Title	**Cutout of proximal femoral nail antirotation resulting from blocking of the gliding mechanism during fracture collapse**
Author(s)	**Cheung, JPY; Chan, CF**
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Cut-out of PFNA Due to Blocking of the Gliding Mechanism During Fracture Collapse

Summary

The proximal femoral nail anti-rotation (PFNA) had been successful in treating unstable trochanteric fractures. Previous studies have shown technical problems such as unsatisfactory fracture reduction, poor insertion technique and poor blade position leading to complications such as cut-out. We present a case of PFNA cut-out due to the blocking of the gliding mechanism during fracture collapse by the lateral cortex. The trochanteric fracture had not healed on presentation and there was significant acetabulum protrusion of the device. Thus, a cemented total hip arthroplasty was required.

Key Words: PFNA; unstable; trochanteric; fracture

Introduction

Intertrochanteric fractures of the proximal femur are common in the elderly due to the rise in life expectancy. Treatment of these fractures can be categorized into methods using either extramedullary or intramedullary devices. Implant decision is controversial in most cases. The ideal implant needs to be close to the center of axial loading for neutralization of the forces displacing the fracture. This will result in a shorter lever arm and lower bending moment. The implant must also be able to bear full load and facilitate controlled fracture impaction and compression by the gliding mechanism. There should also be a low risk of cut-out and periosteal blood supply disruption.

In our hospital, the proximal femoral nail anti-rotation (PFNA Synthes (Hong Kong) Ltd. 87-105 Chatham Road South, Kowloon, Hong Kong) is the preferred device. This is because the surgeons believe that the helical blade design affords rotational and angular stability to the fracture, and does not require an additional anti-rotation screw. Despite the PFNA offering generally good results in our hands, the technique for its insertion is extremely important. The follow review will help illustrate a flaw during PFNA insertion that can cause cut-out if not identified and addressed intra-operatively by the surgeon.

Case Report

An 81 year-old man in good health and unaided ambulation was admitted to our unit after a slip and fall resulting in an OTA 31A-2.2 trochanteric fracture of the left hip (figures 1 and 2). An operation was performed on the first day after admission and

a PFNA was inserted due to the large postero-medial fragment. Postoperative x-ray (figures 3 and 4) showed satisfactory alignment with a tip-apex distance of 16mm, a neck-shaft angle (AP) of 128 degrees and Garden alignment index of 166 degrees in the anterior-posterior (AP) view and 178 degrees in lateral view. The placement of the helical blade was at the center of the femoral head in both the AP and lateral views.

The patient was subsequently transferred to a rehabilitation center on postoperative day 5 for further training. He was able to walk with a quad cane after one month. The patient returned to our clinic two months after the operation complaining of left hip pain. He was able to tolerate walking without aids and there was no associated trauma or fever. Radiographs (figures 5 and 6) revealed protrusion of the PFNA into the acetabulum.

He was admitted into hospital for work-up and blood tests showed a normal white cell count, erythrocyte sedimentation rate and C-reactive protein. Hip joint aspiration was performed yielding no positive cultures. A CT scan was also performed (figure 7) revealing a 2 cm blade cut-out into the acetabulum with a fracture that had not healed. Thus, a cemented total hip arthroplasty was performed. Intra-operatively (figures 8 and 9), there were no signs of infection and the lateral cortex was found to be obstructing the blade entry site preventing it from gliding during fracture collapse.

Postoperatively (figure 10), the patient recovered well. He was most recently seen in follow-up 5 months after the operation with no more hip pain. He was able to tolerate walking with a quad cane for 30 to 60 minutes and was very satisfied with the final result.

Discussion

Anatomical and biomechanical studies have shown that the superio-medial quadrant of the femoral head is the weakest portion of the head/neck segment. Cut-out most commonly occurs when an implant is placed in this quadrant, especially in osteoporotic bone.(1) The helical blade of the PFNA has been demonstrated in biomechanical studies to be suitable for unstable trochanteric fractures.(2) The helical blade theoretically increases contact surface area between the device and the femoral head cancellous bone, by causing compression rather than removing bone.(1) Most of the complications documented in the literature associated with the PFNA were caused by insertion technique rather than equipment failure.(2-4) Cut-out rate of PFNA was described to be 3.4% in one study(3) and reoperation rate was noted to be 4%.(2) Simmermacher et al. studied the PFNA in 315 patients and found 4 penetrations of the helical blade into the acetabulum.(5) However, they found that 3 penetrations occurred after a fall onto the ipsilateral trochanter.(5)

The PFNA has a few problems that are only faced while treating Asian patients.

