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FULL PAPER

Detour sign in the diagnosis of subluxation of the long head of the biceps tendon with arthroscopic correlation

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Objective: To determine whether detection of the detour sign *via* MRI indicates subluxation of the long head of the biceps tendon (SLBT) in the shoulder joint and to investigate the association of SLBT with the degeneration of the long head of the biceps tendon (LBT) and rotator cuff tears.

Methods: This retrospective study included 65 patients with shoulder pain who underwent shoulder MRI and arthroscopic surgery. When axial images revealed that the LBT was displaced over the inner rim of the bicipital groove with some remaining contact with the groove (Criterion 1), or demonstrated a "detour sign" of the biceps tendon (Criterion 2), the lesion was diagnosed as an SLBT. Shoulder arthroscopy was used as the reference standard.

Results: Arthroscopy identified SLBT in 18 patients. When the MRI diagnosis was based on Criterion 1 alone, SLBT was diagnosed with a sensitivity of 44.4–55.6% and 75.4–80% accuracy. However, when the MRI diagnosis was based on Criteria 1 plus 2, SLBT was diagnosed with a sensitivity of 83.3–94.4% and 78.5–81.5% accuracy. There was a significant difference ($p < 0.05$) in the diagnostic sensitivity of Criteria 1 and 2.

Conclusion: The detour sign based on axial MRI may be regarded an additional useful anatomical feature that improves the diagnostic performance of MRI in the identification of SLBT lesions.

Advances in knowledge: Recognition of the detour sign may enhance the diagnostic performance of the conventional MRI protocol over the MR arthrography protocol for SLBT.

INTRODUCTION

Tendinosis, partial tear and instability of the biceps long head tendon (LBT) are all considered in the differential diagnosis of anterior shoulder pain owing to the rich innervation of the proximal third of the tendon.[1] Subluxations of the long head of the biceps tendon (SLBT) or dislocation of the long head of the biceps tendon (DLBT) usually present as anterior shoulder pain along the bicipital groove. In patients who are older, they often occur in association with degenerative rotator cuff tears, such as subscapularis and supraspinatus tendon tears.[2–4] However, SLBT or DLBT can be seen in patients who are younger who participate in throwing sports and are accompanied by limited external rotation of the shoulder joint.[3] Walch et al[5] classified SLBT into three subtypes: Type I, superior subluxation with partial or complete tear of the rotator cuff; Type II, medial subluxation of the LBT over the medial rim of the bicipital groove and onto the lesser tuberosity; and Type III, malunion or non-union of the lesser tuberosity.[5,6]

Unlike a DLBT, which allows direct visualization of the course and morphology of the biceps tendon,[2,7] an accurate diagnosis of subluxation is made in <30% of patients. The main reasons that make a diagnosis of SLBT challenging are the lack of specificity in physical examination and the overlap of clinical symptoms associated with an SLBT with those of an accompanying rotator cuff tear.[1,6,8,9] In addition, absolute diagnostic imaging criteria for SLBT have not been established.

Although the diagnosis of SLBT itself may not be clinically significant, it is a fixed lesion that cannot be reduced spontaneously by a physical maneuver.[6] Therefore, it is important to detect this injury in advance because an untreated SLBT is more likely to develop into a dislocation.[10,11]

There are few studies regarding the diagnosis of an isolated SLBT. Generally, arthroscopy and conventional MRI are used in the diagnosis of LBT pathology including biceps instability. Particularly, MR arthrography shows a high sensitivity for detecting biceps instability, as demonstrated in several previous studies.[12–14] But, MR arthrography has some limitations. It is a long, invasive, painful, costly and inconvenient procedure for patients.[12,15] In our practice, we have observed a characteristic MRI finding we call the "detour sign" on the shoulder MRI of patients with LBT subluxation.

The aim of this study was to determine whether the detour sign seen on a conventional MRI is a reliable marker for SLBT in patients with shoulder pain.

