



Contents lists available at ScienceDirect

# Asia-Pacific Journal of Sports Medicine, Arthroscopy, Rehabilitation and Technology

journal homepage: [www.ap-smart.com](http://www.ap-smart.com)

## Factors influencing outcomes of nonsurgical treatment for baseball players with SLAP lesion

Hiroshi Hashiguchi <sup>a,\*</sup>, Satoshi Iwashita <sup>b</sup>, Minoru Yoneda <sup>b</sup>, Shinro Takai <sup>b</sup>

<sup>a</sup> Department of Orthopaedic Surgery, Nippon Medical School Chiba Hokusoh Hospital, Japan

<sup>b</sup> Department of Orthopaedic Surgery, Nippon Medical School, Japan



### ARTICLE INFO

#### Article history:

Received 17 April 2018

Received in revised form

12 July 2018

Accepted 14 August 2018

Available online 5 September 2018

#### Keywords:

Glenohumeral internal rotation deficit

Nonsurgical treatment

Posterior joint tightness

SLAP lesion

### ABSTRACT

**Background/objective:** Superior labrum anterior posterior (SLAP) lesion of the shoulder joint occurs in throwing athletes as a result of overuse, such as from repetitive baseball pitching. Nonsurgical treatments are usually the first-line therapy for symptomatic SLAP lesion. However, some patients cannot obtain satisfactory improvement of their symptoms, leading to dysfunction of the shoulder and diminished pitching performance. The purpose of this study was to analyze factors that influence outcomes of nonsurgical treatments for SLAP lesion.

**Methods:** Forty-five baseball players with SLAP lesion, whose mean age was 21.6 (range, 16–36) years and who underwent nonsurgical treatments, were the subjects of this study. SLAP lesion was diagnosed by shoulder arthrography and magnetic resonance imaging (MRI). Exclusion criteria included definite associated trauma such as dislocation, fracture or injuries related to sports activities. Playing positions included pitcher (21 patients), catcher (3 patients), infielder (13 patients) and outfielder (8 patients). Mean symptomatic duration from the onset of shoulder pain to the beginning of nonsurgical treatments was 8.5 (range, 1–72) months. Nonsurgical treatments included physical therapy, such as range of motion, stretching, and rotator cuff exercises, as well as prescription of nonsteroidal anti-inflammatory drugs if necessary. To identify factors that influenced outcomes of nonsurgical treatments for SLAP lesion, various factors of 13 nonresponsive patients were compared with those of 32 patients who responded to nonsurgical treatment. The factors were as follows: patient background, such as age or playing position; range of shoulder motion; shoulder joint laxity; and findings of radiographs and MRI. All data were statistically assessed using logistic analysis and Spearman's correlation coefficient. The significance level was set at  $P < 0.05$ , and odds ratios were determined.

**Results:** Factors identified as having significant difference between the 2 groups were age, duration of baseball experience, symptomatic period, playing position, range of internal and external rotation in the first medical examination, range of total rotation of 90° abduction 2 months after nonsurgical treatments, and presence of Bennett spur and partial-thickness tears of the articular-side rotator cuff. Factors with high odds ratios were symptomatic period, range of total rotation of 90° abduction 2 months after the treatment, age, and duration of baseball experience.

**Conclusion:** Symptomatic period, duration of baseball experience, age, and findings of radiographs and MRI are inevitable factors that cannot be improved by nonsurgical treatment. On the other hand, restriction of shoulder motion due to posterior muscular tightness is a factor that can be improved by nonsurgical treatment. Early improvement of shoulder motion is important to obtain satisfactory outcomes of nonsurgical treatments for SLAP lesion.

© 2018 Asia Pacific Knee, Arthroscopy and Sports Medicine Society. Published by Elsevier (Singapore) Pte Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

### Introduction

Throwing shoulder disorder is often caused by overuse, such as excessive or consecutive pitching. The condition is a soft-tissue change, such as the labrum and rotator cuff tendon, and reactive

\* Corresponding author. Department of Orthopaedic Surgery, Nippon Medical School Chiba Hokusoh Hospital, 1715 Kamagari, Inzai, Chiba, 270-1694, Japan.