In the shorter elderly patients, there is a mismatch between the proximal end of the nail and proximal femur.(4) Thus, if the helical blade is placed in the lower half of the femoral neck, the proximal end of the nail would not be completely inserted into the tip of the greater trochanter leading to impingement of surrounding soft tissues and thigh pain.(4) Furthermore, excessive anterior bowing of the femur is encountered in the Asian population and shorter nails must be chosen during insertion to prevent impingement of the anterio-lateral cortex.(4, 6) In such cases, hammering of the PFNA nail should be avoided.(6)

There are a few established guidelines to determine whether the fixation technique is satisfactory or not. There is a higher rate of varus collapse and subsequent cut-out with a tip-apex distance of >25mm(7) and neck-shaft angles of less than 125 degrees.(8) Furthermore, the position of helical blade in the inferio-posterior aspect of the femoral head has a lower cut-out risk.(1, 5, 8) We have followed these guidelines in the treatment of our patient. Despite this, our patient still had cut-out of the helical blade. We must attribute this to the disruption of the normal gliding mechanism. There was no history of trauma or no evidence of infection leading to the cut-out in our patient. The primary operation was performed satisfactorily with adequate reduction and satisfactory positioning of the PFNA and helical blade. In retrospect, the inferior end of the helical blade was already abutting the lateral cortex (figure 2) after the initial operation. Thus, when the fracture collapsed, the blade was only able to slide proximally through the femoral head into the hip joint. For future reference, a longer length, with the helical blade protruding from the lateral shaft would have probably been a better decision to prevent the lateral cortex from blocking the gliding mechanism during fracture collapse. Unfortunately this has the unwanted consequence of lateral thigh pain, especially when sleeping on that side.

Some studies have advocated revision fixation for cut-out PFNA.(6, 8) We were unable to apply this treatment option in our case because the trochanteric fracture had not healed and there was significant protrusion into the acetabulum (2cm on CT scan). Therefore revision fixation would have likely failed and we performed a cemented total hip arthroplasty instead. Fortunately for our patient, the arthroplasty was successful in treating the complication and he was able to return to walking without pain.

Conclusion

Achieving good reduction and fixation of unstable trochanteric fractures is difficult. Intramedullary devices such as the PFNA are popular devices for fixation and they generally perform well. However, the technique for its insertion is still

critical. Proper reduction of the fracture, insertion of the PFNA at the tip of the greater trochanter and good placement of the helical blade are all vital to the success of the implant. It is good practice to keep 2-3mm of the blade end protruded from the lateral cortex to avoid a similar complication.

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Figure Legend

Figure 1: Injury film (AP view)
Figure 2: Injury film (lateral view)
Figure 3: Post-operative PFNA film (AP view)
Figure 4: Post-operative PFNA film (lateral view)
Figure 5: Cut-out PFNA film (AP view)
Figure 6: Cut-out PFNA film (lateral view)
Figure 7: CT scan showing cut-out helical blade
Figure 8: Intra-operative photo showing the lateral cortex abutting the helical blade; fracture has collapsed without gliding of the blade
Figure 9: Intra-operative photo showing cut-out PFNA through the femoral head
Figure 10: Post-operative film after cemented total hip arthroplasty

Figure 1a (Pelvis Injury Film)

Figure 1b (AP Injury Film)

Figure 1c (Lateral Injury Film)

Figure 2a (AP Post-operative X-ray)

