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Supracondylar femur fracture in a severely obese patient: a case report and brief literature review

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Summary

The obesity epidemic afflicting the Western world leads to an increase in orthopedic procedures on such patients. Primary concerns relate to peri-operative complications and a more challenging surgical technique, even in the most common fracture patterns. The aim of this manuscript is to describe a supracondylar femur fracture in morbidly obese patient (BMI > 69), from arrival at the Emergency Department to post-operative follow-up. This particular case prompted the authors wonder about possible complications that will arise in the near future, and thus the need for more awareness. A supracondylar femur fracture is a testing procedure for surgeons, especially in an obese patient; it requires careful pre-operative planning to minimize the operative time and, subsequently, the complication rate. In our patient, a double plating with an endomedullary allograft was performed to withstand the weight and provide adequate fixation to a comminuted fracture. The aim of this case report is to describe a rare case which will most likely be more frequent in the near future. Furthermore, the obese population faces more post-operative complications due to multiple comorbidities, coupled with more challenging fracture fixation and longer operative time.

Key words: obesity, supracondylar, femur, fracture, ORIF

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Introduction

Obesity in the Western world is a concerning and frequent medical condition. Unfortunately, it has been growing for the last decades, affecting daily living activities and carrying a higher risk for concurrent diseases. In addition, the obesity epidemic increases the number of these patients needing orthopedic surgery. Typically, trochanteric fractures are the most common kind in the elderly population, but in morbidly obese patients, it is more likely to expect a distal shaft or supracondylar fracture, which can be caused by a low-energy trauma such as a fall, even from a standing position in 57% of cases [1].

A higher body mass index (BMI) leads to higher rates of diabetes and pulmonary-related complications (mortality rate of 9 and 0.6%, respectively) [2]. Additionally, from an orthopedic standpoint, obesity affects the non-union rate in distal femur fractures [3]. It is suggested that the relationship between poor outcomes and obesity can be triggered by an increased inflammatory state and greater biomechanical stress [4-6]. Moreover, in the case of lower limb fractures, there is a 10% increase in mortality following motor vehicle crashes compared to the general population [5].

Supracondylar fractures are usually complicated to manage. Even more so in the high BMI population, thorough surgical planning is mandatory to minimize complications and grant patients a good outcome.
Starting from a complex fracture in a severely morbid and elderly obese patient, we would like to highlight the orthopedic assessment, surgical procedure and the concurrent complications on a topic that will affect our society in the upcoming future.

Description of the case

Patient presentation

S.O. is a 70-year-old woman who presented to our Emergency Department after falling at home on April 27th, 2022. Our patient presented with a left distal femur fracture (AO classification: 33A3.2) (Fig. 1) associated with severe obesity (height 170 cm, weight 200 kg, and BMI 69.2), diabetes, chronic kidney disease (CKD), and anemia (Hb 9.2 g/dl) most likely caused by the CKD that worsened following the trauma. She was immediately admitted to the Orthopedic Department and underwent a left knee CT scan to further analyze the fracture pattern.
The orthopedic treatment was delayed until May 5th, only after consulting with other specialists regarding her general health conditions and being cleared for surgery. For the same reason, due to all her concurrent medical conditions (ASA score 4), the patient was set to be admitted to the Intensive Care Unit (ICU) immediately after the surgical procedure for observation.

Surgical treatment

The patient was placed supine on a reinforced bariatric operative table (Fig. 2) due to her obese body type administered general anesthesia. The operative leg was prepared with skin preparation solution from the hip to the foot and then draped in a sterile fashion.

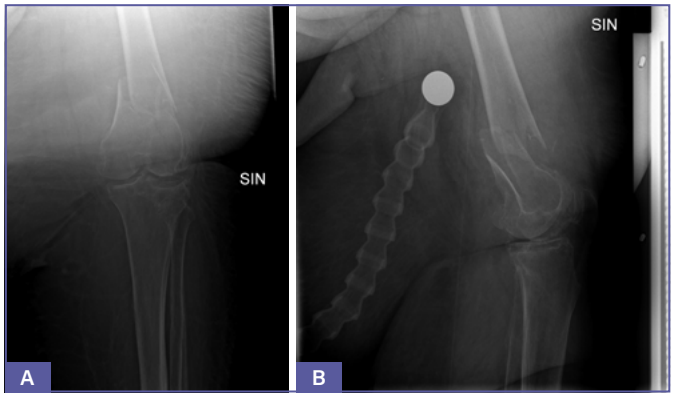

Figure 1. Pre-operative X-ray of the supracondylar femur fracture.

Figure 2. The patient was placed supine on the operating table.

