

Custom Total Hip Arthroplasty with Image-Free Screw Removing Assisted by CT Based Navigation: A Case Report

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Abstract

It is a huge stress that remaining screws in the bone cannot be seen from the bone surface to remove the screw with fluoroscopy. Sometimes 2D fluoroscopy technique is difficult to remove hidden screws or metal pieces. To seek the hidden screw, skin incision, cortical bone loss and weakness of the long bone shaft will be increased. No case of total hip arthroplasty with screw removing assisted only CT based navigation was reported. We experienced such rare case first in the world. 77years old woman complained her left hip pain. Another surgeon had done femoral neck abduction osteotomy in 1989. A Broken screw was remained covering the cortical bone at the shaft of femur. We planned total hip arthroplasty with custom stem and screw removal, assisted by CT based navigation. In total hip arthroplasty, there were some issues that increased bone breaking and infection risks with the use of fluoroscopy. It seems that THA with screw removing assisted CT based navigation is a valuable method.

Keywords: CT based navigation; Screw remove; Total hip arthroplasty; Custum stems

Introduction

There were many total hip arthroplasty (THA) cases after pelvic and/or femoral Osteotomy. For example: Rotational acetabula osteotomy, Chiary osteotomy, femoral neck osteotomy, and so forth. In some of those, screw fixation was performed. The left screws interfered with THA in some cases. It was troublesome due to broken invisible screws hind in the cortical bone. To remove these screws, universally fluoroscope should be used to search screws, but there might be a possibility of increased infection rate by using a fluoroscope [1]. And by 2D seeking with fluoroscopy, unnecessary damage to cortical bone may occur during the search of missing screws. We made the plan of THA with custom stem for the total hip case after femoral neck osteotomy with CT based navigation. The hidden screw in femoral shaft was removed successfully with CT based Navigation system without C-arm.

Case report

77 years old female came to Nagoya City University Hospital with left coxalgia. She had Bombeli femoral Ottoman in 1989at another hospital. Implant removal was performed at another hospital several years after Osteotomy. With plain X-Ray films, a piece of broken screw was left in the femoral shaft (Figure 1). Moreover, it seemed that broken screw was completely covered with femoral cortical bone (Figure2). Due to this, left proximal femur had severe deformity by Osteotomy; we prepared custom made implant (JMM, Kyoto, Japan) and CT-based navigation system. Vector Vision Hip Ver.2.5.1 (Brain LAB, Munich, Germany) was applied as CT based Navigation system. The CT scans were obtained with SIEMENS SOATOM definition (Siemens, Erlangen, Germany), and the scanning protocol involved scanning of the lower lumbar spine to foot with 2 mm slice. Position of patients in the scanner was standardized with neutral abduction/adduction and with the patellae pointing directly upwards. The estimated total CTDI was 20 mGy.

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Figure 1: X-ray AP film before arthroplasty. Completely hidden screw was recognized in the femoral shaft.



Figure 2: In MPR-CT scan on Vector vision Hip®, broken screw was seemed completely covered by cortical bone.

Operation

The operation was done in 2009. Before the operation, 3D image was made with Magics® and Mimics® (Materialize Co Ltd, Belgium). The images showed the broken screw left in the bone interfering with stem insertion (Figure 3). Plain X-ray films and CT shows that the broken screw was hidden under cortical bone. The patient was in Lateral position during operation. Markers for navigation were set up on the pelvis and distal femoral (around 10cm proximal joint line). Posterior approach was performed. Registration was performed first. Calculated accuracy was 1.8 mm on registration of the CT based Navigation. It was below 1.9 mm that was recommended as verification of registration. To point out the hidden broken screw, the wound was extended to femoral side. We could accurately point out the hidden screw by the CT based Navigation (Figure 4). And the broken screw was easily removed from the screw removal, set (Synthes, Swiss) from a small drill hole made on femoral shaft (Figure 5). To prevent the fracture of the femoral shaft, commercial metal band (CCG

band, Smith & Nephew, UK) was set on the femoral cortex at the inferior small trabecular. Total operating time was 128 min and the total blood loss was 814 ml. The patient started to walk on the next day of operation. After the arthroplasty there was no symptom with her left hip. After five years from primary total hip arthroplasty, there was no trouble with her hip (Figure 6).

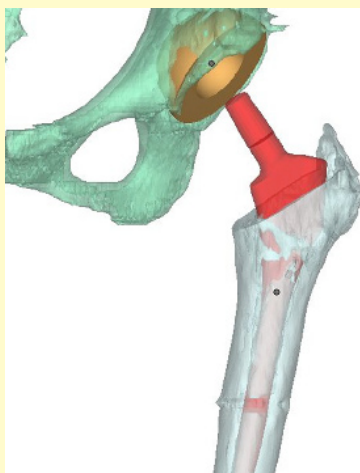


Figure 3: Hidden broken screw will disturb the custom stem insertion on 3D template.