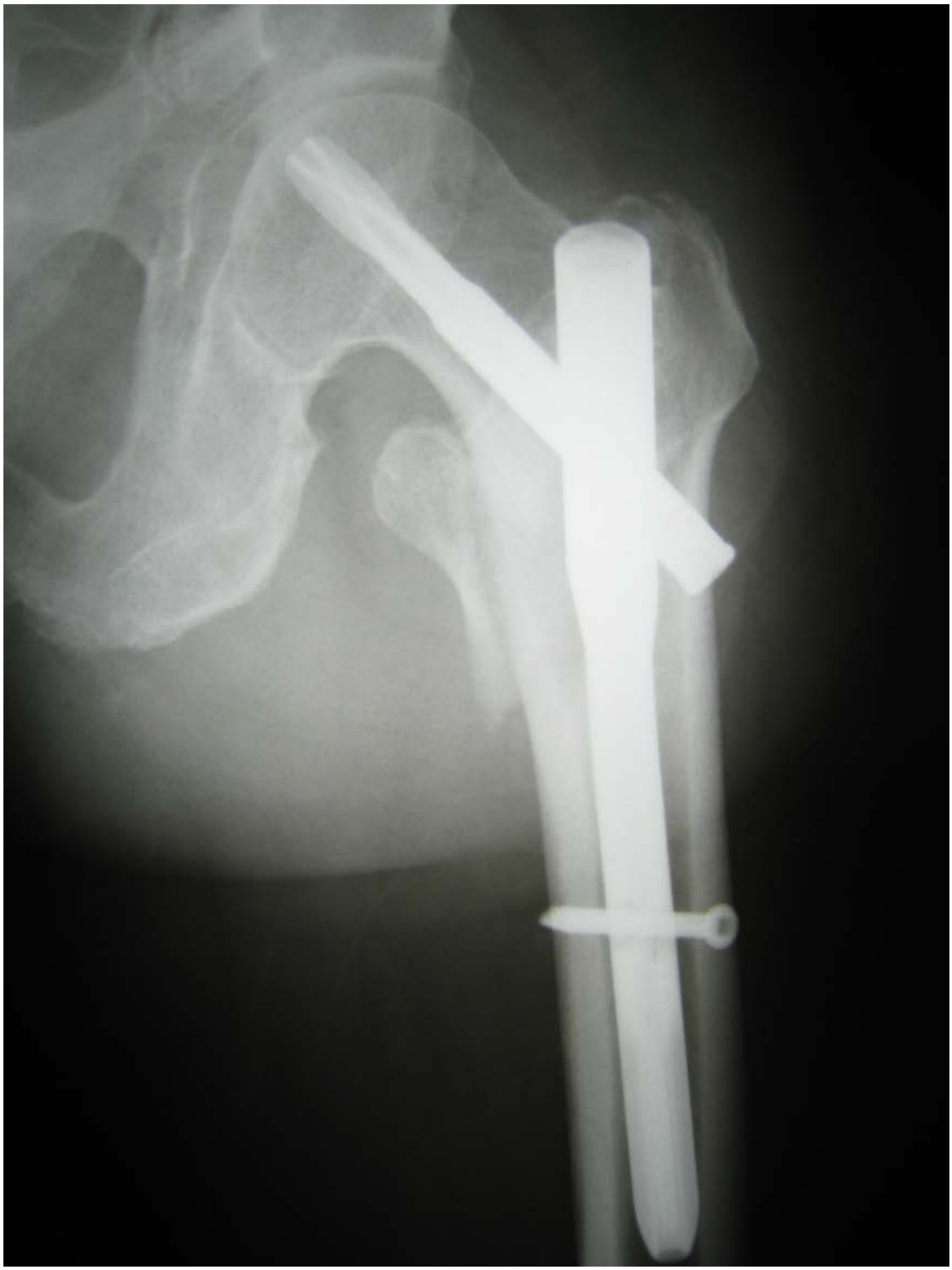

Figure 2b (Lateral Post-operative X-ray)

Figure 3a (Pelvis AP Film Showing Cut-out Blade)