METHODS AND MATERIALS

Patient

We retrospectively evaluated 500 patients had visited our hospital for shoulder pain and had undergone shoulder MRI from January 2012 to February 2013. Among these patients, 136 patients subsequently had arthroscopic surgery. We excluded 65 of these patients owing to the presence of a fracture ($n = 1$), pathological conditions (*e.g.* infections, inflammatory arthritis, tumours; $n = 6$), prolonged interval of more than 6 months between MRI and arthroscopy and the presence of an LBT dislocation confirmed by arthroscopy ($n = 58$). Two musculoskeletal radiologists confirmed that the MR images obtained were in neutral position. We defined neutral position as when the bicipital groove was located between 11 and 12 o'clock at the midpoint of the subscapularis tendon[16,17] (Figure 1); cases with excessive internal or external rotation were excluded from the study ($n = 6$). Thus, in total, 65 patients were enrolled (29 male and 36 female patients; age range, 49–79 years; mean age, 58.4 years), as shown in Figure 2. All of these patients underwent arthroscopic surgery for symptoms and signs of rotator cuff tear upon presentation.

The institutional review board approved the research protocol and waived the requirement for patient informed consent because the study was retrospective in nature. All procedures involving human participants were performed in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

MRI

We acquired MRI using a 3.0-T MRI unit (Signa HDx, GE Healthcare) fitted with an High-density (HD) shoulder array coil. First, the patients were placed in a neutral position with the arm of the patient adducted along the side of the thorax.[18,19] We then obtained axial, sagittal and coronal images to detect disorders of the shoulder joint. The parameters used for these imaging protocols are listed in Table 1.

Image interpretation

Two experienced musculoskeletal radiologists (with 12 and 7 years' experience, respectively) were blinded to the patient histories and operative findings and independently reviewed all MR images obtained from the 65 patients. Axial images revealed that an LBT only partially displaced over the inner rim of the bicipital was considered to be an SLBT as per diagnostic Criterion 1 (Figure 3).

Only axial fat-saturated T_2 weighted images were used to evaluate the utility of the "detour sign". On axial T_2 weighted images, the LBT normally passes from the bicipital groove towards the posterior labroligamentous complex, forming a straight line on the humeral head. When the LBT deviated from this straight line and instead coursed along the anteromedial cortical margin of the humeral head, we defined it as a detour sign (Figure 4). Additional review was performed to determine the presence or absence of mucoid degeneration of the LBT, which is considered as one of the possible explanations for the detour sign. Mucoid degeneration of the LBT was defined as a thickening of the tendon with a hypointense signal intensity on a T_1 weighted image and hyperintense signal intensity on a T_2 weighted image.[20]

We interpreted the axial images in two separate sessions. The detour sign was used as diagnostic Criterion 2. In the first review

Figure 1. Neutral position for shoulder MRI studies: the axial images are obtained at the midpoint of the subscapularis tendon (a). The neutral position is defined as when the bicipital groove is located between 11 and 12 o'clock on axial imaging (b).

