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Clinical Case Report

Rescue Arthroplasty After Cut in Cephalomedullary Hip Nail

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Abstract

The use of intramedullary devices has increased, representing the first treatment option in pertrochanteric fractures. The most common mechanism of osteosynthesis failure is the cut out of the cephalic screw with secondary varus collapse of the femoral neck-shaft angle. We present a case of osteosynthesis failure after hip fracture with migration of the cephalic screw of a gamma 3® nail, with the rare complication of migration of the nail towards the pelvis (cut in). In this case, we opted to perform a rescue arthroplasty once the osteosynthesis material was removed. Achieving a good result in terms of pain relief and recovering the functionality of our patient.

Keywords: Cut In; Osteosynthesis Failure; Salvage Arthroplasty

Introduction

Proximal femur fractures are becoming more frequent as the population ages. Hip fracture is the most serious type of osteoporotic fracture that can happen to a patient. It is considered an epidemic disease, given the progressive aging of the population and the high morbidity and mortality and economic cost they associate. It is estimated that by 2050 there will be around 4.5 million hip fractures worldwide [1].

At the same time, the use of intramedullary devices has increased, representing the first treatment option in intertrochanteric fractures. Gamma 3® Nail is a wide spread and well-established intramedullary device for fixation of intertrochanteric fractures. Cranial cut out of the lag screw is the most common complication of Gamma 3® fixation system with incidence ranging from 1.6% to 4.3% [2]. These complications can generate length discrepancy in the lower extremities, hip pain, functional deterioration and even require a new surgery [3].

The most common mechanism of osteosynthesis failure is the cutting out of the cephalic screw with secondary varus collapse of the cervico-diaphyseal femoral angle. Known risk factors for cut out are: the type of fracture, quality of fracture reduction, distance to the apex and position of the screw in the femoral head after fixation [4-6].

To avoid this complication it is essential to achieve the correct reduction in all planes of the fracture before the introduction of the nail as well as the size and position-orientation of the cephalic screw [3].

There is no standardized system to define the quality of fracture reduction, but Baumgaertner., *et al.* established a three-grade classification system to define the quality of postoperative fracture reduction. A good reduction is considered if the fracture is normo-aligned or mild valgus on an anteroposterior x-ray, with less than 20 degrees of angulation on a lateral x-ray and if it has 4 mm or less displacement in any fragment of the fracture. An acceptable reduction meets the same criteria, but in terms of alignment or displacement, it fails to meet both. On the other hand, a deficient reduction is established when none of the above criteria are met (Table 1) [4].

It is known that the distance to the apex is a predictor of cut out so that a distance to the apex less than 25 mm works as a protective factor against the cut-out [3,4]. The Tip Apex Distance (TAD) is the sum of the distances in millimeters between the distal ends of the cephalic screw to the cut-off point of the major axis of the femoral head and neck with the coxofemoral articular surface, after applying a radiographic correction factor (Figure 1).

Alignment
Anteroposterior View: Normal or Mild Valgus of the cervico-diaphyseal angle* Side Vision: Angulation less than 20°
Displacement
Vision Anteroposterior: Displacement minor to 4 mm in any fragment. Side Vision: Displacement less than 4 mm in any fragment.
Reduction quality
Good: Both criteria are met. Acceptable: Meets only 1 criterion. Deficient: No criteria are met.

Table 1: Baumgaertner reduction quality criteria [4].

*Mild valgus means a valgus of no more than 10° [4].

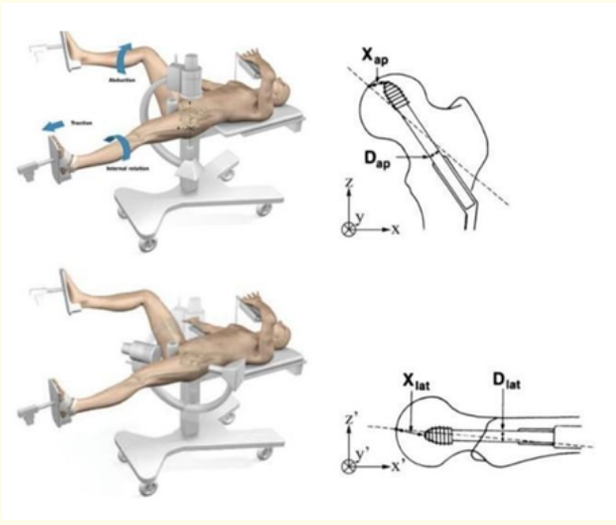

Figure 1: Technique of calculating the Tip apex distance [4].

In 2015 and based on the Gotfried reduction technique for subcapital femur fractures, Chang proposed the concept of positive medial cortical support and negative medial cortical support to evaluate the reduction of pertrochanteric fractures (Table 2). Chang's reduction quality criteria are based on non-anatomical reductions that frequently occur after the process of milling, nail insertion and head screw. They have proven reliable in predicting mechanical complications even surpassing Baumgaertner in Mao's series [3].