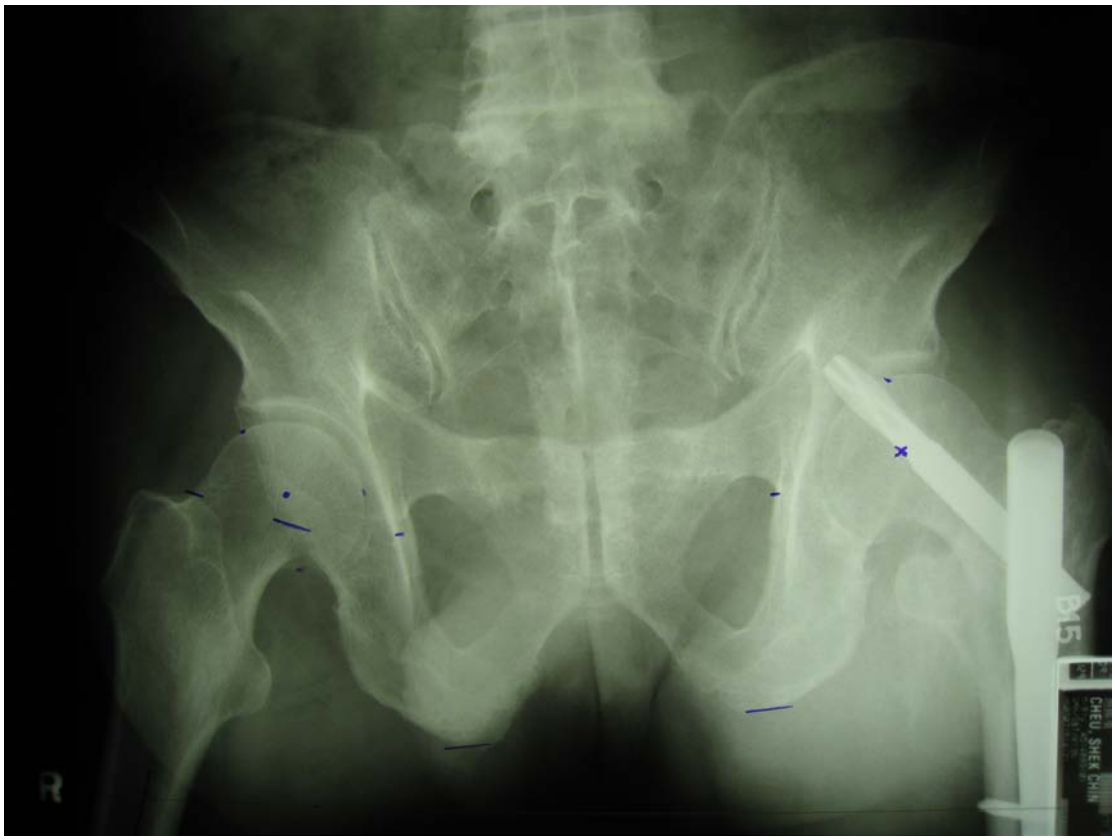

Figure 3b (AP Film Showing Cut-out Blade)