E-mail address: [hashi.h@ac.auone-net.jp](mailto:hashi.h@ac.auone-net.jp) (H. Hashiguchi).

bony changes, such as a spur formation, and both are diversely mixed and present a complex pathology. A study of the vascularity of the shoulder labrum showed that the vascular supply to the labrum is very rich and abundant around the entire glenoid, with the exception of the superior glenoid.<sup>1</sup> The poor vascularity and healing environment of the superior labrum results in a tendency to non-healing after trauma or repetitive stress, such as throwing activities. In 1985, Andrews et al.<sup>2</sup> first characterized labrum injury as a detachment of the superior labrum from anchor of the long head of the biceps. In 1990, Snyder et al.<sup>3</sup> described superior labrum detachment as a superior labrum anterior posterior (SLAP) lesion, which is widely recognized as a pathology of throwing shoulder disorder. Walch et al.<sup>4</sup> indicated in 1992 that posterior internal impingement induced soft tissue injuries in throwing athletes by excessive contact between the undersurface of the rotator cuff and the posterosuperior labrum. Paley et al.<sup>5</sup> found that fraying of the undersurface rotator cuff was observed in 93% of overhand throwing athletes and fraying of the posterosuperior labrum was found in 88%. Recently, Shah et al.<sup>6</sup> reported that SLAP flap tears were found in 81.4% of 54 rugby players and overhead athletes, and undersurface rotator cuff flap tears were found in 44.4% by arthroscopic assessment.

Nonsurgical treatments are usually the first-line therapy for symptomatic SLAP lesion. In most patients, the treatments are successful, and it is possible to return to competition activities. Some patients cannot obtain satisfactory improvement of their symptoms, dysfunction of the shoulder, or pitching performance, resulting in arthroscopic surgery or abandonment of the competition activities because of the decrease in performance level. A retrospective study of 39 patients with SLAP lesion revealed that 51% of the patients were considered nonoperative treatment failures and had arthroscopic surgical reconstruction.<sup>7</sup> In a study of professional baseball players with SLAP lesion, 27 of 68 (40%) of the players could return to baseball.<sup>8</sup> However, there are few reports regarding the outcomes data and rehabilitation protocol of nonsurgical treatments for SLAP lesion.

The purpose of this study was to analyze factors that influence outcomes of nonsurgical treatments for SLAP lesion and to provide suggestions for decision-making of treatment for SLAP lesion in baseball players.

## Materials and methods

This retrospective study was approved by the ethics committee at our hospital, and consent was obtained from all patients for the research. We reviewed a database of our shoulder and sports medicine clinic between 2005 and 2015. Subjects were baseball players who had shoulder joint pain caused by pitching and first visited our hospital with no history of treatment. Definitive diagnosis of SLAP lesion was obtained by magnetic resonance imaging combined with arthrography (MRA) (Fig. 1). Inclusion criteria were a minimum follow-up of 2 years. Patients with SLAP lesion caused by apparent trauma such as a fall and cases treated for instability, fracture, dislocation and frozen shoulder were excluded.

Medical checkup and physical examination were done for all patients by the same orthopaedic surgeon and physical therapist at the initial visit every month and at the final follow-up. Nonsurgical treatments included physical therapy, such as range of motion, stretching (sleeper stretch, cross-body stretch), and rotator cuff functional exercises, and prescription of nonsteroidal anti-inflammatory drugs if necessary.

Patients were divided into 2 groups based on the outcomes. Responders could return to competitive level in their playing position. Nonresponders were defined as patients who needed to change their position, patients who finally underwent arthroscopic

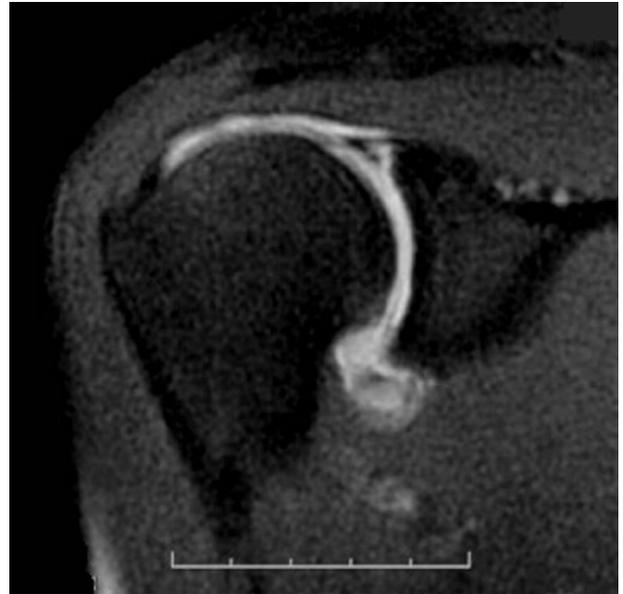


Fig. 1. SLAP lesion by magnetic resonance imaging combined with arthrography.

