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Agreement in the Classification and Treatment of the Superior Labrum

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Investigation performed by the Multicenter Orthopaedic Outcomes Network–Shoulder (MOON Shoulder Group)

Background: The Snyder classification scheme is the most commonly used system for classifying superior labral injuries. Although this scheme is intended to be used for arthroscopic visual classification only, it is thought that other nonarthroscopic historical variables also influence the classification.

Purpose: This study was conducted to evaluate the intrasurgeon and intersurgeon agreement in classifying variable presentations of the superior labrum and to evaluate the influence of clinical variables on the classification and treatment choices of surgeons.

Study Design: Cohort study (diagnosis); Level of evidence, 3.

Methods: A group of arthroscopic shoulder surgeons were asked to rank in order of importance clinical variables considered in diagnosing and treating the superior labrum. The surgeons then watched 50 arthroscopic videos of the superior labrum, ranging from normal to pathologic, on 3 different occasions. The first and third viewings were accompanied by no clinical information. The second viewing was accompanied by a detailed clinical vignette for each video. The surgeons selected a classification and treatment for each video.

Results: A patient's job/sport, age, and physical examination findings were considered the most important clinical variables surgeons consider during management of the superior labrum. Comparing the 2 viewings without clinical information, surgeons selected a different classification 28.5% of the time from the first to the second time. A different classification was chosen 71.5% of the time when the surgeon was supplied a clinical vignette at the subsequent viewing. Similarly, the treatment selected changed in 36% and 69.1% of cases when viewed again without vignettes and with vignettes, respectively. Intersurgeon agreement was moderate without clinical vignettes and fair with vignettes. Historical, physical examination, and surgical observations were found to influence the odds of change of classification.

Conclusion: There is significant intrasurgeon and intersurgeon variability in classification and treatment of the superior labrum. Clinical historical, examination, and surgical findings influence classification and treatment choices.

Keywords: SLAP; classification; superior labrum; agreement; shoulder

The anatomy of the superior labrum has been described in detail.[4,17] There is significant variability in the structure and appearance of the superior labrum at the time of arthroscopy.[5,9,14] Davidson and Rivenburgh[5] described nonpathologic triangular, bumper, and meniscal variations of the superior labrum. This variability can contribute to difficulty in the diagnosis of superior labral lesions during arthroscopy.

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Injury to the superior labrum was originally described by Andrews et al[2] in 1985. The original, and most commonly used, classification system of injury patterns at the superior labrum was described by Snyder et al[19] in 1990. This classification is based on the arthroscopic appearance of the superior labrum and describes 4 types of superior labral anterior to posterior (SLAP) lesions of the superior labrum that include fraying (type I), a detached biceps anchor (type II), a bucket-handle tear of a meniscal superior labrum (type III), and a bucket-handle tear that extends into the biceps tendon (type IV). There have subsequently been additional types of superior labral injury described beyond the original classification to include more complex injury patterns that did not fit the original classification system.[13,15]

The true prevalence of SLAP lesions is unknown. However, Snyder's original SLAP classification came from identification of 27 cases among 700 arthroscopies (3.9%).[19] A later study found the prevalence of type I through IV SLAP lesions at the time of shoulder arthroscopy to be 26% of 544 patients undergoing shoulder arthroscopy for various reasons.[11] Approximately three-fourths of these

lesions were classified as type I lesions. The discrepancy in prevalence estimates may stem from disagreement among surgeons regarding whether observed labral tissue represents a pathologic lesion or a normal anatomic variant. Treatment of the superior labrum has increased significantly since Snyder's original description in 1990. However, identifying a tear versus normal tissue versus an anatomic variant at the superior labrum remains difficult even for surgeons considered experts in the field; this prompted the current study.

Prior studies have evaluated the interobserver agreement between surgeons with regard to injury and variability at the superior labrum.[7,18] Agreement in identifying and classifying the superior labrum was found to be moderate. However, prior studies have not investigated how associated patient historical and physical examination findings potentially affect classification and treatment of the superior labrum.

The present study had 3 purposes: (1) to identify and investigate the relative importance placed on variables pertinent to the diagnosis and treatment of SLAP injuries as perceived by a group of shoulder surgeons, (2) to evaluate the intrasurgeon and intersurgeon agreement in classifying the superior labrum using the Snyder classification and in treating variable presentations of the superior labrum, and (3) to evaluate the influence of clinical variables on the classification and treatment choices of surgeons.

