

# Avoid to over-unlocking the helical blade in proximal femoral nail anti-rotation: a case report and literature review

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## Technical note

**Keywords:** Over-unlocking, Helical blade, Proximal femoral nail anti-rotation

**Posted Date:** June 11th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-33753/v1>

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# Abstract

## Purpose

To discuss the reason and treatment method of helical blade over-unlocking.

## Methods

The case reported in this paper is that the helical blade cannot be locked due to over-unlocking during the treatment of intertrochanteric fracture with PFNA, which is very rare. We expound why it happens and how to deal with it.

## Results

When the helical blade is over-unlocking, if the aiming arm is not disassembled, you can try to take out the helical blade and fix it again. If the aiming arm has been removed, it is not recommended to remove the helical blade, we suggest that we should consider adding a screw from the lateral wall through the femoral neck for anti-rotation, or you can observe the tail of helical blade and find suitable screw driver to fix it if there is one.

## Conclusions

In order to avoid over-unlocking of the helical blade, intraoperative fluoroscopy should not only pay attention to the position of the helical blade, but also pay more attention to the abnormal shape of the helical blade itself. Once the helical blade is over-unlocking, it needs to be handled in time.

# Introduction

Femoral intertrochanteric fracture is a common orthopedic disease, accounting for about 5% of systemic fractures and 40% of hip fractures<sup>[1]</sup>. With the aggravation of the aging of the world population, its incidence is increasing year by year. Most elderly patients are often complicated with different degrees of underlying diseases, non-operative treatment requires long-term bed rest, and is prone to complications such as hypostatic pneumonia, urinary system infection, pressure sores, deep venous thrombosis and so on, so surgical treatment is adopted by more and more people<sup>[2]</sup>. Proximal femoral nail anti-rotation (PFNA) belongs to the intramedullary fixation system, which has the advantages of small tissue injury, less bleeding, short bed rest time and early activity, so it is the first choice for the treatment of intertrochanteric fractures<sup>[3]</sup>. The reported case is the helical blade cannot be locked due to over-unlocking during the treatment of intertrochanteric fracture with PFNA, which is extremely rare and easy to ignore, as follows:

# Case Report

The patient, a 74-year-old male, was admitted to hospital with hip pain caused by a fall for 4 days. X-ray and three-dimensional CT showed femoral intertrochanteric fracture (Fig. 1 - A, B, C). After evaluating the basic condition of the patients, we propose to use PFNA to treat it (Waston Medical Corporation, China), to follow the standard operation procedures. After inserting the main nail and helical blade, the position of the anterior and lateral radiographs is good (Fig. 1 - D, E). Then without perspective, lock the helical blade directly and remove the aiming arm.

After all the fixation was completed, the final fixed state fluoroscopy was performed when preparing for the end of the operation, and it was found that the gap between the head and tail of the helical blade was abnormal (Fig. 2-A), and helical blade with a distance greater than the unlocked state and the locked state (Fig. 2-B, C). In order to further confirm our judgment, we placed unlocking and locking helical blades on the body surface and performed perspective (Figure- 2D, E), found that the inserted helical blades were indeed over-unlocking.

Helical blade locking can play the role of pressurization, once unable to lock will lose the pressurization effect, at the same time lead to rotation instability and increase the risk of internal fixation failure. The operation manual recommends that the helical blade should be removed and replaced with a new helical blade, but at this time the aiming arm has been removed, which may lead to loss of reduction, loss of bone mass, prolonged operation time, and so on. In order to solve this problem, we think that if it is impossible to lock the helical blade and it is difficult to remove it, we can consider adding a nail anti-rotation (Fig. 3-A). At the same time, we try the distal lock screw driver (Fig. 3-B, C), found that it can complete the locking of the helical blade (Fig. 3-D), postoperative reexamination showed that the fracture of the X-ray film was well placed and the internal fixation was reliable. (Fig. 3-E, F).

