condition of the bone, corroborated by the raise of the CBR (21). Given the high percentage of osteoporotic patients who undergo elective THA, many studies suggest verifying bone status through both routinary screening for osteoporosis and measurement of bone mineral density before proceeding with elective joint replacement (22-24). Furthermore, Tan et al. demonstrated that the level of albumin deeply influences the postoperative course after primary THA (25). Newman et al., instead, stated that the lack of albumin is also a risk factor for reoperation within 30-days: on a total cohort of 1667 patients, they found that suffering from hypoalbuminemia is linked with a 97% increased risk to undergo a re-operation compared to patients with a level of albumin  $\geq 3.5$  g/dL (26).

However there are only a few studies that examine the relation between malnutrition and outcomes after THA. Consequently, we suppose that the condition mentioned above had a negative impact on bone quality and so in the following IFF. In fact, also Miao et al. pointed out that protein-depleted patients with a hip fracture are correlated to a postoperative course with longer hospitalization and more complications (27). They also suggested calculating the prognostic nutritional index (PNI) at admission because it's the most accurate independent predictor factor for adverse complications in patients with femoral fractures. Moreover they recommended to value the nutritional assessment of the patient and to correct it before surgery, to improve the outcome after THA (27).

Another important point to analyze is the alcohol addiction of the patient. It is known that alcoholism is associated with a worse condition of the bone tissue, increasing the risk of fractures as well as the prevalence of bone diseases, especially osteoporosis (28). Although ethanol has a direct toxic effect on the bone and is recognized as a risk factor for bone disease; it acts by altering the bone metabolism, but this action is reversible, so the prerogative of treatment should be alcohol abstinence (29).

The preoperative planning for the elective THA is different for non osteoporotic and osteoporotic

patients, because as the bone density decreases, the cortex becomes more and more thin and the femoral canal takes the classic stovepipe shape (30). In these patients, nowadays a cemented stem or a short cementless stem are usually adopted (31,32).

During the first 6 months after surgery, we highly recommended an osteoanabolic treatment with Teriparatide (recombinant parathyroid hormone), which has a proven influence in metabolic processes of the bone (33-35). In fact, aside from the ability to stimulate bone formation, it plays a role in accelerating fracture's healing and in the improvement of bone strength (34). Furthermore, recent studies on patients with osteoporotic femur fractures have demonstrated that Teriparatide promotes the early return to daily activities, decreasing also the risk of nonunion, mortality and morbidity (35,36). A valid alternative to drug therapies, or a synergistic solution, could be the use of Pulsed Electromagnetic Fields, which has been shown to be effective in enhancing bone repair, favoring the formation of callus and a consequent acceleration of the healing process of the recent fracture (37).

The progressive increase of both total hip replacements and consequent IFFs will lead to an increasingly frequent presentation of border-line fractures, which could be difficult to classify. Our experience confirms this occurrence and so we believe that further classification or implementation of current ones are needed.

Moreover, our findings, supported by Literature, highlight the requirement of a global investigation of the patient's nutritional status. However, in the face of a fracture we do not always have the possibility to correct these deficiencies, so adequate preoperative planning is mandatory. Indeed in the osteoporotic patient it is fundamental to choose the adequate implant.

Finally, in these situations an osteoanabolic therapy could be advisable to favor fracture healing, improve postoperative outcomes and limit insidious complications that may lead to re-operations.

**Conflict of Interest:** Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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