We hypothesized that experienced shoulder surgeons would demonstrate a lack of agreement in classification and treatment of the superior labrum. Lastly, we hypothesized that specific clinical patient variables would influence surgeons' classification and treatment of the superior labrum.

MATERIALS AND METHODS

This study was approved by our Institutional Review Board.

Identification and Ranking of Significant Clinical Variables

The Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Group is a shoulder research group composed of sports medicine or shoulder fellowship-trained surgeons who perform a significant amount of shoulder surgery in their practices. Although the majority of MOON shoulder surgeons work in academic centers, the group also includes several surgeons in private practice. The group represents a broad range of surgeon experience, from recent fellowship graduates to over 20 years in practice. Sixteen members, the members of the group at the time of the survey, were surveyed regarding variables that might potentially affect the treatment of possible superior labrum lesions in patients. Based on the group's experience, 9 factors were identified. The factors were patient age, gender, sport or job activity, hand dominance, MRI findings, physical examination findings, workers' compensation status, any history of trauma or injury, and the presence of other pathologic changes within the shoulder. These 16 surgeons in the group were then surveyed 2 months later and each surgeon was asked to independently rank these factors in order of importance relative to treating a patient with a potential SLAP lesion.

Surgeon Agreement

A total of 50 deidentified shoulder arthroscopy videos were collected from the personal collections of 2 surgeons and edited to contain 15- to 30-second evaluations of the superior labrum as visualized with the camera in a standard posterior portal. The superior labrum was probed from an anterior portal to evaluate the stability of the biceps anchor and to demonstrate any potential labral injury. The videos demonstrated superior labrums that ranged from normal to pathologic, consistent with SLAP lesions. Although the majority of the videos were considered by the contributing surgeons to represent the normal labrum and type I and type II SLAP lesions, no explicit diagnosis was assumed for any video. Both surgeons contributing the videos were fellowship-trained members of the MOON Shoulder Group. Neither participated in the subsequent video evaluation portion of the study.

Eleven shoulder surgeons in the MOON Shoulder Group completed all components of the video analysis portion of the study. Eight of these surgeons also participated in the initial survey. Each surgeon evaluated 50 video clips. Surgeons initially viewed the videos without any additional information (viewing 1). The videos were then watched a second time later the same day in a different order, with the addition of a clinical vignette (viewing 2). The vignettes incorporated the previously identified pertinent historical factors including patient age, gender, job/sport, mechanism of injury or history of trauma, physical examination findings, and details of other shoulder injury present at the time of surgery. Eight months later, the surgeons viewed the videos a third time (viewing 3). At the third viewing, the surgeons were shown the videos without vignettes exactly as in viewing 1. At each viewing, the surgeons classified the superior labrum as normal or as a SLAP lesion using the Snyder classification scheme.[19] At each viewing, the surgeon also chose a treatment, which could include no treatment, debridement only, debridement and repair, labrum repair, biceps tenodesis, or other. For analysis purposes, treatment options were subsequently condensed into 3 groups: no treatment, debridement, and intervention (repair/tenodesis/other). Labral repair and tenodesis were combined because of the small number of videos for which tenodesis was selected.

Statistical Analysis

Surgeon rankings of factors affecting treatment were assessed using a mean of the rank values.

The frequencies of classification and treatment chosen were calculated for all 3 viewing time points. The percentage change of classification and treatment was calculated by surgeon and by case to evaluate changes between viewings 1 and 2 and between viewings 1 and 3. In addition,

TABLE 1
Factors Affecting Treatment Decisions Ranked From Most Important to Least Important[a]

Rank		Frequency Reported (N = 16)		
		Upper Third, No. (%)	Middle Third, No. (%)	Lower Third, No. (%)
1	Job or athletic activity	12 (75)	4 (25)	0
2	Age	13 (81)	2 (12)	1 (7)
3	Physical examination findings	10 (63)	4 (25)	2 (12)
4	Injury mechanism	6 (37)	9 (56)	1 (7)
5	Associated findings or pathology at surgery	6 (37)	7 (44)	3 (19)
6	MRI	1 (7)	11 (68)	4 (25)
7	Hand dominance	0	6 (37)	10 (63)
8	Workers' compensation status	0	4 (25)	12 (75)
9	Gender	1 (7)	2 (12)	13 (81)

[a]Rank calculated as the mean of the rank values.