At the end of the operation, we measured the helical blade and found that the distance between the normal unlocked helical blade head and tail was 5 mm, while the over-unlocking was 10 mm. We observed the tail shape between the three, and also found that there was a significant difference (Fig. 4). The over-unlocked helical blade can see the black mark line on the tail.

## Discussion

Femoral intertrochanteric fracture is mainly caused by fall, car accident and other reasons, which is called the last fracture in life<sup>[4]</sup>. Although conservative treatment has the advantages of non-trauma and low cost, it needs to be bedridden for a long time and has many complications. Although surgical treatment is traumatic, it is beneficial for patients to get out of bed and exercise in the early stage, so it has become the first choice for the treatment of intertrochanteric fractures<sup>[5]</sup>. PFNA, as the representative of the intramedullary system, plays an important role in the treatment of intertrochanteric fractures. It has the following advantages: (1) the force arm is short and close to the gravity line, which can reduce the stress bending of gravity on the nail after weight bearing, and at the same time has the effect of local direct compression, which is in line with the biomechanical characteristics, which greatly reduces the pressure of the femoral calcar and reduces the stress shielding effect, and is conducive to fracture healing; (2) the

minimally invasive incision has small tissue injury and less bleeding during the operation; (3) the helical blade has the effect of anti-rotation and compression, which can reduce the cutting of the femoral neck, and the helical blade implantation can better compress the cancellous bone and reduce the loss of bone mass, it provides a strong guarantee for patients to get out of bed in the early stage after operation<sup>[6, 7]</sup>. However, during the clinical follow-up, it was found that 6–21% of the patients with PFNA had internal fixation failure, which led to complications such as nail withdrawal, cutting and so on<sup>[8]</sup>. In essence, the cutting of the helical blade is caused by the micro fracture of the surrounding cancellous bone, especially the fragile and loose bone trabecula of osteoporosis, the fracture of the surrounding large bone trabecula after the injury accumulation, and the local instability and movement of the unsupported helical blade. If excessive osteoporosis, it needs to be treated with other treatments. According to previous reports, the failure of PFNA internal fixation can be divided into controllable factors and uncontrollable factors<sup>[9]</sup>. The controllable factors include the mode of anesthesia, the time of operation, the amount of intraoperative blood loss and postoperative rehabilitation measures. The uncontrollable factors mainly include age, sex, basic diseases, fracture types and bone quality, etc. When TAD (Tip-apex distance) > 30 mm, severe osteoporosis, poor fracture reduction and severe underlying diseases are the high risk factors for the failure of PFNA<sup>[10]</sup>.

The case reported in this paper, the helical blade was over-unlocking during the operation, resulting in inability to lock. If it is not handled or ignored, the compression effect will be lost after the operation, and at the same time, it will lead to rotation instability and increase the risk of internal fixation failure. Although the helical blade is locked successfully through a distal screwdriver in our operation, it is still necessary to pay attention to the recurrence of similar problems. Wang report similar case with us and suggest to use the SW4.00 mm Cannulated hexagonal screwdriver to lock the helical blade, which the same as we used, however, they don't discuss what's the problem about the helical blade and why has that happened<sup>[11]</sup>. In this paper, we propose the concept of over-unlocking of spiral blade. PFNA helical blades from different equipment companies are not consistent, but no matter which kind. All need to be tested before inserting the helical blade to prevent the helical blade from being over-unlocking and unable to lock during the operation. Intraoperative fluoroscopy should not only pay attention to the position of the helical blade, but also pay more attention to the abnormal shape of the helical blade itself. When the helical blade is over-unlocking, if the aiming arm is not disassembled, you can try to take out the helical blade and fix it again. If the aiming arm has been removed, it is not recommended to remove the helical blade, which can easily lead to loss of reduction, loss of bone mass and prolongation of operation time. We suggest that we should consider adding a screw from the lateral wall through the femoral neck for anti-rotation, or you can observe the tail of helical blade and find suitable screw driver to fix it if there is one.

