# Hip Arthroscopy has Good Clinical Outcomes in the Treatment of Osteoid Osteoma of the Acetabulum

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**Research Article**

**Keywords:** osteoid osteoma, hip, arthroscopy, patient-reported outcomes

**Posted Date:** January 11th, 2021

**DOI:** https://doi.org/10.21203/rs.3.rs-141789/v1



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## Abstract

Background: Osteoid osteoma (OO) of the acetabulum is a relatively rare disease. The clinical outcomes of hip arthroscopy for treatment of OO of the acetabulum is still uncertain.

Methods: We evaluated consecutive patients who were diagnosed with OO of the acetabulum and underwent hip arthroscopy for treatment in our hospital between January 2013 and March 2020. All patients underwent preoperative physical examination. Preoperative supine anteroposterior hip radiographs, cross-table lateral radiographs, CT images, and MR images were obtained for all patients. Alpha angle and lateral center-edge angle were measured before surgery. Supine anteroposterior hip radiographs and CT images were obtained for all patients postoperatively. Preoperative patient-reported outcomes (PROs), including visual analog scale (VAS), the International Hip Outcome Tool-12 (iHOT-12) and modified Harris Hip Score (mHHS), and PROs at final follow-up were evaluated.

Results: A total of 6 patients (mean age, 18.7 years; age range, 6-31 years; 5 males and 1 females) were included in this study. The average follow-up period after surgery was 28.3 months (range, 6–90 months). Before surgery, mean mHHS was 45.2±10.5 (range, 33-56), mean iHOT-12 was 33.3±14.5 (range, 13-49), and mean VAS was 8.2±1.0 (range, 7-9). At one month after surgery, mean mHHS was 78.7±1.9 (range, 77-81), iHOT-12 was 71.0±4.5 (range, 68-80), and mean VAS was 0. At the final post-operative follow-up, mean mHHS was 89.2±2.1 (range, 86-91), iHOT-12 was 93.5±5.0 (range, 88-98), and mean VAS was 0. All results, except VAS between one month after surgery and at final follow-up, demonstrated statistically significant improvement ($P < 0.05$). One patient underwent revision surgery.

Conclusion: Hip arthroscopy has good clinical outcomes in the treatment of OO of the acetabulum.

## Background

An osteoid osteoma (OO) is a small, benign, osseous neoplasm characterized by a nidus surrounded by reactive sclerotic bone with a size usually less than 20 mm.[1-3] Patients often present with local pain, increasing pain, pain at night, and pain with relief by using of nonsteroidal anti-inflammatory drugs (NSAIDs).[4] An OO can be diagnosed with a combination of plain radiographs, technetium-99m (Tc-99m) bone scans, computed tomography (CT) scans, and magnetic resonance (MR) images.[1] Most OO were seen in the long bones of the lower extremities of patients in the second and third decade of their lives.[5] The femur and tibia account for greater than 50%; however, this tumor is rare in the pelvis and difficult to diagnose.[6-8] OO of the acetabulum is even more rare. In recent literature, we found several case reports of treatment of OO of the acetabulum, but no case series of treatment of OO of the acetabulum.[1, 5, 9-18] Minimally invasive percutaneous techniques including CT-guided approaches and ablation using radiofrequency or lasers, and arthroscopic excision technique for OO excision in acetabulum have been described in these case reports. However, there are no case series or clinical follow-up to prove the clinical outcomes of these treatments.

The purpose of this study was to evaluate the clinical outcomes of hip arthroscopy in the treatment of OO of the acetabulum. We hypothesized that hip arthroscopy has good clinical outcomes in the treatment of OO of the acetabulum.

# Patients And Methods

Patients

We evaluated consecutive patients who were diagnosed with OO of the acetabulum and underwent hip arthroscopy for treatment in our hospital between January 2013 and March 2020. The inclusion criteria were as follows: (1) patients who were diagnosed with OO of the acetabulum by clinical findings, plain radiographs, CT scans, and MR images; and (2) underwent hip arthroscopy for treatment with (3) postoperative pathology confirmed that the diagnose was OO. Patients who could not complete the clinical follow-up were excluded from the study. All participants signed informed consent. The study was approved by the Ethics Committee of the Third Hospital of Peking University. All methods were performed in accordance with the guidelines and regulations of the Ethics Committee of the Third Hospital of Peking University.

