

# Intraoperative Frog Lateral View, An Effective and Easy Way to Avoid Screw Cutout for Femoral Neck Fractures Fixed with Multiple Cancellous Screws

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## Technical advance

**Keywords:** frog lateral view, CT examination, femoral neck fracture, cannulated screw

**Posted Date:** March 18th, 2021

**DOI:** <https://doi.org/10.21203/rs.3.rs-330126/v1>

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# Abstract

## Background

This study analyzed the imaging data of patients retrospectively to understand the risk of cannulated screw fixation for femoral neck fracture. At the same time, we try to use intraoperative frog lateral view to avoid the risk of screw cutout.

## Method

The imaging data of patients with femoral neck fracture treated with cannulated screws between January 2015 and September 2016 was reviewed, and patients with screw cutout or suspicious cutout were found. The postoperative imaging data of 41 patients who attempted to use frog lateral view during the operation was reviewed, and patients with screw cutout or suspicious cutout were found.

## Result

Among the 479 patients, only 72 patients underwent CT examination after the operation, and 18 of the 72 patients had obvious screw cutout. Screw cutout cases accounted for 3.8% of the total number of cases and 25% of the patients undergoing CT examination. Of the 41 patients who received intraoperative frog lateral view, only 2 cases were cutout from the neck, and no cases were cutout from the femoral head.

## Conclusion

The anterior upper part of the femoral head is a high-risk area cutout by cannulated screws. Postoperative CT is very necessary and can accurately detect the screw cutout, for the long-term prognosis of the implications. The application of frog lateral view in the operation of femoral neck fracture can effectively avoid the risk of cannulated screw cutout.

# Background

Femoral neck fracture is a common lower limb injury. With the aging of society, the treatment of femoral neck fracture has attracted more and more attention<sup>[1, 2]</sup>. In general, early recovery of joint replacement is the best treatment for elderly patients with femoral neck fractures<sup>[3-5]</sup>. However, in young patients with femoral neck fractures, internal fixation is a more reasonable treatment than joint replacement<sup>[6]</sup>. At present, there are many methods of internal fixation for the treatment of femoral neck fracture, and some techniques have achieved good therapeutic effects and the most widely used and effective technique is cannulated screw fixation for femoral neck fractures. Cannulated screws are widely used in the treatment of femoral neck fractures. Due to their minimally invasive, definite fixation effect and follow-up compression effects, they are very popular among orthopedic surgeons<sup>[7]</sup>. At present, more studies are focused on the number, configuration and direction of screws. However, due to the wide application of intraoperative fluoroscopy, the problem of screw cutting out the femoral neck or femoral head is often

overlooked<sup>[8-11]</sup>. So can conventional positive and lateral fluoroscopy of c-arm during operation effectively prevent the screw from being cutout? The purpose of this study was to review and analyze CT data to understand the risk of screw cutout, and to demonstrate by imaging studies that the application of intraoperative frog lateral view can effectively avoid the risk of cannulated screw cutout.

## Method

The medical records of patients with femoral neck fracture admitted to our hospital from January 1st, 2015 to September 30, 2016 were retrospectively analyzed. Inclusion criteria: 1. Femoral neck fracture; 2. Older than 18; 3. No pelvic acetabular fractures or other severe ipsilateral lower limb injuries were observed. Exclusion criteria: 1. Patients treated with joint replacement; 2. Patients with other internal fixation such as dynamic hip therapy; 3. Patients with open reduction cannulated screw internal fixation; 4. Patients receiving conservative treatment. All the imaging data were reviewed by orthopedic surgeons with more than five years of professional clinical experience to determine whether the screws were cutout.

In order to explore ways to avoid screw cutting out during surgery, 41 patients with femoral neck fractures were treated with cannulated screw fixation in our hospital and received intraoperative frog lateral view test from September 2017 to December 2017. All the 41 patients were over 18 years old, without pelvic acetabular fractures or other severe ipsilateral lower limb injuries. C-arm fluoroscopy was used during the operation, and the frog lateral view was used before the lower traction bed for final verification after no cutout in the positive and lateral positions. The standard frog lateral view is: the patient is in a supine position with hip flexion and knee flexion on the affected side, so that the lateral sole of the foot touches the level of the opposing knee joint. The hip is then extremely abducted so that the pelvis is in full contact with the receiving panel. The rays are coming in vertically from front to back, with the projection center at the center of the femoral head<sup>[12]</sup>. All 41 patients underwent CT examination of the affected side of the hip joint after the operation, and orthopedic surgeons with more than five years of professional clinical experience reviewed the CT fluoroscopy results to determine the screw position and whether the screws were cutout.