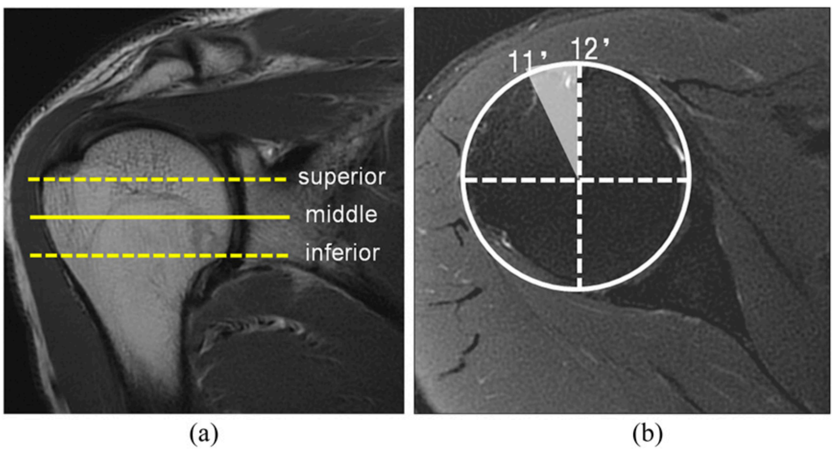
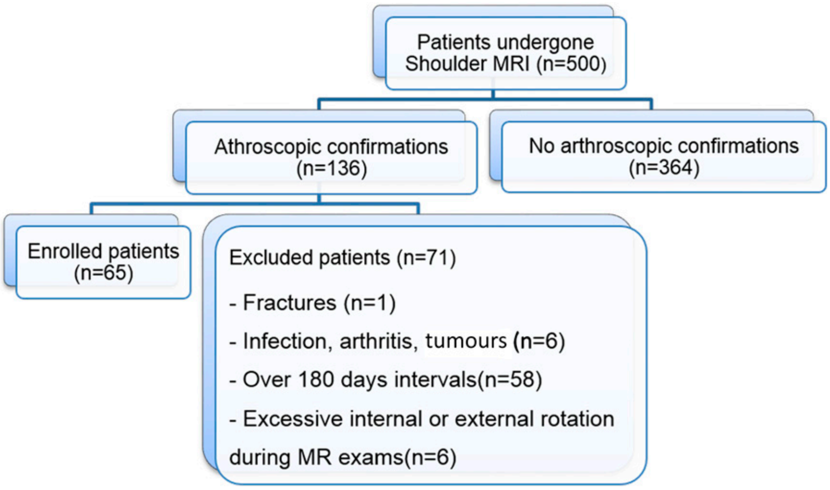


Figure 2. A flow diagram of patient exclusion, leading to the selection of the final study group.



session, each reviewer examined the MRI and noted the presence or absence of LBT subluxation. In the second review session, each reviewer further evaluated the axial fat-saturated T_2 weighted images for LBT subluxation by applying Criterion 2 to detect the detour sign. Next, they assessed the images for evidence of mucoid degeneration. The review sessions and interpretations were separated by at least 2 weeks so as to eliminate recall bias.

Shoulder arthroscopy

We used shoulder arthroscopy as the reference standard in this study. All arthroscopy examinations were performed by one orthopaedic surgeon (KDM) with 18 years' experience in shoulder surgery. Before shoulder arthroscopy, the orthopaedic surgeon reviewed the MRI reports, which did not indicate the presence or absence of a detour sign.

The orthopaedic surgeon evaluated the arthroscopic results for the presence of a rotator cuff tear or tendinopathy, a biceps pulley lesion and signs of an SLBT or DLBT. Arthroscopic studies were considered to be positive for an SLBT when a biceps tendon strayed medially or laterally from its normal course within the bicipital groove, but did not dislocate over the lesser or greater tubercle.[6]

In addition, the surgeon noted whether the rotator cuff tendons, including the supraspinatus and subscapularis tendons, were completely or partially disrupted.