Physical examination and radiographic assessment

All patients underwent a thorough and systematic physical examination, including specific tests previously described for diagnosing hip diseases.[19] Flexion, adduction, and internal rotation (FADIR) or flexion abduction external rotation (FABER) tests are considered positive if hip or groin pain was elicited when the hip was placed in 90° of flexion and then adduction and internal rotation or flexion, abduction and external rotation applied.[20] Supine anteroposterior hip radiographs, cross-table lateral radiographs, CT images, and MR images were obtained for all patients preoperatively (Figure 1, 2). Cross-table lateral radiographs and CT images were obtained for all patients postoperatively. Preoperative alpha angle and lateral center-edge angle (LCEA) were measured as described by previous studies.[21, 22]

Surgical technique

One surgeon with more than 10 years of experience performed standard hip joint arthroscopy for all patients. All surgeries were performed using a standard supine approach as described by Gao et al.[23] In brief, a detailed inspection of the central compartment was performed to assess the acetabular rim, acetabular labrum, articular cartilage, and ligamentum teres. Labral repair or labral debridement was performed according to the nature of injury. If a cam bump in the head-neck junction or acetabular overcoverage was identified, femoral osteoplasty or acetabuloplasty was performed. Cartilage damages were recorded according to Outerbridge classification system. To identify the location of OO, we would increase the force of traction for better exposure and vision. After the OO was identified, a fine guide wire was placed to mark the nidus. Then the C-arm was used to confirm that the identified nidus matched what was seen in the preoperative radiographic images. The tumor and surrounding sclerotic bone tissue were then removed using a narrow bone knife and abrasive drill until normal cancellous bone was reached. Posterior area of the hip was usually difficult to get access to in arthroscopy. A 70 degrees arthroscope and flexible instruments could help remove lesions. The location of OO was recorded according to a geographic zone method described by Ilizaliturri et al.[24] The acetabulum was divided into six zones as follows: the anterior inferior (zone 1), the anterior superior (zone 2), the middle superior (zone 3), the posterior superior (zone 4), the posterior inferior (zone 5) and the middle inferior (zone 6; cotyloid fossa). After the treatment of the central compartment, the lower extremities were relaxed and the arthroscope was inserted into the peripheral compartment. Capsular closure was routinely done at the end of surgery.

Clinical evaluation

Preoperative patient-reported outcomes (PROs) and PROs one month after surgery and at final follow-up were obtained, including visual analog scale (VAS) for pain, the International Hip Outcome Tool-12 (iHOT-12) and modified Harris Hip Score (mHHS). Complications or revision hip arthroscopy were recorded.

Statistics

The two-tailed paired t test was used to evaluate significance between preoperative and postoperative PROs. P values <.05 were considered statistically significant. All statistical analyses were performed with SPSS Statistics, version 22 (IBM).

# Results

As shown in Table 1, a total of 6 patients (mean age, 18.7 years; age range, 6-31 years; 5 males and 1 females) were included in this study. There were 5 left sides and 1 right side. The mean body mass index (BMI) was 20.6 (range, 12.4-33.2). The mean duration of pain before surgery in our hospital was 17.5 months (range, 6-36 months). Five (83.3%) patients had pain increased at night and the remaining one patient had the same pain during the day and at night. Five (83.3%) patients had pain relief after taking NSAIDs and the remaining one patient did not take NSAIDS ever. Three patients (50%) had previous surgery in another hospital and underwent revision surgery in our hospital. OO of the acetabulum in 2 of these 3 patients were misdiagnosed and the 2 patients only underwent femoral osteoplasty and labral repair as their primary surgery. One patient had correct diagnose of OO of the acetabulum and underwent radiofrequency ablation guided by CT in another hospital. However, none of these three patients had pain relief after primary surgery and they came to our hospital. The FADIR test as evaluated by the treating physician was positive in 4 (66.7%) patients. The physician obtained a positive FABER test in 5 (83.3%) patients. In addition, 3 patients had tenderness in groin area, 2 patients had tenderness in posterior hip, 2 patients had tenderness over the greater trochanter, 1 had tenderness in sacroiliac joint and 1 had tenderness in posterior superior iliac. Mean preoperative alpha angle and LCEA were 62.4±12.9 (range, 50.6-79.6) and 33.4±4.5 (range, 28.1-40.6), respectively.

