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Original article

Arthroscopically assisted treatment for nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture: Medium-term clinical and radiological outcomes

Daohong Zhao[a,*], Hong Chen[b], Bo Zhao[c], Duo Shen[d], Zhaowei Jiang[e], Yuhao Zhang[a], Jun Zhang[a]

[a] Department of Orthopaedics, The Second Affiliated Hospital of Kunming Medical University, No374, dianmian road, Kunming, 650101, China
[b] Department of Orthopaedics, The First People Hospital of Kunming City, No1228, beijing road, Kunming, 650224, China
[c] Department of Orthopaedics, The Second People Hospital of BaoShan City, No13, zhengyang road, BaoShan, 678000, China
[d] Department of Orthopaedics, The People Hospital of LongChuan County, No32, longfeng road, LongChuan, 678700, China
[e] Department of Orthopaedics, The First People Hospital of DeHong State, No13, yonghan road, DeHong, 678400, China

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ABSTRACT

Background: Nonconcentric reduction of hip posterior dislocation caused by the acetabular labrum rim fracture is rare. There has been very little study on the feasibility of arthroscopically treatment and medium and mid-term evaluation to this pathology. The objectives of the current study were: (1) Is the arthroscopically assisted technique feasible to this manage this injury? (2) What is the effectiveness of arthroscopic treatment for nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture.

Hypothesis: Arthroscopically assisted procedure is an alternative treatment modality for nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture.

Patients and methods: Thirteen of 257 posterior hip dislocations who were admitted to our hospital from February 2008 to March 2017 were included: 9 males and 4 females, with an average age of 23.7 (15–36) years. All of them underwent hip posterior dislocation and nonconcentric reduction related to acetabular labrum rim fracture. All of them had arthroscopic reduction and fixation of the rim fracture. Visual Analogic Score (VAS) score, modified Harris score, Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) score and the last follow-up radiographs were analyzed respectively. Postoperative complication and the need for secondary operation were recorded during the process.

Results: The incidence rate of this pathology was nearly 5%. Twelve out of 13 patients were followed up for an average of 42 (range, 26–68) months. At the final follow-up, VAS score was decreased from 5.2 ± 0.9 (range, 4.0–6.1) preoperatively to 0.5 ± 0.5 (range, 0.0–1.0) ($p < 0.0001$), modified Harris score and WOMAC score were increased statistically significant from 32 ± 8 (range, 28–40) and 30 ± 5 (range, 25–35) to 94 ± 5 (range, 89–99) and 95 ± 4 (range, 91–99) respectively ($p < 0.0001$). All patients have had completely concentric reduction and returned to activities of daily life. There was not any hip arthroscopic complication such as sciatic nerve injury and intra-abdominal fluid extravasation. Besides, there were no aseptic necrosis and revision case.

Conclusion: Arthroscopically assisted procedure is an alternative treatment modality for nonconcentric reduction of hip posterior dislocation caused by the acetabular labrum rim fracture without surgical dislocation procedure. Good clinical results can be achieved without any complications related to the surgical procedure.

Level of evidence: Level IV, therapeutic case series.

* Corresponding author.
E-mail address: 381454239@qq.com (D. Zhao).

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1. Introduction

Traumatic posterior dislocation of the hip is often caused by high-energy injuries in young patients [1–3]. Nonconcentric reduction of hip posterior dislocation is not common in clinical practice, which can be caused by bone fragments or soft tissues such as a torn labrum, ruptured joint capsules, and ligamentous injuries locked in the articular cavity [4,5]. The pathology of subluxation joint due to acetabular labrum rim fracture is rare [6]. It may lead to post-traumatic osteoarthritis following improper management [7,8].

With the development of arthroscopic surgery, there are some encouraging reports when used after the traumatic hip dislocation. Compared to open surgery, it has less trauma, quick recovery and fewer complications [9–12]. The treatment modality to address under arthroscopic control hip joint injuries remains controversial. In previous case reports, arthroscopic removal was the main procedure to manage torn labrum and bone fragment caused by posterior hip dislocation [13,14]. There are few clinical reports on the reduction and fixation of acetabular labrum rim fracture under arthroscopic control. Stabile et al. [15] reported a single case in which they performed this technique and obtained good result. Kruppa et al. [4] reported a case of 13-year-old boy, who suffered of posterior hip dislocation, an intra-articular labrum bony fragment resulting in nonconcentric hip was identified after reduction, and excellent outcome was achieved by arthroscopic treatment. But to the best of our knowledge, no large scale and mid to long-term follow-up of such cases has been reported previously.

