

Triple Pelvic Osteotomy In The Treatment of Pincer Type Of Femoroacetabular Impingement Syndrome.

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Research Article

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Abstract

Purpose: Femoroacetabular impingement (FAI) syndrome is a dynamic cause of hip arthritis, and it is commonly diagnosed in young adults without any other causes of hip joint pain. Pincer type of FAI in this study, is typically present in active middle-aged females.

Methods: Eighteen patients diagnosed only with pincer type FAI received triple pelvic osteotomy reverse in type between 2011 and 2020. The average age of the patients was 37.3 years (28.0-45.0). The joint preserving surgery consisted of open dislocation and trochanteric flip osteotomy. We chose to do in series of selected patients only a triple pelvic osteotomy reverse in type as a extraarticular procedure in order to safely address intraarticular arthritis.

Results: After surgery, the Harris Hip Score increased from 55.1 to 91.4. The patients experienced a greater range of motion in the hip and less pain. Medium-term follow-up indicated that the surgeries were successful. In our series treated with triple pelvic osteotomy 22% (4 in 18 patients) after the operation appeared clinically rear pelvic FAI test. This result was not taken as significant due to small sample size (CI 95%). After the operation we used special guidelines and we postponed total hip replacement. We did no additional operation to selected patients.

Conclusion: This technique is a safe procedure to restore hip mobility. This is an extraarticular operation, and therefore it helps this process inside the joint.

Introduction

Femoroacetabular impingement (FAI) is characterized by an abnormally shaped hip joint and is a cause of arthritis in the hip joint [10]. Pain occurs during certain hip joint movements, particularly during flexion, adduction, and inner rotation of the hip. There are multiple causes of FAI including developmental (Perthes disease, coxa vara adolescentium), the result of trauma of the hip joint, and after osteotomy of the proximal femur, which can cause changes to the angles in the proximal femur.

FAI is divided into three types: cam, pincer, and combined. The majority of patients are diagnosed with the combined type (71.8%), followed by cam type (17.5%), and then pincer type (10.7%) [1]. Cam FAI is more common in young athletic males. It is caused when the femoral head is deformed and cannot rotate smoothly against the acetabulum. Pain is most commonly felt during flexion, inner rotation, and adduction of the hip joint. This is clinically known as the anterior impingent sign. Pincer FAI is more common in active, middle-aged women. It is caused by extra bone growth on the acetabulum that causes an overlap between the frontal part of the acetabulum with the femoral head. Combined FAI has features of both cam and pincer FAI. X-ray, computed tomography, and magnetic resonance imaging are used to aid in the diagnose of FAI and the type.

Treatments for FAI include activity changes, over-the-counter pain medication, physical therapy, and surgery. If nonsurgical methods do not reduce the patient's pain or there is joint damage, then surgery is

recommended. Patients can undergo arthroscopic surgery if the damage to the joint and cartilage is minor. However, open surgery, pelvic osteotomy, or total hip replacement may be required in some cases. Ganz *et al* [2] verified a trochanteric flip osteotomy technique to operate the FAI. This study reports the diagnosis and outcomes of a series of patients with only pincer type FAI treated with this type of triple pelvic osteotomy reverse in type (Figure 1). We suspected, that this operation is one of the only which can change the orientation of the acetabulum without an improvement of the intra joint arthritis.

Materials And Methods

From 2011 to 2020, patients who received a reverse triple pelvic osteotomy (Figure 8) for treatment of pincer type FAI at the Orthopedic Clinic Bulovka in Prague were recruited for this study – in total 18 patients completed our follow up. The average age of the patients was 37.3 years (28.0-45.0). Harris Hip Score before and after operation was performed. X-ray imaging was performed to verify diagnosis of cam type FAI, and magnetic resonance imaging scan of the hip joints for all patients. We also provided pre and post operative X-ray parameters for comparison (Figure 2, 8, 9).

We did the magnetic resonance imaging scan to know the status of the cartilage inside the joint – Figure 3.

The operative technique, reverse triple pelvic osteotomy, was performed to change the orientation of the acetabulum. We chose to do this extraarticular procedure in order to safely address intraarticular arthritis. Patients were followed up after surgery for up to nine years, so we did middle age follow up. The Harris Hip Score and impingement test frontal and dorsal type were evaluated again. X-ray images and magnetic resonance imaging were obtained to determine the success of the surgery.