## Statistical Analysis

The data was analyzed with SPSS 19.0 for Windows (SPSS Inc., Chicago, IL, USA). Categorical data was statistically analyzed by means of chi-square test or Fischer's exact test ( $n < 40$  or  $T < 1$ ). Differences were regarded as statistically significant when  $p < 0.05$ .

## Result

There were 1376 cases, of which 422 underwent joint replacement and 479 underwent closed reduction and cannulated screw fixation, 8 underwent open reduction and cannulated screw fixation, and 467 underwent other methods including conservative, dynamic hip or other fixation techniques. Among the 479 patients, 334 patients only underwent X-ray examination in the positive position of the affected side

hip joint after surgery, and no screw cutout. In 145 patients, X-ray examination in the positive and lateral positions of the affected side hip joint was performed, and 3 cases of suspicious screws cutout were found. Among the 479 patients, only 72 patients underwent CT examination after the operation, and 18 of the 72 patients had obvious screw cutout, among which 9 cases were anterior upper part, 7 cases were neck cutout, 2 cases were upper posterior part, and 54 cases were not cutout. Screw cutout cases accounted for 3.8% of the total number of cases and 25% of the patients undergoing CT examination. Of the 41 patients with intraoperative frog lateral view acceptance, only two cases were cutout through the neck and no cases were cutout from the femoral head. (Fig. 1a, 1b, 1c)

## Discussion

The use of three cannulated screws in the treatment of femoral neck fracture has long been a routine technique for the surgical treatment of femoral neck fracture due to its simple and minimally invasive method, less bleeding and accurate curative effect [13-15]. However, due to the long clinical application time and the large number of patients receiving cannulated screw fixation, clinicians have found many problems in practice. Many studies focused on the analysis of the failure of cannulated screw fixation to improve the technique of cannulated screw fixation for femoral neck fracture [16-20]. A large number of relevant studies not only improve the success rate of cannulated screw fixation, but also standardize the fixation method and shorten the learning curve, so that the method of cannulated screw fixation is more widely used. During the operation, the c-arm can be used to simply understand the position of the screw, facilitate the insertion of the screw and avoid the cannulated screw cutout the femoral neck. Therefore, the cutout of cannulated screw has not been frequently researched and noticed, but can c-arm fluoroscopy effectively avoid the screw cutout? This study aims to review this issue and try to improve the existing intraoperative fluoroscopy techniques.

Studies have shown that sufficient screw length to reach the subchondral bone can improve fixation strength and reduce the possibility of fixation failure<sup>[6]</sup>. Especially the femur under the femoral head type fracture, if the thread can not cross the fracture line, often can not achieve follow-up pressure, leading to fixation failure. The screw is long enough to be close to the subchondral bone so that to increase the fixation strength, but it also increases the risk of the cancellous screw cutting out the femoral head. Once the screw is cutout and inserted into the acetabulum it may cause damage to the joint, leading to severe traumatic arthritis and even necrosis of the femoral head. Therefore, how to accurately grasp the length of the screw is the key to the success of cannulated screw fixation. Traction bed assisted reduction of femoral neck fracture is a most commonly used reduction technique in surgery. This method can not only simply and effectively reduce the femoral neck, but also achieve relative stability and avoid loss of reduction during fixation. At the same time, the use of traction bed can provide convenience for intraoperative C-arm fluoroscopy(Figure 2a,2b).

But the positive and lateral position of the femoral neck be shown in the c-arm during the operation can accurately display the length of the screw accurately and prevent the screw from cutting out the femoral head? According to the results of the retrospective analysis, 72 of the 479 patients with femoral neck

fracture fixation with cannulated screws underwent postoperative CT examination, of which 18 cases had screw cutout, with a cutout rate as high as 25%. 11 cases were cutout from the position of the femoral head, and 9 of them were cutout from the anterior upper part of the femoral head. It can be seen that the anterior upper part of the femoral head is a high-risk area for screw cutout.

