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ARTHROSCOPY AND SPORTS MEDICINE

Clinical outcomes after arthroscopic acetabular labral repair using knot-tying or knotless suture technique

Sung-Min Rhee[1] · Soo Yong Kang[1] · Eui-Chan Jang[1] · Jae Yoon Kim[1] · Yong-Chan Ha[1]

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Abstract
Background The purpose of the study was to compare the clinical results of arthroscopic labral repair using knot-tying and knotless suture anchor techniques for patients with labral tears.
Methods From September 2012 to May 2013, we performed a randomized, prospective analysis of 40 hips with labral tears treated with arthroscopic labral repair via knot-tying (group A) or knotless suture anchors (group B). A total of 33 patients were treated for labral tears, and 7 of them received bilateral labral repair. Outcomes and intraoperative parameters were prospectively measured with the UCLA score, the modified Harris Hip Score (MHHS), the Hip disability and Osteoarthritis Outcome Score (HOOS), and the Hip Outcome Score (HOS).
Results Three patients (3 hips) were lost to follow up. A total of 37 hips (30 patients) were finally analyzed: 19 hips in group A and 18 in group B. The mean traction time for group A and group B was 72.2 versus 68.7 min, respectively ($p = 0.314$). Although the clinical outcome scores in both groups improved between the initial and final visits, there was no difference in measurements parameters between the two groups. Survival rate, using reoperation or progression of osteoarthritis as the primary end points, was 100 %. 83 % of cases had excellent and good MHHS scores after 2 years of follow-up. During arthroscopic surgery, the drill penetrated the closing subchondral area or the joint in three hips. There was no progression of arthritic change at the latest follow-up.
Conclusions Labral repair with either knot-tying or knotless suture anchor resulted in significant postoperative improvements and no difference between the two groups after 2 years of follow-up.

Keywords Hip · Labral tear · Hip arthroscopy · Clinical outcome

Introduction

With advances in hip arthroscopic instruments, diagnostic modalities and surgical techniques have improved much during the last decade. Potential applications for hip arthroscopy have expanded, and hip arthroscopic surgery is now considered a useful procedure for treating intra and extraarticular hip pathologies. Consequently, the number of hip arthroscopy surgeries has been increasing since the last decade [1, 2].

The most common pathology in patients with hip pain that surgeons encounter is labral tear. Labral tear is the most common cause of mechanical symptoms and is found in 22–55 % of patients with hip pain [3, 4]. Untreated acetabular labral tears are predisposed to osteoarthritis of the affected hip joint, because acetabular labral tears can lead to nonsymmetric force distribution [5, 6]. Therefore, acetabular labral tears are common arthroscopic surgery indications. Although acetabular labral debridement shows comparable clinical outcomes, arthroscopic labral repair or refixations have better outcomes [7, 8].

Knot-tying with suture anchors is the most popular technique for repairing a torn acetabular labrum. However, knot-tying has some disadvantages, such as potential loss

✉ Yong-Chan Ha
hayongch@naver.com

[1] Department of Orthopedic Surgery, Chung-Ang University College of Medicine, 102 Heukseok-ro, Dongjak-ku, Seoul 156-755, South Korea

of knot security. Tying the knot can also be challenging, even for experienced arthroscopic surgeons [9, 10].

In 2001, therefore, Thal developed the knotless suture anchor and reported its advantages over the traditional suture anchor technique, such as allowing secure, low-profile soft tissue-to-bone repair without the need for knot tying [10]. However, disadvantages with using knotless suture anchors have been reported such as greater gap formation between the bone and soft tissue in comparison with knot-tying anchors [11–13].

Although there are numerous articles on the biomechanics as well as clinical studies comparing knot-tying and knotless suture anchors in shoulder surgery, no such reports exist for hip arthroscopic surgery [11–15].

