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## The O'Brien test demonstrates a higher diagnostic value in identifying posteroinferior labral tears than superior labral anterior to posterior (SLAP) tears



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**Background:** The primary aim was to determine the diagnostic value of the O'Brien test in localizing labral tears of the shoulder.

**Methods:** A consecutive series of patients electing for labral repair between January 2005 and March 2021 were included in this retrospective study. Inclusion criteria were as follows: (1) any patient with a labral tear who was elected for arthroscopic labral repair and (2) had documentation of the O'Brien test in the preoperative evaluation. Exclusion criteria were patients that had a negative arthrographically enhanced computed tomography or magnetic resonance imaging scan. During arthroscopy, the localization and extension of the labral tear was documented in a standardized 12-o'clock configuration. Anteroinferior, posteroinferior, superior labrum anterior to posterior (SLAP), and combined labral tears were documented. The sensitivity, specificity, positive and negative predictive values, accuracy, positive and negative likelihood ratios, receiver operating characteristic curve, and area under the curve were calculated to determine the diagnostic value.

**Results:** The cohort consisted of 271 patients (77% male) and included 105 anteroinferior, 86 posteroinferior, 46 SLAP, and 32 combined parts of the labrum. The mean age at time of surgery was 30 ( $\pm 10.2$ ) years. The O'Brien test was positive in 142 (52%) patients and showed the highest sensitivity and specificity for the posteroinferior tears (83% and 62%) compared to the anteroinferior (16% and 25%), combined labral parts (69% and 50%), and SLAP (65% and 50%) tears. In addition, receiver operating characteristic-analysis demonstrated a significantly higher area under the curve for posteroinferior tears compared to the other tears ( $P < .001$ ).

**Conclusion:** The O'Brien test demonstrates more diagnostic value for posteroinferior tears than other labral tears. This includes the SLAP tear, for which the O'Brien test was originally designed.

**Clinical Relevance:** These findings are helpful towards reinterpreting the O'Brien test as well as diagnosing, and more specifically localizing labral tears in clinics.

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Posterior labral lesion is becoming an increasingly recognized pathology in patients with shoulder instability, with incidences of up to 24%.<sup>8,18</sup> It is commonly caused by a posteriorly directed force with the arm in an adducted position.<sup>4,13</sup> However, the trauma often seems minor and dislocation is not often reported.<sup>4</sup> Symptoms are typically vague and include intermittent posterior pain,

fatigue, or weakness during certain activities, which are associated with decreased performance in sports.<sup>13</sup> If the labral tear is associated with a mobile bucket handle, it can sometimes create blockages and falsely orientate the physician to diagnose stiffness.

A variety of clinical tests have been described to evaluate a posterior labral tear such as the Kim test, which has a reported sensitivity of 80% and a specificity of 94%, and the Jerk test, with a reported sensitivity of 73% and a specificity of 98%.<sup>9</sup> The low sensitivity of these and other described tests remains one of the main challenges making the clinical diagnosis of posterior labral tear difficult—hence tend to be missed if not specifically looked for. Imaging is mandatory to confirm its diagnosis, but even magnetic resonance imaging underestimates true labral tear.<sup>11</sup> Consistent with other shoulder pathology, combining clinical tests provides increased (pooled) diagnostic performance.<sup>10</sup> Therefore, it remains key to keep fine-tuning and reinterpreting the value of existing, combined, and new clinical tests to improve the clinical diagnosis of complex shoulder pathology as posteroinferior labral tears.

The O'Brien test was originally described for superior labrum anterior to posterior (SLAP) lesions; however, the diagnostic performance is quite low with a sensitivity of 64% and accuracy of 54%.<sup>6</sup> Moreover, based upon our clinical experience and recent biomechanical data, we hypothesized that the O'Brien test would be the most predictive of posteroinferior labral tears.<sup>7,15,21</sup> Therefore, the primary aim was to determine the diagnostic value of the O'Brien test in localizing labral tears of the shoulder.