## Conclusion

In order to avoid over-unlocking of the helical blade, we recommend that the following actions be performed during the operation: ensure that the helical blade is factory packaged in the locked state; do

not overtighten when rotating counterclockwise to connect the impactor and the helical blade, which prevent the helical blade in a slithering state; make sure that the helical blade is not over-unlocked before entering; after locking the helical blade, it should be confirmed by fluoroscopy.

## **Abbreviations**

PFNA: Proximal femoral nail anti-rotation. TAD: Tip-apex distance.

## **Declarations**

### **Ethics approval and consent to participate**

This is a case report and technical precautions. It has been approved by the hospital before surgery.

### **Consent for publication**

Informed consent was obtained from all individual participants included in the study.

### **Availability of data and material**

The datasets during and/or analysed during the current study are available from the corresponding author on reasonable request.

### **Competing interests**

The authors declare that they have no competing interest.

### **Funding**

This work was supported by Grants from the Natural Science Fund of China (No. 81701896), Natural Science Basic Research Program of Shaanxi (No. 2020JM-682) and The Fundamental Research Funds for the Central Universities (No. xjj2018jchz03).

### **Authors' contributions**

Meng Li is an operation during the surgery.

Wenchen Ji is the first assistant during the operation and write the paper.

Kai Liu is mainly responsible for image processing and text proofreading

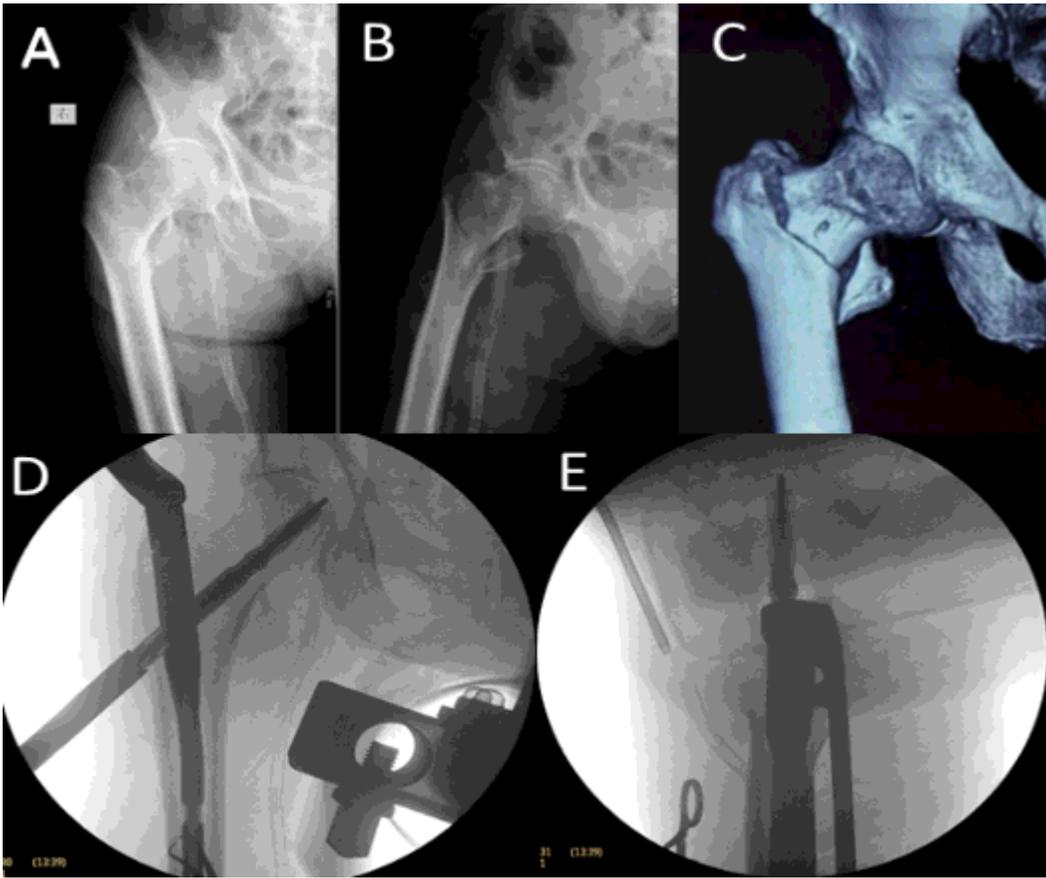
### **Acknowledgements**

Thanks to the Department of operating room of the first Affiliated Hospital of Xi 'an Jiaotong University for their support and help during the whole process