The current study, based on the mid-term follow-up of 13 cases who underwent arthroscopically assisted procedure, was designed to answer the following questions:

- Is the arthroscopically assisted technique feasible to manage this injury?
- What is the effectiveness of arthroscopic treatment for nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture.

The hypothesis was put forward that good results can be acquired through arthroscopic reduction and reliable fixation procedure, and the aim of this study

2. Patients and methods

2.1. Patients

Thirteen patients were included from February 2008 to March 2017, in the same period, 257 cases of hip posterior dislocations associated with acetabular wall fracture were treated in our department, case selection criteria is shown in the flowchart (Fig. 1). A retrospective study of this cohort was conducted with prospectively collected data. This study was performed according to a protocol that was approved by the Institutional Review Board of Kun Ming Medical University. All subjects provided their informed consent to participate in this study. All of them were high-energy injuries such as high fall, traffic accidents. The time of the first reduction, the interval between the first reduction to arthroscopic surgery and complications was recorded in detail. All patients received manual reduction in emergency, postoperative X-ray showed nonconcentric joint where a bone fragment locked in it, CT scan confirmed that the fragment came from posterior wall of the acetabulum. All patients underwent arthroscopic reduction and fixation of acetabular labrum rim fracture (Table 1). Inclusion criteria: nonconcentric joint was caused by bone fragment interposition which came from posterior wall of the acetabulum after manual reduction. Patients with ipsilateral injuries were unable to use lower limb traction were excluded from this study.

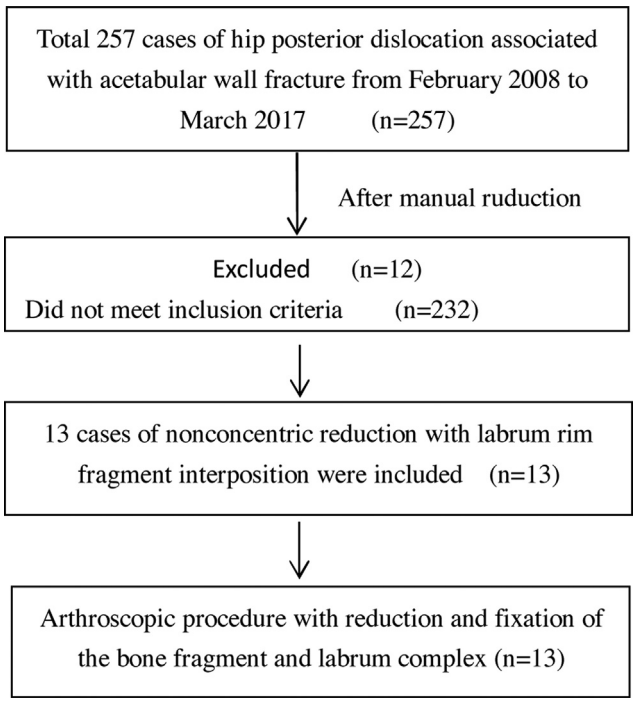

Fig. 1. Flowchart of the study.

Table 1
General and surgical information of patient.

Patient No.	Side	Time to first reduction (hour)	Time to arthroscope (day)	Anchor (*n*)	Surgery time (minute)	Fragment size (length*width) (cm)	Combined chondral lesions	Complication of arthroscopy
Case 1	Left	3	3	2	110	1.5*0.6	Femur	No
Case 2	Right	1	5	4	115	1.8*0.5	Femur	No
Case 3	Left	4	6	3	120	2.0*0.6	No	No
Case 4	Right	3	4	3	100	1.8*0.5	No	No
Case 5	Left	4	8	2	140	1.3*0.6	Acetabular	No
Case 6	Left	2	5	3	90	1.8*0.8	No	No
Case 7	Left	4	4	4	100	1.8*1.1	Femur	No
Case 8	Right	4	3	3	120	2.1*0.8	Femur	No
Case9	Right	1	5	2	130	1.4*0.5	Femur	No
Case10	Left	4	4	4	130	2.5*1.0	Femur	No
Case11	Left	5	7	3	125	1.9*0.7	Femur	No
Case12	Right	2	4	4	120	2.2*1.0	No	No
Case13	Left	3	4	3	110	1.5*0.7	Femur	No

2.2. Surgical technique

All operations were performed by the same senior physician. The patient was placed with supine position under general anesthesia, 5 degrees of adduction and 10 degrees of medial rotation of the affected limb was applied with conventional traction table. The optimal joint cavity traction is 8–10 mm. Thick cotton pads were needed to protect the feet from pressure sores. Puncture site was located by C-arm, the anterolateral, anterior and posterolateral portal were established under 30° endoscope (Smith &Nephew Endoscopy, Andover, MA, USA), the rest auxiliary portals were established if needed.

