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Research Article / Araştırma Makalesi

Comparison of SLAP Lesions on MRI and Arthroscopy

SLAP Lezyonlarının MRG ve Artroskopik Karşılaştırması

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Abstract

Superior labrum anterior-posterior (SLAP) tears are a source of shoulder pain in orthopaedic patients. Magnetic resonance imaging (MRI) is a necessary tool for diagnosis in these patients. The aim of this study was to show correlation between MRI and arthroscopy evaluations of SLAP lesions. The study included a total of 52 patients, comprising 32 females and 20 males with a mean age of 50.40 years (range: 19-74 years) who underwent shoulder arthroscopy surgery for an existing shoulder pathology between April 2019- May 2020. The right shoulder was affected in 34 (65%) patients and the left in 18 (35%). The pre-operative diagnoses were rotator cuff syndrome (n:34), impingement syndrome (n:7), frozen shoulder (n:2) and Bankart lesion (n:9). MRI of the shoulder joint was applied followed by shoulder arthroscopy. Only SLAP type classifications were detected on arthroscopic examination and there were 13 Type 1 (33%), 23 (58%) Type 2, one (3%) Type 3, one (3%) Type 4, and one (3%) Type 5 lesion. SLAP lesions were detected on both MRI and arthroscopy in 12 patients. The lesion could not be detected arthroscopically in 3 patients although MRI reported a SLAP lesion. SLAP lesions were negative on both MRI and arthroscopy in 10 patients. In 27 patients, MRI was negative, but the SLAP lesions were detected in arthroscopy. In the diagnosis of SLAP lesions, MRI showed 31% sensitivity, 77% specificity, 80% positive predictive value, and 27% negative predictive value. The accuracy of MRI was found to be 42%. Reliability of agreement (Fleiss kappa) between MRI and arthroscopy was found to be 0.048 (p=0.596). Although MRI is a useful tool for diagnosing other shoulder pathologies, it is not sufficient for the detection of SLAP lesions compared to gold standard shoulder arthroscopy.

Keywords: Shoulder; SLAP lesion; Arthroscopy; MRI; Diagnosis; Sensitivity; Specificity

Özet

Superior labrum anterior-posterior (SLAP) yırtıkları ortopedi hastalarında omuz ağrısı kaynaklarındandır. Manyetik rezonans görüntüleme (MRG) bu hastalarda teşhis için gereklidir. Bu çalışmanın amacı SLAP lezyonlarının MRG ve artroskopi değerlendirmeleri arasındaki uyumu göstermektir. Çalışma Nisan 2019- Mayıs 2020 tarihleri arasında varolan omuz patolojisi için omuz artroskopi cerrahisine giden yaş ortalaması 50.40 (aralık: 19-74 yaş) olan, 32 kadın ve 20 erkek içeren toplam 52 hastadan oluşmaktadır. 34 hastada (%65) sağ, 18' nde (%35) sol omuz etkilenmişti. Hastalarda ameliyat öncesi teşhis; rotator kaf sendromu (n:34), impingement sendromu (n:7), donuk omuz (n:2) ve bankart lezyonu (n:9) idi. MRG yapıldıktan sonra omuz artroskopisi yapıldı. Sadece artroskopik değerlendirmede SLAP tip sınıflaması tespit edildi ve 13 Tip 1 (%33), 23 Tip 2 (%58), bir Tip 3 (%3), bir Tip 4 (%3) ve 1 Tip 5 (%3) lezyon mevcut idi. Oniki hastada hem MRG hemde artroskopi de SLAP lezyonları saptandı. MRG de SLAP lezyon olmasına rağmen 3 hastada artroskopik olarak lezyon saptanmadı. 10 hastada hem artroskopi hem de MRG de SLAP lezyonu yoktu. 27 hastada MRG de lezyon yok iken, artroskopi de lezyon saptandı. SLAP lezyonlarının teşhisinde, MRG %31 duyarlılık, %77 özgüllük, %80 pozitif öngörme değeri ve %27 negatif öngörme değeri gösterdi. MRG' nin doğruluğu %42 olarak bulundu. MRG ve artroskopi arasında anlaşmanın güvenilirliği (Fleiss kappa) 0.048 (p=0.596) olarak bulundu. MRG diğer omuz patolojilerini teşhis etmekte yararlı bir araç olmasına ragmen, altın standart olan omuz artroskopisine kıyasla SLAP lezyonlarını tespit etmekte yeterli değildir.

