

# The use of Fretsaw as a Substitute Osteotomy Tool while Oscillating Saw Malfunction in Hip Arthroplasty

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## Research article

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# Abstract

**Background:** The occurrence of oscillating saw malfunction, power shortage, or contamination occurs frequently when implementing femoral neck osteotomy during total hip arthroplasty (THA). This study aimed to introduce the fretsaw as a novel substitute osteotomy tool with various advantages.

**Methods:** Twenty patients (20 hips) who underwent primary THA were included. Ten patients underwent femoral neck osteotomy using a fretsaw, while the other 10 patients underwent the procedure using an oscillating saw. Intraoperative evaluation and radiographic data were obtained for all patients during and after surgery.

**Results:** The mean osteotomy time was  $20.60 \pm 1.08$ s (range 16–27) and  $22.10 \pm 1.49$ s (range 16–31) in the oscillating saw and fretsaw groups, respectively. The mean osteotomy height was  $1.21 \pm 0.16$  (range 1.01–1.43) cm and  $1.14 \pm 0.08$  (range 1.02–1.28) cm in the oscillating saw and fretsaw groups, respectively. The use of fretsaw did not result in bone notch or blood splashes.

**Conclusion:** The fretsaw can be a substitute femoral neck osteotomy tool with various advantages in THA while oscillating saw malfunction.

## Background

Total hip arthroplasty (THA) is a frequently performed and highly successful surgery for patients with end-stage hip disease. It can relieve pain, enhance function, and improve patient quality of life[1, 2]. Globally, more than one million THAs are performed each year, and the number has increased annually[3]. Since the pioneering work of Wiles, Charnley, and others in the mid-20th century, implant technology and instruments have steadily been improved and perfected[4]. Nowadays, the procedures and devices of THA have become normalized and routinized. However, complications still occasionally occur due to faults with the instruments.

Problems associated with the oscillating saw include power shortage and contamination when performing femoral neck osteotomy during THA. Presently, there is a lack of a suitable alternative osteotomy tool. Moreover, the oscillating saw has certain disadvantages of its own (Fig. 1). Firstly, the oscillating saw tends to sway due to the strong reverse impact when the saw touches bone, potentially resulting in cortical bone injury[5]. Secondly, notch formation can occur on the osteotomy position. The oscillating saw may also lead to the incidence of soft tissue and greater trochanter damage[6] (Fig. 1B-D). Furthermore, the oscillating saw generates a high frequency of blood splash during surgery[7], which puts surgeons at greater risk of disease transmission (Fig. 1A, 1E). Lastly, due to the dead zone at the contralateral side of the femoral neck, it is difficult to estimate the osteotomy border, which increases the risk of damage to the soft tissue and acetabular by the oscillating saw.

In our previous clinical work for decades, we identified the fretsaw could be an ideal substitute tool for femoral neck osteotomy when oscillating saw malfunction during THA. Moreover, using a fretsaw has no

risk of notch formation, decreases the risk of soft tissue and greater trochanter damage, and does not generate blood splash. This study aimed to describe the use of fretsaw as a substitute osteotomy tool in THA, especially when oscillating saw malfunction.

## Methods

The study was conducted in accordance with the Declaration of Helsinki. The study was approved by Ethics Committee of Shanghai Ninth People's Hospital affiliated to Shanghai Jiao Tong University School of Medicine and informed consent was taken from all individual participants.

## Patients

Twenty patients (20 hips) were evenly randomly divided into two groups. Patients eligible for inclusion were those undergoing primary THA due to femoral neck fracture, femoral head necrosis, developmental hip dysplasia (Crowe I), or primary osteoarthritis using a posterolateral approach and a cementless press-fit cup. The exclusion criteria were as follows: those with severe deformity of the femoral neck or hip ankylosis. In the fretsaw group, 10 patients underwent femoral neck osteotomy with fretsaw (5 males and 5 females,  $66.3 \pm 16.1$  ys), while the other 10 patients, in the oscillating saw group, underwent femoral neck osteotomy with oscillating saw (5 males and 5 females,  $63.4 \pm 19.8$  ys).

