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A unique cause of Gamma 3 cut-out: A case report and literature review

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ABSTRACT

Gamma 3 nail is a wide spread intramedullary device for fixation of per trochanteric fractures. Cut out of the lag screw is the most common complication of this implant. We present a 62-year-old female patient, who underwent a total hip arthroplasty following cut out of a Gamma 3 nail in the femoral neck. The cause of the cut out in our case is actually unique. Our intraoperative findings accompanied with the radiographic evaluation argue that the malposition of the set screw was the cause of failure, due to the rotational instability of femoral head-lag screw unit. We present this case with detailed description, highlighting the proper use of this specific nail and appose a brief literature review.

1. Introduction

Gamma 3 Nail (Trochanteric Nail 180; Stryker Trauma GmbH, Schoenkirchen, Germany) is a wide spread and well-established intramedullary device for fixation of per trochanteric 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%.[1] Concerning the surgical technique, the already known main causes and risk factors for this complication are the following: not anatomical reduction of the fracture, suboptimal lag screw position and improper entry point.[1,2] In this case, we describe a unique cause of cut out failure of Gamma 3 nail, which to our knowledge, has never been reported before. Set screw malposition has never been considered as a cause of lag screw cut out, although the uncontrollable rotation of head-lag screw unit can cause catastrophic failure of the construct. We present the case with details, we describe methods to recognize rotation of head-lag screw unit, we highlight the proper use of the implant and finally we appose a brief literature review.

2. Case presentation

A 62-year-old female patient was admitted to our emergency department two months after a Gamma 3 implantation, due to a per trochanteric fracture. On admission, she complained for severe groin pain and inability to bear weight at her left leg, without any reported new trauma. Physical examination disclosed remarkable pain during passive motion of the left hip, while x-rays revealed a cranial cut-out of the lag screw (Fig. 1). We decided to revise this failed osteosynthesis to a total hip arthroplasty, based on the patient's age and the fact that a new failure would be unacceptable for this specific immunocompromised patient (insulin dependent diabetes mellitus, chronic kidney failure, congestive heart failure). The surgery was performed with the patient in the supine position via a modified Watson-Jones approach. The gamma nail was removed from the same incision, while the distal screw was also removed percutaneously. It is worth noting that during the removal of the implant the surgeon was able to rotate the lag screw with the appropriate screwdriver before unscrewing the set screw, while set screw was needed about half a turn to be fully screwed. After removal of the implants we found out that the set screw wasn't in the proper position (Fig. 2). Furthermore, it was also noticed that the femoral head was upside-down, while the damage of the femoral head from the lag screw concerned only the area near to calcar and not all the head. Moreover, the bone loss to the acetabulum was of type 2A according to Paprosky classification and the

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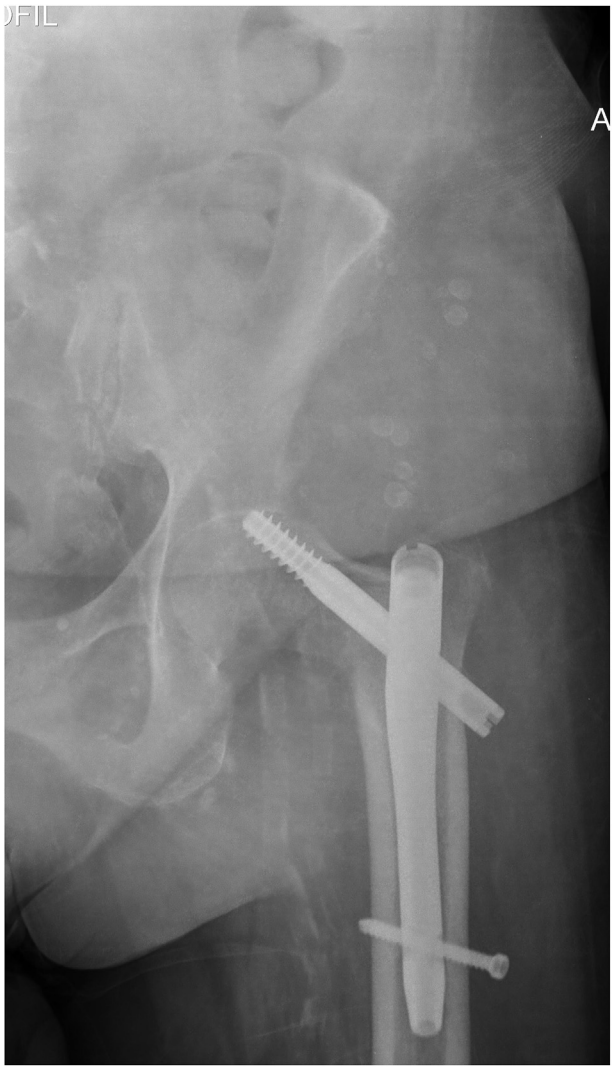