surgeries, and patients who gave up playing baseball. To identify the risk factors that influenced outcomes of nonsurgical treatments for SLAP lesion, various factors of the nonresponders were compared with those of the responders. Background information collected from patients included age, symptomatic period, duration of baseball experience, and playing position. Range of shoulder motion, joint laxity, and manual tests (apprehension test, compression and rotation test, anterior slide test, impingement test, O'Brien test) were checked and performed for physical findings (Table 1). A Bennett spur, a subacromial spur, and rotator cuff tears were evaluated as findings of MRA and radiographs (Fig. 2).

All data were statistically assessed using logistic regression analysis to determine the factors that significantly influenced outcomes of nonsurgical treatments for SLAP lesion. Correlation between the patient factors was assessed using Spearman's correlation coefficient. Statistical analysis was conducted with the program IBM SPSS Statistics 21 (IBM Japan, Tokyo, Japan). A significance level was set at  $P < 0.05$ , and odds ratios were determined. As number of patients necessary to detect a significant difference for an error rate of 0.05 in logistic regression analysis, the sample size with enough power to statistical significant was calculated at 43 patients and an odds ratio of 5.5. Accordingly, we chose factors with an odds ratio more than 5.5 as a statistically significant.

## Results

Forty-five patients with SLAP lesion that matched the criteria were examined. The subjects were 45 men with a mean age of 21.6 (range, 16–36) years. The throwing hand was the right side in 44 cases and the left side in 1 case. The average duration of baseball experience was 12.6 (range, 5–25) years. Playing level was 9 patients in high school teams, 22 in college teams, 12 in non-professional teams and 2 in professional leagues. Playing position included 21 pitchers, 3 catchers, 13 infielders and 8 outfielders. The mean symptomatic period was 8.5 (range, 1–72) months. The mean period of nonsurgical treatment was 5.2 (range, 3–11) months. As a result of nonsurgical treatment, 32 patients could return to their original playing position, and had not suffered from recurrent pain and dysfunction in the follow-up period (average 12.6 months,

**Table 1**  
Evaluated factors.

Characteristics of the patients
Age, duration of baseball experience, symptomatic period, playing position
Range of shoulder motion (first visit and every month after treatment)
Internal rotation, external rotation, abduction, forward elevation
Internal rotation, external rotation and total rotation of 90° abduction
Manual test
Impingement test, O'Brien test, compression and rotation test, anterior slide test, impingement test
Shoulder joint laxity
Sulcus test, apprehension test, relocation test
Radiographic findings
Subacromial spur, Bennett spur
MRI findings
SLAP lesion
Rotator cuff tear

**Fig. 2.** Bennett spur.

range, 6–27 months). On the other hand, there were 7 patients who finally underwent arthroscopic surgery, 4 patients for whom positions were changed, and 2 patients who gave up playing baseball.

We compared patient factors, physical findings, radiographic findings and MRA findings between 32 responders and 13 non-responders. Patient factors that were statistically significant were age, duration of baseball experience, symptomatic period, and playing position. As a playing position, the pitcher had a significance probability less than 5% (Table 2). There was a positive

**Table 2**  
Patient demographics.

	Responders (N = 32)	Nonresponders (N = 13)	p value
Age (yrs)	19.9 ± 4.1 (16–30)	25.8 ± 5.0 (19–36)	0.001
Playing position	11 pitchers 3 catchers 11 infielders 6 outfielders	10 pitchers  1 infielders 2 outfielders	0.033 N.S. N.S. N.S.
Baseball experience (yrs)	10.4 ± 3.5 (5–20)	16.5 ± 5.0 (7–25)	0.001
Symptomatic period (months)	4.8 ± 8.0 (1–42)	17.5 ± 21.7 (1–72)	<.001
Bennett spur (N = 8)	2	6	0.007
AST of the rotator cuff (N = 12)	2	10	0.032

correlation between age and duration of baseball experience ( $R = 0.85$ ,  $P < 0.001$ ) and between age and symptomatic period ( $R = 0.38$ ,  $P = 0.02$ ). Compared with the group not admitting Bennett spur or partial tear of the artificial-side rotator cuff as image findings, the admitted group showed a significantly higher age (Table 3). Findings of manual tests such as anterior slide test or O'Brien test were not significantly different between the 2 groups.