TABLE 2
Distribution of Snyder Classification and Treatment Selected by Participants at 3 Time Points

Snyder Classification	Treatment								
	Viewing 1			Viewing 2 (With Vignette)			Viewing 3		
	No Repair, No. (%)	Any Repair, No. (%)	Total, No. (%)	No Repair, No. (%)	Any Repair, No. (%)	Total, No. (%)	No Repair, No. (%)	Any Repair, No. (%)	Total, No. (%)
Normal	172 (100.0)	0 (0.0)	172 (31.3)	157 (99.4)	1 (0.6)	158 (28.7)	166 (99.4)	1 (0.6)	167 (30.4)
Type I	122 (97.6)	3 (2.4)	125 (22.7)	112 (97.4)	3 (2.6)	115 (20.9)	107 (99.1)	1 (0.9)	108 (19.6)
Type II	7 (4.3)	155 (95.7)	162 (29.5)	21 (11.1)	169 (88.9)	190 (34.6)	3 (1.5)	196 (98.5)	199 (36.2)
Type III	30 (79.0)	8 (21.0)	38 (6.9)	28 (77.8)	8 (22.2)	36 (6.6)	29 (90.6)	3 (9.4)	32 (5.8)
Type IV	8 (22.2)	28 (77.8)	36 (6.6)	14 (43.8)	18 (56.2)	32 (5.8)	13 (34.2)	25 (65.8)	38 (6.9)
Other	4 (23.5)	13 (76.5)	17 (3.0)	5 (26.3)	14 (73.7)	19 (3.4)	0 (0.0)	6 (100.0)	6 (1.1)
Total	343 (62.4)	207 (37.6)	550 (100.0)	340 (61.8)	210 (38.2)	550 (100.0)	318 (57.8)	232 (42.2)	550 (100.0)

generalized kappa values for multirater agreement were calculated to assess intersurgeon reliability.[6,12]

Logistic regression was used to evaluate the association of historical information with the probability of any change in classification or treatment. The logistic model was chosen so that the effect of 1 variable given the other variables on the probability of change in classification or treatment could be assessed. Hosmer-Lemeshow statistics were calculated for logistic regression models to assess model lack of fit. All statistical analysis was completed using SAS version 9.1 (SAS Institute Inc, Cary, North Carolina).

RESULTS

Clinical Variables Ranking

Among the 16 shoulder surgeons surveyed, the patient's sport or job activity was thought to be the most important variable that might affect treatment decisions relative to the superior labrum (Table 1). This was followed closely by patient age and physical examination findings. Mechanism of injury, MRI findings, and other surgical findings followed. Hand dominance, workers' compensation, and gender were consistently rated lowest in importance.

Intraobserver Agreement

The distribution of classification and treatment results are summarized in Table 2. For simplicity, in Table 2 the "no repair" and "debridement" categories were combined. In the majority of cases, the superior labrum was classified as being normal or showing a type I or type II labral tear.

Eleven surgeons completed all 3 viewings. Table 3 shows the percentage of cases by surgeon in which a different classification or treatment was chosen at different viewings. The percentage change in selected classification from viewing 1 to viewing 3 (no vignettes) for individual surgeons was a mean of 28.5% of the cases and ranged from a low of 14% (7 of 50) of cases to a high of 52% (26 of 50). The percentage change in classification for individual surgeons from viewing 1 to viewing 2, with the addition of a clinical vignette, was a mean of 71.5% of the cases and ranged from 56% (28 of 50) of cases to 78% (39 of 50 cases). The percentage change in treatment chosen for individual surgeons was a mean of 36% of cases and ranged from 20% (10 of 50 cases) to 52% (26 of 50 cases) from viewings 1 to 3 (no vignettes). Treatment chosen by individual surgeon changed in a mean of 69.1% of cases (range, 62% [31 of 50] to 82% [41 of 50]) from viewing 1 to viewing 2 with the additional vignette.