Therefore, we designed a prospective, randomized, comparative study assessing knot-tying versus knotless suture anchor techniques in hip arthroscopic surgery. The purpose of this study was to compare the clinical results of arthroscopic labral repair between knot-tying and knotless suture anchor techniques for patients with labral tear. Our hypothesis was that there would be no difference in clinical outcomes after knotless repair versus knot-tying repair.

Methods

This study is prospective and randomized in nature, and the protocol was approved by our institutional review board. Prior to the study, informed consent was obtained from all of the patients.

Forty consecutive hips (33 patients) that underwent arthroscopic acetabular labral repairs from September 2012 to May 2013 due to groin pain with positive anterior impingement test and pain with no improvements even after non-operative treatment for more than 6 months were considered eligible for this study. The exclusion criteria applied included labral debridement, patients with preoperative radiographic evidence of arthritis (Tonnis grade 2 or greater) [16], those with a history of hip surgery, immunologic disorders, such as rheumatoid arthritis, avascular necrosis of the femur head or dysplasia based on radiographic evidence of lateral center edge angle less than 25°, septic hip, loose body removal, and refusal to participate. The decision to enroll or exclude patients was made by an investigator who did not otherwise participate in the study (Fig. 1).

In this randomized, single-blinded study, randomization into one of the two study group was performed using Microsoft Excel (Microsoft, Redmond, Washington) to generate random numbers. Group allocations were made by a statistician, who also did not otherwise participate in the study, and were unknown to the investigators and patients. Allocations were kept in a set of sealed envelopes. One hour prior to surgery, the appropriately numbered envelope was opened, and the card inside determined the group allocation. The patients were divided into two groups: group A, which was treated with the knot-tying suture anchor technique, and group B, which was treated with the knotless suture anchor technique.

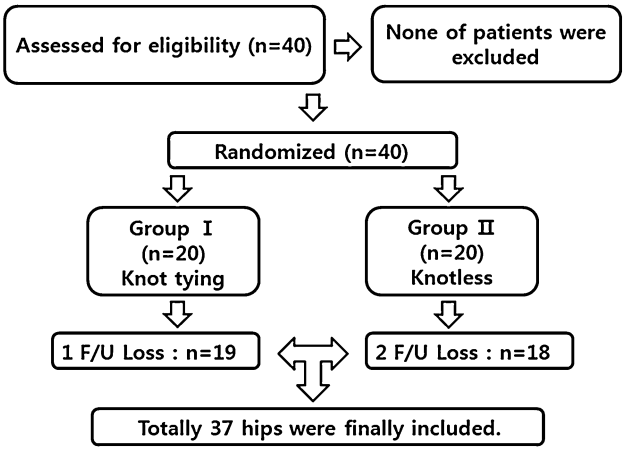

Fig. 1 Diagram showing the flow of participants through each stage of this randomized trial

All arthroscopic acetabular labral repair procedures were performed by a single surgeon, an experienced hip arthroscopist, using Bioraptor™ suture anchors (Smith & Nephew, Andover, MA, USA) for group A and Bioraptor™ knotless suture anchors (Smith & Nephew, Andover, MA, USA) for group B (Fig. 2).

We performed hip arthroscopy using a standard fracture table with the patient in the supine position. Traction was applied with slight extension and adduction of the hip joint, using enough force to open the joint by approximately 10–12 mm under an image intensifier to enable easy passage of the hip arthroscope and to facilitate instrument maneuverability without any difficulties. Two or three portals (anterolateral, anterior, and/or posterolateral) were placed for the arthroscopic labral repair. After firm insertion of the suture anchor was confirmed, we applied tension to the suture and locked the suture. Disengagement of the suture anchor from the inserter was done gently. In most cases, a total of 2–4 suture anchors were used depending on the extent of labral lesion. After repairing the torn labrum, additional surgeries, such as bumpectomy or acetabuloplasty, were performed.