Statistical evaluation

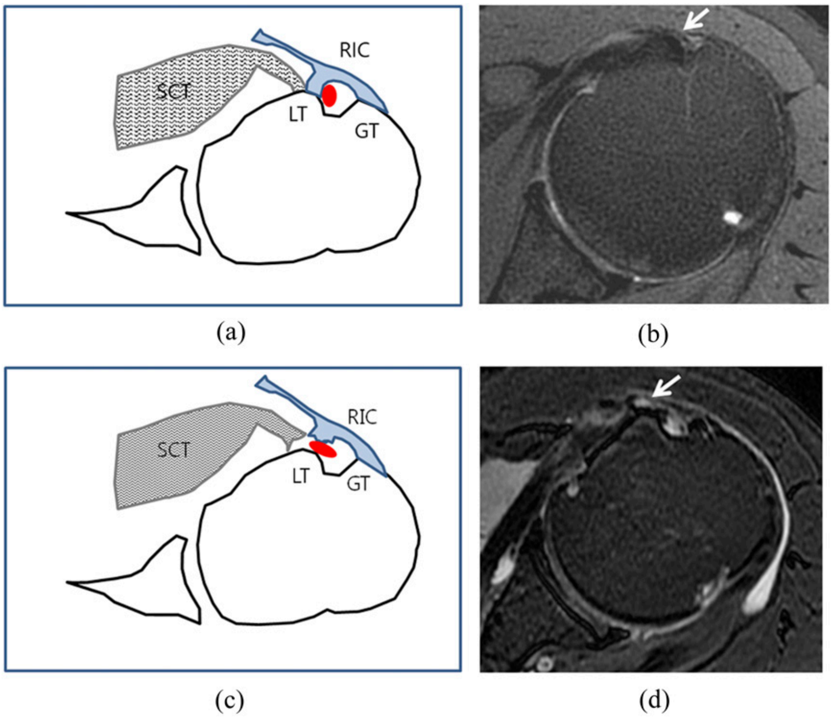
The MRI results were compared with the arthroscopic results. Descriptive statistics were used to evaluate the results using the conventional MRI Criterion 1 alone, Criterion 2 alone (for the detour sign) and both criteria. The Fisher's exact test was used to assess for an association between an SLBT and rotator cuff tears and between an SLBT and LBT mucoid degeneration. We sought statistically significant differences in the sensitivity of the first and second review sessions using the McNemar test. The area under the curve (AUC) was compared to determine the diagnostic performance of Criterion 1 *vs* that of both Criteria 1

Table 1. MRI parameters

MR parameters/pulse sequences	Axial		Coronal		Sagittal
	FSE T_1	FS FSE T_2	FSE PD	FS FSE T_2	FSE T_2
Repetition time (ms)	660	4000	4000	4000	4000
Echo time (ms)	9.4	68	30	68	68
Matrix	384 × 192	320 × 224	384 × 224	320 × 192	384 × 224
Field of view (cm)	16	16	16	16	16
Number of acquisitions	2	2	2	2	2
Echo train length	4	8	12	8	14
Section thickness (mm)	3	2	3	2	3
Intersection gap (mm)	0.3	0.5	0.3	0.5	0.3
Bandwidth (kHz/pixel)	31.25	31.25	31.25	31.25	41.67
Acquisition time	3 min 12 s	3 min 53 s	3 min 1 s	3 min 11 s	3 min 22 s

FS, fat saturated; FSE, fast spin echo; PD, proton density image.

Figure 3. A schematic drawing of the normal anatomic configuration of the long head of the biceps tendon (LBT) (a) and subluxation of the long head of the biceps tendon (b) with corresponding axial fat-saturated T_2 weighted MR images at the superior level of the bicipital groove (c, d). Figure 3a,b are showing an oval-shaped LBT (white arrow) tightly attached to the lesser tubercle that remains within the bicipital groove. Normally, LBT is surrounded by the rotator interval capsule (RIC) and the subscapularis tendon (SCT), which act as soft-tissue restraints to preserve LBT stability. Figure 3c,d are revealing that the LBT (white arrow) is medially displaced through a defect in the medial rim of the RIC and SCT and resting on top of the lesser tubercle. GT, greater tubercle; LT, lesser tubercle.



and 2. The detour sign was correlated with the presence or absence of an SLBT on arthroscopy using a two-sided Pearson's χ^2 analysis. The relationship between the presence or absence of the sign on MRI and the rotator cuff tears involving the supraspinatus and subscapularis tendons on arthroscopy was determined using the Fisher's exact test. Statistical significance was set at a p-value of <0.05.

Kappa values were calculated to assess the extent of interobserver agreement in the identification of the detour sign and mucoid degeneration of the biceps tendon on MRI. The results of the kappa statistics were interpreted as follows: kappa values of 0.21–0.4 indicated poor correspondence, 0.41–0.6 indicated fair correspondence, 0.61–0.8 indicated good correspondence and 0.81–1.0 indicated excellent correspondence.