## Methods

### Study design

A retrospective cross-sectional study was performed using prospectively collected data. The data was entered into a database prior to undergoing arthroscopic examination and procedure.

### Patient selection

Between January 2005 and March 2021, all consecutive patients who were operated for an elected labral repair by 1 of the 3 surgeons (LL, TL, GAB) at our clinics were included in the study. Inclusion criteria for participation in this study were as follows: (1) any patient with labral tear who elected for arthroscopic labral repair (including patients in whom the procedure was converted to an arthroscopic bone block procedure after intraoperative evaluation) and (2) had documentation of the O'Brien test in the preoperative evaluation. Exclusion criteria included the following: patients with a clinical suspicion of labral tear that was deemed either not electable for repair (e.g. elected for primary bone block reconstruction) or had a negative arthrographically enhanced computed tomography or magnetic resonance imaging scan, and patients with concomitant biceps and acromioclavicular joint pathologies.

### O'Brien test

The O'Brien test was performed by an attending orthopedic surgeon preoperatively in clinics following the original description for the diagnosis of SLAP lesion.<sup>15</sup> The patient positions his arm at 90° elevation, 10° adduction, and internal rotation (thumb down) with the elbow in extension. He then elevated his arm against the downward force applied by the examiner. The test was considered positive if this movement was painful, and if the pain decreased when the test was performed with the forearm in external rotation (thumb up).<sup>15</sup>

### Labral tear examination

Surgeries were performed in a beach chair position under general anesthesia in combination with an interscalene regional block. Arthroscopic evaluation consisted of documenting the exact localization and extension of the labral tear using a standardized 12-hour clockwise configuration. Tears were categorized as involving the anteroinferior (defined between 2- and 6-o'clock positions), posteroinferior (defined between 6- and 10-o'clock positions), SLAP (vast majority was Type 2) (defined between 10- and 2-o'clock positions), or combined parts of the labrum (defined as involving at least 2 of the former categories).

### Data extraction

The following baseline characteristics were extracted from the database: gender, age at surgery, pain, apprehension, dislocation (defined as radiographically confirmed dislocations), subluxation, and hyperelasticity (defined as an external rotation of  $\geq 85^\circ$ ). The arthroscopic evaluation of the labral tears was extracted from the operative report. The preoperative O'Brien test results were extracted from the database.

### Statistical analysis

The findings at clinical examination were compared to the findings during arthroscopy, which was considered the gold standard for labral tears. The true positive (TP), true negative (TN), false positive (FP), and false negative (FN) values were determined. The sensitivity (TP/[TP + FN]), specificity (TN/[TN + FP]), positive predictive value (TP/[TP + FP]) and negative predictive values (TN/[TN + FN]), accuracy ((TP + TN)/total number of tests), and positive likelihood ratio (sensitivity/[1-specificity]) and negative likelihood ratio ((1 - sensitivity)/specificity) of the O'Brien test to diagnose each lesion (anteroinferior, posteroinferior, SLAP, or combined parts of the labrum) were calculated. To determine the ability of the O'Brien test to distinguish between lesions, the receiver operating characteristic (ROC) curve was created and area under the curve (AUC) was determined. Diagnostic value definitions of the AUC-values were as follows: fail (<0.6), poor (0.6-0.7), acceptable (0.7-0.8), excellent (0.8-0.9), and outstanding (0.9-1.0).<sup>14</sup> ROC-analysis was performed to compare the AUC of the O'Brien test to identify the different labral tears. Statistical analyses were performed using the SPSS (Statistical Package for Social Sciences) software (IBM SPSS Statistics for Apple, Version 26.0 Released 2019; IBM Corp. Armonk, NY, USA). Localization and extent of the labral tears were then analyzed in standard data managing software and the calculated frequencies rendered in 3-dimensional imaging software using color coding for improved infographic interpretation purposes (heatmapping) (Cinema 4D R23 Version R23 Released September 2020; Maxon, Friedrichsdorf, Germany).