Through autopsy study, we found that when c-arm fluoroscopy was used during the operation, the screws cutout from the anterior upper and posterior upper part were easily covered by the maximum circumference of the femoral head due to the special fluoroscopy position (Figure 2c, 2d, 2e, 2f). Because the screw requires parallel femoral neck inserting, the femoral neck has a forward Angle, and the inverted triangle screw placement technology is widely used [22], the odd of femoral head cutout from the anterior upper is the biggest. These causes make the anterior upper part of the femoral head a high-risk area for screw cutout. If intraoperative CT data can be obtained, the screw cutout can be effectively avoided, but this is not possible in most medical institutions and it also increases the cost of treatment and increases the risk of radiation. Therefore, to solve this problem, we adopted intraoperative frog lateral view to verify whether the screw was cutout from the anterior upper (Figure 3a). Through the test, when the affected hip is in the frog lateral view, the hip joint is extremely extended and rotated, so that the anterior upper area is parallel to the direction of the rays, and any cutout part will not be covered (Figure 3b, 3c). In this study, none of the 41 patients who underwent intraoperative frog lateral view verification had the anterior upper screw cutout. It can successfully reduce the risk of cutout, lower the cost of treatment and avoid excessive fluoroscopy.

If intraoperative frog lateral view is not performed, even in the positive and lateral position of the femoral neck after the conventional fluoroscopy, the screw cutout cannot be effectively detected. First of all, after out of the state of anesthesia, the patient can not cooperate with the lateral perspective fluoroscopy mostly because of pain. Secondly, even if some patients are able to cooperate, they could not fully abduct and rotate the hip joint as fully as the frog lateral view during the operation. The upper anterior cutout is still easy to be covered by the maximum circumferential diameter, which is also the main reason why the positive lateral X-ray cannot effectively prompt the incision in this study. In addition, intraoperative frog lateral view examination before the patient leaves the traction bed more conducive to correct screw cutout. If the patient leaves the traction bed, even if the screw is found to cutout the femoral head after the frog position examination, it is difficult to find the position of the screw from the original skin incision due to the change of the traction position. Usually need to increase the incision and adjust, but this will increase the trauma and prolong the operation time. During the operation, the frog lateral view fluoroscopy examination was performed on the traction bed. If the screw is cutout, the lower limbs are directly restored to the previous position for traction, and the screw cap can be easily found through the previous skin incision, avoiding the expansion of the incision.

At present, there are some research problems shown in this paper as follows:

1. In this study, although the use of the frog lateral view can reduce the risk of screw cutting out of the anterior and upper femoral head area, the screw still has a low probability of cutting out from other

positions, so cutting out cannot be completely avoided; 2. In this study, the prognosis and outcome of patients with screw cutout were not further followed up. The consequences of screw cutout at different locations should be further studied; 3. More precisely designed experimental studies, larger sample sizes and long-term follow-up are needed to verify this point.

## **Conclusion**

C-arm fluoroscopy in the operation of femoral neck fracture cannot avoid the risk of cannulated screw cutout. The anterior upper region of the femoral head is a high-risk area cutout by cannulated screw. Postoperative CT is extremely necessary and can accurately detect the screw cutout for the long-term prognosis of the implications. In the operation of femoral neck fracture, frog lateral view fluoroscopy can effectively avoid the risk of cannulated screw cutout.

## **Abbreviations**

Not applicable

## **Declarations**

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

The Ethical Board Review of the Third Hospital of Hebei Medical University (Shijiazhuang, China) has approved the conduction of the study after a thorough examination and verification. The study has been performed in accordance with the ethical standards of Declaration of Helsinki in the 1964.

### **Consent for publication**

Not applicable

### **Availability of data and materials**

The datasets used 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 interests.

### **Funding**

Not applicable

### **Authors' contributions**

TZ, XD and HW designed research; TZ and HW made substantial contributions to acquire X-ray films and hold the assessment of radiographs; HW and TZ analyzed CT images and recorded the results of radiography assessment; TZ and XD analyzed data and performed statistical analysis; TZ and XD drafted and designed the manuscript; TZ had primary responsibility for final content; All authors read and approved the final manuscript.

## Acknowledgements

The authors wish to thank radiologist, for their assistance and cooperation in this study.