## Surgical technique

All operations were performed by the same group of surgeons using a posterolateral approach under general anesthesia. The femoral neck was osteotomized using either a fretsaw or oscillating saw (Fig. 2 and supplemental video). The remaining procedures were identical between the two groups.

## Evaluation method

Clinical and radiographic data were obtained for all patients during and after surgery. Intraoperative evaluation, including osteotomy time (calculating the time between the beginning of osteotomy, with either a fretsaw or oscillating saw, and the femoral neck division), osteotomy height (the heights of the osteotomies were measured from the lesser trochanter to the cuneiform plane), notch formation, and blood splash generation (calculating the surgical masks with blood splashes after surgery). Standard radiographs included a routine anteroposterior (AP) view of the pelvis and proximal femur.

## Statistical analysis

SPSS software (Version 19; SPSS Inc., Chicago, IL) was used for statistical analysis. Student's t-test was used to compare means of the clinical results. A P value less than 0.05 was considered to be significant.

## Results

The femoral neck osteotomy time is shown in Fig. 3A. The mean osteotomy time ( $\pm$  standard deviation, SD) for the oscillating saw and fretsaw groups was  $20.60 \pm 1.08$  s (range 16–27 s) and  $22.10 \pm 1.49$  s (range 16–31 s), respectively. There was no significant difference in osteotomy time between the two groups ( $P > 0.05$ ).

The femoral neck osteotomy height is shown in Fig. 3B. The mean osteotomy height for the oscillating saw and fretsaw groups was  $1.21 \pm 0.16$  cm (range 1.01–1.43 cm) and  $1.14 \pm 0.08$  cm (range 1.02–1.28 cm), respectively. There was no significant difference in osteotomy height between the two groups ( $P > 0.05$ ). All procedures fell within the target osteotomy height of 1.0–1.5 cm.

There are four bone notches (4 hips) formed in oscillating saw group, while none in fretsaw group (Fig. 3C). In the fretsaw group, no blood splash was generated during the femoral neck osteotomy. However, many splashes were generated when using the oscillating saw, landing on the mask, glasses, and forehead of surgeons and assistants. In our study, there are four doctors in each operation. Statistically, twenty-six surgical masks with blood splashes occur in oscillating saw group while none in fretsaw group (Fig. 3D). The intra-operative process was smooth and postoperative radiographs showed no prostheses malposition in both fretsaw and oscillating saw groups (Fig. 4).

## Discussion

Malfunction, power shortage, or contamination of oscillating saw, as a femoral neck osteotomy tool in THA, could happen from time to time. Re-sterilization or replacement of the instruments adds to the cost of providing the instruments and also be time consuming[8]. To the best of our knowledge, this is the first study that introduces the fretsaw as a substitute osteotomy tool in THA. This study demonstrates the satisfactory osteotomy outcomes, as well as distinct advantages, of using the fretsaw for this purpose.

Operation time is an important factor in intraoperative safety and postoperative rehabilitation of patients[9]. In the present study, there was no significant difference in osteotomy time between the fretsaw and oscillating saw groups. The fretsaw was equally efficient as a tool for femoral neck osteotomy and did not prolong the operative time. In our study, the fretsaw group achieved a satisfactory osteotomy height, which was consistent with preoperative planning. There was no significant difference in osteotomy height between the two groups. More interestingly, the deviation of the fretsaw group was lower than that of the oscillating saw group. This might be related to the saw blade swaying due to the strong reverse impact when the high-speed saw blade touches bone.

Notch generation in the femoral neck contributes to a high stress concentration during canal preparation and stem implantation, increasing the risk of Intraoperative periprosthetic femoral fracture (IOPFF)[10–12]. In our study, using a fretsaw as the femoral neck osteotomy tool resulted in a smooth osteotomy plane, and there is no occurrence of notch generation.

Blood splash occurs frequently when using an oscillating saw for femoral neck osteotomy. This puts surgeons and assistants at greater risk of infection with blood-borne diseases transmitted from the patient[7]. Furthermore, patients are also susceptible to infection due to reverse splashes, which can deflect off a surface and contaminate the surgical site[13, 14]. A surgical mask cannot provide sufficient protection against blood splash. Many surgeons neglect eye and whole face protection due to discomfort or a misty field of view[15]. In our study, no blood splash was generated when using the fretsaw as the femoral neck osteotomy tool, demonstrating another advantage to using the fretsaw for this purpose.