## Results

### Patient demographics

A total of 271 patients met the inclusion criteria (Table 1). There were 209 males (77%) and 62 females (23%). The mean age at time of surgery was 30 years ( $\pm 10.2$ ). The dominant side was affected in 141 patients (52%), 174 patients complained of pain (64%), and 211 patients complained of apprehension (78%). One hundred forty-three patients had a dislocation (53%) and 147 subluxations were described (54%). In 210 patients, a trauma initiated the symptoms (78%) and 55 patients had shoulder hyperelasticity. A total of 105 patients had an isolated anteroinferior tear, 86 patients had an

**Table I**  
Patient demographics.

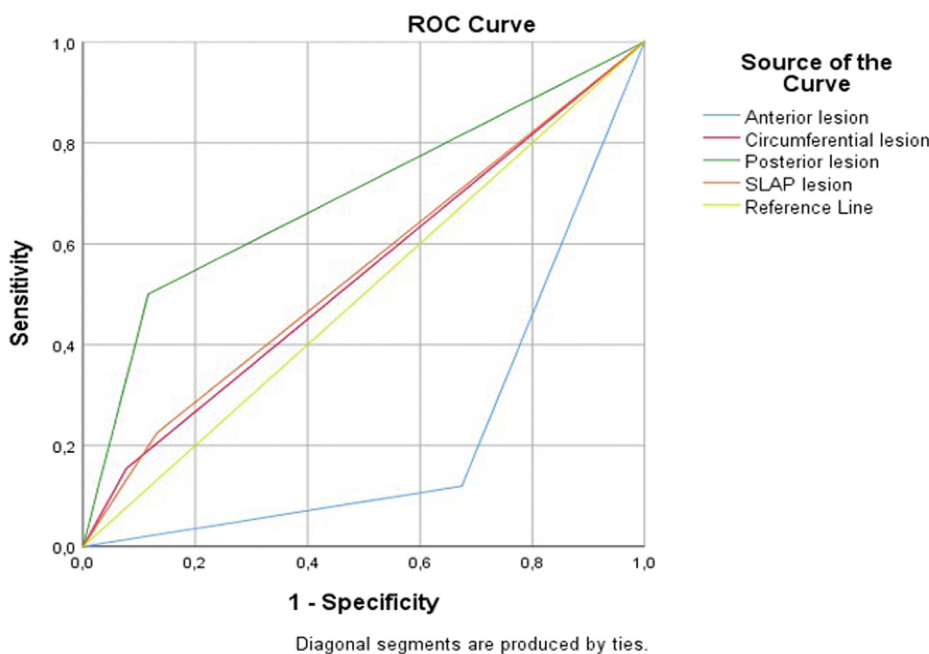
	Anteroinferior (n = 104)	Posteroinferior (n = 86)	SLAP (n = 49)	Combined parts (n = 32)	Total (n = 271)
Gender (m)	72	73	37	27	209
Age (y, mean ± SD)	28 ± 10.7	32 ± 10.9	31 ± 9.3	29 ± 7.1	30 ± 10.2
Pain (n)	50	63	34	27	174
Apprehension (n)	93	66	30	22	211
Dislocation (n)	70	38	22	13	143
Subluxation (n)	65	45	21	16	147
Positive O'Brien tests (n)	17	71	32	22	142

m, male; n, sample size; SD, standard deviation; SLAP, superior labrum anterior to posterior lesions.

**Table II**  
Diagnostic values of the O'Brien test for each labral tear.

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	LR+	LR–	AUC
Posteroinferior (n = 86)	83	62	50	88	68	2.18	0.27	0.69
SLAP (n = 46)	65	50	23	87	53	1.30	0.70	0.55
Anteroinferior (n = 105)	16	25	12	33	22	0.21	3.36	0.22
Combined parts (n = 32)	69	50	15	92	52	1.38	0.62	0.54

AUC, area under the curve; LR+, positive likelihood ratio; LR–, negative likelihood ratio; n, sample size; NPV, negative predictive value; PPV, positive predictive value; SLAP, superior labrum anterior to posterior lesions.



