Management of traumatic labral tear in acetabular fractures with posterior wall component

J.H. Yoo a,*, J.H. Hwang b, J.D. Chang c, J.B. Oh a
a Department of Orthopaedic Surgery, Hallym University Sacred Heart Hospital, 896 Pyeongchon-dong, Dongan-gu, Anyang 431-070, Republic of Korea
b Department of Orthopaedic Surgery, Kangnam Sacred Heart Hospital, Hallym University College of Medicine, 948–1 Daerim-dong, Yeongdeungpo-gu, Seoul 150-950, Republic of Korea
c Department of Orthopaedic Surgery, Dongtan Sacred Heart Hospital, Hallym University College of Medicine, 40 Seokwom-dong, Hwasung 445-907, Republic of Korea

ABSTRACT

Background: Posterior labral tear is frequently encountered in acetabular fractures with posterior wall component (AFPWC). However, there has been very little information in the literature on the type and management of traumatic labral tears in AFPWC.

Hypothesis: Traumatic labral tear is a constant intracapsular injury in AFPWC and can be repaired using adequate methods according to its type and size.

Materials and methods: A retrospective study of 14 patients (mean age 28 years [16–58]) who underwent open surgery for AFPWC was conducted using prospectively collected data. The types of posterior labral tear were investigated at intraoperative examination through the ruptured joint capsule or its extension, and were concomitantly managed. Surgical outcomes were clinically assessed using Merle d’Aubigné (PMA) score and Visual Analog Scale (VAS), and radiologically evaluated at final follow-up.

Results: Posterior labral tears were present in all 14 patients. The types of labral tear were osseous avulsion and posterior root avulsion tear (n = 9), longitudinal peripheral tear and posterior root avulsion tear (n = 2), longitudinal peripheral tear (n = 2), and osseous avulsion tear (n = 1). All unstable labra in 12 patients (86%) were repaired. All avulsion tears of the posterior root were repaired using a suture anchor, longitudinal peripheral tears using suture fixation or/suture anchors, and osseous avulsion tears using a spring plate. The mean PMA score and VAS were 16.4 (14–18) and 1.7 (0–3) at final follow-up, respectively. The radiologic grades at last follow-up were good or excellent in all patients.

Discussion: All AFPWC in this study consistently revealed posterior labral tear. Posterior root avulsion tears accompanied with osseous avulsion was the most common type. Torn labra should be repaired as much as possible if unstable, considering the important functions of a normal labrum; fixation using a suture anchor may be useful for an avulsion tear of the posterior root.

Level of evidence: Level IV, therapeutic case series.

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1. Introduction

Generally, an axial load applied to the femur with the hip flexed about 90°, drives the femoral head against the posterior articular surface of the acetabulum, which causes acetabular fractures with a posterior wall component (AFPWC) according to the degree of hip abduction [1–3]. The mechanism of injury that leads to these fracture types is mostly high-energy trauma such as a motor vehicle accident, which frequently causes concurrent posterior hip dislocation [2,3]. Considering this mechanism of injury, to varying degrees the posterior labrum may be injured in conjunction with comminution in the posterior acetabular wall and hip instability. However, to date there has been very little information in the literature on the type and repair of traumatic labral injury in acetabular fracture, especially in AFPWC.

This study is based on the treatment of 14 consecutive patients who underwent open surgery for AFPWC. Based on these findings, the hypothesis was put forward that posterior labral tears are a constant intracapsular injury in AFPWC and that close examination of tears during open surgery and the appropriate repair of unstable labra according to tear location and size are needed in AFPWC. The aim of this study was to report the presence and types of the labral tears identified during open surgery in AFPWC and our treatment methods of them.
2. Material and method

2.1. Patients

Between December 2007 and February 2012, 14 patients who sustained AFFWC and underwent open reduction and internal fixation by a single surgeon (JHY), were enrolled in the current study. Three patients who underwent conservative treatment with non-displaced or minimally displaced AFFWC and stable hip joints during the same period, were excluded. A retrospective study of this cohort was conducted with prospectively collected data. All surgical treatments and clinical follow-up visits were conducted at a university teaching hospital.