There is the significant decrease of probability of clinically ventral FAI test positive sign, regardless which type of surgery we use i.e., triple pelvic osteotomy, Ganz approach (CI 95%). All patients were with positive FAI sign before surgery. Between these two major surgeries were not find any significant difference, regard clinically FAI test ventral type. If patient choose operative therapy in FAI, this decreases FAI test clinically positive < 1% after surgery. This makes conservative therapy in all patients positive after this proceed. In our series treated with triple pelvic osteotomy 22% (4 in 18 patients) after the operation appeared clinically rear pelvic FAI test. This result was not taken as significant due to small sample size (CI 95%).

Results

We recruited twenty patients in this retrospective study. However, due to insufficient data and follow-up only two patients were lost in our analysis. These patients represent a consecutive series from our institute over period of time. These patients experienced pain all the time but especially when sitting, playing sports like skating, or sitting astraddle (*e.g.* horse riding). All patients were diagnosed with pincer type/combined version of the FAI. We needed to do X-ray and magnetic resonance imaging, to clearly

express focal retroversion of the acetabulum, or global retroversion of the acetabulum. Otherwise we could not distinguish between a retroverted acetabulum and a prominent anterior rim. Only in that case we could use this procedure as the retroverted pelvic osteotomy (Figure 8B).

We mostly found the focal bump on the cervicocapital junction – more appropriate for cam type FAI. Magnetic resonance imaging is particularly useful to evaluate the level of the cartilage in the acetabulum. Figure 2 indicated that the middle and caudal part of the acetabulum was in anteversion. Representative X-ray images are shown in Figure 4.

Before and after surgery, we evaluated the Harris Hip Score in eighteen patients. All patients gradually moved into the excellent zone with the score increasing from 55.1 to 91.4 (Figure 5).

Upon administering the hip impingement test, there was clearly no frontal impingement sign and no pain like before the operation. Some patients reported more discomfort in the hip joint when walking for a long period. Overall, there was complete relief of painful movement in the hip joint (Figure 6).

After surgery, patients were instructed to start physiotherapy and to follow our guide lines. They prevented periarticular adhesions with immediately physiotherapy. Continuous passive motion (CPM), walking with two crutches for at least eight weeks, and limiting range of flexion motion in the hip to 70° for three to six months were recommended.

When performing the reverse pelvic osteotomy, it was necessary to evaluate the degree of destruction of the cartilage inside the joint and the morphology of the backside edge of the acetabulum (Figure 7).

The Kirschner wires held the bones in place. One year after surgery, the hip was still in proper alignment (Figure 8).

Two years after surgery, the bone healed completely, and the Kirschner wires were removed (Figure 9A). Three years after surgery, there was no damage to the femoral head or necrosis (Figure 9B).

Discussion

Because FAI is a dynamic cause of hip arthritis, it is imperative to correctly diagnose and treat FAI. Chronic clinical symptoms, FAI attributes from X-ray images, and damage to the labrum and cartilage of the joint are all indicators for operative therapy to resolve FAI [3]. A patient with cam/pincer type FAI who came to our clinic was previously treated with arthroscopic surgery and received limited relief from the operation. When the patient was seen in our clinic, they had progressed to arthritis, and a total hip replacement was required. This example highlights the importance of correct diagnosis and treatment. For the treatment of purely pincer FAI with total or global retroverted acetabulum, we choose to do primary reverse pelvic osteotomy, because it's one of the only method to change the orientation of the acetabulum (Figure 8B).

Beaulé *et al* [4] found that an alpha angle in FAI cam type, of more than 65° was a risk factor for cartilage damage inside the hip joint and was associated with delamination of the cartilage with or without tears resulting in macroscopic classification of degree 3 according to Beck *et al* [5]. However, there is no correlation between the cross-over sign and damage to the cartilage. Anderson *et al* [3] and Johnston *et al* [6] specified that the alpha angle was also a risk factor for delamination of the cartilage of the acetabulum and could quantify cam type FAI deformity. Barton *et al* [3] observed that the alpha angle has a 70%-90 % reliability on the planar X-rays when diagnosing FAI. An X-ray positive finding of FAI that is actually clinically negative is found in 14% of patients. But a perioperative finding of acetabulum cartilage destruction is found in 44%-75% of patients. Computed tomography and magnetic resonance imaging scans have advantages in diagnosing FAI with 3D reconstruction. They reveal the deformity of the femoral head, acetabulum, and cervicocapital junction of the hip joint particularly well. However, it is not always practical to obtain computed tomography and magnetic resonance images. Therefore, it is important to correctly interpret the X-ray images.