**Figure 1** Receiver operating characteristic-curves of O'Brien test to identify the labral tears. Diagonal segments are produced by ties. ROC, receiver operating characteristic; SLAP, superior labrum anterior to posterior lesions.

isolated posteroinferior tear, 46 patients an isolated SLAP tear, and 32 patients had a tear of combined parts of the labrum. In total, 142 patients had a positive O'Brien test (52%).

*Diagnostic value of the O'Brien test for labral tears*

The O'Brien test demonstrated the highest sensitivity and specificity for posteroinferior tears (Table II), which were 83% and 62%, respectively. The diagnostic value of the test according to the AUC was classified as fail for anteroinferior (0.22), combined labral parts (0.54), and SLAP (0.55) tears, and poor for posteroinferior (0.69) tears. The O'Brien test demonstrated the highest AUC for posteroinferior lesions according to the ROC-analysis (Fig. 1,  $P < .001$ ; Table III).

*Heatmapping*

Heatmapping of the lesions shows that a positive O'Brien test was most predictive of isolated posteroinferior labral tears, less predictive of SLAP lesions, and least predictive of isolated anteroinferior lesions (Fig. 2).

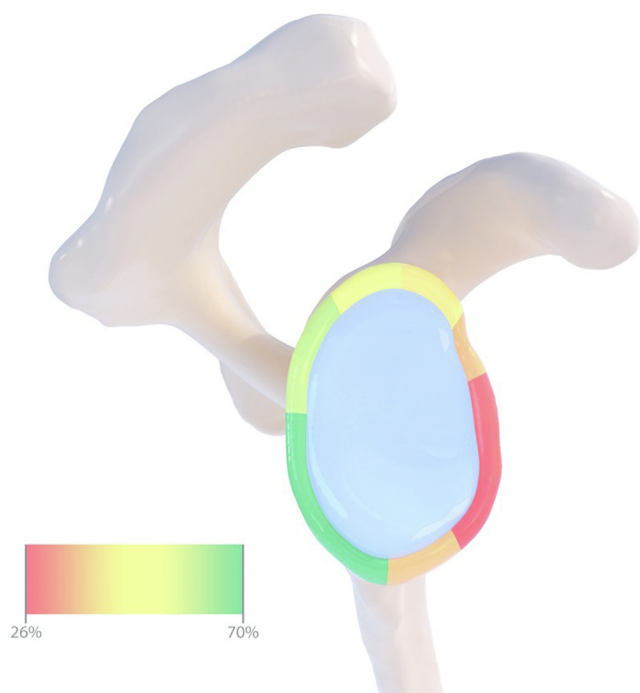
**Discussion**

The most important finding is that the present study confirms our primary hypothesis that the O'Brien test—originally described for SLAP lesions—demonstrates the highest diagnostic value in identifying posteroinferior labral tears. Interestingly, these findings are in conflict to the original description of the O'Brien test, aiming

**Table III**  
Statistical analysis of the inter-lesion differences of the O'Brien test to distinguish different lesions.

	AUC difference	P value	95% confidence interval
SLAP-posteroinferior	−0.145	<.001	−0.224 to −0.066
SLAP-anteroinferior	0.324	<.001	0.246–0.402
SLAP-combined parts	0.008	.805	−0.056 to 0.072
Posteroinferior-anteroinferior	0.469	<.001	0.387–0.552
Posteroinferior-combined parts	0.153	.000	0.082–0.225
Anteroinferior-combined parts	−0.316	.000	−0.386 to −0.247

AUC, area under the curve; SLAP, superior labrum anterior to posterior lesions.