Table 1. Demography of patients (n = 6)

| Parameter | Data |
|---|---|
| Age, y, mean (range) | 18.7 (6-31) |
| Gender | |
| Male | 5 (83.3%) |
| Female | 1 (16.7%) |
| BMI, kg/$m^2$, mean (range) | 20.6 (12.4-33.2) |
| FADIR test | |
| Positive | 4 (66.7%) |
| Negative | 2 (33.3%) |
| FABER test | |
| Positive | 5 (83.3%) |
| Negative | 1 (16.7%) |
| Duration of pain (range) | 17.5 (6-36) |
| Alpha angle (range) | 62.4 (50.6-79.6) |
| LCEA (range) | 33.4 (28.1-40.6) |

NOTE. Unless otherwise specified, data are numbers of patients, with percentages in parentheses.

Arthroscopic and radiographic diagnosis of these patients was shown in Table 2. Among these 6 patients, 4 (66.7) patients were diagnosed with combined femoroacetabular impingement (FAI). One patient was diagnosed with Tonnis grade 1 osteoarthritis (OA) by anteroposterior hip radiographs. Two patients were found to have periosteal reaction in the joint surface of acetabulum (Figure 3). All 6 patients underwent arthroscopic excision of OO, 4 patients underwent femoral osteoplasty, 1 patients underwent acetabuloplasty and 2 patients underwent labral repair. OO of the acetabulum in 4 (66.7%) patients were located in zone 5, 1 (16.7%) was in zone 4, and 1 (16.7%) was located in zone 6. There were 2 (33.3%) patients who had Outerbridge I or II femoral cartilage damages, 1 (16.7%) patients who had Outerbridge IV femoral cartilage damages, 1 (16.7%) patients who had Outerbridge II acetabular cartilage damages and 3 patients (50%) who had Outerbridge III acetabular cartilage damages.

Table 2. Diagnosis and Arthroscopic Findings

| | Data |
|---|---|
| Diagnosis | |
| OO of the acetabulum | 6 (100%) |
| Cam impingement | 4 (66.7%) |
| Pincer impingement | 1 (16.7%) |
| Acetabular labral tear | 3 (50%) |
| Osteoarthritis | 1 (16.7%) |
| Location of OO | |
| Zone 4 | 1 (16.7%) |
| Zone 5 | 4 (66.7%) |
| Zone 6 | 1 (16.7%) |
| Femoral cartilage damages | |
| 0 | 3 (50%) |
| I | 1 (16.7%) |
| II | 1 (16.7%) |
| III | 0 |
| IV | 1 (16.7%) |
| Acetabular cartilage damages | |
| 0 | 2 (33.3%) |
| I | 0 |
| II | 1 (16.7%) |
| III | 3 (50%) |
| IV | 0 |

NOTE. Unless otherwise specified, data are numbers of patients, with percentages in parentheses.

The average follow-up period after surgery was 28.3 months (range, 6–90 months). The pain disappeared immediately after surgery in all patients. Before surgery, mean mHHS was 45.2±10.5 (range, 33-56), mean iHOT-12 was 33.3±14.5 (range, 13-49), and mean VAS was 8.2±1.0 (range, 7-9). At one month after surgery, mean mHHS was 78.7±1.9 (range, 77-81), iHOT-12 was 71.0±4.5 (range, 68-80), and mean VAS was 0. At the final post-operative follow-up, mean mHHS was 89.2±2.1 (range, 86-91), iHOT-12 was 93.5±5.0 (range, 88-98), and mean VAS was 0. All results, except VAS between one month after surgery and at final follow-up, demonstrated statistically significant improvement ($P < 0.05$). No complications were recorded during the study period. One patient still had pain after surgery and underwent revision arthroscopy because of excision of the wrong position. This patient had a complete pain relief after revision surgery.

# Discussion

In this study, we found that hip arthroscopy has good clinical outcomes in the treatment of osteoid osteoma of the acetabulum. The pain disappeared immediately after surgery in all patients. The mHHS and iHOT-12 improved significantly one month after surgery and at final follow-up. VAS improved significantly one month after surgery. There was no significant difference in VAS between one month after surgery and final follow-up. The pain disappeared immediately after surgery in all patients.