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## Tables

Table 1

**Comparison of screw cutout in two groups of patients with and without frog lateral view acceptance**

	<b>72 cases of fluoroscopy without using intraoperative frog position</b>	<b>41 cases of fluoroscopy using intraoperative frog position</b>	<b><i>P</i></b>
Cancellous Screws cutout or suspicious cutout	18/72	2/41	0.015
anterior upper cutout	9/72	0/41	0.025
neck cutout	7/72	2/41	0.58
Other parts cutout	2/72	0/41	0.53

# Figures

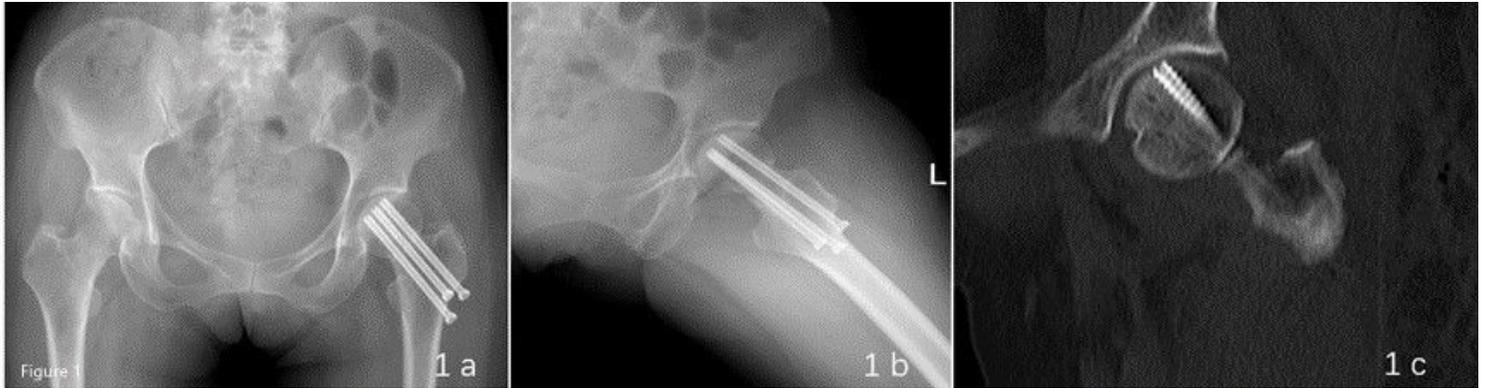


Figure 1

Imaging data of hip joint after cannulated screw treatment of femoral neck fracture In the figure 1a and 1b, the standard postoperative hip joint positive and lateral X-ray examinations showed no screw cutout, but the postoperative hip joint CT examination 1c showed the screw cutout