There were 11 male and 3 female patients with a mean age of 38 years old (range, 16–58 years old). The mechanism of injury in all patients was a motor vehicle accident and the left side was involved in 10 patients. Concurrent posterior dislocation of the hip occurred in 13 patients (93%). Other associated injuries were rupture of the posterior cruciate ligament in the ipsilateral knee of 3 patients and the contralateral knee of one, and concurrent fractures in upper or lower extremities in 5 patients (Table 1).

2.2. Surgical procedures and labral tears assessment

According to Letournel and Judet classification [1], there were posterior wall fractures in six patients, posterior column and wall fractures in six, and transverse and posterior wall fractures in two. Prior to surgery, 3-dimensional computed tomography (3-D CT) scans were taken in all patients for more accurate assessment of fracture pattern and a detailed preoperative plan [4]. Surgery was performed 4 to 12 days after the injury, according to the patient’s condition. Surgery time ranged between 2 and 4.5 hours. All patients were operated on using Kocher-Langenbeck approach without surgical dislocation of the hip. Trochanteric flip osteotomy was performed to secure enough space for plating in only 6 patients, with superior extension of posterior wall fracture (Table 2). The hip joint was explored through the fracture site of the posterior wall and the ruptured capsule, with its extension as the case might be, to investigate the presence of associated labral injuries.

Labral tears were characterized as longitudinal peripheral tear at the junction of the labrum with the acetabular rim, posterior root avulsion tear close to the transverse ligament, osseous avulsion tear with an attached fragment of the posterior wall, or mixed tear, according to location and shape. Torn labra were defined as unstable in cases that were considered to be interposed between the articular surfaces [5] or accompanied with posterior root avulsion tears. All unstable labral tears were repaired (Table 2).

Internal fixation was performed with one to two 3.5-mm reconstruction plates according to the fracture type and a spring plate was added when necessary. In cases with a bone defect in the posterior wall due to depression or comminution, cancellous bone harvested from the trochanteric osteotomy site or greater trochanter was packed into the bone defect site.

After surgery, non-weight bearing on the operated side was maintained for about 4 weeks; thereafter, tolerable weight bearing with a pair of crutches was allowed. Full weight bearing was permitted about 10 weeks after surgery, depending on the degree of radiographic consolidation of the fracture. Throughout the postoperative period, isometric quadriceps contraction exercise with the leg in extension was encouraged.

2.3. Methods of assessment

Clinical outcomes were evaluated using the Merle d’Aubigné (PMA) score [6] and a visual analog scale (VAS) [7] at final follow-up. The quality of reduction for the articular surface and the congruency of the hip joint were evaluated by postoperative plain radiographs using the Matta classification system of anatomic (0–1 mm), imperfect (1–3 mm), and poor (more than 3 mm) [2] and additionally reviewed on 3-D CT scans taken in all patients for detailed assessment of reduction and fixation status. The radiological evaluation at final follow-up was performed based on the criteria of Matta: excellent (a normal appearing hip joint), good (mild changes with minimal sclerosis and joint narrowing less than 1 mm), fair (intermediate changes with moderate sclerosis and joint narrowing less than 50%), and poor (advanced changes) [2]. During the follow-up period, complications such as reduction loss, infection, nerve palsy, post-traumatic arthritis, osteonecrosis of the femoral head and heterotopic ossification were investigated.

3. Results

3.1. Types of labral tear and their treatment

Posterior labral tears were confirmed in all 14 patients and unstable in 12 (86%). In a majority of the patients (11/14), labral tear revealed a mixed type. The types of labral tear were osseous avulsion tear and posterior root avulsion tear in 9 patients, longitudinal peripheral tear and posterior root avulsion tear in 2, longitudinal peripheral tear in 2, and osseous avulsion tear in 1. No patients had a radial tear (Fig. 1).