The position of the screw on the femoral head after fixation is also linked to the cut-out. According to the nine quadrants defined by Cleveland., *et al,* the safest quadrants arethe central ones and should avoid the positioning of the head screw in the anterosuperior and posteroinferior quadrant, for which we must use intraoperative scopy in your anteroposterior and axial vision [4-6].

Alignment	Score
Anteroposterior View: Normal or Mild Valgus of the cervico-diaphyseal angle*	1
Side Vision: Angulation less than 20°	1
Displacement	
Vision Anteroposterior: Support neutralor positive medial cortical.	1
Lateral Vision: Light anterior cortical contact.	1
Quality reduction	
Excellent	4
Acceptable	2 or 3
Deficient	0 or 1

Table 2: Chang reduction quality criteria [3].

*Mild valgus means a valgus of no more than 10° [4].

*Displacement is less than half the thickness of cortical [3].

Treatment options after osteosynthesis failure include re-osteosynthesis or joint replacement. In general, in young patients with good bone quality and recent failure (less than 4 weeks) re-osteosynthesis trying to preserve the hip could be an option. On the other hand, in older patients with osteoporotic bone or femoral head damage, acetabular involvement or scarce bone remnant, rescue through total hip arthroplasty (THA) emerges as the most predictable option in terms of results [7-10].

We present a case of osteosynthesis failure after hip fracture with migration of the cephalic screw of a gamma 3® nail, with the rare complication of migration of the nail towards the pelvis. We review the literature and detail the way in which the salvage to a totalhip arthroplasty was performed, managing to alleviate pain and improve functionality in our patient.

Clinical Case

A 72- year-old female patient was admitted to our emergency department four months after a gamma 3 120°® implantation, due to a pertrochanteric fracture (31-A2.3 (AO Foundation)). The reduction was acceptable and the TAD was 23.8 mm (post-surgery control). The patient had a medical history of hypertension, insulin-dependent diabetes mellitus, and advanced chronic kidney disease without hemodialysis.

The patient presented severe pain and functional impotence along with shortening of the left lower extremity.

On physical examination, pain was evident upon mobilization of the left hip. The radiographic study of the Emergency Department shows a migration of the cephalic screw from the cephalomedullary nail to the endopelvis (cut in) with evident acetabular involve-

ment, in addition to non-union at the level of the pertrochanteric fracture, with varus collapse of the cervico-diaphyseal femoral angle (Figure 2).

Given the case, an imaging study was also performed with a Scanner of the abdomen and pelvis, determining according to the report that there was no vascular damagebut if it was close to these structures (Figure 3).

The case was discussed as a team, we decided to carry out a rescue of this osteosynthesis to a total hip arthroplasty based on the patient´s age, joint damage, bone fragility and the fact that a new failure would be unacceptable for this specific inmunocompromised patient (insulin dependent diabetes mellitus, chronic kidney failure, hipertensión arterial).

A Kocher Langenbeck approach was used with the patient positioned in lateral decubitus on the operating table. The gamma nail was removed from the same incision, while distal screw was also removed percutaneosly. The removal of the head screw was performed with extreme care given the contact with the endopelvis, and required the use of a clamp to take the most distal part of the head screw and achieve its safe removal. It was required to perform this maneuver since when trying to hook the cephalic screw and removeit, it was trying to continue migrating within the pelvis.

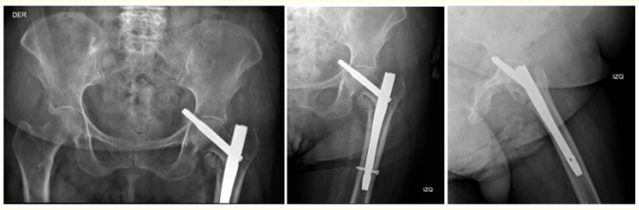

Figure 2: Radiographic study of the case in the Emergency Department.

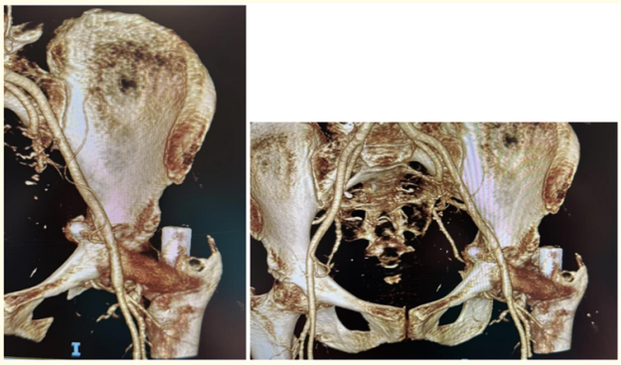

Figure 3: Preoperative imaging study. Scanner Abdomen and Pelvis. 3D reconstruction.