OO of the acetabulum can be difficult to diagnose. Delay in diagnosis may lead to muscle atrophy, tenderness, localized swelling, possibly contractures, damage of articulation and early osteoarthritis.[6] Previous studies have proved the effect of NSAIDs for treatment of OO and cases of spontaneous healing of OO treated with NSAIDs have been reported.[4, 25] In this study, patients with OO of the acetabulum can also have pain relief by use of NSAIDs. In recent researches, percutaneous resection guided by CT scan, radiofrequency ablation, arthroscopy-assisted radiofrequency ablation and arthroscopic excision for treatment of OO of the acetabulum have been reported.[1, 5, 9-13, 15, 17, 18] In the CT-guided ablation, destruction of the articular cartilage around the lesion is unavoidable and a specimen for pathologic examination may not be able to obtain because of thermal damage.[8, 26] The advantages of arthroscopy are less surgical damage, accurate targeting and excision of the lesion, and treatment of the possible resultant cartilage damage.[12] Synovectomy can be also done during arthroscopic lesion removal, which may prevent cartilage damage, speed the healing process, and relieve pain immediately.[4] We found descriptions of five cases using arthroscopic excision and one case using arthroscopy-assisted radiofrequency ablation for treatment of the OO of the acetabulum.[1, 5, 9, 10, 12, 17] But the number of patients was scare, and there was no clinical follow-up and PROs.

OO of the acetabulum in 2 (33.3%) of all 6 patients were misdiagnosed in another hospital and the 2 patients only underwent femoral osteoplasty and labral repair as their primary surgery. OO of the acetabulum is easy to be misdiagnosed and this feature has been previously described.[6, 12, 27] Two patients in our study underwent revision surgery after radiofrequency ablation guided by CT and arthroscopic excision. Sometimes it is indeed difficult to locate the lesion under arthroscopy. In some patients, cartilage changes could be observed on the surface of the lesion, which could help identifying the lesion. However, sometimes no abnormality was observed in cartilage.

It should be noticed that OO of the acetabulum in 4 (66.7%) patients among all 6 patients was located in zone 5. The other two OO were in zone 4 and zone 6. In the existing studies on arthroscopic treatment of

OO of the acetabulum described above, two cases were located in the posterior area,[9, 10] one was in the posteroinferior area,[13] one was at the bottom of the acetabulum,[1] one was in the superior portion of the acetabulum,[12] and one (a 10-year-old boy) was located under the triradiate cartilage.[17] So we could conclude that there is a high incidence of OO in the posterior acetabulum. In our clinical work, we need to focus on this area. Although we used a 70 degrees arthroscope and flexible instruments in the procedure of arthroscopic excision, it was usually difficult and time-spending to get access to the posterior area of acetabulum, especially to zone 5. Excision of OO of the acetabulum in posterior area of hip need suitable equipment, patience and experience.

In this study, 4 (66.7%) patients among all 6 patients had concomitant FAI. We thought that FAI in these patients was secondary to OO. Three (50%) patients had concomitant labral tear caused by secondary FAI. We thought that OO causes repeated inflammatory reaction and bone hyperplasia, which could lead to secondary FAI. Bone hyperplasia of the acetabular fossa and relative lateral movement of femoral head may be a reason of secondary FAI. Further study about secondary FAI is needed in the future.

In addition, one patient in this study had sclerosis of the acetabulum and slight narrowing of the joint space and was diagnosed with Tonnis grade 1 OA. Norman et al.[28] evaluated 30 patients with intraarticular OO of the hip and found OA developed in 50% of those patients. Osteoid osteoma of the hip could stimulate an early onset of osteoarthritis. Repeated inflammatory reactions that damaged cartilage may be the reason of OA caused by OO of the hip. OO of the acetabulum in the joint surface may lead to more direct and severe irritation. Besides, two patients were found to have periosteal reaction in the joint surface of acetabulum, which could be a diagnostic feature of OO of the acetabulum.

# Limitations

This study has some potential limitations. Firstly, this study included a small sample size. However, due to the rarity of OO of the acetabulum, the study contained the largest number of patients so far. Secondly, two patients were followed up for a relatively short time. We found that the pain disappeared immediately after surgery in all patients, so we thought that the therapeutic effect of arthroscopic excision of OO of the acetabulum can be satisfying in a short time.

# Conclusions

Hip arthroscopy has good clinical outcomes in the treatment of osteoid osteoma of the acetabulum.

# Declarations

Acknowledgement

Not applicable

Authors' contributions

GGY: study design, data acquisition, analyses and interpretation of data, draft of manuscripts, tables and figures. WRQ; study design, data acquisition, analyses and interpretation of data. LRG; analyses and interpretation of data, manuscript with tables and figures. WJQ; study design, data acquisition, analyses and interpretation of data, manuscript with tables and figures. AYF; draft of manuscripts, tables and figures. XY; study design, data acquisition, analyses and interpretation of data, manuscript with tables and figures. All authors critically reviewed and approved the final revised manuscript.