A lateral incision to the mid-distal femur was performed (Fig. 3). Once the surgeons reached the fracture, it presented with comminution and bone loss. The pre-operative planning made by the leading surgeon anticipated an endomedullary distal fibula allograft which was immediately implanted. Clamps and K-wires were applied to reduce the fracture first, and then a working cerclage was put in place to stabilize it and finally fixed with a distal femur NCB plate (Zimmer, Varsaw, USA) and screws.
The leading surgeon implemented a mini-open medial approach (Fig. 3) to implant a second plate (Synthes, West Chester, USA) to grant more stability to the fixation. The plate was modelled over the metaphyseal area to span from the medial condyle to the anterior cortex of the femur (Fig. 4).
Additional bone allografts from two femoral heads compensated for the bone loss.

Post-operative management

As expected, our patient encountered a medical complications while in the ICU. First, she experienced oliguria, associated with hypotension and acute anemia. Later atrial fibrillation ensued with palpitations, which was medically treated, and the patient was started on unfractionated heparin and then switched to warfarin 5 mg/day. Once the patient was hemodynamically stable, she was admitted to the internal medicine ward due to her comorbidities. During her hospital stay, she experienced a urinary tract infection (UTI) caused by enterococcus and *Proteus mirabilis* that was successfully treated with a course of

Figure 3. A) mini-open medial approach; B) lateral open approach.

piperacillin and tazobactam. She was discharged in early July after a hospital stay of roughly 2 months and 15 days.

From an orthopedic standpoint, the patient spent the first 2 post-operative months bedridden with the left lower limb extended. Next, she could be seated and start passive and active exercises with a physical therapist. The non-weight-bearing condition was maintained for a total of 5 months. After a follow-up evaluation in October, partial weight bearing was allowed (maximum 50 kg) with a walker. At 8 months post-op, the patient was cleared to weight-bearing as tolerated.

At the 1-year follow-up visit, a total weight loss of 50 kg (BMI 51.9) since the trauma was recorded. Her active ROM was 0-45°, whereas the passive ROM was 0-65°. She can move from a supine to a sitting position unassisted, but does not f yet eel comfortable walking without the aid of physical therapists. X-rays were taken throughout the follow-up period to evaluate the bone healing progression (Fig. 5). So far, the bone has shown signs of healing, and the implant has not displaced. The endomedullary graft did not appear to have undergone osteointegration.

Discussion

Obesity should not be considered a contraindication to surgery, but surgeons must be aware of the potential ensuing complications. Hence, full-fledge planning is necessary, with careful evaluation of the timing, surgical approach, soft tissue conditions, and the obesity itself [7].

The hypothesis that there is a correlation between increased BMI and bone mineral density (BMD) has been validated, but unfortunately, leads to a paradox. First, aromatization of androgens in the adipose tissue increases the estrogen levels and consequently protects the bone; but on the other hand, the excessive adipose tissue produces inflammatory cytokines that increase bone fragility; secondly, the disproportionate weight leads to a higher risk of falling [7-10].

All that being said, it is necessary to balance the patient's prognostic and predictive factors against the mechanical needs of bone healing physiology [11]. Since medial comminution is the most common fracture pattern to evolve in non-union [3], the leading surgeon decided to supplement the medial column with a second plate. It was a regular 3.5 mm LCP, molded intra-operatively to steer away from the femoral artery on the medial side of the thigh. According to different and recent studies [3,4], it is possible to use an intramedullary rod as an endomedullary substitute for a deficient medial cortex, but in our opinion it was complex to approach an intraarticular fracture with a nail. Moreover, it would have been problematic to avoid the nail with all the screws coming from the lateral plate and simultaneously grant stability to our fixation. Although a recent study by Fortenot et al. [12] revealed that an additional medial plate or an intramedullary nail are equivalent in terms of stiffness, survivability, and cycles to failure, in our opinion the latter would have been a more demanding procedure for the surgeons. Other recent studies confirmed the increased biomechanical stability with an additional medial plate as abovementioned [12-14].

The use of an endosteal plate, instead of a medial plate, is still anecdotical as described by Oransky et al. [15]. Out of 10 patients treated with said technique, 9 achieved bone union with an average follow-up of 13.5 months.

Another reason to use a second plate over a nail was the use of an endosteal substitute. Since our patient had a BMI of 70, we wanted to provide as much stability as possible by adding a fibular allograft in the femoral canal. The graft strengthened a hollow endomedullary canal and was transfixed by the screws for stability. The increased stability seems to enhance osseous union, which proved outstanding, coupled with either partial or complete graft incorporation (86%) at 12-month follow-up MRI [16]. Despite not performing an MRI, the endomedullary graft does not appear to have fully incorporated on plain X-rays in our case.