Postoperatively, all patients followed a standardized rehabilitation program. Immediately after surgery, passive and active range of movement was permitted. Patients maintained toe-touch weight bearing for 2 weeks with range of motion encouraged but avoided the extremes of external rotation. In general, patients typically required 2–3 weeks of crutch assistance. Patients who underwent microfracture maintained toe-touch weight bearing for 6–8 weeks.

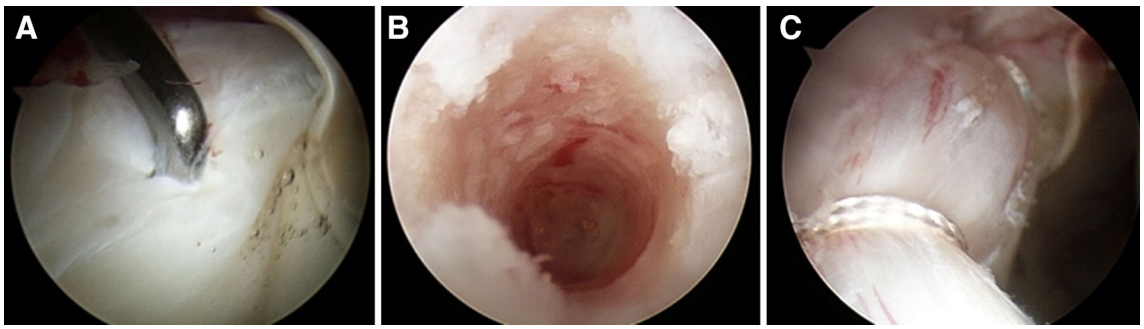

Fig. 2 **a** Arthroscopic view of labral tear. **b** A hole is made for the insertion of the knotless suture anchor. **c** Arthroscopic view of repaired labrum

Clinical and radiographic follow-up evaluations were performed at the 6th week, at the 3rd, 6, and 12th month, and thereafter every 6 months. Patients that could not attend the regularly scheduled visits were contacted by telephone.

During the operation, traction time to complete the labral repair was measured. Clinical evaluation was performed using the preoperative and postoperative pain of the patient and was assessed with the visual analog scale (VAS), University of California, Los Angeles (UCLA) activity score, modified Harris Hip Score (MHHS), Hip disability and Osteoarthritis Outcome Score (HOOS), and Hip Outcome Score (HOS). Radiographic analysis included an anteroposterior view of the pelvis, a frog-leg lateral view, and a translateral view of the hip. All radiographs were assessed using the Tonnis classification [16], which was used to grade radiographic degenerative changes.

Statistical analysis

The sample size for the prospective study was not calculated because of an existing comparable study. We used the Wilcoxon-signed rank test to compare the differences in preoperative and postoperative pain, function, and scores. The Mann–Whitney U test was performed for comparison of results between the two groups. The Statistical Package for the Social Science (SPSS) program was used for all analyses, and significant difference was defined as $p < 0.05$. The distribution of variables was given as the mean and standard deviation (SD).

Results

We performed a prospective analysis of 40 hips with labral tear treated with arthroscopic labral repair via knot-tying or knotless suture anchors. A total of 33 patients underwent labral repair, and 7 of them had bilateral labral tears. During the study period, three hips were lost to follow up. A total of 37 hips were allocated to two groups according to the repair technique employed. Of these 37, 12 hips had isolated labral tears, 7 had labral tears with internal snapping hips, 8 had cam-type impingement, 6 had pincer-type impingement, and 4 had a combination of cam-type impingement and pincer-type impingement. Nineteen hips were enrolled in the knot-tying suture anchor technique group (group A), and 18 hips were enrolled in the knotless suture anchor group (group B). Fifteen hips were male, and 22 were female. The mean age at the time of the operation was 33.8 years (range 19–58 years) in group A and 34.6 years (range 21–58 years) in group B. The mean follow-up period was 32.3 months (range 25.5–40.3 months) in group A and 31.8 months (range 26.0–41.2 months) in group B. The demographic data showed no difference (Table 1).