Posterior root avulsion tears were reattached to the original attachment site as close to the transverse ligament as possible using a 3.5-mm Corkscrew suture anchor (Arthrex, Naples, FL, USA).
3.2. Surgical outcomes

All patients were followed up for at least 12 months (range, 12–48 months). Postoperative evaluation of the quality of fracture reduction was graded as anatomical in 10 patients (72%) and imperfect in 4 (28%) on plain radiographs (Table 3). The overall clinical outcome was excellent for 3 patients (21%), good for 10 (71%) and fair for one (8%) with a mean PMA score of 16.4 (range, 14–18) and mean VAS of 1.7 (range, 0–3) at final follow-up. Six patients with concurrent lower limb injuries complained of no pain, stiffness, or instability of the involved knee joints that impeded their daily activities; and these patients showed relatively satisfactory outcomes at the final follow-up. The final radiographic results on plain radiographs were graded as excellent in twelve patients (86%) and good in two (14%).

3.3. Complications

There were no wound infections, deep infections, sciatic nerve injuries, or loss of reduction in any patients during the early postoperative period. At the final follow-up, there were no complications such as osteonecrosis of the femoral head, post-traumatic arthritis, and non-union at the trochanteric osteotomy site. However, heterotopic ossification developed in 2 of 6 hips with use of trochanteric flip osteotomy, which did not affect range of motion of the operated hips with Brooker Class I and II, respectively [8]. Meanwhile, there was no heterotopic ossification in 8 hips without use of trochanteric osteotomy.

4. Discussion

It has been generally perceived that AFPWC have relatively poor surgical outcomes compared to other fracture types [1–3,9,10]. This result most likely relates to the comminution of posterior wall, non-anatomical reduction, and the chondral lesion of the femoral head and acetabulum. However, little has been mentioned about traumatic labral injury or its treatment in AFPWC to date, which may be important factors affecting surgical outcome. Therefore, this study was conducted to report on the presence and type of the labral tears identified during open surgery in AFPWC and our treatment methods. The current study underlines traumatic posterior labral tears were present in all patients, suggesting that it is one of the main intracapsular pathologies in AFPWC.

The present study is limited by the small cohort size and its retrospective nature despite prospectively collected data. Also, this study has no control group who undergo partial resection or no treatment for labral tear for comparison study and has no assessment for the chondral lesions of the femoral head and acetabulum. However, to date, no comparative study exists in the published literature and there has been little information about traumatic

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**Table 2**

<table>
<thead>
<tr>
<th>Case</th>
<th>Approach</th>
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<th>Labral Tear Type</th>
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</tr>
<tr>
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<tr>
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<tr>
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</table>

KL: Kocher-Langenbeck; OA: osseous avulsion; PRA: posterior root avulsion; LP: longitudinal peripheral.

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Fig. 1. Schematic drawings of the types of posterior labral tear found in this study. A. Osseous avulsion and posterior root avulsion tear. B. Longitudinal peripheral tear and posterior root avulsion tear. C. Longitudinal peripheral tear. D. Osseous avulsion tear.

Longitudinal peripheral tears were reattached to the bony acetabular rim using a suture anchor or a n°2 Ethibond (Ethicon, Somerville, NJ, USA) suture fixation (Fig. 2). For osseous avulsion tears combined with posterior root avulsion tears, posterior wall fragments attached to labrum were first reduced indirectly by repair of the avulsed posterior labral root using a suture anchor, then fixed using a lag screw or a spring plate (Fig. 3). A total of 12 unstable labral tears that were repaired, showed the pattern of circumferential tears such as a peripheral tear or osseous avulsion tear, more than 20 mm in length, of which most (11/12) were accompanied with posterior root avulsion tears.

Two tears that were considered stable were left untreated; one was a longitudinal peripheral tear of 10 mm in length and the other was an osseous avulsion tear of 13 mm in length (Table 2). These stable tears were too small to be amenable to fixation with any repair method.

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labral tears in AFPWC. Accordingly, we believe that important information can be gleaned from this small cohort because this study is the first report on the classification of traumatic labral tears and those treatments in AFPWC and is based on the uniform cohort of patients who sustained AFPWC due to the same mechanism of injury and were treated by a single surgeon at a single institution.