Anahtar Kelimeler: Omuz; SLAP lezyon; Artroskopi; MRG; Teşhis; Duyarlılık; Özgüllük

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1. Introduction

In 1985 Andrews et al. first described superior labral anterior-posterior (SLAP) lesions and, subsequently, Snyder et al. classified SLAP lesions (1,2). However, the diagnosis and treatment of SLAP lesions remains a huge challenge for shoulder surgeons. The long head of the biceps tendon is attached to the superior labrum and has a rich innervation which is responsible for pain whenever injury occurs (3). Snyder classified SLAP injuries into four types (types I–IV), based on arthroscopic findings (2). That classification was later expanded by Maffet et al. with three additional types (Table 1) (2,4,5). The most common SLAP lesion is Type 2, which represents 55% of all lesions in daily practice (6). Physical examination of these lesions has been shown to have poor diagnostic value when performed alone (7). Therefore, conventional magnetic resonance imaging (MRI) and magnetic resonance arthrography (MRA) have become increasingly used diagnostic tools in detecting both shoulder pain and SLAP lesions (8). Many studies in the literature have reported that MRA is the best visualization method for the diagnosis of these lesions (9,10). Although MRI is generally used for the diagnosis in daily practice, the gold standard for SLAP lesion diagnosis is shoulder arthroscopy (2). Nevertheless, in the diagnosis and classification of SLAP lesions, there may be inconsistencies between conventional MRI and shoulder arthroscopy, and therefore, the treatment plan and/or type of surgery may have to be changed during surgery whenever arthroscopy is used. When performing shoulder arthroscopy in our daily practice, SLAP lesions have been seen to differ from the preoperative MRI studies. Thus, it was decided to review both shoulder arthroscopic findings and MRI results for the absence or presence of SLAP lesions and classification. The aim of this study was to evaluate the effectiveness of MRI in the diagnosis of SLAP lesion in a population of subjects with and without multiple concomitant diagnoses with shoulder pain.

Table 1. Classification of SLAP lesions according to arthroscopy

SLAP Type (2,4,5)	Description of the lesion
1	Labral and biceps fraying, biceps anchor intact
2	Labral fraying with detachment of the superior labrum and biceps anchor
3	Bucket-handle tear of the superior labrum, biceps anchor is intact
4	Bucket-handle tear of the superior labrum with detached biceps tendon anchor
5	Type II SLAP lesion and Bankart type anterior labral tear
6	Type II SLAP lesion and an unstable flap tear of the labrum
7	SLAP lesion and capsular injury that extends anteriorly, inferior to the middle glenohumeral ligament
8	Type II SLAP with extension into the posterior labrum
9	Type II tear with circumferential labral disruption
10	Type II lesion with posterior labral disruption

2. Materials and Methods

This retrospective study was approved by the Ethics Committee of our University Hospital (Number: E-25403353-050.99-138972). The study included 52 patients with a shoulder pathology who underwent arthroscopic shoulder surgery between April 2019 and May 2020. All the physical examinations of the patients were performed by the first author in the outpatient clinic of our university hospital. After examination of all patients, shoulder MRI was requested. In 26 patients, shoulder MRI had been taken at a different centre, and if that was within the previous 3 months, additional MRI at our centre was not performed. Additional shoulder MRI was applied to 9 patients as more than 3 months had elapsed since the previous MRI examination. A total of 30 patients were excluded from the study because of previous arthroscopic shoulder surgery (n:6), shoulder fracture (n:8), known malignancy (n:2), and cervical discopathy/radiculopathy (n:14). The

remaining 52 patients were evaluated as the study group. The 52 patients comprised 32 (62%) females and 20 (38%) males with a mean age of 50.40 years (range: 19-74 years).