Joint interportal capsulotomy was performed since it is easy to operate through anterolateral and posterolateral portal, debridement was performed and joint pathology such as chondral damage was checked (Table 1). Intraoperative assessment showed an acetabular postero-inferior labrum rim fracture locked in the joint which connected to the normal labrum. The bone fragment from the posterior acetabular wall was reduced into the intact acetabular side using a probe through posterolateral portal, traction weight was increased appropriately if it was difficult to reduce. Bone fragment was confirmed to be derived from acetabular posterior wall defect by arthroscopy. Then we used two 3.5 mm anchors (Arthrex, Naples, Fl, USA) into the fracture site through posterolateral portal if the fragment size is small, the bone fragment and labral complex was fixed using anchor suture which across the bone fragment. Two or more 3.5 mm anchors (Arthrex, Naples, Fl, USA) were used on both sides of fracture site respectively if the fragment size was large enough, the bone fragment and labral complex was fixed using different anchor suture around it with embedding method, whether the fixation of bone fragment was reliable was rechecked by probe. The concentric joint and anatomical reduction of fragment was reconfirmed by C-arm if needed. Capsulotomy repair were not performed at the end.

2.3. Rehabilitation program

Ankle pump exercise was started in the first day after operation, active and passive functional exercises were performed in all directions of the hip joint, in the first week after operation, and the complete reduction of the joint was confirmed by postoperative X-ray. The affected limb was not admitted to weight within 6 weeks. After 6 weeks, total weight bearing was permitted. The patient was admitted to sports exercise until 6 months if there was neither osteonecrosis nor other complications.

2.4. Methods of assessment

All patients were followed up for more than 2 years, joint concentric reduction and fracture healing were evaluated by postoperative X-ray and CT scan, complications such as sciatic nerve injury and intra-abdominal fluid extravasation were recorded. At the last follow-up, patients with osteoarthritis and femoral head necrosis who required repeated surgeries were recorded.

To evaluate the effectiveness of arthroscopic procedure, the Visual Analogic Score (VAS) score, modified Harris [16] and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [17] scores were recorded in detail before operation and at the last follow-up. Each patient was scheduled to be followed up by a doctor to ensure full data is available, if any patient was lost to follow-up, he was excluded from the statistical analysis.

2.5. Statistical analysis

Since our cohort was limited we only used non-parametrical test (Wilcoxon signed rank sum test, Kruskall Wallis test). SPSS 22.0 statistical software (IBM corporation, Armonk, NY, USA) was used for analysis. The test level was 0.05.

3. Results

3.1. Perioperative data

The incidence rate of this pathology was nearly 5% (13/257). Thirteen patients (9 males and 4 females), with an average age of 23.7 (range, 15–36) years, were included in the current study. All of them were high-energy injuries. The patients were followed up (average, 42 months, range, 26–68 months) in the whole process of study (one patient (case 13) was lost to follow-up at one month and was excluded from follow-up assessments). The time from dislocation to first reduction was 1–5 hours (average, 3 hours), and the time from first reduction to arthroscopic surgery was 3–8 days (average, 4.8 days). All the patients had no symptoms of neurovascular injury and ipsilateral other fracture. The duration of arthroscopic surgery was 90–140 minutes (average, 116 minutes), and the use number of anchor was 2–4 (average, 2.5) during the operation. Of the 13 patients, 8 patients had femoral chondral damage, 1 patient had acetabular chondral damage, 4 patients had no chondral damage. There were no hip arthroscopic complications such as sciatic nerve injury and intra-abdominal fluid extravasation occurred (Table 1).