Funding

No external funds were received in support of this work.

Availability of data and materials

All relevant data supporting the conclusions are included within the article and tables. The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Ethical approval The Ethics Committee of the Third Hospital of Peking University approved this study (ID number 201931802). Informed consent Informed consent was obtained from all individual participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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## Figures

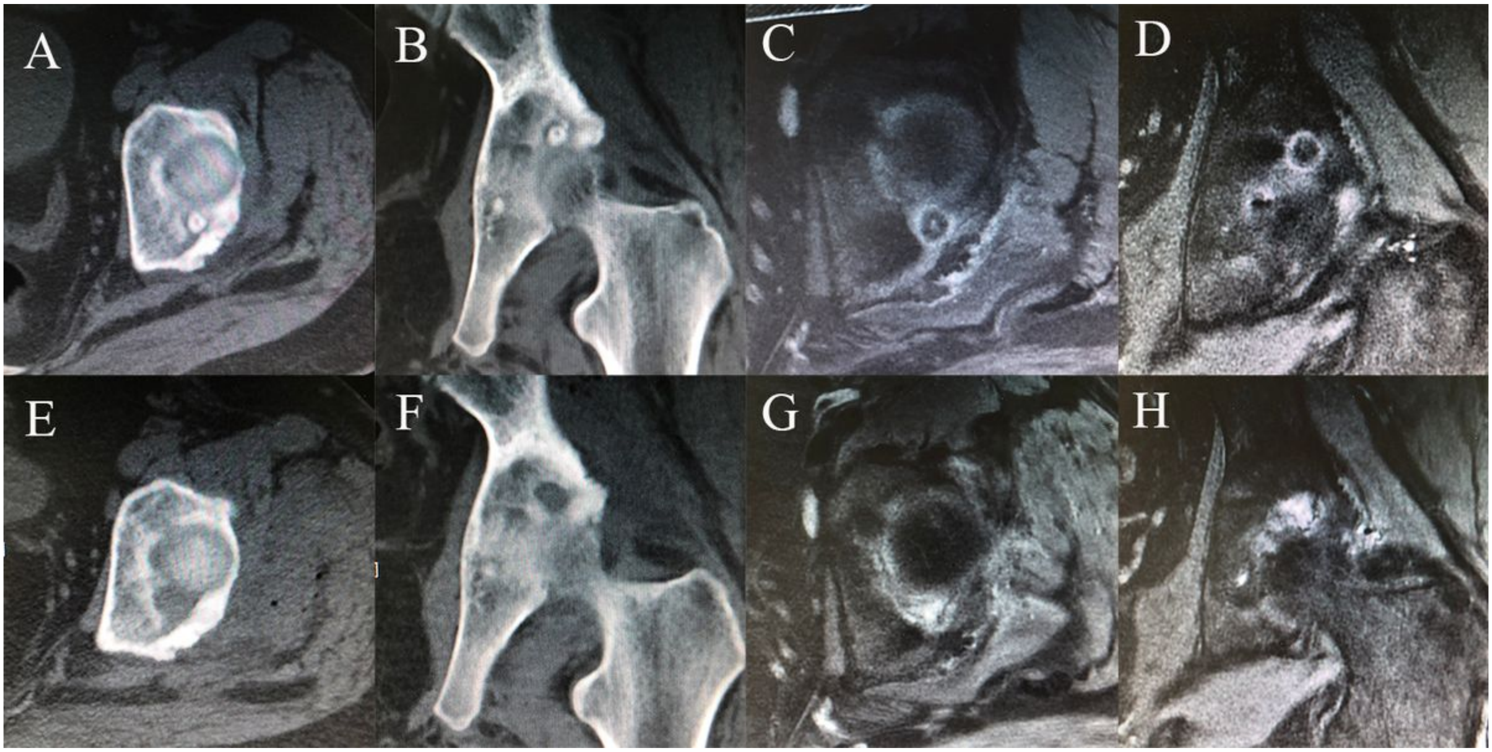


**Figure 1**

Preoperative and postoperative CT and MRI of one patient diagnosed with OO of the acetabulum in zone 4. A-D. Preoperative coronal CT, axial CT, coronal MRI and axial MRI showed the location of OO. E-H. Postoperative coronal CT, axial CT, coronal MRI and axial MRI showed the excision of OO.