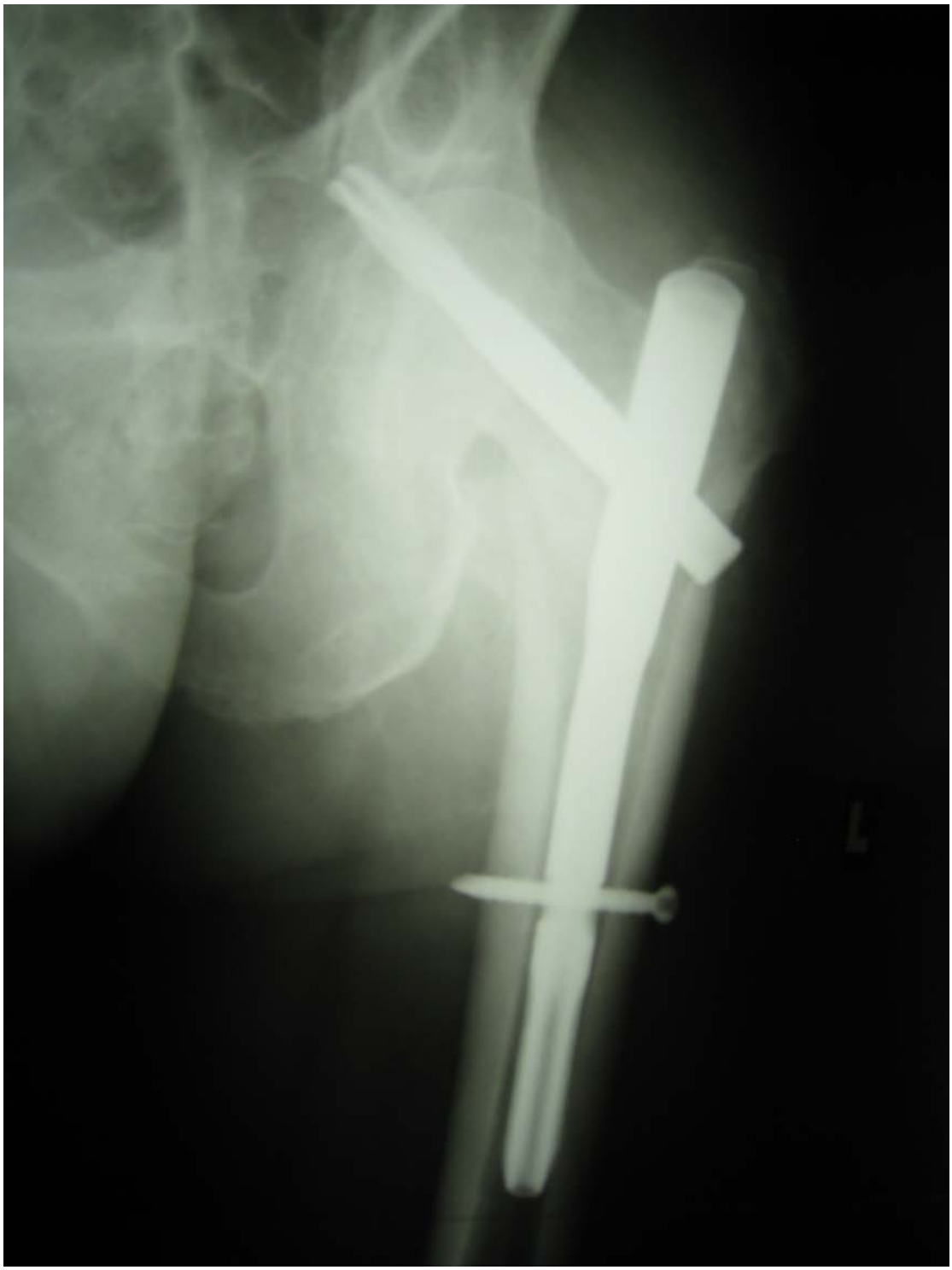

Figure 3c (Lateral Film Showing Cut-out Blade)

Figure 4a (Sagittal CT scan Showing Cut-out Blade)

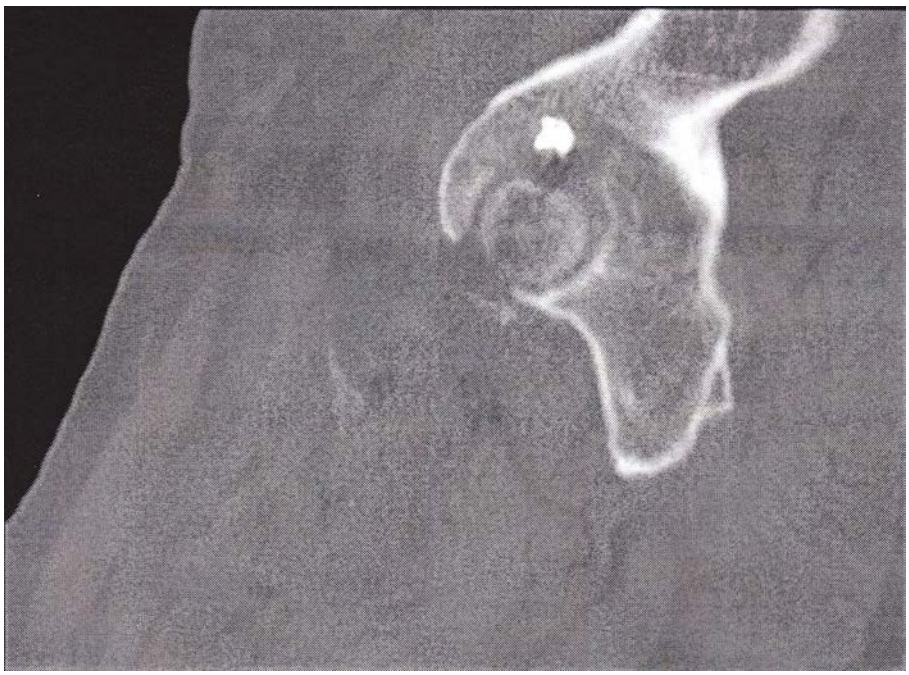

Figure 4b (Axial CT Scan Showing Cut-out Blade)