The MR images were obtained using a conventional 3 Tesla (T) MRI unit (Siemens) without contrast agent in all patients. In addition to routine sections, axial proton density weighted, T2-weighted sagittal and coronal sequences, and axial fat-suppressed T2-weighted images were obtained, and all the images were reviewed. In the patients with MRIs from a different centre, there were both 1.5 and 3 T shoulder MRI. Arthroscopic video records, surgery notes, and shoulder MRI views, were reviewed for all patients. The time interval between the MRI scan and arthroscopic surgery was less than 3 months in all patients. All surgeries were performed by the first author (CG). None of the patients included in the study had undergone previous shoulder surgery. Arthroscopic evaluation, diagnosis and treatment according to the existing pathology were successfully applied in all cases. All surgeries were performed under general anaesthesia in the beach-chair position. After review of the arthroscopic video records and preoperative shoulder MRIs, the sensitivity and specificity of MRI compared to gold standard shoulder arthroscopy, were calculated and accuracy was determined according to the following:

1. True positive (TP): MRI diagnosis of SLAP lesion, confirmed on arthroscopic evaluation.

2. True negative (TN): MRI diagnosis of no SLAP lesion was confirmed on arthroscopy.

3. False positive (FP): MRI showed a SLAP lesion but arthroscopy was negative.

4. False negative (FN): MR images were negative but arthroscopy showed a SLAP lesion.

Statistical Analysis

Data obtained in the study were analyzed statistically using IBM SPSS Statistics Version 22 software. As shoulder arthroscopy is accepted as the gold standard, compliance of both diagnostic methods was compared. Sensitivity, specificity, positive and negative predictive values of the MRI in diagnosis of SLAP lesions were calculated. Reliability of agreement between MRI and arthroscopy in the diagnosis of SLAP lesions was calculated using the Fleiss kappa test. A value of $p<0.05$ was considered to be statistically significant.

3. Results

The right shoulder was affected in 34 patients (65%) and the left shoulder in 18 (35%). The pre-operative diagnoses were rotator cuff syndrome (n:34), impingement syndrome (n:7), frozen shoulder (n:2) and Bankart lesion (n: 9). SLAP lesion types were seen on MRI views as presence of degeneration, tear, or normal. The SLAP type classifications detected on arthroscopic examination were 13 (33%) Type 1, 23 (58%) Type 2, one (3%) Type 3, one (3%) Type 4, and one (3%) Type 5 lesion.

In 12 of 52 patients, SLAP lesions were detected on both MRI and arthroscopy. SLAP lesions were negative on both MRI and arthroscopy in 10 patients. The lesion could not be detected arthroscopically in 3 patients although MRI reported a SLAP lesion. In 27 patients, MRI was negative but the SLAP lesions were detected in arthroscopy (Fig.1,2). In the diagnosis of SLAP lesions in this study, MRI showed 31% sensitivity, 77% specificity, 80% positive predictive value, and 27% negative predictive value (Table 2). Accuracy was found to be 42%. Reliability of agreement (Fleiss kappa) between MRI and arthroscopy was found to be 0.048 ($p=0.596$).

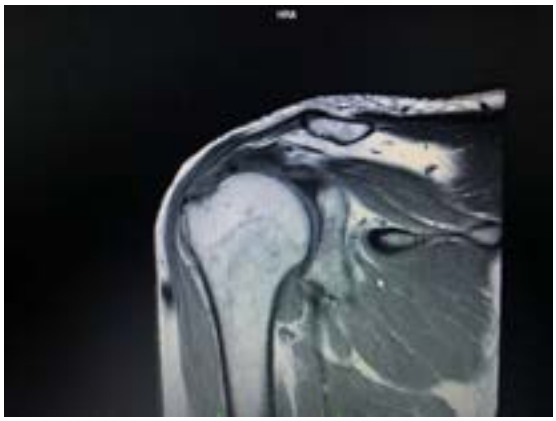

Figure 1. On the MRI, the SLAP lesion was not detected

Figure 2. Type 2 SLAP lesion was seen on arthroscopy (False Negative)

Table 2. Sensitivity, specificity, positive and negative predictive values of MRI compared to gold standard shoulder arthroscopy