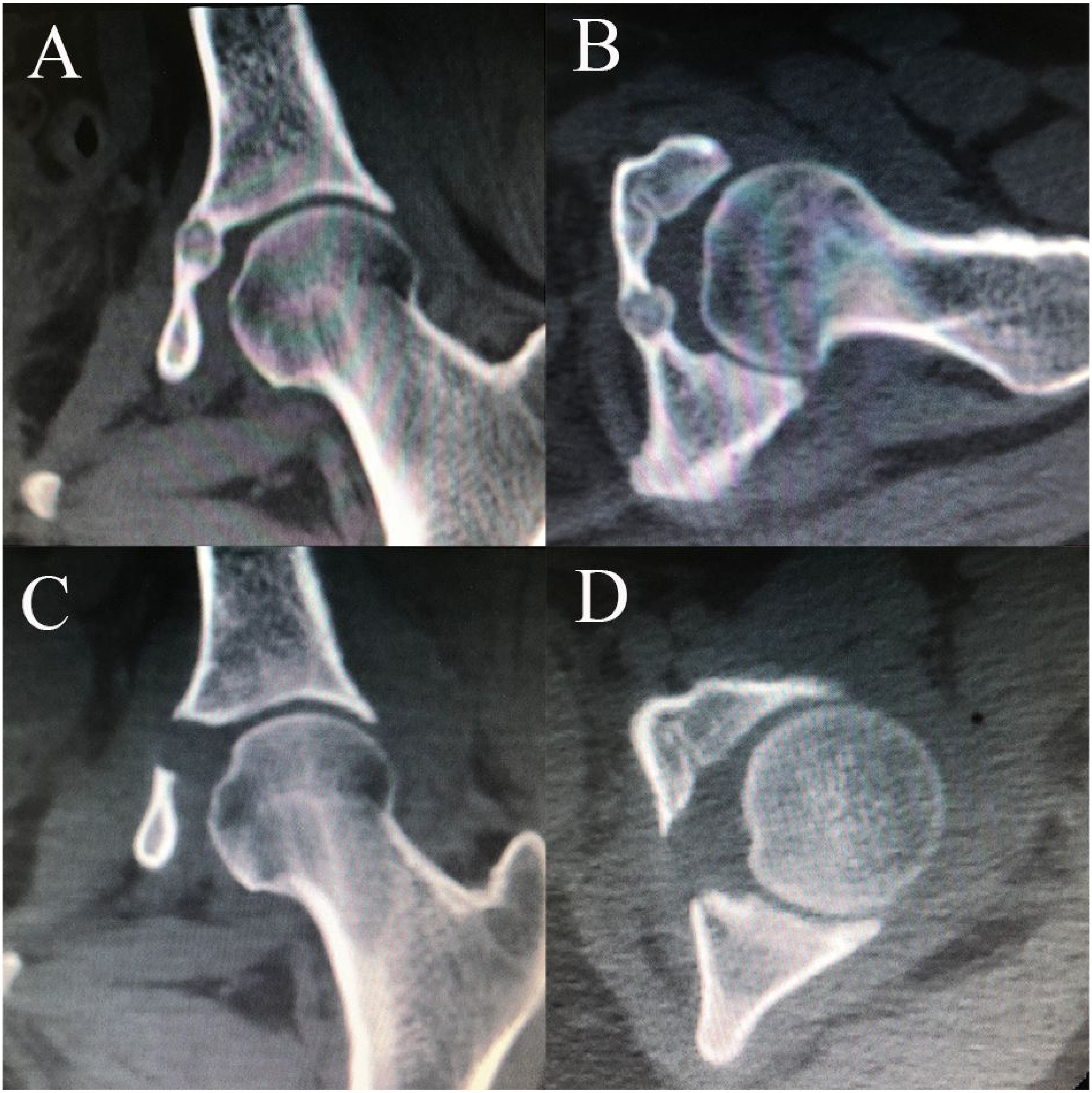


**Figure 2**

Preoperative and postoperative CT of one patient diagnosed with OO of the acetabulum in zone 6. A, C. Preoperative and postoperative axial CT. B, D. Preoperative and postoperative coronal CT.

### Figure 3

Coronal CT showed OO and periosteal reaction in the joint surface of acetabulum.