Our study has several limitations. Firstly, the sample size of study group was relatively small. Secondly, the fretsaw was only used as the osteotomy tool in patients with a relatively normal femoral neck, such as those with osteonecrosis of the femoral head, femoral neck fracture, hip osteoarthritis, or dysplasia of the hip (Crowe type I). Patients with more severe deformity of the femoral neck or hip ankyloses were not included.

## **Conclusion**

This study demonstrated that the fretsaw was an effective femoral neck osteotomy tool with a number of advantages. While oscillating saw malfunction, power shortage, or contamination occurs in THA, the fretsaw could be an ideal substitute osteotomy tool.

## **Abbreviations**

THA: Total hip arthroplasty; AP: Anteroposterior; SD: Standard deviation; IOPFF: Intraoperative periprosthetic femoral fracture

## **Declarations**

## **Authors' contributions**

Yiming Zeng and Mengning Yan conceived and designed the experiment. Zanjing Zhai and Yongyun Chang performed the experiment. Zanjing Zhai, Yongyun Chang and Degang Yu analyzed and interpreted the data. Huiwu Li and Yuanqing Mao supervised the study and provided administrative support. Zanjing Zhai and Yongyun Chang wrote the paper. All authors read and approved the final manuscript.

## **Competing interests**

The authors have no conflicts of interest to declare.

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## Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

## Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. The study was approved by Ethics Committee of Shanghai Ninth People's Hospital affiliated to Shanghai Jiao Tong University School of Medicine and informed consent was taken from all individual participants.

## Consent for publication

Written informed consent was obtained from all participants.

## Acknowledgements

Not applicable.