Traction time

The mean traction time for group A was 72.2 ± 12.7 min. (range 53–96 min). For group B, the traction time was 68.8 ± 13.6 min (range 55–101 min). Although the traction time for the knot-tying group was longer than the knotless group, there was no significant difference between the two groups ($p = 0.314$).

Clinical and radiological assessment

All of the scores for clinical outcome are shown in Table 2. There were no additional surgeries or progression of arthritic changes in both groups. Survival rate, with reoperation or progression of osteoarthritis as the primary end points, was 100 %. 83 % of cases had excellent and good MHHS scores after 2 years of follow-up.

The overall HHS for the 37 hips was 66.2 points (range 45–91 points) preoperatively and 81.3 points (range 52–99 points) postoperatively ($p < 0.001$). Nineteen hips (51 %) had an excellent score, 12 (32 %) had a good score, 4 (11 %) had a fair score, and 2 (5 %) had a poor score.

Table 1 Demographic data

Variable	Knot-tying	Knotless	*p* value
No. of patients	19	18	
Age (year) (mean ± SD)	33.8 ± 11.8	34.6 ± 11.8	0.893
Gender (M/F)	10/9	5/13	0.199
Body mass index (kg/m^2)	22.4 ± 2.4	22.1 ± 3.6	0.612
Surgical side (right/left)	10/9	12/6	0.480
Traction duration (min)	72.2 ± 12.7	68.8 ± 13.6	0.599
Mean f/u period (months)	32.3	31.8	0.916
Combined lesions			0.744
Internal snapping hips	4	3	
Femoroacetabular impingement			
Cam type	4	4	
Pincer type	4	2	
Combined type	3	1	
Preoperative clinical scores			
VAS	5.9 ± 2.5	6.4 ± 1.5	0.620
UCLA	3.2 ± 2.2	3.9 ± 1.5	0.656
MHHS	66.6 ± 13.4	66.0 ± 19.7	0.908
HOOS	44.1 ± 12.5	41.8 ± 15.1	0.941
HOS:ADL	50.9 ± 13.7	51.3 ± 17.7	0.656
HOS:SS	66.9 ± 17.1	58.0 ± 19.9	0.503

SD standard deviation; *VAS* visual analog scale; *UCLA* University of California, Los Angeles activity score; *MHHS* modified Harris Hip Score; *HOOS* Hip disability and Osteoarthritis Outcome Score; *HOS* Hip Outcome Score

Table 2 Comparison of final outcomes with knot-tying and knotless suture anchor group

Variable (mean ± SD)	Knot-tying	Knotless	*p* value
VAS	2.3 ± 1.8	2.9 ± 2.2	0.518
UCLA	6.0 ± 1.6	7.0 ± 2.4	0.295
MHHS	78.5 ± 13.5	84.8 ± 9.2	0.201
Excellent	9 (47 %)	10 (56 %)	
Good	7 (37 %)	5 (28 %)	
Fair	2 (11 %)	2 (11 %)	
Poor	1 (5 %)	1 (5 %)	
HOOS	57.4 ± 14.8	55.1 ± 15.2	0.824
HOS:ADL	63.1 ± 7.8	59.9 ± 12.4	0.656
HOS:SS	75.2 ± 21.3	70.0 ± 27.0	0.552

SD standard deviation; *VAS* visual analog scale; *UCLA* University of California, Los Angeles activity score; *MHHS* modified Harris Hip Score; *HOOS* Hip disability and Osteoarthritis Outcome Score; *HOS* Hip Outcome Score

Comparing the preoperative scores with those at the final evaluation, the mean VAS score, UCLA score, MHHS, HOOS, and HOS in both groups were improved. However, we found no significant differences between the two groups in any of the scores (Table 2). The Tonnis grade of osteoarthritis did not change in any of the patients at the latest follow-up.