Figure 4c (Fracture Not Healed In Coronal CT Scan)

Figure 5a (Intra-operative Photo Showing Sunken Blade with Blocking by the Lateral Cortex)

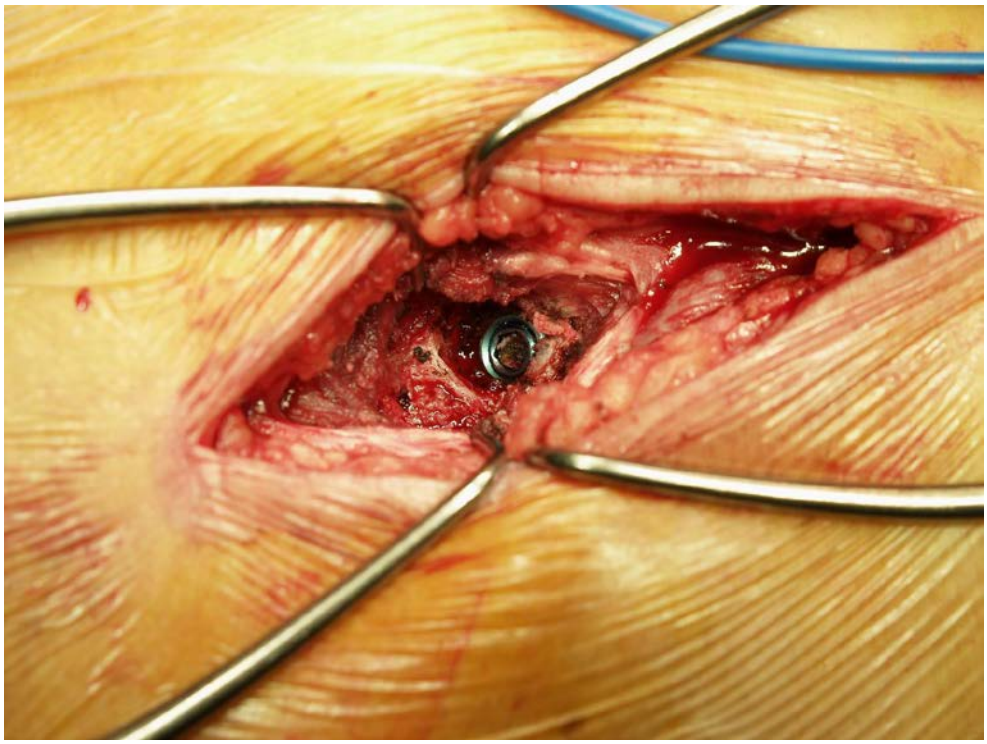

Figure 5b (Intra-operative Photo Showing Large Acetabulum Defect)