Fig. 1. Initial anteroposterior x-ray of left hip and proximal femur on admission to our institution shows the cranial cut out of the lag screw of the Gamma 3 nail.

Fig. 3. Anteroposterior postoperative x-ray of left hip and proximal femur demonstrates the total hip arthroplasty (cemented femoral stem and an acetabular Müller reinforcement ring) after the removal of the Gamma 3 nail.

Fig. 4. a. Anteroposterior x-ray of left hip and proximal femur demonstrates the initial intertrochanteric fracture of AO type 31 A1.1, a fracture type which traditionally has been considered as rotationally unstable,
b. Anteroposterior x-ray of left hip and proximal femur after Gamma 3 nail implantation demonstrates good reduction of the fracture, a low-near to calcar lag screw position, while the H′/H ratio is 3.25.

senior surgeon opted to use a part from the head as autograft to stabilize the acetabular component of the total hip arthroplasty (Fig. 3). Based on our intraoperative findings we believe that the possible cause of this Gamma 3 failure was the malposition of the set screw and the uncontrollable rotation of femoral head-lag screw unit. We managed to confirm this with the previous radiographic evaluation of the patient (Fig. 4a and b, Fig. 5a,b**).** The patient was discharged 5 days after surgery without any complications. At the follow up at 12 months postoperatively, the patient was able to ambulate with one crutch, the Harris Hip score was fair (71/100), while the radiographic evaluation was also satisfactory.

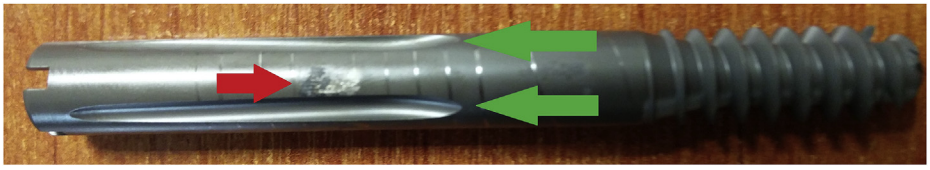

Fig. 2. Photograph from the removed lag screw. The red arrow shows the footprint of the malposition of the set screw outside of the grooves (green arrows). Each lag screw has four grooves, while the correct position of the set screw into the grooves allows lateral sliding and prevents rotation.