3.2. Postoperative imaging

Postoperative X-ray suggested that all the patients had a fully concentric joint, and the CT showed completely concentric reduction and the acetabular labrum rim fracture was well restored (Fig. 2). Complete healing was achieved according to the last follow-up imaging examinations. There were no complications such as femoral head necrosis and osteoarthritis which need second operation.

3.3. Follow-up outcomes

The mean VAS score of the hip joint before surgery was 5.2 ± 0.9, and the mean VAS score of the final follow-up was 0.5 ± 0.5 ($p < 0.0001$). Preoperative modified Harris score was 32 ± 8 on average and 94 ± 5 at the final follow-up ($p < 0.0001$). Preoperative WOMAC score was 30 ± 5 on average and 95 ± 4 at the final follow-up ($p < 0.0001$) (Table 2). All patients returned to activities of daily life.

4. Discussion

Hip posterior dislocation associated with acetabular wall fracture is common in clinic [2,18,19], but nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture is rare. To date, few authors have described a case report of similar cases [4]. This study shows that: among the total 257 cases of hip posterior dislocation associated with acetabular wall fracture, there were only 13 cases (5%), of nonconcentric reduction resulted in acetabular labrum rim fracture. While the incidence rate was low (5%), all the bone fragment size was small, the biggest is 2.5 mm by 1.0 mm. The bone fragment type is different to the other common acetabular wall fracture which is not easy to result in entrapment. Its mechanism is similar to bankart lesions that caused by dislocation of the shoulder joint. When the hip joint is posterior dislocated, the acetabular labrum complex is damaged, during the hip joint reduction, the dislocated femoral head squeezes the damaged labrum complex into the articular cavity, resulting in nonconcentric reduction of the hip joint (Fig. 3).