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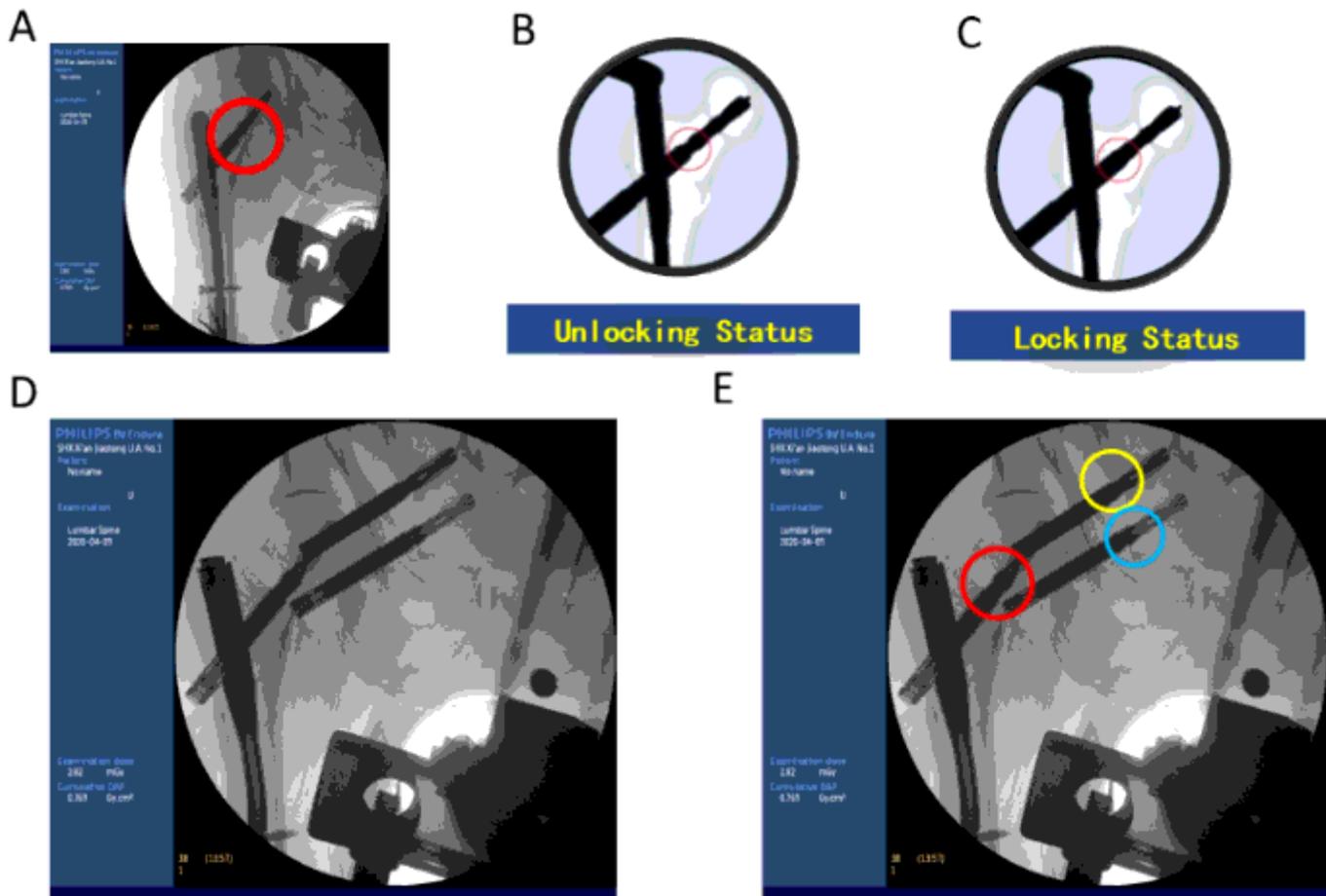
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## Figures