Figure 4. A 47-year-old female with subluxation of the long head of the biceps tendon in the right shoulder: axial fat-saturated T_2 weighted images obtained at the level of the coracoid process (a) and corresponding schematic drawing (b) are depicting an anteriorly displaced long head of the biceps tendon (LBT) (arrows) coursing along the anteromedial cortical margin of the humeral head and deviating from the normal LBT course (dashed lines). This constitutes a detour sign.

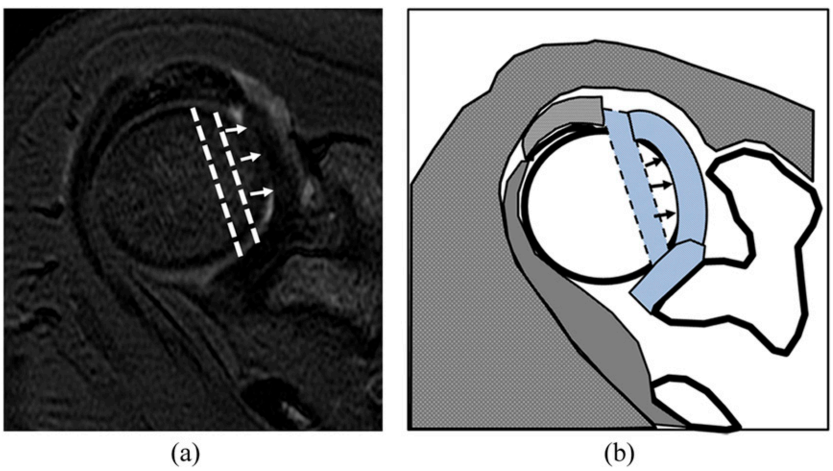


Table 2. Comparison of diagnostic performance on the basis of MR imaging criteria

Diagnostic parameter/criteria	Reviewer 1		Reviewer 2	
	Criterion 1	Criteria 1 + 2	Criterion 1	Criteria 1 + 2
Sensitivity	44.4 (8/18)	83.3 (15/18)[a]	55.6 (10/18)	94.4 (17/18)[a]
Specificity	87.2 (41/47)	80.9 (38/47)	89.4 (42/47)	72.3 (34/47)[a]
Accuracy	80.4 (49/65)	81.5 (53/65)	80.0 (52/65)	78.5 (51/65)
AUC (95% CI)	0.66 (0.53–0.79)	0.83 (0.73–0.94)[b]	0.72 (0.60–0.85)	0.83 (0.75–0.92)

AUC, area under the curve; CI, confidence interval.
Data are % (number/total). Criterion 1 refers to the long head of the biceps tendon (LBT) displaced over the inner rim of the bicipital groove, but with some groove contact remaining. Criterion 2 refers to the detour sign; the LBT around along the anteromedial cortical margin of the humeral head apart from this straight line.
[a]$p < 0.05$, for significant difference from data for Criteria 1 by using McNemar test.
[b]$p < 0.05$, for significant difference compared with AUC of Criteria 1 by using Delong's method.

All statistical operations were processed using the Stata v. 11.0 (StataCorp, College Station, TX) statistical software.