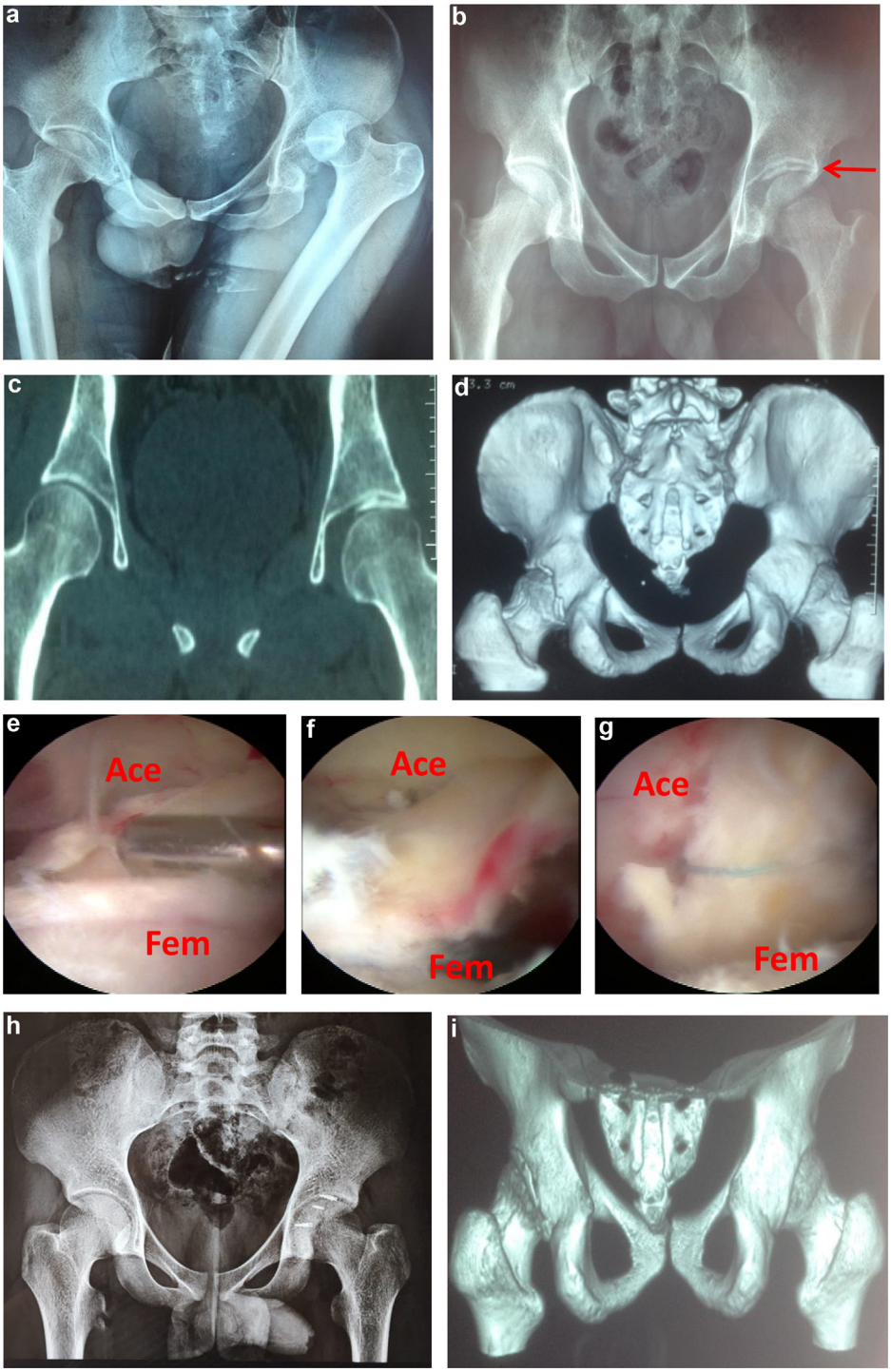

Fig. 2. A typical case of nonconcentric reduction of hip posterior dislocation: a: showed left hip posterior dislocation; b: showed nonconcentric joint with a bone fragment; c: CT showed entrapment of a bone fragment in joint; d: 3-dimensional CT confirmed the bone fragment come from the posterior wall of the acetabulum; e and f: the labrum bony bankart lesion was showed under arthroscopy; g: the image of labrum rim fracture after reduction and fixation; h: postoperative X-ray showed concentric joint.; i: CT showed anatomical reduction of labrum rim fracture. A: acetabulum; F: femoral head.

For most similar cases previously reported, resection was performed on the labrum lesions (including the rim fracture) [20,21]. However, with the understanding of the importance of acetabular labrum, more and more authors propose to repair or reconstruct the damaged labrum [20–23]. If the defect of the posterior wall exceeds 25–30%, the stability of the acetabulum will be significantly affected and it is necessary to reconstruct the integrity of the acetabulum [24]. After the application of the hip arthroscope, labrum repair has achieved good clinical results. Ilizaliturri et al. [14] once performed arthroscopic surgery on 17 patients with persistent pain after dislocation of the hip. All patients had different degrees of labrum injury, and good results were obtained after repairing or partial resection of the damaged labrum. Philippon et al. [25] performed arthroscopy on 14 professional athletes that dislocated their hip, all patients had labrum injuries, good results were also obtained after repairing or partial resection of the damaged labrum. In 2010, Cross et al. [26] reported a case of acetabular anterior and posterior labrum injuries caused by hip dislocation, good result was achieved

Table 2
Evaluation of patients at follow-up.

Patient No.	Last follow-up (months)	VAS		Modified Harris scores [16]		WOMAC [17]		Complication
		Pre-op	Follow-up	Pre-op	Follow-up	Pre-op	Follow-up	
Case 1	36	5.8	1.0	32	98	30	95	0
Case 2	48	5.0	1.0	39	94	28	94	0
Case 3	68	4.0	0.0	30	95	25	95	0
Case 4	30	5.2	1.0	28	92	31	98	0
Case 5	36	5.7	0.5	30	89	30	91	0
Case 6	36	5.0	0.5	31	95	35	96	0
Case 7	26	5.0	0.0	35	94	32	95	0
Case 8	40	6.1	0.0	35	94	35	95	0
Case9	42	5.0	0.0	40	98	28	99	0
Case 10	48	5.2	0.0	28	99	29	98	0
Case 11	60	5.5	0.5	30	96	27	95	0
Case 12	40	5.0	0.0	28	92	29	94	0

VAS: Visual Analogic Score; WOMAC: Western Ontario and McMaster Universities Osteoarthritis Index.