TABLE 3
Percentage Change in Classification and Treatment by Surgeon

	Change in Snyder Classification		Change in Treatment	
Surgeon	% Change 1 vs 3	% Change 1 vs 2 (With History)	% Change 1 vs 3	% Change 1 vs 2 (With History)
1	26 (13/50)	76 (38/50)	42 (21/50)	78 (39/50)
2	16 (8/50)	72 (36/50)	20 (10/50)	62 (31/50)
3	18 (9/50)	78 (39/50)	24 (12/50)	72 (36/50)
4	14 (7/50)	56 (28/50)	28 (14/50)	64 (32/50)
5	30 (15/50)	70 (35/50)	40 (20/50)	78 (39/50)
6	30 (15/50)	78 (39/50)	32 (16/50)	68 (34/50)
7	34 (17/50)	78 (39/50)	38 (19/50)	72 (36/50)
8	52 (26/50)	70 (35/50)	52 (26/50)	72 (36/50)
9	28 (14/50)	72 (36/50)	44 (22/50)	82 (41/50)
10	32 (16/50)	68 (34/50)	44 (22/50)	62 (31/50)
11	34 (17/50)	68 (34/50)	32 (16/50)	50 (25/50)
Mean % Change (Range)	28.5 (14-52)	71.5 (56-78)	36.0 (20-52)	69.1 (50-82)

TABLE 4
Generalized Kappa Values for Between-Rater (Interrater) Agreement[a]

	Generalized Kappa (50 Cases × 11 Raters), κ (Standard Error)		
	Classification (6 Groups)	Treatment (6 Groups)	Treatment (3 Groups)
Viewing 1 (no patient history)	0.467 (0.014)	0.371 (0.015)	0.420 (0.014)
Viewing 2 (with patient history)	0.387 (0.015)	0.353 (0.014)	0.396 (0.014)
Viewing 3 (no patient history)	0.469 (0.016)	0.366 (0.014)	0.425 (0.016)

[a]Kappa values were interpreted as follows: <0.20, poor agreement; 0.20-0.40, fair agreement; 0.40-0.60, moderate agreement; 0.60-0.80, good agreement; >0.80, excellent agreement.

Interobserver Agreement

The generalized kappa values for interrater reliability between surgeons are enumerated in Table 4. Agreement was moderate for classification at viewings 1 and 3 and fair for viewing 2. Agreement was fair for treatment at all time points when categorized into the original 6 options. Agreement in treatment improved slightly to moderate for viewings 1 and 3 when the treatment groups were collapsed into 3 categories (no treatment; debridement; intervention of some kind such as repair, tenodesis, or other).

Influence of Clinical Variables

The overall influence of individual clinical variables on change in classification or treatment between viewings 1 and 2 is shown in Table 5. All odds ratios reported are assuming all other variables in the model are held constant.

Age, traumatic history, a positive O'Brien active compression test, and cartilage abnormalities were significantly associated with increased odds of change in classification. Reported cartilage abnormalities were associated with a 4-fold increase in odds of change in classification (odds ratio [OR], 4.04; 95% confidence interval [CI], 1.65-9.94). The odds of change in classification increased over 2.5 times for both traumatic history (OR, 2.65; 95% CI, 1.57-4.47) and positive O'Brien test (OR, 2.70; 95% CI, 1.17-6.26). A positive apprehension test, rotator cuff weakness, and laxity present on examination under anesthesia were significantly associated with decreased odds of change in classification. Positive apprehension decreased the odds of change by 75% (OR, 0.24; 95% CI, 0.07-0.88), and weakness (OR, 0.47; 95% CI, 0.26-0.84) and laxity (OR, 0.41; 95% CI, 0.21-0.81) by 50%.

Being a laborer (OR, 2.66; 95% CI, 1.28-5.523) and a history of trauma (OR, 2.41; 95% CI, 1.50-3.89) were associated with approximately a 2.5-fold increase in the odds of change in treatment. Weakness (OR, 0.32; 95% CI, 0.18-0.56) and laxity (OR, 0.34; 95% CI, 0.18-0.65) were associated with a 60% decrease in the odds of change in treatment. Abnormal rotator cuff findings were associated with a 40% decrease (OR, 0.60; 95% CI, 0.37-0.98) in the odds of change in treatment. Other historical, physical examination, and surgical findings were not significantly associated with change in classification or treatment when all variables were included in the model.