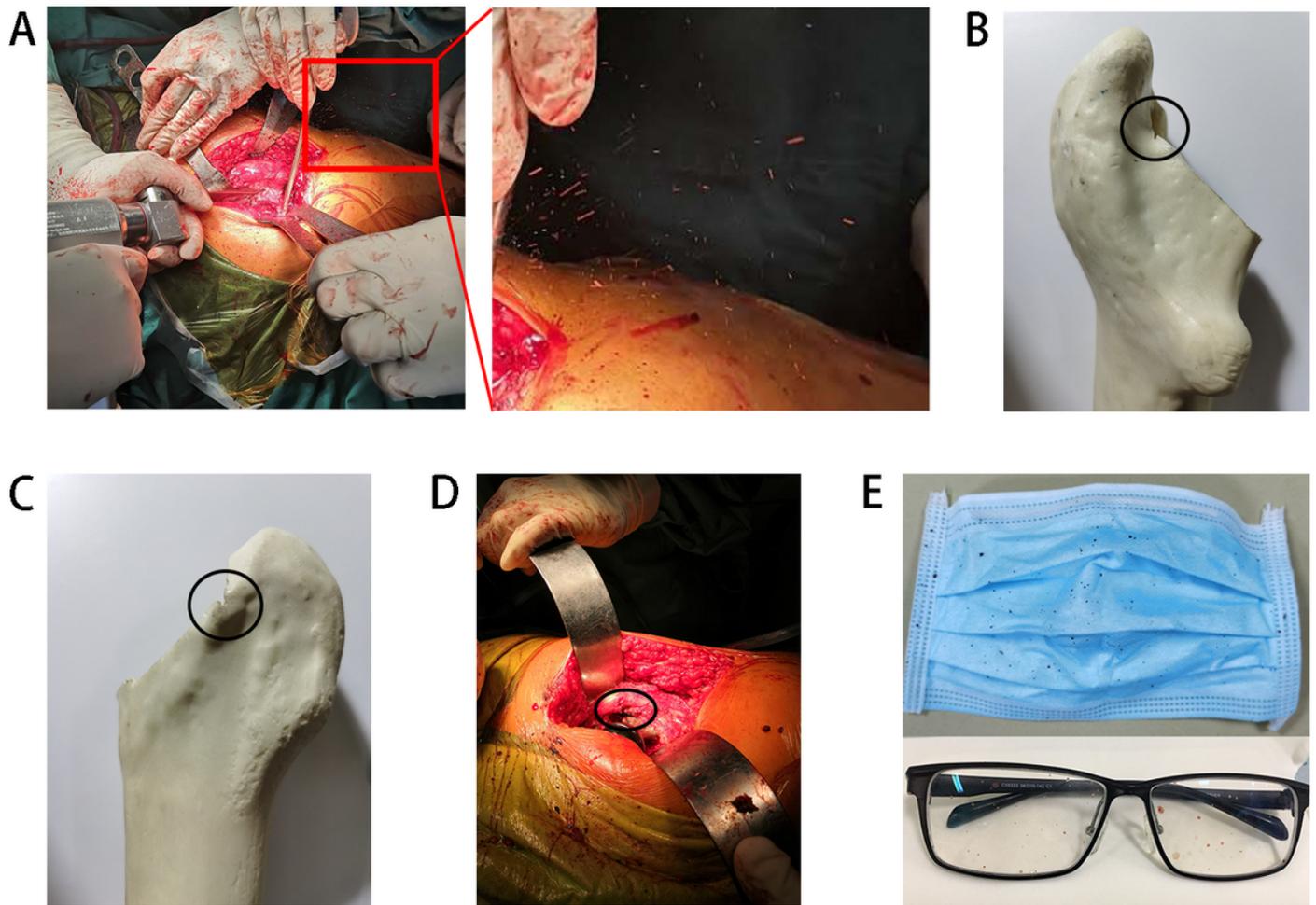
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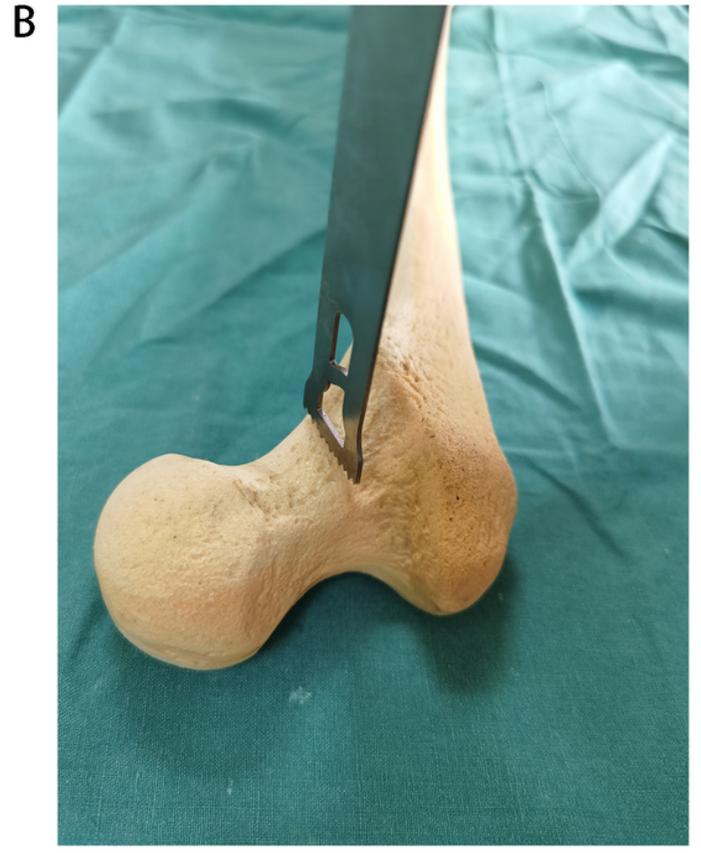
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## Figures