Once the implant was removed, it was observed that it was in good condition with its locking screw properly installed, with no obvious material fatigue. Based on the intraoperative findings, we believe that the possible cause of osteosynthesis failure is related to the patient's bone fragility coupled with the uncontrolled rotation of the femoral head around the head screw, which probably loosened the set screw (Figure 4).

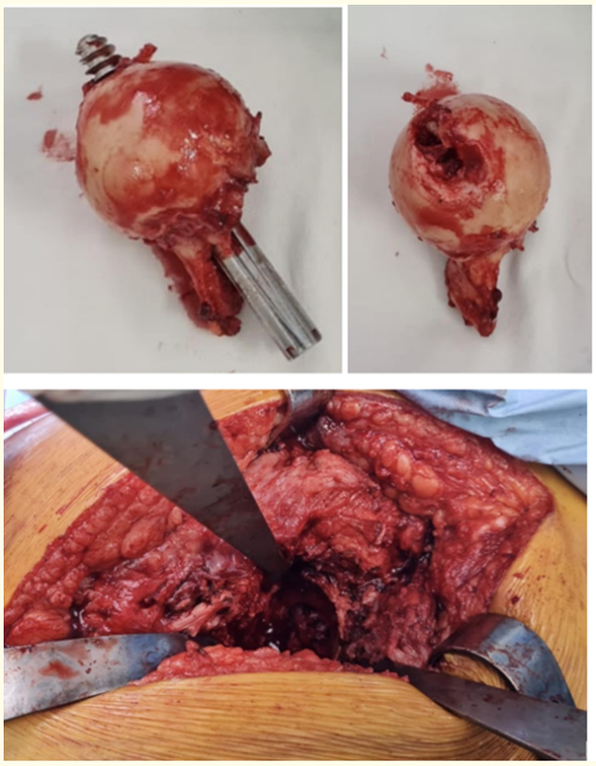

Figure 4: Photographs of intraoperative findings.

ter achieving gait with 2 canes.

One year after surgery, a good evolution was observed, without obvious infectionand with a Modified Harris Hip Score of 82.5. Radiographic control was satisfactory (Figure 6).

Discussion

Pertrochanteric fractures commonly occur in the long-lived population [9,10]. In most cases, the treatment is satisfactory with adequate reduction and osteosynthesis, tending to use endomedullary interlocking in unstable pertrochanteric fractures due to its biomechanical advantages over other implants [5,11,12]. However, it should be borne in mind that there are complications after performing the endomedullary interlocking of proximal femur fractures, which can be classified as mechanical, biological and in some cases, technical errors in the execution of the interlocking [13].

We know that as for the cephalic screw of the nail, it seems

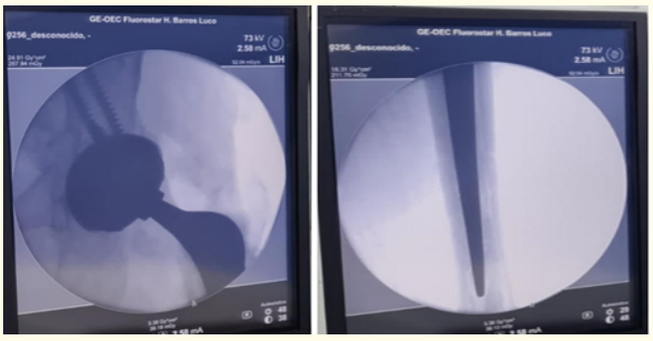

Figure 5: Intraoperative radiographic monitoring.

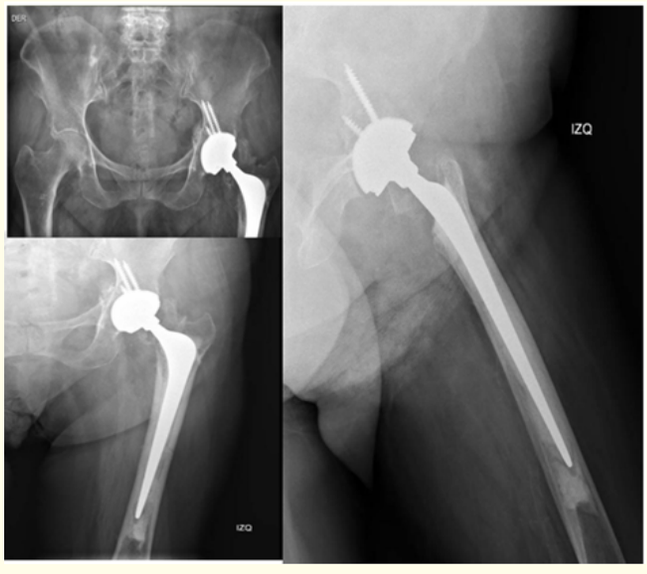

Figure 6: Postoperative radiographic control.