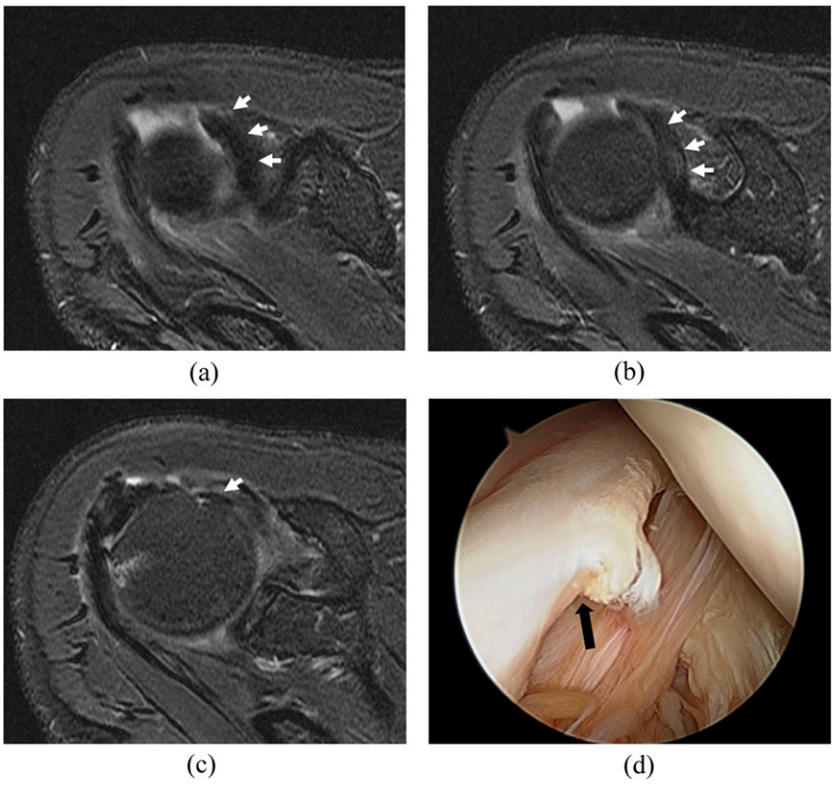
RESULTS

The mean time interval between shoulder MRI and arthroscopy was 15.5 days (range, 1–175 days). Regarding the results of arthroscopic surgery, 18 of the 65 patients had SLBT. Supraspinatus tendon tears were observed in a total of 40 patients, including 28 patients with complete tears and 12 patients with partial tears. 19 patients had subscapularis tendon tears, among whom 18 patients had partial tears and only 1 patient had a complete tear.

MRI interpretation using conventional Criterion 1 for subluxation of the long head of the biceps tendon detection

Using arthroscopic findings as the reference standard, the application of the conventional criterion (Criterion 1) alone revealed 8 and 10 patients with SLBT injuries as per Reviewers 1 and 2, respectively. In terms of the ability of Reviewers 1 and 2 to

Figure 5. A 62-year-old male who complained of shoulder pain: arthroscopic diagnosis was subluxation of the long head of the biceps tendon—(a–c) sequential fat-saturated axial T_2 weighted MRI scans are showing the long head of the biceps tendon (LBT) departing the anterior cortical margin of the humeral head with diffuse thickening and focal increased signal intensity in the LBT (arrows in a and b). LBT (arrow in c) is hanging at the inner rim of the bicipital groove. (d) Arthroscopic findings are showing the biceps tendon (arrow) straying medially from its normal course in the bicipital groove with localized fraying.



correctly diagnose the SLBT using Criterion 1, the respective sensitivities for each reviewer were calculated to be 44.4% and 55.6%, while the respective specificities were 87.2% and 89.4% and the respective accuracies were 80.4% and 80.0% (Table 2).

MRI interpretation using Criteria 1 and 2 for subluxation of the long head of the biceps tendon detection

With the addition of Criterion 2, the presence of a detour sign, to Criterion 1 in the interpretation of the MRI results, both reviewers diagnosed seven additional cases of SLBT. Compared with the use of Criterion 1 alone, the application of both criteria increased the sensitivity significantly to 83.3% and 94.4% ($p < 0.05$) and decreased the specificity to 80.9% ($p = 0.08$) and 72.3% ($p = 0.01$) for Readers 1 and 2, respectively (Table 2). The respective accuracies were calculated as 83.1% and 78.5% for Readers 1 and 2. Our results showed higher AUC values for the combination of Criteria 1 and 2 than those for Criterion 1 for Reviewer 1 ($p = 0.005$) and for Reviewer 2 ($p = 0.094$). Although there was no statistical significance for Reviewer 2, it revealed a trend towards higher AUC values using an additional detour sign for the two reviewers.