Internal and external rotation in the first medical examination, and rotation of 90° abduction 2 months after the treatment were significantly different between the 2 groups. With regard to image findings, Bennett spur was significantly different between the 2 groups. Inevitable factors showed high odds ratio were symptomatic period, age, duration of baseball experience and Bennett spur. Factors able to improve by nonsurgical treatment and showed high odds ratio were total rotation and internal rotation of 90° abduction 2 months after the treatment (Table 4).

## Discussion

Nonsurgical treatment is a first-line therapy for SLAP lesion caused by overuse, such as excessive pitches or pitching in consecutive games, and it consists of methods such as stopping pitching, functional exercise of the rotator cuff muscles, and stretching exercises. In most of cases, such treatments will be effective, and it will be possible to return to competition activities. However, if treatment is ineffective, some athletes' competition level is diminished, and some athletes need surgical treatment. Pinpointing the factors that affect the outcome of nonsurgical treatment increases patients' motivation for rehabilitation and also helps to select between nonsurgical treatment and surgical treatment.

In patient factors affecting the results of nonsurgical treatment, there was a positive correlation between age and duration of baseball experience, as well as between age and symptomatic period. Furthermore, compared with the group without Bennett spur or partial tear of the artificial-side rotator cuff as image

**Table 3**  
Patient age and imaging findings.

Imaging findings		Mean age, yr	p value
Bennett spur	(+) N = 8	28.8 ± 4.0 (25–36)	<.001
	(-) N = 37	19.3 ± 2.7 (16–22)	
AST	(+) N = 12	28.1 ± 3.8 (22–36)	<.05
	(-) N = 33	20.4 ± 3.3 (16–27)	

(AST: articular side tear).

**Table 4**  
Odds ratio of influenced factors.

Factor	Odds ratio
1 Symptomatic period	14.4
2 Total rotation of 90° abduction 2months after treatment	13.8
3 Age	12.1
4 Duration of baseball experience	11.8
5 Internalrotation of 90° abduction 2months after treatment	9.2
6 Bennett spur	7.3
7 Internalrotation in the first medical examination	6.3
8 External rotation in the first medical examination	5.8
9 Internalrotation 2months after treatment	5.8

findings, the group with a spur or tear was significantly older. In other words, it was considered that Bennett spur and partial tear of the artificial-side rotator cuff were concomitantly added to SLAP lesion, because of the long duration of baseball experience and older age of patients. The association between irreversible changes such as rotator cuff tears or bony spurs was thought to complicate the pathology that may cause pain and resist nonsurgical treatments. Pitcher position, Bennett spur, partial tear of the artificial-side rotator cuff, age, symptomatic period, and other factors that may influence the outcomes are inevitable factors already seen at the first visit, and improvement using nonsurgical treatments is impossible. On the other hand, limitation of total rotation of 90° abduction at 2 months after nonsurgical treatment is a factor that can be improved by focusing treatment on it.

Limitation of internal rotation of 90° abduction of the shoulder joint is called glenohumeral internal rotation deficit (GIRD),<sup>9</sup> and is observed as a physical finding in athletes who play overhead sports, caused by muscular tightness of the posterior muscles and the capsule of the shoulder joint.<sup>10</sup> When GIRD is caused by posterior tightness of the shoulder joint, superior translation of the humeral head occurs in external rotation of the abduction position.<sup>11</sup> The translation will result in shear stress to the long head tendon of the biceps or the labrum, resulting in SLAP lesion.<sup>12,13</sup> Furthermore, the translation of the humeral head and SLAP lesion cause an internal impingement and partial tear of the artificial-side rotator cuff.<sup>14</sup> It has also been pointed out that when the ratio of GIRD and external rotation gain (ERG) is one or more, there is a high risk of structural breakdown.<sup>15</sup> In this study, limitation of total rotation or internal rotation of 90° abduction is a factor influencing the outcomes of nonsurgical treatment for SLAP lesion and reflects the physical condition of GIRD or GIRD/ERG > 1. In other words, improvement of GIRD is an improvement in the posterior tightness of the shoulder, reducing the translation of the humeral head and the excessive load on the SLAP lesion. Improvement of total rotation of 90° abduction at an early stage by intensive stretching such as sleeper's stretch to the posterior muscles and capsule of the shoulder joint is an important point in responding to nonsurgical treatment for SLAP lesion.<sup>15</sup>