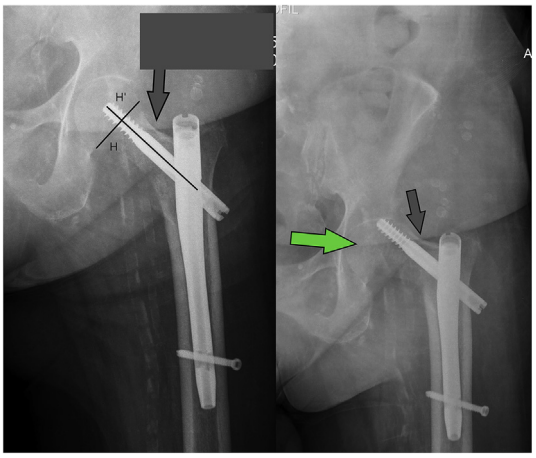

Fig. 5. a. Postoperative anteroposterior x-ray of left hip and proximal femur at 25 days follow up demonstrates more cranial position of the lag screw without any lytic defect behind, while the H′/H is now 0.65. The grey arrow shows the calcar to the opposite side. All these findings are indicative of the 180° rotation of femoral head-lag screw unit.
b. Anteroposterior x-ray of left hip and proximal femur on admission to our institution shows the cranial cut out of the lag screw. After the intraoperative findings, we can now conclude that the grey arrow shows the upside-down calcar, while the green arrow shows the lytic defect from the initial placement of the lag screw, close to the calcar.

3. Discussion

Concerning the Gamma 3 device the reported risk factors for cut out failure due to suboptimal use of the device are the improper entry point, the non-optimal lag screw position[1] and the inadequate three-point lag screw fixation,[3] but no mention exists regarding the improper set screw placement. In this case report we present a unique catastrophic failure of a Gamma 3 nail due to a malposition of the set screw. To best of our knowledge, this cause of Gamma 3 failure has never been reported in the literature. Although, in this case there are several additional factors that are likely to contribute to this construct failure and should definitely be taken into consideration. The comorbidities of the patient (insulin-dependent diabetes mellitus, kidney failure) can compromise the bone quality and this can affect the bone-lag screw construct. In addition, other possible patient or surgeon related issues except bone quality are: the early weight bearing, the smaller nail diameter and the toggling of the implant due to the distal locking screw loosening. During Gamma 3 implantation it is very crucial to insert the set screw in one of the four grooves (Fig. 2) of the lag screw, to avoid rotation of the femoral head-lag screw unit and then the set screw should be slightly tightened (static lag screw). Afterwards, the set screw should be unscrewed by one quarter of turn to allow lateral sliding (dynamic set screw). At this point, rotation of the lag screw should be checked with the appropriate screwdriver. If the set screw is out of the groove, even one quarter of turn can lead to rotational instability and failure, as in our case. There is consensus that set screw utilization is obligatory, although recently controversy exists if the sliding effect of the head-screw unit is beneficial. There are studies,[4,5] which support not to unscrew the set screw to avoid the sliding effect, which has been correlated with leg length discrepancy, poorer functional outcomes and cut-out phenomenon.[4] The results of a randomized control trial concerning the dynamic or static lag screw configuration of Gamma 3 nail would be very interesting.[5] Rotation in femoral head-screw unit exists even in cases with proper surgical technique and this has been proven with biomechanical studies.[6,7] Rotation of the head-screw unit may be the mechanism of fixation failure of per trochanteric fractures treated with intramedullary nails,[8] although the exact mechanism has not been adequately investigated so far. Surgeons should be able to recognize the risk factors predisposing to this failure mechanism. Basicervical fractures, A3 AO/OTA proximal femoral fractures with extension of the fracture line to the femoral neck, suboptimal lag screw position and inadequate fracture reduction are considered as the main risk factors for rotational instability of femoral head-lag screw unit. These types of fractures may require an anti-rotational element, although further research is urgently needed,[8] while center to center position of the lag screw minimize the rotation of the femoral head and prevents cut out.[6]

4. Conclusions

Flaws in surgical technique concerning nailing of intertrochanteric fractures can lead to devastating complications and failure. Revision surgery of failed cases is technical demanding and is associated with many complications. Trauma surgeons should be able to choose the appropriate implant for each patient and to use it also properly. Trauma surgeons should be aware of this possible cause of Gamma 3 failure and strict adherence to surgical technique is mandatory to avoid this devastating “iatrogenic” failure. Orthopedic surgeons should also be able to recognize signs of rotational instability of such fractures as soon as possible.

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CRediT authorship contribution statement

Ioannis Papaioannou: Conceptualization, Writing - original draft. **Thomas Repantis:** Conceptualization, Project administration. **Panagiotis Korovessis:** Writing - review & editing, Visualization, Supervision.

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