We proceeded to evaluate the damage at the level of the acetabulum, determining a Paprosky II C defect. It was decided to use autograft of the same femoral head of the patientto fill this bone defect and achieve the appropriate press fit for a tantalum cup with double mobility system.

At the level of the femoral component, a cemented stem was used given the characteristics of the patient in terms of comorbidities and bone fragility. Trying to cover with an assistant surgeon's finger the area of the distal locking screw during cementation. In addition to using a long Exeter® stem, in order to bypass the area of theoretical bone weakness in the femur (area of distal nail blockage). Given the complexity of the case, it wasdecided to use intraoperative radiography to control the implantation of the prosthetic components (Figure 5).

Extended oral antibiotic prophylaxis was used postoperatively. On the fifth postoperative day, she was discharged from hospital after clear that positions in anterior quadrants must be avoided following Cleveland's concepts, given the greater risk of migration of the screw [4-6]. Along with these recommendations, it is essential to consider the complications associated with the surgical technique and to ensure the correct reduction of the fracture in all planes before the introduction of the nail. Considering the already described criteria of reduction, together with the size and position of the placement of the head screw [10,13,14].

In the case we present, we showed a perforation of the femoral head with rotation and varus collapse, together with a migration of the central cephalic screw due to failure of the set screw. However, it is important to note that the origin of the mechanical failure in the unstable migration of the head screw is due to the existence of trabecular microfractures around it. In the first instance, by a rotational summation movement of the forces on the implant in the femoral head when the patient begins to perform a full load, which causes a progressive loosening that is evidenced as a cephalic varization linked to the rotation of the femoral head. Then begins a "windshield wiper" effect in which there is a migration of the implant and the femoral head by unanchoring the screw, determining micro-tears of the trabeculae around it. This is confirmed radiologically by osteolysis of the femoral head. In a final phase and in the case of a cut in, the cephalic screw presents a suction effect towards medial, in relation to the rest of the implant [13].

Failures in the management of these fractures are usually treated by salvage with new osteosynthesis in young patients and with early cut-out (less than 4 weeks) in order to preserve the hip. In older patients or with damage of the femoral head, acetabular involvement and/or scarce bone remnant, rescue with a THA is the option with more predictable results [2]. However, it is a procedure not without complications and presents a greater record of complications than a primary THA due to the altered anatomy both in the acetabulum and in the proximal region of the femur. In the preparation of the acetabulum it is important to define clear anatomical references, and mill bearing in mind that we can find bone defects secondary to the migration of the cephalic screw to the coxofemoral joint, in addition to considering bone weakness if the patient was some time in discharge [15].

In the femoral preparation, it is essential to show the anatomical references to achieve an adequate femoral version, this not being easy since it is highly likely that both theposteromedial cortical and the lesser trochanter present with an altered anatomy and the femoral intramedullary canal presents with fibrosis. We consider privileging the use of cemented stems after an adequate preoperative evaluation taking into account the physiological age of the pa-

tients (in this case 72 years) and bone quality by Dorr index. We believe that a cemented stem allows us an early load and a complete recovery relatively fastand safe.

With respect to the length of the femoral stems, we prefer to circumvent the area of bone defect associated with the distal screw of the endomedullary nail in at least twice the femoral cortical, given the greater theoretical risk of fracture associated with increased stress in an area of bone weakness. However, in some works it is established that it would not be necessary since the bone defect associated with the distal screw only compromises between 20 to 30% of the diameter of the femur, and the use of long stems would only generate an increase in costs and greater complexity if it were necessary to remove it in a future revision. It does seem to be transcendental, closing the bone holes with cement [15]. To accomplish this, we use the fingers of assistant surgeons to try to plug the holes and achieve proper cementation.

We believe that the detection of these cases early allows us to act more effectively, achieving a definitive treatment that seeks to avoid the greater migration of the cephalic screw, whose tendency is to produce the destruction of the coxofemoral joint. A late diagnosis obviously limits the therapeutic options, having to perform more aggressive therapeutic actions with greater perioperative complications.

For all the above, we recommend performing a control X-ray before the end of the first postoperative month of osteosynthesis for an early detection of failures avoiding their progression.

Conclusion

Total hip arthroplasty (THA) is an effective therapeutic option for the rescue of failed osteosynthesis of pertrochanteric fractures in elderly patients with damage to the femoral head and/or acetabulum. Pain and functional capacity improve significantly.

Acknowledgment

Department of Orthopedics and Traumatology Hospital Barros Luco Trudeau, Santiago de Chile.

Conflicts of Interest

The authors declare that there is no conflict of interest directly or indirectly related to the content of the article.

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