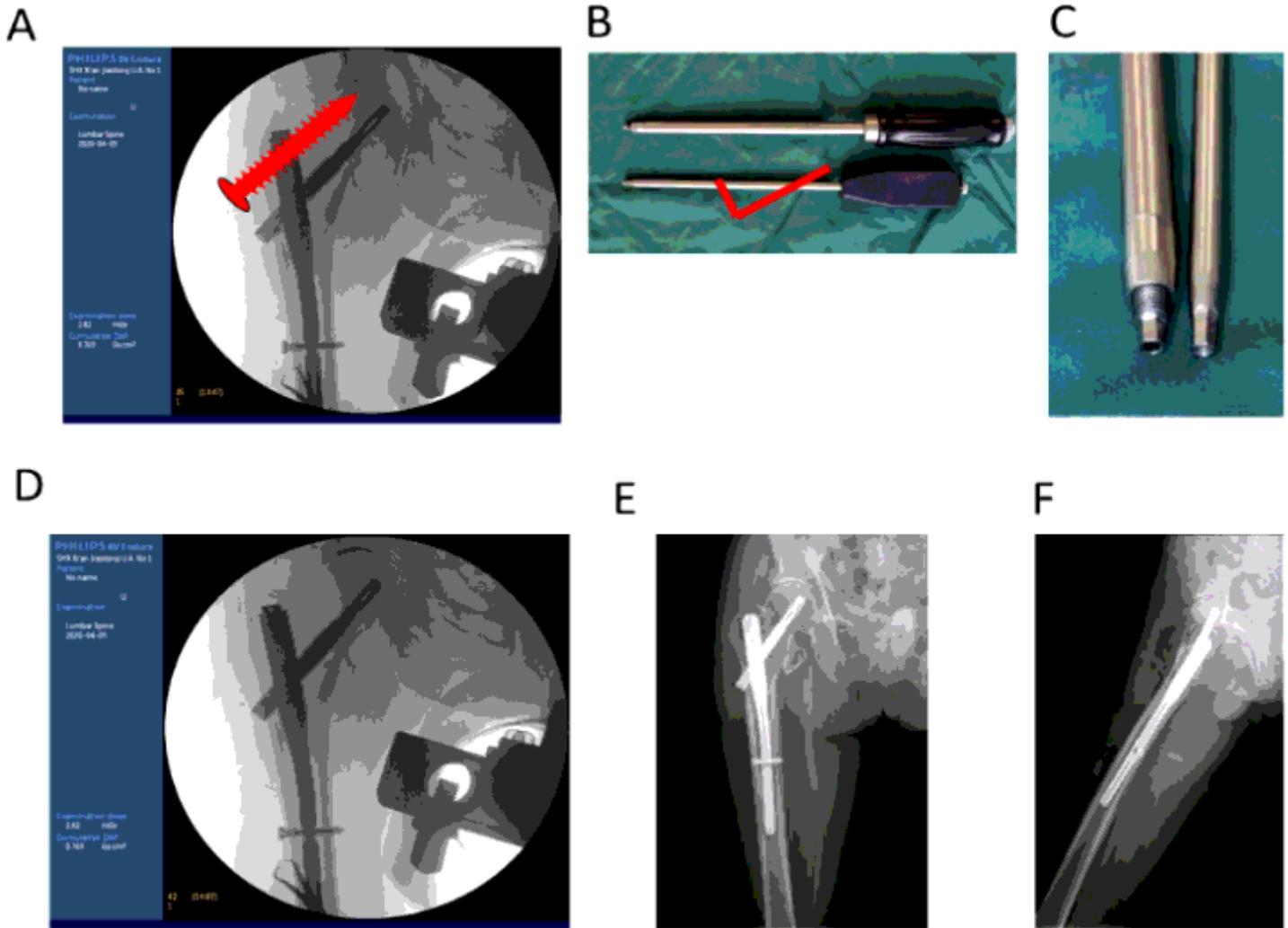
**Figure 1**

A, B. Anterior and lateral hip radiography before operation. C. Three-dimensional CT of hip before operation. D, E. Intraoperative anteroposterior and lateral radiographs.