To date, a few authors have reported traumatic labral tears identified arthroscopically only in the series of non-fracture traumatic hip dislocations [11,12]. In addition, the authors did not specify the criteria of unstable labral tear or labral repair. Hence, this study is the first reporting on the type of traumatic labral tears and those treatments in AFPWC, which induce relatively poor outcomes. Moreover, the current study suggests the criteria of unstable

Fig. 2. A. 3-dimensional CT of a 24-year-old man (case 3), showing a fracture-dislocation of the right acetabulum (posterior column and wall). B. Intraoperative photographs through the ruptured capsule (black arrow) showing a torn posterior acetabular labrum of longitudinal peripheral tear type (white arrow) and a labrum repaired using No. 2 Ethibond suture fixation (white arrowhead). C. Anteroposterior radiograph 30 months after surgery showing good union without arthritic change of a hip joint or osteonecrosis of the femoral head.

Fig. 3. A. 3-dimensional CT of a 54-year-old man (case 4), showing a fracture-dislocation of the left acetabulum (posterior wall). B. Intraoperative photographs through the ruptured capsule showing an osseous avulsion tear with posterior wall fragment attached to posterior labrum (black arrow) and posterior root avulsion tear (white arrow), and posterior labral root repaired using a sutured anchor (white arrowhead) and posterior wall fragment fixed using a spring plate (black arrowhead). C. Anteroposterior radiograph 29 months after surgery showing good union without arthritic change of a hip joint.
tear as torn labra to be able to be interposed between the articular surfaces or/and accompanied with posterior root avulsion tears, all of which showed tears more than 20 mm in length. We believe that these unstable tears can cause joint instability or disrupt joint sealing function, based on basic science data related to important functions of normal labrum [13–16].

However, this classification has been made according to the type of degenerative labral tears due to bony pathologies or minor repetitive insults during daily or sport activities. Our classification of traumatic labral tears in AFPWC shows a completely different aspect compared with the previous classification of degenerative tears. In this study, posterior labra were circumferentially torn at the acetabular rim or torn attached to the posterior wall fragment without radial tear in all patients (14/14) and additionally avulsed at the posterior root close to the transverse ligament in most of them with concurrent posterior hip dislocation (11/13). We believe that these findings are due to the strong tensile properties of the labrum according to the direction of its fiber and that a greater eccentric posterior force causes an avulsion tear of the posterior root instead of a radial tear in most cases with posterior hip dislocation.

The avulsed posterior root may disrupt the joint sealing function of a normal labrum and induce hip joint instability [13,16]. Therefore, it is suggested to repair all avulsed posterior roots at the original attachment site as close to the transverse ligament as possible. The repair of the avulsed posterior root using a suture anchor can be easily done and induce indirect reduction of a posterior wall fragment attached to the labrum. Accordingly, this repair method is more useful for osseous avulsion tear combined with posterior root avulsion tear.

Labral tears have become more recognized as a source of mechanical pain and functional limitation in the hip region if left untreated [18]. In recent years, there has been evidence that labral repair provides a superior result to labral resection for labral tears [19,20]. Moreover, Audenaert et al. [21] reported that human labral tears showed healing potential on histologic assessment after surgical repair, and neither remnants of the tear nor the presence of fibro-vascular scar tissue was observed. Meanwhile, it has been suggested that anatomical reduction alone is not sufficient to restore function to normal in AFPWC [9,10]. Eventually, based on these reports and our study, a torn or avulsed labrum in AFPWC should be treated appropriately and preserved as far as possible. Also, we believe that the appropriate management of labral tear as well as more accurate acetabular reduction would play important roles in inducing favorable results in the current study, even if our results are not based on long-term follow-up data.

5. Conclusion

The present study reveals posterior labral tear as a constant intracapsular injury in all AFPWC and that it can be repaired using adequate methods according to its type and size. We suggest that posterior labral tears in AFPWC should be prudently examined during open surgery and preserved as much as possible. Besides, it should be highlighted that clinical outcomes in AFPWC may depend on concurrent labral tear and its treatment as well as the quality of fracture reduction and chondral injury of acetabulum or femoral head.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References