Figure 4A: Hidden screw seeking with pointer of Navigation System.

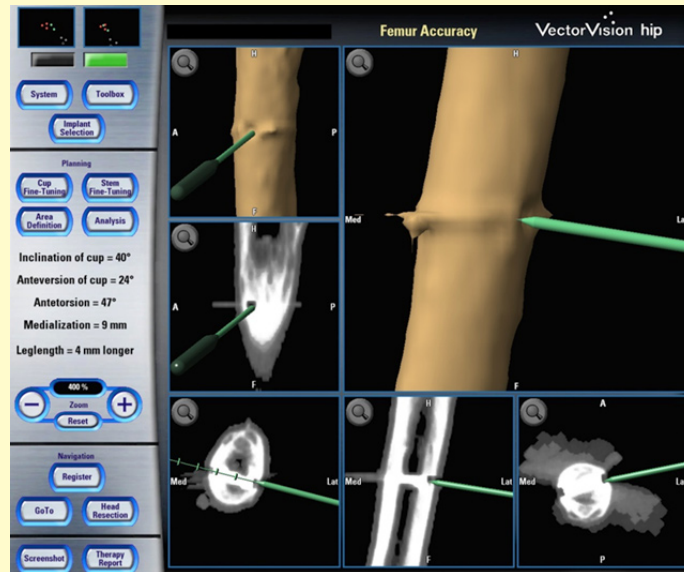


Figure 4B: Hidden broken screw was pointed out by CT-based navigation.

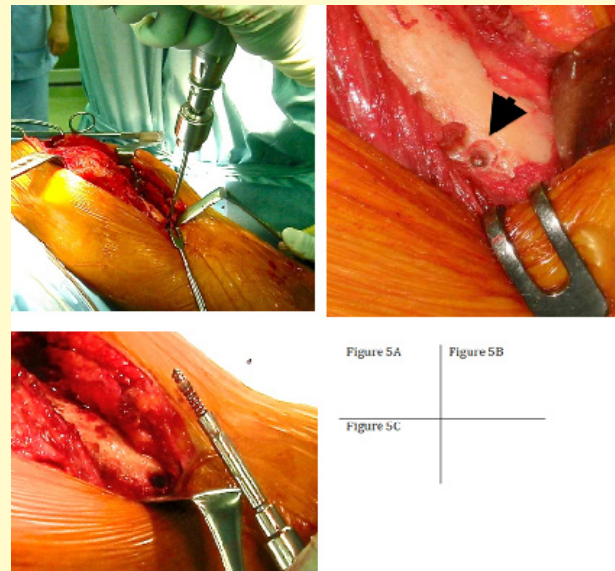


Figure 5A: Small drill hole was made on cortical bone at the position pointed out by CT-navigation.

Figure 5B: Broken screw was seen from small drill hole. (Black arrow)

Figure 5C: Safety removing hidden screw with screw removal kit.



Figure 6: AP x-ray view after five years total hip arthroplasty.

Discussion

Removing screw with fluoroscopy-assisted navigation was reported, but there was no report with image-free navigation [2] [3]. We believe this report is a first case that hidden screw was removed successfully with image-free CT based navigation in the world. It is a huge stress that the remaining screws cannot be seen from the bone surface. By 2D fluoroscopy, it will be sometimes difficult to point out and remove broken hidden screws. If it is difficult to point out the screw, the skin incision and the cortical defect will be large to seek the hidden metal parts, and radiation exposure will be increased for both patients and surgeons [4]. The advantages of screw removing with CT based navigation are minimal cortical defect and no exposure to radiation during operation. Rodriguez et al. reported special technique for “Novel placement of cortical bone trajectory screws in the previously instrumented pedicles for adjacent-segment lumbar disease using CT image-guided navigation”. In this report they pointed out instruments by CT based navigation, but did not remove it [5].

It suggested that an operation with the fluoroscopy increase infection rate during surgery [1]. The limitation of metal removing with CT based navigation is the cost of navigation and the accuracy of the system. Khan., *et al.* reported that the accuracy on Vector Vision Hip Ver.2.5.1 was within 1.9 mm [6]. Honl., *et al.* reported that CT based navigation should be accurate than image free navigation systems [7]. In our case, we could remove the hidden broken screw easily from a small hole on the femoral shaft.

This patient’s total hip implant condition was seen no subsidence and loosening. There were no major complications, for example, infection, periprosthetic fracture and so forth. The hidden screw removal with CT navigation will be a useful technique for navigation guided total hip or total knee arthroplasty.

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