Siebenrock *et al* [7] reported a series of patients who received periacetabular osteotomy for reorientation of the retroversion of the acetabulum and observed that 90% of patients had great results. We followed this results, and we performed the osteotomies to correct the FAI before we choose to do total hip replacement. To prevent the intraarticular affection we didn't use the surgical hip dislocation as an intraarticular procedure.

It is necessary to do this osteotomy in the correct position (*i.e.* to the inner rotation and flexion) because this type of osteotomy can cause secondary rear FAI. The iliofemoral approach is recommended for lesser deformities, especially in the frontal part of the cervicocapital junction. The study on the cadavers [4] showed that resection of more than 30% of the anterolateral part of the cervicocapital junction has a risk of iatrogenic fracture in FAI cam type. It is usually sufficient to resect 20% of the cervicocapital junction.

Ganz *et al* [2] performed 213 luxations of the hip joint and included 19 patients who underwent simultaneous intertrochanteric osteotomy. In 1.4% of hips, revision for nonunion osteotomy ground trochanter was required. Although none of the patients developed avascular necrosis during the follow-up, 37% of patients experienced the development of heterotopic ossifications. Murphy *et al* [8] did open surgery to treat FAI in 23 patients, and 30% of patients eventually required total hip replacement. Beck *et al* [9] also treated 19 patients with FAI, and 26% of patients later needed total hip replacement. We found in our patient series that total hip replacement was not need during the follow-up period.

The majority of studies do not show any complications regarding necrosis of the femoral head, and in the short-term follow-up, the patients experience clinical relief. However, they are lacking long-term follow-up. It is evident that early correction of FAI leads to better function of the hip movement. Unfortunately, it is not clearly known how often this correction leads to prevention of arthritis of the hip joint.

Conclusion

We presented a total of eighteen patients who received a triple pelvic osteotomy reverse in type, which was a limited sample size due to few patients requiring this surgery [7]. This surgery was much less invasive than periacetabular osteotomy (PAO) [11]. We have highlighted the importance of using imaging to assist in diagnosing FAI. It is also important to know the extent of damage to the cartilage in the hip joint in order to recommend the appropriate surgery and to confirm the converting to the total hip replacement. More long-term studies are required in the future to determine whether this technique can prevent hip arthritis. In our patients followed, are nobody in this danger potency, because of extraarticular approach.

We think that, in general, substantial acetabular retroversion in young symptomatic patients up to the age of thirty-five years is best treated with the triple pelvic osteotomy. Generally, the results of acetabular rim trimming for treatment of acetabular retroversion seem to be inferior to those of pelvic osteotomy. Since acetabular retroversion is due to malorientation of the acetabulum rather than the acetabular rim being excessive anteriorly and deficient posteriorly, acetabular reorientation is a more logical treatment. Rim trimming potentially can result in insufficient acetabular coverage [11].

Declarations

Ethics approval and consent to participate – all methods were carried out in accordance with relevant guidelines and regulations. All experimental protocols were approved by our Institution of post-gradual orthopedic surgery – informed consent was obtained from all subjects.

Consent for publication – not applicable for this study.

Availability of data and material – The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests – not applicable

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Authors' contributions – not applicable

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Figures



Figure 1

X-ray images typical pre operatively. A: FAI pincer type with typical bottom of the acetabulum going through the ilioischiadic line = Köhler line – coxa profunda. B: hip after developing arthritis with pincer type FAI.

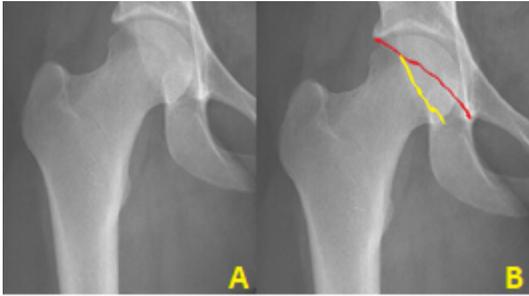


Figure 2

Typical cross-over sign. A: Focal retroversion of the acetabulum and cross-over sign; B: Frontal edge in red, reverse edge yellow.