Complications

During arthroscopic surgery, the drill penetrated close to the subchondral area or into the joint in three hips (2 hips in group B and 1 hip in group A), and redrilling was performed. However, there was no radiologic progression at the latest follow-up. Two patients complained of transient pudendal nerve palsy but recovered within 6 weeks. Significant complications, such as infection, heterotopic ossification, thromboembolic episodes or permanent nerve injury, did not occur at the latest follow-up.

Discussions

Surgical techniques for arthroscopic acetabular labral repair have advanced significantly, since the last decade and clinical outcomes with acetabular labral repair have been reported to be better than debridement [7, 17]. Several different types of suture anchors were recently introduced and used in the clinical field. This prospective randomized study demonstrates that labral repair with both knot-tying and knotless suture anchors result in significantly improved postoperative outcomes. In addition, there was no difference in clinical and radiological outcomes between the two groups.

Numerous comparison studies using knot-tying or knotless suture anchors have been performed to evaluate the outcomes of Bankart repair in shoulder arthroscopic surgery. However, the reported outcomes for the two techniques are not consistent. In rotator cuff repair surgery, the knotless suture bridge technique can reduce soft tissue necrosis in the knot-tying area and lowers the chance of labrum strangulation, impingement, and irritation [18]. In addition, successful results with suture anchors in arthroscopic labral repair mostly depend on knot security, and thus, treatment failure can easily result from improper knot-tying by an unskilled surgeon [19]. However, Kocaoglu et al. [9] stated that since there was no difference between the two techniques, knotless suture anchors provide low-profile repair without the complexities of knot-tying [9]. In hip arthroscopic surgery, several studies reported that arthroscopic labral repair in patients with femoroacetabular impingement had better outcomes than debridement [7, 17]. However, arthroscopically tied knots in hip arthroscopy are bulky, and the technique is still challenging for even well-experienced surgeons [20]. Therefore, the knotless suture technique is one of the alternatives to avoid the difficulties of knot-tying.

However, this study showed no difference in clinical and radiologic outcomes between the two techniques.

In this study, survival rate, using reoperation or progression of osteoarthritis as primary end points, was 100 %. 89 % of cases had excellent and good mHHS scores after 2 years of follow-up. Byrd et al. [21] evaluated 37 patients (38 hips) who underwent primary repair of a torn acetabular labrum and had reached 2 years of follow-up. They reported that the mean improvement in the modified Harris Hip Score was 18.9 points (70.5 points preoperatively and 89.4 points postoperatively), with 35 hips (92 %) showing improvement, including good and excellent results. Four patients (11 %) in the study underwent repeated arthroscopy [21]. Other studies have reported success rates ranging from 57 to 94 % [7, 8, 22, 23].

During the arthroscopic repair procedure, we experienced three incidents of penetration into the joint. Philippon [24] recommends inserting an anchor at an approximate angle of 15° to the vertical to avoid penetration into the articular surface. Hernabdez and McGrath [25] recommend a "target angle" of 10° at the labral insertion. In hip arthroscopic procedures, the safe zone for an insertion angle is relatively narrow. Therefore, suture anchors (2.9 mm for knotless type) with large diameters may be more likely to penetrate into the joint than those with small diameters (2.1 mm for knot-tying type).

Our study has a few limitations. First, the most significant weakness in our study is the small number of patients in both groups. Second, we could not adjust for the patients' occupations, which can influence the outcomes for either group. Finally, acetabular labral tear is frequently associated with other osseous structural abnormalities, such as cam- and/or pincer-type deformities. Therefore, it is difficult to evaluate the isolated effects of arthroscopic labral repair.

In conclusion, labral repair with both knot-tying and knotless suture anchors showed significantly improved postoperative outcomes at the last follow-up. Based on the authors' understanding of the advantages and disadvantages of both suture techniques, this finding suggests that the knotless suture anchor may become the dominant option in arthroscopic labral repair.

Compliance with ethical standards

Conflict of interest No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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