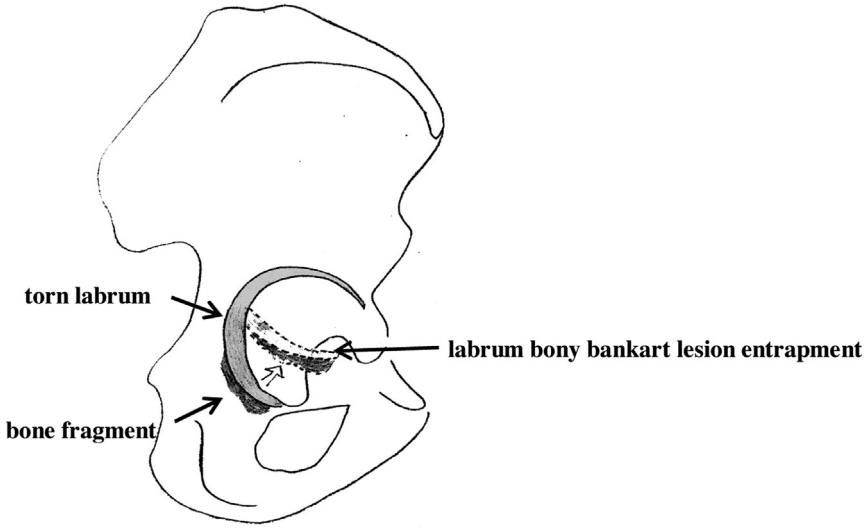

Fig. 3. Mechanism of this injury. The labrum lesion torn by the posteriorly dislocated femoral head was entrapped in the joint by manual reduction.

with the labrum suture repair under arthroscopy. However, there are few reports on arthroscopy applied to nonconcentric reduction of posterior hip dislocation caused by rim fracture. In 2003, Svoboda et al. [27] reported a patient with residual bone in the articular cavity after posterior hip dislocation, the result of arthroscopic fragment removal was satisfactory, and it was considered that hip arthroscopy was a safe and effective technique. Posterior labrum injury is more likely to be associated with acetabular margin fracture, forming a labrum rim fracture, the healing rate is much more than pure labrum lesions. As for the nonconcentric reduction of posterior hip dislocation caused by the labrum rim fracture, some authors reported that the posterior approach incision with dislocation of the joint, and bone reduction fixation were performed with satisfactory results, but the trauma was relatively large and the risk of femoral head necrosis was high [28,29]. To the best of our knowledge, up to now, Stabile et al. [15] has only reported one case of acetabular labrum bucket handle tears with bone fragment due to posterior hip dislocation, performing acetabular labrum reduction and fixation under arthroscopy and achieving good clinical results. In our study, we present a series of 13 patients with well documented nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture. According to the radiography, all patients got a completely concentric joint with well reduction of bone fragment under arthroscopy. At the last follow-up, all the patients showed significant improvement in function and complete fracture healing, with no complications such as femoral head necrosis or secondary operation caused by osteoarthritis

Two potentially devastating complications in hip arthroscopy are sciatic nerve injury and intra-abdominal fluid extravasation [30]. Sciatic nerve injury was often caused by long time traction and direct damage in surgery, in our study, the average operation time was less than 120 minutes, which is safe to sciatic nerve according to literature review [31,25]. Also, we had no cases of intra-abdominal fluid extravasation in our series, probably because all pathology was only acetabular labrum rim fracture which was not communicated to the pelvic cavity, and the number of cases were small.

The most important purpose of this study is that it is the first reporting a series of cases of nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture and evaluated the feasibility and effectiveness of arthroscopic treatment, this study demonstrates that arthroscopic technique is completely feasible in these cases. But, admittedly, this study has some limitations. First, this was a retrospective study, but the data were prospectively collected. Second, due to the extremely low incidence of nonconcentric reduction of hip posterior dislocation caused by acetabular labrum rim fracture, this study investigated a limited size population. Third, there was no open surgery control group to demonstrate which procedure is better, and no control group to demonstrate whether it is improved from a simple debridement procedure to bone fragment.

5. Conclusions

The present study reveals that acetabular labrum rim fracture can cause nonconcentric reduction of hip joint, the bone fragment and acetabular labrum complex is important to maintain the integrity of acetabular labrum, which deserved to preserve. Arthroscopic technique is completely feasible to these cases to achieved good outcomes.

Disclosure of interest

The authors declare that they have no competing interest.

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Authors' contributions

D.H.Z. and H.C. participated in the acquisition of the data. J.Z., B.Z. and D.S. contributed to data analysis. Z.D.W. and H.C. revised the manuscript carefully for important content. D.H.Z. conceived, designed, and led the study. H.C. and J.Z. made contributions to drafting the manuscript. All authors read and approved the final manuscript.

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