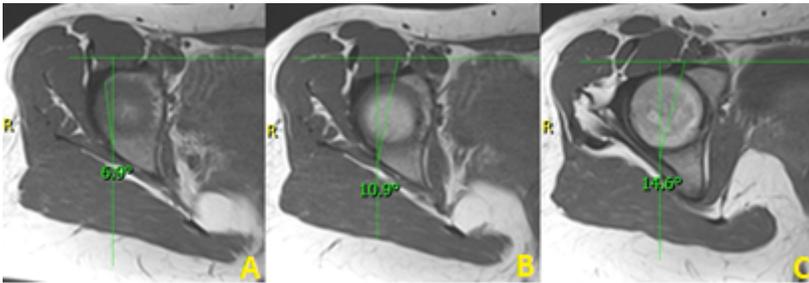


Figure 3

Transverse cuts of the magnetic resonance imaging of the acetabulum in different levels., A: Focal retroversion 6.9°; B: Middle part of the acetabulum in anteversion 10.9°; C: Caudal part of the acetabulum in anteversion 14.6°. [12].

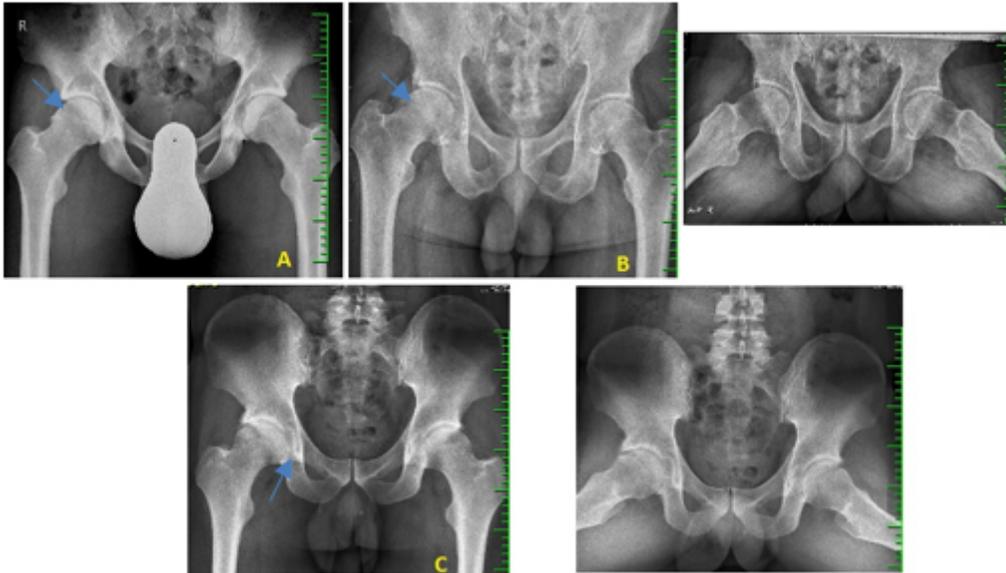


Figure 4

Representative X-ray images of cam type FAI. A: This patient was 28 years old. The blue arrow indicates a typical deformity on the cervicocapital junction; B: This patient was 36 years old. The blue arrow indicates a typical deformity on the cervicocapital junction An X-ray image in the axial position was also obtained. C: This patient was 40 years old. The blue arrow indicates mediocaudal arthritis. An X-ray image in the axial position was also obtained.