The agreement rates between the two radiologists were 0.81 for the detour sign detection and 0.84 for the presence of SLBT on MRI, both of which signify an excellent agreement.

Relationship between subluxation of the long head of the biceps tendon and the detour sign

On fat-saturated axial T_2 weighted images, the detour sign was observed in 22 (33.8%) patients of the 65 patients for Reader 1 and in 27 (41.5%) patients of the 65 patients for Reader 2 (Figure 5). The sign was highly associated with an SLBT ($p < 0.001$) (Table 3). Using the detour sign in the evaluation of SLBT, the readers were together able to diagnose 15 of the 18 SLBT cases. 7 cases read by Reader 1 and 12 cases read by Reader 2 had normal biceps tendons that were misinterpreted as being subluxed, yielding a sensitivity of 83.33%, a specificity of 74.5–85.1% and an accuracy of 76.92–84.62% (Table 3). A total of three false-negative cases were identified upon review of SLBT cases identified on arthroscopy with the absence of a detour sign (Figure 6). Among them, two patients had LBT degeneration.

Relationship between detour sign and long head of the biceps tendon mucoid degeneration

Degeneration of the LBT was found in 31 (47.7%) of the 65 patients. A detour sign was observed in 17 (54.8%) patients of these 31 patients by Reader 1 *vs* 21 (67.7%) patients of these 31 patients by Reader 2. The detour sign had a significant association with LBT degeneration for both readers ($p < 0.001$) (Table 3). Interobserver agreement was excellent for the detection of mucoid LBT degeneration ($\kappa = 0.82$).

Relationship between the detour sign and rotator cuff tears

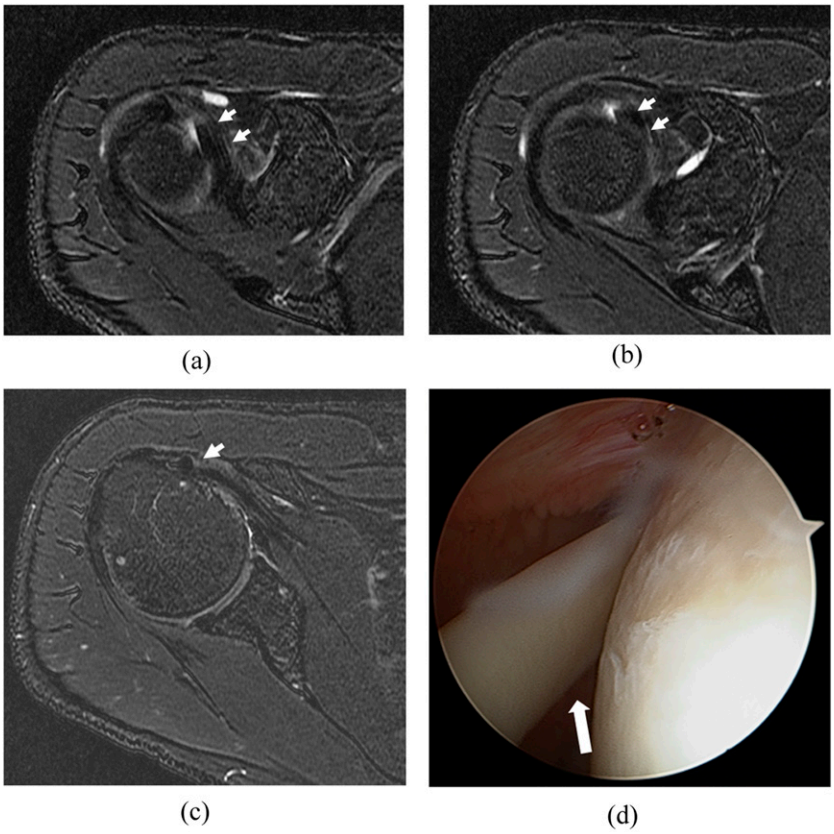
The relationship between the presence or absence of the detour sign and a rotator cuff tendon tear is shown in Table 3. Detour signs were significantly associated ($p < 0.001$) with subscapular tendon tears. Reader 1 noted detour signs in 13 (68.4%) patients with subscapular tendon tears, while Reader 2 identified 15 (78.9%) patients with the same combination of lesions. In contrast, of the 46 patients with intact subscapular tendons signs, 9 (19.6%) patients and 12 (26.1%) patients had detour