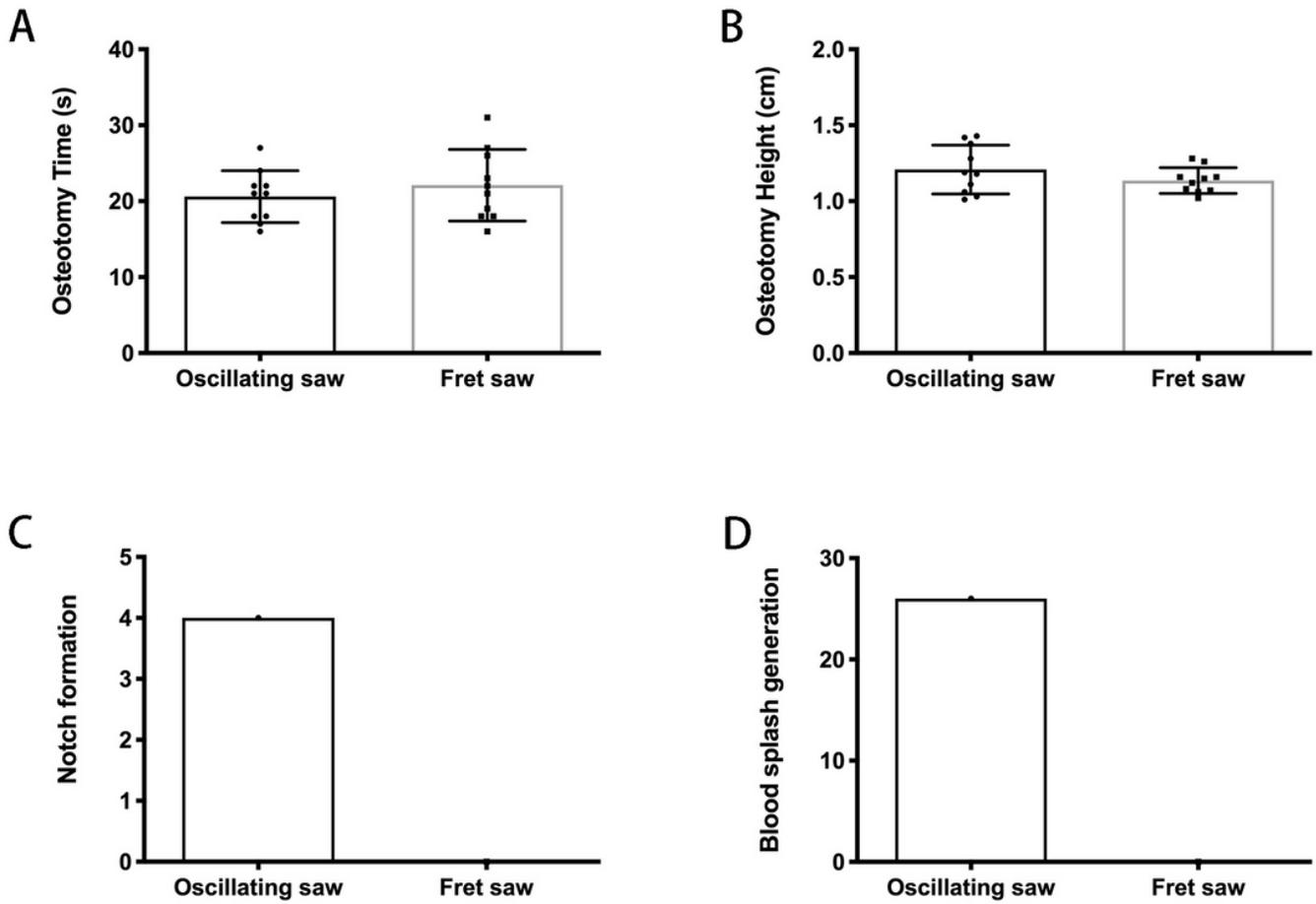
**Figure 1**

The deficiencies of the oscillating saw. Femoral neck osteotomy using oscillating saw during surgery and plenty of splashes generating (A). A notch on the intersecting position of the osteotomy (B, C). Damage to the soft tissue and greater trochanter as a result of the oscillating saw (D). Blood splashes generated by the use of oscillating saw on the masks and glasses (E).