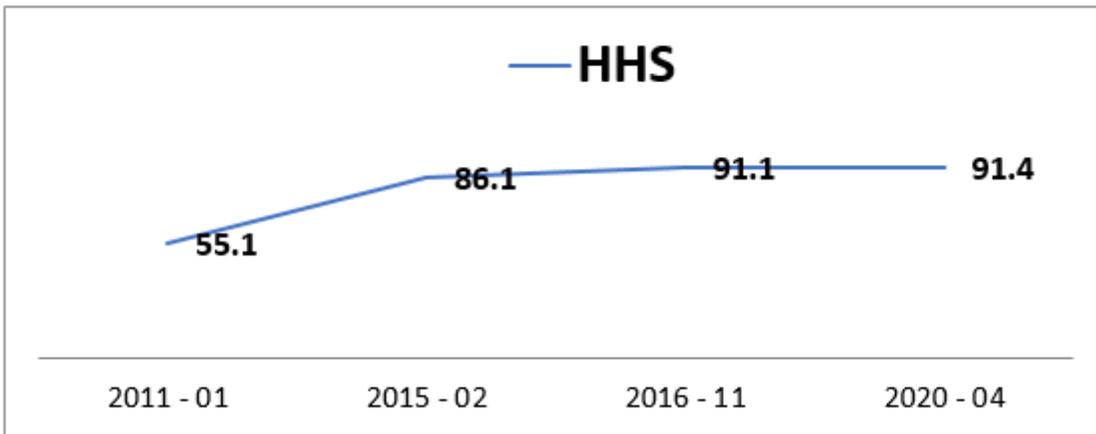


Figure 5

Average Harris Hip Score in five patients after reverse pelvic osteotomy. HHS: Harris Hip Score.