DISCUSSION

The surgeons we queried ranked job or athletic activity, age, and physical examination findings as the most important factors affecting treatment decisions for SLAP lesions. Surgeon agreement for the classification of SLAP lesions

TABLE 5
Demographic, Historical, and Surgical Factors Associated With the Odds of Change of Classification and Treatment From Viewing 1 (Without History) to Viewing 2 With History)[a]

	Change in Classification, Odds Ratio (95% CI)	Change in Treatment, Odds Ratio (95% CI)
Age	**0.96 (0.93-0.99)**	1.00 (0.98-1.03)
Laborer		
No	1.00	1.00
Yes	1.09 (0.49-2.45)	**2.66 (1.28-5.23)**
Competitive athlete		
No	1.00	1.00
Yes	0.68 (0.32-1.44)	1.51 (0.77-2.95)
History of trauma		
No	1.00	1.00
Yes	**2.65 (1.57-4.47)**	**2.41 (1.50-3.89)**
O'Brien		
Negative	1.00	1.00
Positive	**2.70 (1.17-6.26)**	0.90 (0.43-1.93)
Apprehension		
Negative	1.00	1.00
Positive	**0.24 (0.07-0.88)**	0.58 (0.17-1.91)
Relocation		
Negative	1.00	1.00
Positive	0.99 (0.30-3.27)	1.58 (0.52-4.83)
Impingement		
Negative	1.00	1.00
Positive	1.16 (0.54-2.49)	1.22 (0.59-2.52)
AC joint tenderness		
Negative	1.00	1.00
Positive	1.24 (0.53-2.89)	1.58 (0.72-3.46)
Weakness		
None	1.00	1.00
Mild	**0.47 (0.26-0.84)**	**0.32 (0.18-0.56)**
Significant	–	–
EUA laxity		
Normal	1.00	1.00
Abnormal	**0.41 (0.21-0.81)**	**0.34 (0.18-0.65)**
Cartilage		
Normal	1.00	1.00
Abnormal	**4.04 (1.65-9.94)**	1.72 (0.76-3.89)
Labrum		
Normal	1.00	1.00
Abnormal	1.63 (0.85-3.15)	1.50 (0.82-2.76)
Rotator cuff		
Normal	1.00	1.00
Abnormal	0.73 (0.45-1.21)	**0.60 (0.37-0.98)**
Subacromial space		
Normal	1.00	1.00
Abnormal	1.64 (0.69-3.94)	0.93 (0.41-2.10)
Not evaluated	1.87 (0.79-4.45)	1.30 (0.60-2.85)

[a]Factors with significant odds ratios are shown in **boldface** type. CI, confidence interval; AC, acromioclavicular; EUA, examination under anesthesia.

using Snyder classification scheme was moderate at best. Adding patient history information slightly decreased intersurgeon agreement on classification. This same pattern was observed for treatment decisions. Positive apprehension, weakness, and abnormal laxity at examination under anesthesia were associated with a significant decrease in the odds of change of classification when all other historical variables were held constant. Weakness, abnormal laxity at examination under anesthesia, and rotator cuff abnormalities were associated with a significant decrease in the odds of change in treatment.

It was not surprising to find that this group of shoulder surgeons ranked job or sport, age, and physical examination findings as the most important variables they consider in treating patients with potential superior labral injury. Injuries to the superior labrum are often associated with athletes, especially overhead throwing athletes, or laborers who place greater stresses on the shoulder.[1,3,8,10,16]

Intersurgeon and intrasurgeon agreement in classification of the superior labrum has been evaluated previously. Sasyniuk et al[18] demonstrated that the agreement between 6 surgeons for the arthroscopic assessment of intra-articular shoulder anatomy in patients with anterior instability varied, with the greatest agreement for the anterior labrum, supraspinatus tendon, and presence of a Hill-Sachs lesion. There was poor agreement for the glenoid and the anterior inferior glenohumeral ligament. Agreement for the superior labrum was considered to be moderate at 60%.[18]

A wide spectrum of intrasurgeon variability in classification and treatment of SLAP lesions was also noted by Gobezie et al[7] in their study using 22 shoulder arthroscopy videos without vignettes. Their data reflect 73 surgeons' responses, although only 17 surgeons completed both viewings to evaluate intraobserver reliability. This study demonstrated moderate intrasurgeon reliability in both classification and treatment of labrum injury. When individual classifications and treatments were analyzed, the kappa values ranged from poor to moderate. In addition, the authors found that surgeons had a difficult time distinguishing normal from type I and type II labrum injuries.