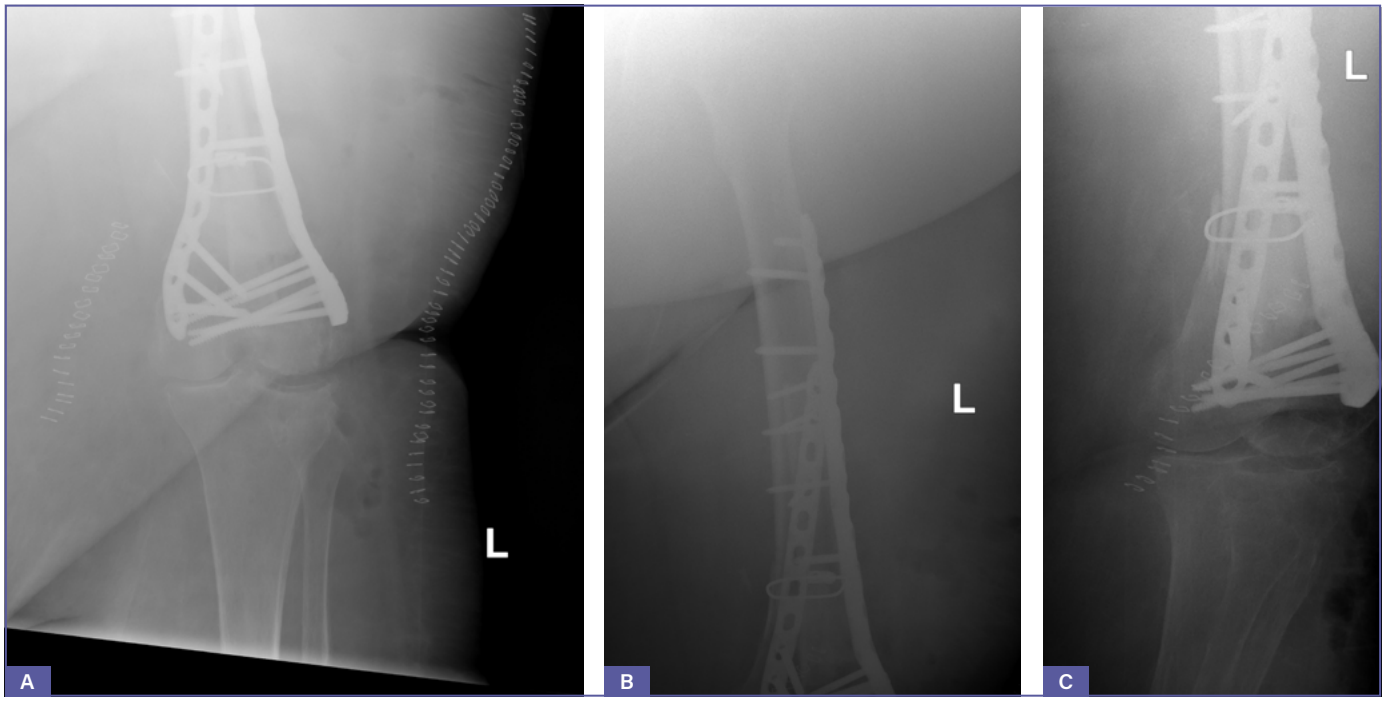

Figure 4. Post-operative X-rays.

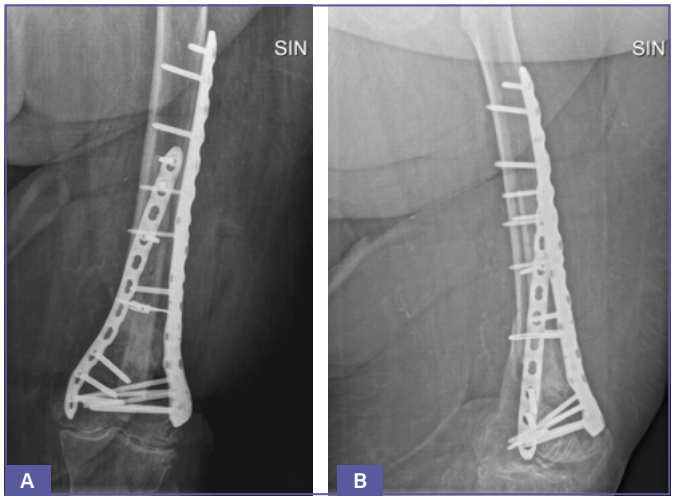

Figure 5. Follow-up X-ray at 1 year.

Regular titanium plates are meant for a population with regular body mass, and in case of overweight or obese patients they might not be durable enough. Especially during dynamic weight-bearing their common limit is easily exceeded [17]. Therefore, the authors advised the patient to be non-weight-bearing for 5 months, longer than they would recommend for someone with a normal weight. Each case must be scrutinized to allow weight-bearing at the proper time, especially to not overload the fixation device implanted and set it to failure. A study by Vincent et al. [18] compared the rehab period in the obese and non-obese populations following orthopedic traumas. The results showed functional improvements in both groups, but an expected and significant difference arose: the obese group demonstrated fewer improvements. Likewise, the patient described herein worked throughout physical therapy, but struggled to be fully weight-bearing.