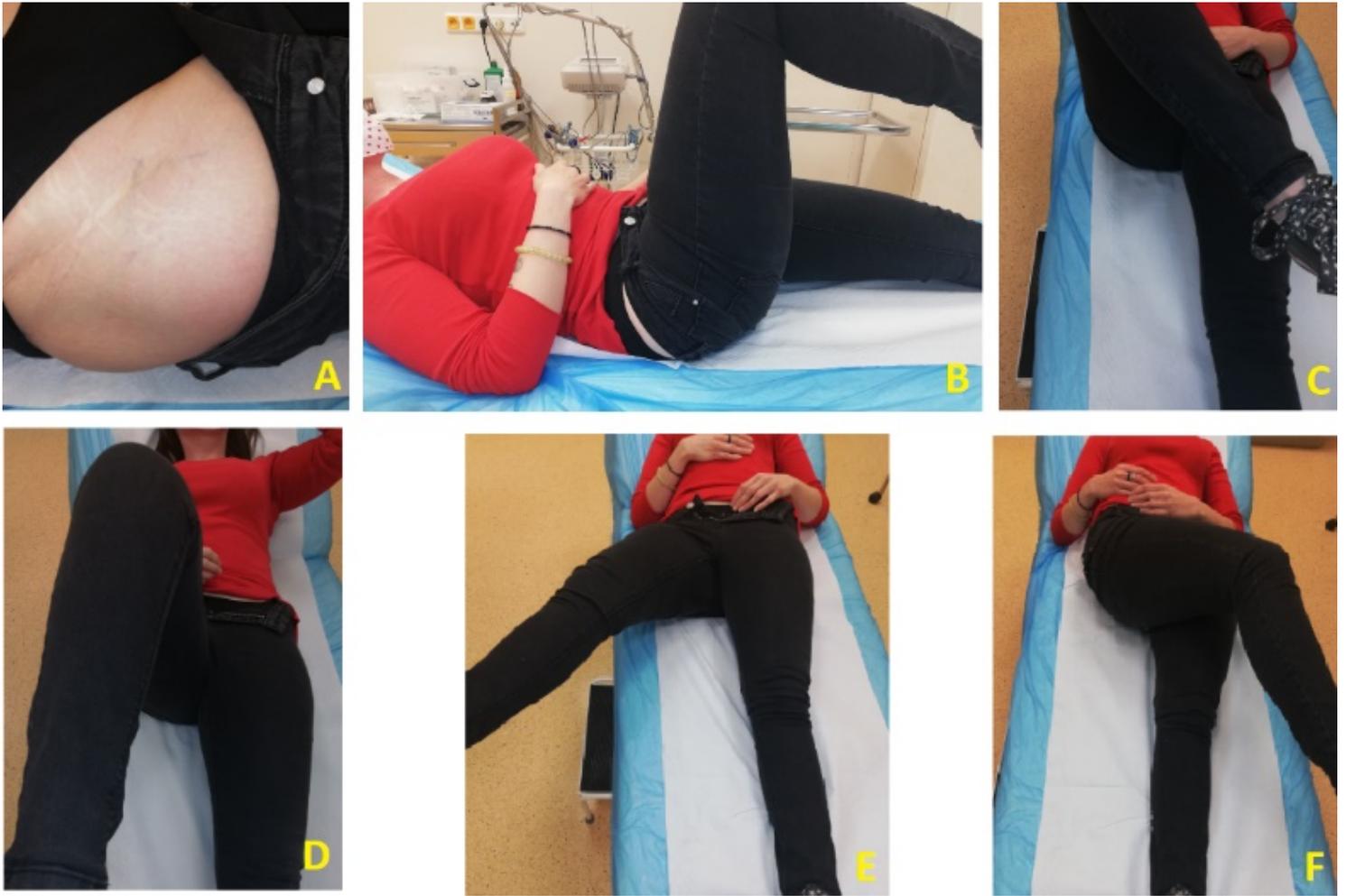


Figure 6

Clinical photo of one patient after eight years post operation (March 2020). A: Approach to the hip; B: Flexion movement is complete with no pain; C: Outer rotation of the hip; D: Inner rotation movement is slightly limited; E: Abduction; F: Adduction.

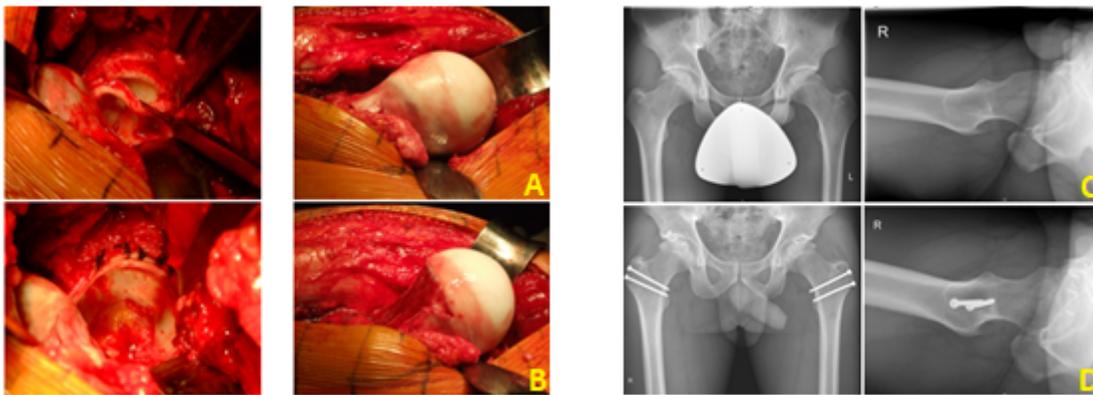


Figure 7

The joint preserving surgery before, during, and after surgery. A: During surgery the labrum was cut and the cam type FAI deformity on the femoral head is shown; B: The labrum was reattached after the bone deformity was removed; C: X-ray images before surgery indicates cam type FAI; D: After the operation, the X-ray show the Kirschner wires fixing the trochanter flip approach.

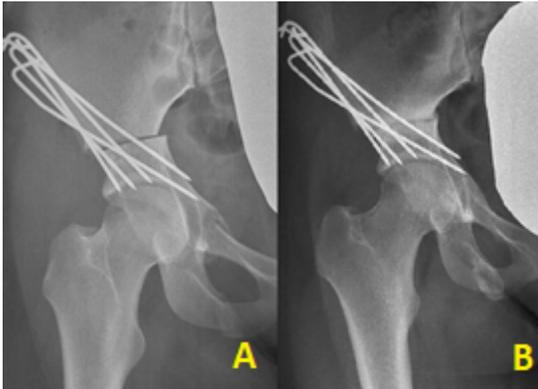


Figure 8

X-ray image after osteotomy. A: Postsurgical image of the pelvis after osteotomy; B: Image of the pelvis one year after surgery. The proper alignment is maintained.



Figure 9

X-ray images after the Kirschner wires were removed. A: Two years after the operation Kirschner wires were extracted; B: One year after the Kirschner wires were extracted, we detected no defect at the head of the femur, no signs of necrosis, and proper align. Yellow lines in last picture shows how triple pelvic osteotomy was performed.