	Arthroscopy-Positive	Arthroscopy-Negative	Total
MRI-Positive	12 (23%)	3 (6%)	15 (29%)
MRI-Negative	27 (52%)	10 (19%)	37 (71%)
Total	39 (75%)	13 (25%)	52 (100%)

Sensitivitiy of MRI: TP/(TP+FN)= 12/39= 31%
Specificity of MRI: TN/TN+FP=10/13= 77%
PPV of MRI: TP/TP+FP=12/15= 80%
NPV of MRI: TN/TN+FN=10/37= 27%
Accuracy: (TP+TN)/(TP+TN+FP+FN)= 22/52= 42%

4. Discussion

SLAP lesions often cause shoulder pain, dysfunction, and instability. The classic definition of the SLAP lesion is known descriptively as a disruption of the superior labrum between the 10 to 2-o'clock positions of the superior part of the glenoid (2). SLAP injuries usually occur in throwing athletes and in the normal population with traction and/or compression injuries to the shoulder joint. In literature, different physical examination manoeuvres have been described for the identification of SLAP lesions. The O'Brien active-compression test, Kim test, Biceps load test, Crank test, Yergason and Speed tests are some examples of the tests used for detecting SLAP lesions in daily practice (11). These

examination tests only suggest the presence of SLAP pathology, and there is no single test which shows the high diagnostic accuracy. Moreover, these examinations do not fully diagnose SLAP lesions and they can be confused with other pathologies of the shoulder joint. Snyder et al. classified SLAP lesions as follows; Type I lesions; show degenerative changes to the glenoid labrum but an attached labrum to the glenoid rim. Type II lesions; show degenerative changes and fraying, as well as complete detachment of the labrum from the glenoid rim and instability of the biceps tendon attachment. Type III lesions; involve a displaced free margin of the labrum into the joint and an attached biceps tendon. Type IV lesions are categorized as a displaced labrum into the joint and an affected long biceps tendon injury (2). Surgical options for type 2 SLAP lesions include biceps tenodesis/tenotomy or repair of the SLAP lesion. Patients aged > 40 years have been reported to have worse functional results and higher failure rates after repair of these lesions (12). Therefore, in the current study, SLAP lesions were only repaired in younger patients.

Many studies have evaluated the accuracy of MRI for the diagnosis of SLAP lesions (Table 3) (8,13-18). Reported specificity has ranged from 69% to 99% and sensitivity from 75% to 98% (9). It was stated in one study that conventional MRI was not a suitable test for accurately diagnosing SLAP tears in patients with concomitant disorders who were not primarily overhead-throwing athletes (13). In contrast, Connell et al reported sensitivity of 98% and specificity of 89.5% in the detection of SLAP lesions on conventional MRI (14). Unlike the current study, the population of the Connell included athletes (79%), and therefore, can be considered not to reflect accurate results. MR and MR arthrography with 1.5-T and 3-T scanners are currently the mainstays of imaging used to diagnose SLAP lesions prior to arthroscopy. In the current study, both 1.5-T and 3-T MRI were used. MRI of the shoulder has been found to be a suitable method for the detection of labral tears, but it has been shown that a number of pathologies may be missed (19). Therefore, the use of Gadolinium to enhance the accuracy of MRI may advance the detection of SLAP lesions (20). Gadolinium-enhanced MRI was not used in the current study because the standardization and application of this technique is quite difficult in practice. It has also been reported that compared to arthroscopy, 3.0 T MRI of the shoulder is very specific and sensitive for the diagnosis of labral tears (10). However, according to the current study results, 3.0 T MRI was not closely correlated with arthroscopy for the detection of SLAP lesions. Most patients in this study group had 3.0 T MRI, but no correlation was determined of SLAP lesions with arthroscopy despite the use of 3.0 T MRI rather than 1 or 1.5 T MRI. Arthroscopy is the current gold standard for the diagnosis of shoulder pathologies. In previous studies, arthroscopic surgery has been used as the reference standard for a SLAP lesion (14). Arthroscopy has disadvantages in visualising the internal part of the tissues in the shoulder joint. Nevertheless, MRI also provides information in some fields not seen in arthroscopy, such as the internal structure of the rotator cuff. Field et al (22) stated that SLAP tears which have been arthroscopically confirmed, were inconsistent with preoperative MRIs. Liu et al (23) showed that physical examination for labral pathology was more accurate than MRI diagnosis for arthroscopically confirmed SLAP lesions. Snyder et al reported MRI reports from multiple centres for 73 patients with SLAP lesions. Only 26% of the radiologists' MRI reports suggested a SLAP lesion (6). In another study, it was shown that rotator cuff tears, Bankart lesions and osteochondral defects were detected on MRI more accurately than on the gold standard shoulder arthroscopy, although there were differences in the detection of SLAP lesions (24). There was also tremendous variation in the protocols for these MRI studies. Hence, the quality of many of these films in the current study may not have been consistent with the high and consistent standards present in the practices and in the studies of their peers in previous literature.