Unfortunately, there is barely any literature on complex cases like the present one. Only Badghish et al. [14] described a case report on a similar patient, but the femur fracture was extra-articular and required a closed reduction and internal fixation with an endomedullary nail.

So far, literature on the correlation between obesity and fractures is mostly focused on epidemiology, bone fragility, and fracture location [1,19-21]. There is scarce information about the correct timing, setting, and treatment of patients whose BMI far exceeds the normal weight standard.

Supracondylar fractures are relatively rare, and for this reason recent studies are mostly focused on intertrochanteric fractures in order to collect more reliable data about complications in the morbidly obese population. To date, only a couple of studies inquired about other fractures besides the one mentioned above [1,22]. Both agreed on the increased risk of surgical site infection: Soliman [1] reported a p value < 0.001, and Childs [22] a p value $= 0.038$. Other than that, the former noticed a significant difference in the risk of developing a deep venous thrombosis and pulmonary embolism with the normal weight population, and the latter did not detect differences (Tab. I). It must be

Table I. Post-operative complications and surgical timing.

	No. of patients	Type of fracture	Deep SSI	Duperficial SSI	DVT	PE	Cardiac arrest
Soliman et al. [1]	2528	All kinds of femur fractures	0.7% (< 0.001)	0.5% (< 0.001)	2.3% (< 0.001)	1.5% (0.001)	1.6% (< 0.001)
Childs et al. [22]	158	Femur, acetabulum, pelvic ring and spine	11.4% (0.038)	/	4.43% (0.069)	1.90% (0.31)	/
Akinleye et al. [23]	197	Interthrocanteric	2.72% (< 0.001)	0.78% (<0.001)	1.56% (0.001)	0.39% (0.16)	1.17% (0.82)
Kempegowda et al. [24]	257	Interthrocanteric	3% (0.07)	/	2% (0.06)	11% (< 0.001)	10% (0.32)

Table II. Operative variables.

	No. of patients	Type of fracture	Length of stay	Time to surgery	Duration of surgery in minutes
Childs et al. [22]	158	Femur, acetabulum, pelvic ring and spine	/	1.5 days (0.03)	220′ (0.025)
Akinleye et al. [23]	197	Interthrocanteric	7.8 days (< 0.001)	1.9 days (< 0.001)	154′ (< 0.001)
Kempegowda et al. [24]	257	Interthrocanteric	6.5 days (0.04)	2.4 days (0.93)	96′ (0.02)
Schuette et al. [25]	37	Interthrocanteric	/	0.9 days (0.44)	73′ (0.002)

noted that Childs et al. [22] focused their attention on different multiple injuries, spanning from femur fracture to pelvic ring and spine. Therefore, their results are hardly comparable to any other study on obese patients.

Nowadays, the difficulties in managing obese patients from a medical standpoint are clear: comorbidities and the ensuing complications related to a fracture lead to increased time to surgery and prolonged duration of the surgical procedure compared to normal-weight patients. Both these variables were significant according to Childs et al. [22] (Tab. II).

The duration of surgery is closely related to increased body weight, which leads to a more difficult reduction and fixation and consequently to higher rates of complications. For instance, a recent study by Akinleye et al. [23] recorded a significant delay in time to surgery and surgery duration (p value < 0.001) in a population affected by intertrochanteric fractures (Tab. II). In addition, other recent studies on intertrochanteric fractures in obese patients [24,25] demonstrated a significant increase in the operative room time.

Conclusions

Since there are no guidelines on how to treat these patients, everything must be tailored: pre-operative planning, surgery, implants, and rehabilitation. In a world with an ever-growing concern about morbid obesity is fundamental to lower as much as possible the risk of complications and failure of our implants. For instance, a clear cost-benefit is to delay the weight-bearing to avoid implant failure and need for a revision surgery along with all the ensuing complications.

In the upcoming future, implant manufacturers will probably adapt their devices to face the obesity epidemic, but in the meantime surgeons must be aware and ready to face all the additional difficulties that these fractures have to guarantee the best outcome.

Conflict of interest statement

The authors declare no conflict of interest.

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Author contributions
NE: wrote the manuscript; MR: revised the draft and reviewed the literature; LP: planned the surgical case and followed-up the patient; AR: planned and performed the surgery; AM, SG: conceived the manuscript and followed-up the patient

Ethical consideration
The study is retrospective and it follows the Helsinki ethical principles for appropriate medical research.

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