**Figure 2**

A. During the operation, the helical blade was over-unlocking. B, C. Helical blade unlocking and locking state. D, E. Place the locking and unlocking helical blades on the body surface and compare them with the inserted helical blades.



**Figure 3**

A. Insert one nail anti-rotation. B, C. Distal lock screwdriver. D. During the operation, the helical blade was successfully locked and the gap became smaller. E, F. The position of positive and lateral films was good after operation.

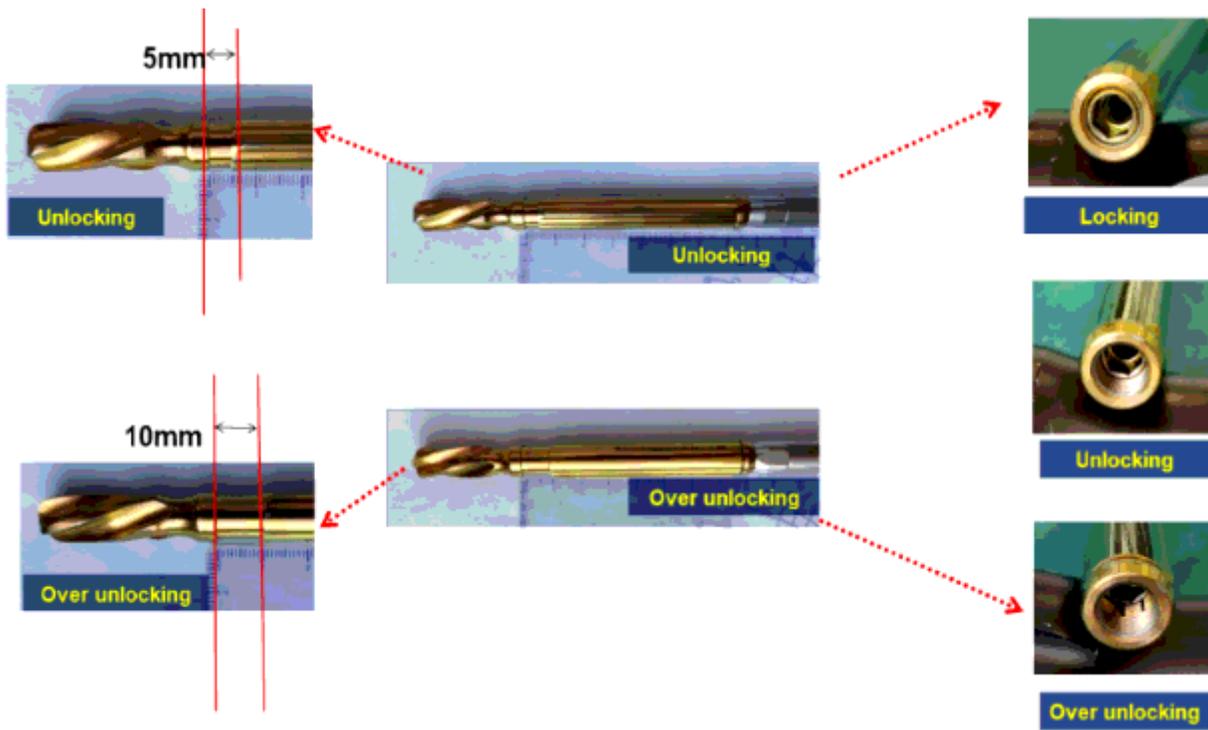


Figure 4

Different states of helical blade