**Figure 2** Heatmap of the accuracy of a positive O'Brien test in our cohort of patients with variable color intensity along the various positions of the labrum.

to diagnose a SLAP lesion.<sup>15</sup> During a trauma, after minor and repetitive trauma in overhead athletes, a SLAP lesion can occur due to the biceps exerting an eccentric and torsional force on its proximal insertion.<sup>13,17</sup> In a cadaveric study, Lin et al reported that deltoid loading leads to an increased contact pressure on the superior glenoid compared to inferior glenoid, which can explain the pain elicited during O'Brien test in presence of SLAP lesion.<sup>12</sup> However, biomechanically one would expect an opposite result to the test as the tensile load onto the tendon of the long head biceps is increased in external rotation of the shoulder, when one expects a pain relieve during the second part of the test.<sup>7,21</sup> Green et al suggested that this failure to support its proposed anatomic basis may partly explain the variable likelihood ratios obtained in clinical accuracy studies of the O'Brien test.<sup>5,7,19,20</sup>

Biomechanically, it would be expected that the O'Brien test is positive in case of a posterior labral tear. As the posteroinferior capsule and the posteroinferior glenohumeral ligament are frail compared to the anterior capsule, posterior labrum tightness is mandatory to stabilize the glenohumeral joint.<sup>2</sup> Deltoid loading also induces a slight posterior translation of the humeral head. Lin et al showed that the posterior capsule becomes tight during the first part of the O'Brien test, whereas, the anterior capsule is loose, allowing posterior translation of the humeral head.<sup>12</sup> This is

consistent with the following: (1) the typical mechanism of a posterior shoulder dislocation being an unresisted downward compression force in forward elevation, internal rotation, and adduction—reflecting the position of the first part of the O'Brien test; and (2) the fact the shoulder is posteriorly stabilized by external rotation—reflecting the position of the second part of the O'Brien test. Interestingly, the O'Brien test demonstrated an AUC far below 0.5 in diagnosing anteroinferior tears, suggesting that a negative test is more predictive for anteroinferior tears. Therefore, the O'Brien test may be of additional value to distinguish between anteroinferior and posteroinferior lesions. At our clinic, we can even report anecdotal evidence of posterior shoulder dislocation at clinical examination during the first part of the O'Brien test. We, therefore, recommend performing this test with caution, similar as when performing anterior shoulder apprehension tests.

Owen et al already reported a relationship between O'Brien test and posterior labral tear.<sup>16</sup> Their retrospective study on 74 patients showed a sensitivity of 83% and a specificity of 25%.<sup>16</sup> This sensitivity is similar to the results of our study. However, O'Brien test was evaluated as positive when the patient presented weakness at the examination, and not pain. Our study was different as we retrospectively analyzed the labral tears that were confirmed by imaging and operated on, instead of evaluating patients with clinical suspicion of labral tear. As the sensitivity and specificity of the Kim test and Jerk test are 80% and 94%, and 73% and 98%, respectively, it is recommended to use a combination of these and the O'Brien tests to diagnose posterior labral lesions.<sup>9</sup>

#### Limitations

The results of this study should be interpreted in light of its limitations, including those pertaining to any retrospective study. We only evaluated patients who had a confirmed labral tear at the time of surgery. Hence, some parameters such as test specificity in case of posterior labrum tear and positive and negative predictive values could not be evaluated. Also, patients with posterior instability caused by other pathology than labral tears were missed in the study. Another limitation of the study is the fact that we did not report on eventual concomitant glenoid dysplasia associated with a labral tear. A dysplastic glenoid, such as one with important retroversion, could cause a posterior translation of the humeral head and a discomfort of the patient, even without labral tear, and was not accounted for in this study. The long time inclusion phase was another limitation, as indications for labral repair have changed significantly over time.

#### Conclusions

The O'Brien test demonstrates more diagnostic value for posteroinferior tears than other labral tears. This includes the SLAP tear, for which the O'Brien test was originally designed.

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