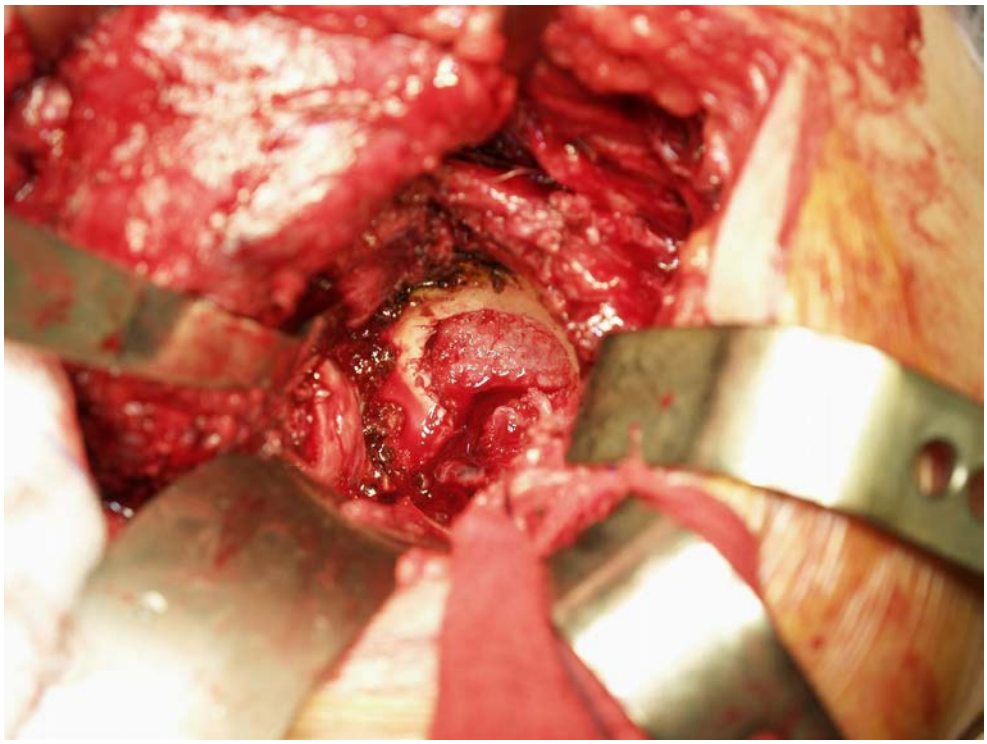

Figure 5c (Intra-operative Photo Showing Cut-out Blade)

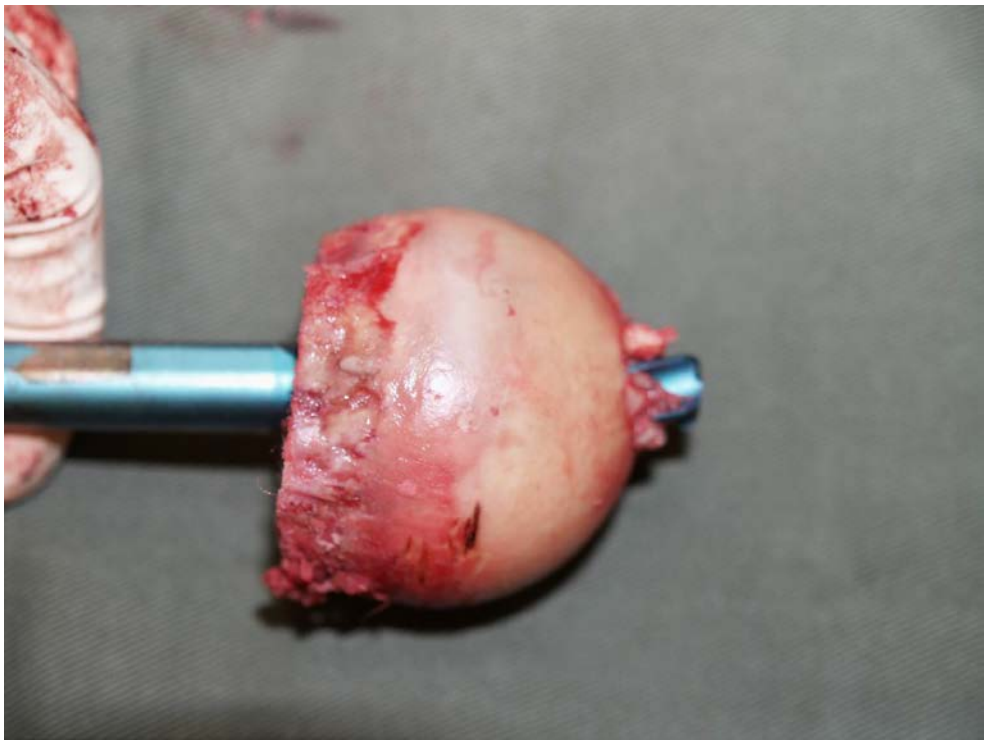

Figure 6a (Post-arthroplasty AP X-ray)

Figure 6b (Post-arthroplasty Lateral X-ray)


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