There were several limitations in this study. This was a retrospective study, and the number of cases was small. However, few studies have examined outcomes of nonsurgical treatment for SLAP lesion, and it is a useful study that can provide suggestions for decision making of surgical treatment for SLAP lesion.

In conclusion, the duration of baseball experience, age, and findings of radiographs and MRI are inevitable factors that cannot be improved by nonsurgical treatments. On the other hand, restriction of shoulder motion due to posterior muscular tightness is a factor that can be improved by nonsurgical treatments. Early improvement of shoulder motion is important to obtain satisfactory outcomes of nonsurgical treatments for SLAP lesion.

### Conflicts of interest

The authors have no conflicts of interest relevant to this article.

### References

1. Abrassart S, Stern R, Hoffmeyer P. Arterial supply of the glenoid: an anatomic study. *J Shoulder Elbow Surg.* 2006;15:232–238.
2. Andrews JR, Carson WG, Mcleod WD. Glenoid labrum tears related to the long head of the biceps. *Am J Sports Med.* 1985;13:337–341.
3. Snyder SJ, Karzel RP, Pizzo WD, Ferkel RD, Friedman MJ. SLAP lesions of the shoulder. *Arthroscopy.* 1990;6:274–279.
4. Walch G, Boileau P, Noel E, Donell ST. Impingement of the deep surface of the supraspinatus on the posterosuperior or glenoid rim: an arthroscopic study. *J Shoulder Elbow Surg.* 1992;1:238–245.
5. Paley KJ, Jobe FW, Pink MM, Kvitne RS, ElAttrache NS. Arthroscopic findings in the overhead throwing athletes: evidence for posterior internal impingement of the rotator cuff. *Arthroscopy.* 2000;16:35–40.
6. Shah SR, Horsley I, Rolf CG. Anterior internal impingement of the shoulder in rugby players and other overhead athletes. *Asia Pac J Sports Med Arthrosc Rehabil Technol.* 2017;8:13–17.
7. Edwards SL, Lee JA, Bell JE, et al. Nonoperative treatment of superior labrum anterior posterior tears. *Am J Sports Med.* 2010;38:1456–1461.
8. Fedoriw WW, Ramkumar P, McCulloch PC, Litner DM. Return to play after treatment of superior labrum tears in professional baseball players. *Am J Sports Med.* 2014;42:1155–1160.
9. Burkhart SS, et al. Shoulder injuries in overhead athletes: the “dead arm” revisited. *Clin Sports Med.* 2000;19:125–158.
10. Thomas SJ, Swanik CB, Hqqinson JS, et al. A bilateral comparison of posterior capsule thickness and its correlation with glenohumeral range of motion and scapular upward rotation in collegiate baseball players. *J Shoulder Elbow Surg.* 2011;20:708–716.
11. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology part I: pathoanatomy and biomechanics. *Arthroscopy.* 2003;19:404–420.
12. Fitzpatrick MJ, Tibone JE, Grossman MG, McGarry MH, Lee TQ. Development of cadaveric models of a thrower's shoulder. *J Shoulder Elbow Surg.* 2005;14:S49–S57.
13. Burkhart SS, Morgan CD. The peel back mechanism: its role in producing and extending posterior type II SLAP lesions and its effect on SLAP repair rehabilitation. *Arthroscopy.* 1998;14:637–640.
14. Jobe CM. Posterior superior glenoid impingement: expanded spectrum. *Arthroscopy.* 1995;11:530–536.
15. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology part III: the SICK scapula, scapular dyskinesis, the kinetic chain, and rehabilitation. *Arthroscopy.* 2003;19:641–661.