We found a surprisingly high number of cases where surgeons changed classification of the superior labrum between viewings. We observed that more than 28% of the cases had a change in classification and 36% had a change in treatment at 2 separate viewings of the same videos without vignettes. There may be several things contributing to this observation. First, there can be subtle differences between normal and type I and II labrum injuries. Second, it can be difficult to gain full comprehension of an arthroscopic finding from a short video of varying quality where the surgeon has no tactile ability to test the labrum. Lastly, intraobserver agreement on the superior labrum has historically been moderate. Our results are somewhat better than those found by Gobezie et al,[7] who found the intrasurgeon mean percentage agreement to be 64% (36% change) for classification and 61% (39% change) for treatment.

The intersurgeon agreement was only fair to moderate in our study. It was interesting to see that the agreement was slightly less when participating surgeons were provided with the clinical vignettes. Our observations reflect the need for continued investigation into appropriate means of diagnosing and treating the superior labrum. They also reflect the significant variability seen in this

area of shoulder surgery. This relatively poor overall agreement may demonstrate a need for better classification and treatment algorithms. Our intersurgeon observations are similar to those demonstrated by Sasyniuk et al,[18] who found 60% agreement on diagnosis. In the study by Gobezie et al,[7] the senior authors identified the "correct" diagnosis for their 22 cases based on satisfactory treatment outcomes for chosen videos. They found substantial variability (23% to 67%) in the percentage of surgeons selecting the appropriate diagnosis and treatment for their videos. We made no assumptions about the correct diagnosis and drew no conclusions about how often superior labral injury was correctly classified.

We noted dramatic changes in classification and treatment when surgeons were provided with clinical vignettes that included patient history, physical examination, and surgical findings. Approximately 70% of cases underwent a change when clinical information was provided. The Snyder classification is an arthroscopic classification system, yet these clinical variables appeared to greatly influence diagnostic decisions. We anticipated that surgeon agreement would improve when they were provided with more information. This did not turn out to be the case as agreement between surgeons was actually slightly less. These results reflect the complex nature of managing superior labrum injuries in various clinical scenarios.

We were interested in identifying the clinical variables that influenced change in classification or treatment. In the full logistic model including patient history, physical examination, and arthroscopic observations, age, traumatic history, positive O'Brien test, and cartilage abnormalities were associated with increased odds that a different classification would be selected, whereas apprehension, weakness, and laxity at examination under anesthesia were associated with decreased probability of change in classification. Working as a laborer and traumatic history were associated with increased odds of change in treatment and weakness, laxity, and rotator cuff abnormalities were associated with decreased odds of change in treatment. Again, this would suggest that surgeons use a multifactorial approach to identify, classify, and treat superior labral injury, using the Snyder classification system beyond its original conception as a purely arthroscopic classification system.

Our study had several limitations. First, the videos were varying lengths and quality. However, each selected video was deemed adequate by the senior author (B.R.W.) and was selected from a much larger video pool. A second limitation is the possibility that some of the pathologic conditions demonstrated in the videos did not fit well into the Snyder classification system and would have been better classified using some of the modifications that have been proposed subsequently. However, this would have added further complexity beyond the scope of this study. It is also possible that the surgeons suffered from responder fatigue from watching 50 arthroscopic videos. In addition, the distribution of our surgeon responses to the video evaluations resulted in a limited number of interventions beyond repair, such as tenotomy or tenodesis. The limited number of these other interventions beyond repair did not represent sufficient data to further analyze the agreement for the different interventions independently. Lastly, we surveyed 11 shoulder surgeons in the MOON shoulder research group. It is possible that this small group does not reflect the general population of specialists in orthopaedic shoulder surgery.

CONCLUSION

This study demonstrates significant intersurgeon and intrasurgeon variability in the classification and treatment of the superior labrum. In addition, this study demonstrates the negative influence of clinical, historical, examination, and surgical variables on the agreement for diagnosis and treatment of the superior labrum. This variability should be considered when analyzing studies on interventions for the superior labrum. Further work on classification systems for the superior labrum is needed.

CONTRIBUTING AUTHORS

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