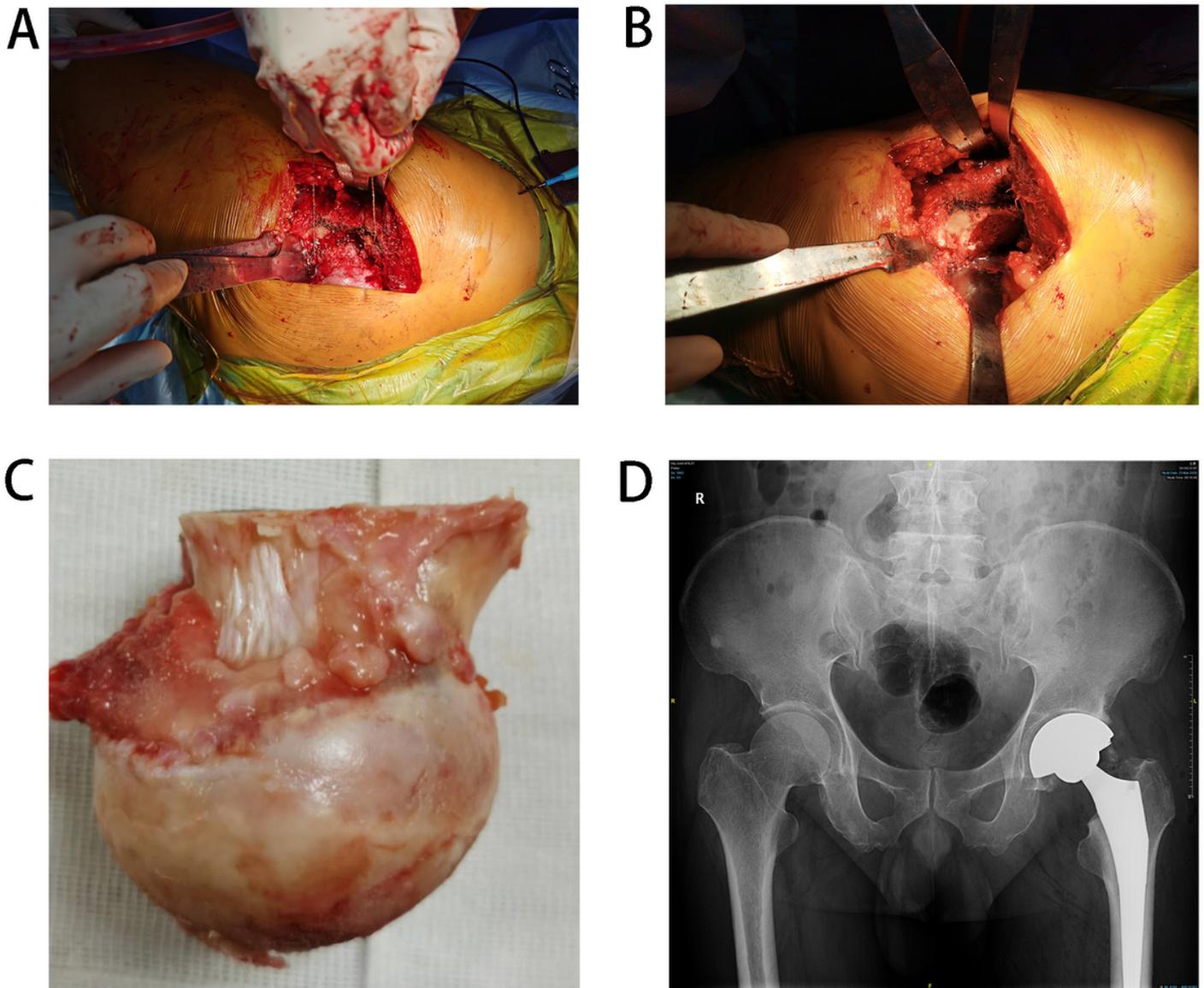
**Figure 2**

Photograph of a fretsaw (A) and an oscillating saw (B) as femoral neck osteotomy tool.



**Figure 3**

The osteotomy time (A) and height (B) when using the fretsaw and oscillating saw. There are four notches (4 hips) formed in oscillating saw group, while none in fretsaw group (C). Twenty-six surgical masks with blood splashes occur in oscillating saw group while none in fretsaw group (D).



**Figure 4**

Intraoperative photographs and radiographic data were obtained for all patients during and after surgery. Osteotomy using a fretsaw (A). Intraoperative photographs of the fretsaw group (B, C). Radiographs of a patient within the fretsaw group after surgery (D).

## Supplementary Files

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- [supplementalfigure.mp4.mp4](#)