Table 3. Studies in the literature and current study

Reference number	Number of Patients	Specificity	Sensitivity	PPV	NPV	Accuracy	MRI Tesla (T)
Connell (14)	102	89	98	96	94	96	1.5
Legan (16)	88	99	75	-	-	95	1.5
Sheridan (8)	234	79-89	14-64	5-29	91-98	77-87	1.5
Philips (13)	77	4-22	83-91	63-70	11-53	85	1.5
Conolly (17)	144	94	38	90	51	61	1.5/3
Magee (15)	75	100	84	99	83	90	3
Yıldız (18)	132	40	71	80	29	64	1.5
Current study	52	77	31	80	27	42	1.5/3

PPV: positive predictive value, NPV: negative predictive value

The glenoid labrum shape is curved along the glenoid surface, so coronal images of MR are typically not oriented along the long axis of the glenoid, which limits the accuracy of the SLAP pathology (25-27). The probable reasons that SLAP lesions were either missed or misdiagnosed may be that the abnormalities were very small, and thus inadequate spatial resolution may caused them to go undetected (9). A good history and physical examination should still be considered most important in the diagnosis of shoulder pathologies in general. However, detecting SLAP lesions in this way is not as simple as for other pathologies of shoulder. MRI is helpful in diagnosing a shoulder pathology. It is also valuable in assessing the injury status and the severity when many structures are involved and it becomes difficult to show the exact pathology in the shoulder joint with clinical examination. However, it is difficult to diagnose SLAP lesions on conventional MRI. The radiologist's interpretation is an important factor in providing an accurate MRI diagnosis. Appropriate clinical assessment and providing detailed clinical findings to the radiologist, could improve the accuracy of MRI in the diagnosis of shoulder pathology. Both MRI and arthroscopy can be considered to have significant roles in the diagnosis of SLAP pathology. In shoulder arthroscopy, there is a long learning curve, although it is a safe procedure, cost effective, and the diagnosis is more accurate when compared to MRI. In the current study, the sensitivity and accuracy of MRI compared to gold standard arthroscopy was found to be 31% and 42%, respectively. These results were compared in Table 3 with those of other studies in the literature and it can be seen that, the sensitivity and accuracy values obtained in the current study were low compared to other data. These results were unique in respect of showing the lowest sensitivity results in the literature despite the highest use of 3T MRI. The importance of the current study can be considered to be the low values of sensitivity and accuracy of the MRI results obtained compared to gold standard arthroscopy. This could be attributed of missing properties of MRI.

There were some limitations to this study; 1) The patient sample size was not large enough to make a conclusive comment on this topic 2) MR arthrography was not used instead of MRI, because of the difficulty of application of arthrogram in usual outpatient clinic conditions.

5. Conclusions

Although the clinical examination and history are the main procedures to detect most

shoulder pathologies, the detection of SLAP lesions requires further examination. In the current study, the percentage rate of detection of SLAP lesions on MRI was not found to be as high as gold standard arthroscopy. Care should be taken in arthroscopy for the detection of real SLAP lesions, which have not been seen on conventional MRI. There is a need for further clinical studies of larger series, including both MRI and MR arthrography compared to arthroscopy, to be able to fully clarify this topic.

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