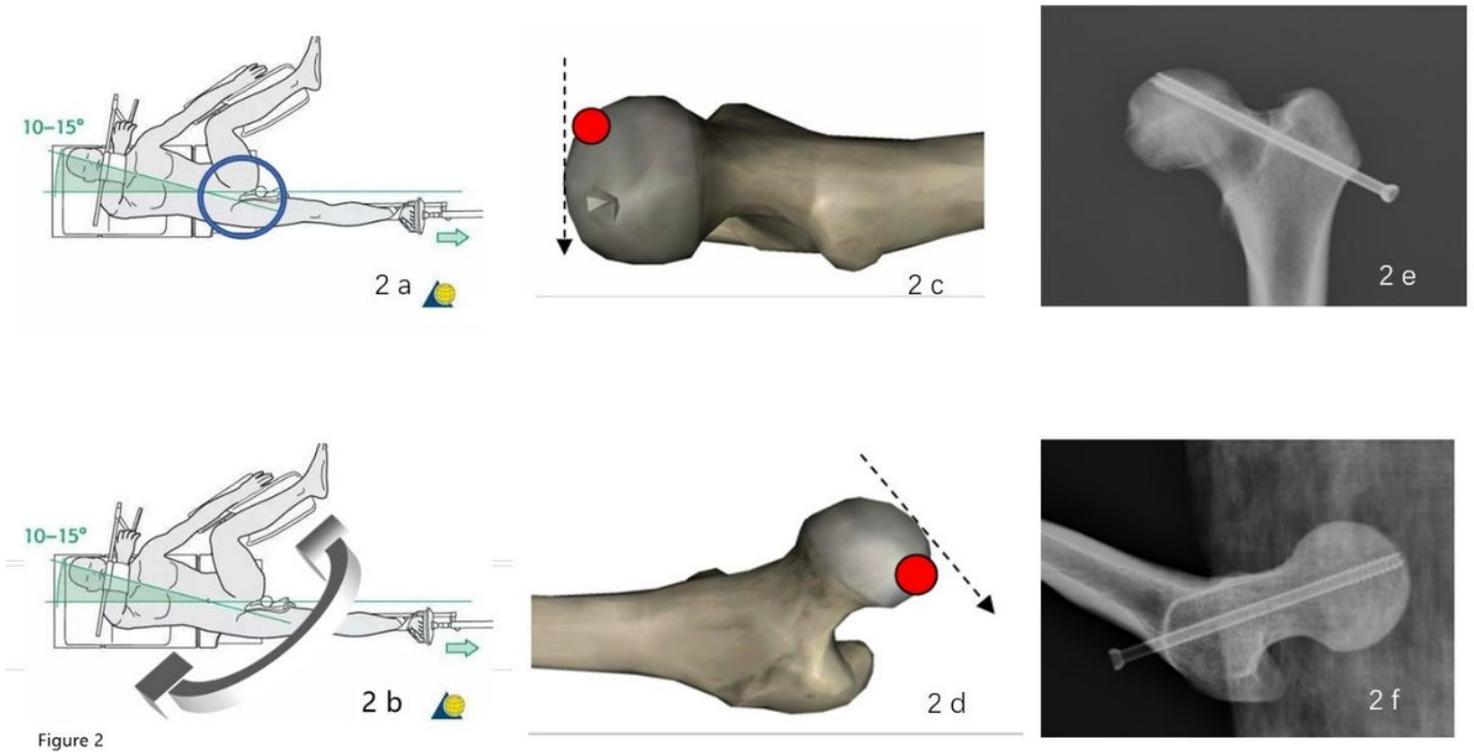
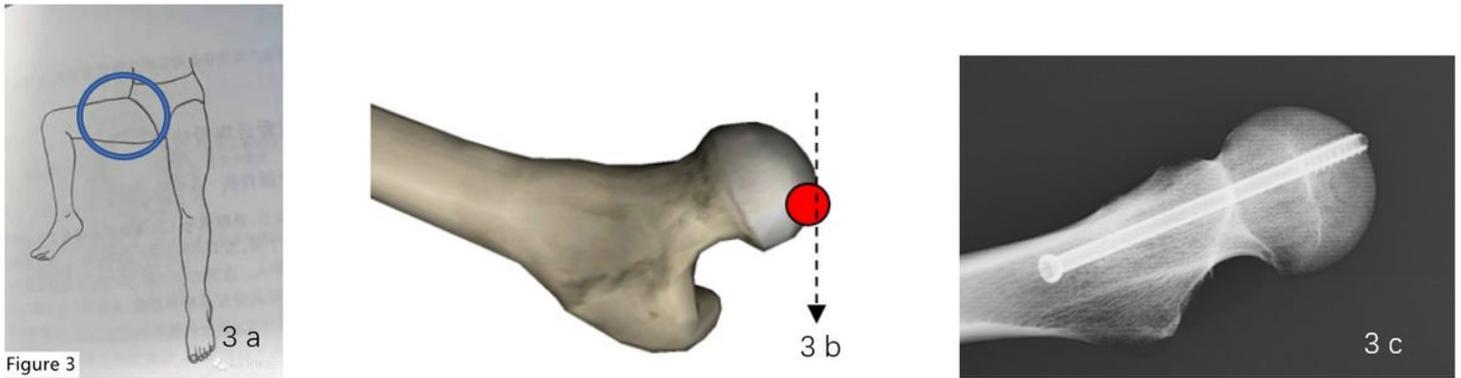


Figure 2

Schematic diagram of positive and lateral X-ray examination of the affected limb under the traction of the traction table using the C-arm during the operation Select the femoral shaft specimen and use the cancellous screw to make a model which cutout of the anterior upper region of the femoral head It was

found that after simulating perspective Angle during the surgery that the protruding part of the screw was covered by the maximum circumference of the femoral head under the perspective Angle of positive and lateral position, and no cut-out part of the screw was found.



**Figure 3**

Schematic diagram of frog lateral view X-ray examination with C-arm during operation. When the affected hip is in the frog lateral view, the hip joint is extremely extended and rotated, so that the anterior upper area is parallel to the direction of the rays and any cutout part will not be blocked.