Table 3. Analysis of association between the detour sign and joint pathologies including subluxation of the long head of the biceps tendon (SLBT), degeneration of the long head of the biceps tendon (LBT) and tear of the supraspinatus and subscapularis tendons

Pathology of LBT/Detour sign		Reader 1		Reader 2	
		Sign (+)	Sign (−)	Sign (+)	Sign (−)
SLBT[a]	Positive	15	3	15	3
	Negative	7	40	12	35
	Total	22	43	27	38
LBT degeneration[b]	Positive	17	14	21	10
	Negative	5	29	6	28
	Total	22	43	27	38
Subscapularis[c] tendon	Tear (+)	13	6	15	4
	Tear (−)	9	37	12	34
	Total	22	43	27	38
Supraspinatus[d] tendon	Tear (+)	18	22	19	21
	Tear (−)	4	21	8	17
	Total	22	43	27	38

[a]$p < 0.05$ for comparison with data for Criterion 1 by using χ^2 test in both reviews.
[b]$p < 0.05$ for comparison with data for Criterion 1 by using χ^2 test in both reviews.
[c]$p < 0.05$ for comparison with data for Criterion 1 by using χ^2 test in both reviews.
[d]$p < 0.05$ for comparison with data for Criterion 1 by using χ^2 test in Reviewer 1.

Figure 6. A 69-year-old male with right shoulder pain: (a, b) the sequential fat-saturated axial T_2 weighted MRI scan is showing the long head of the biceps tendon (LBT) (arrows) running straight across the humeral head. (c) Fat-saturated axial T_2 weighted MRI scan obtained from a section caudal to (b) is showing the LBT entering (arrow) the bicipital groove without signal intensity or tendon thickness alterations. (d) Arthroscopic findings are showing the biceps tendon (arrow) deviating medially from its normal course in the bicipital groove.



signs as per Readers 1 and 2, respectively. In addition, the sign was observed by Reader 1 in 18 (45.0%) of 40 patients with supraspinatus tendon tears and in 19 (47.5%) patients by Reader 2. The sign was significantly correlated ($p = 0.02$) with a supraspinatus tendon tear for Reader 1, whereas there was no significant association for Reader 2 ($p = 0.22$).

Relationship between the subluxation of the long head of the biceps tendon and rotator cuff tears

The 18 patients with SLBTs comprised 12 (66.7%) patients with subscapularis tendon tears and 15 (83.3%) patients with supraspinatus tendon tears, whereas the other 47 patients without SLBTs had 7 (14.9%) patients with subscapularis tendon tears and 25 (53.2%) patients with supraspinatus tendon tears. Of the 65 patients we studied, 15 patients had both subscapularis and supraspinatus tendon tears. SLBT showed a significant association with subscapularis tendon tears ($p < 0.001$) and with supraspinatus tendon tears ($p = 0.02$).

DISCUSSION

Walch et al[5,6] defined SLBT as a partial or incomplete loss of contact between the tendon and its bony groove, in contrast to dislocation, which is a complete loss of contact between the tendon and its bony groove. On MRI scans, a subluxation can be visualized when the LBT overlies the lesser tuberosity on the axial plane, which is the view best depicting the descending portion of the biceps within the bicipital groove.[21]

The detour sign was coined to describe the intra-articular portion of an SLBT lesion as it runs from the site of origin in the glenoid labrum along the outer margin of the humeral head, while a normal LBT runs across the superior convexity of the humeral head. Although the detour sign is only an indirect guide in the diagnosis of an SLBT lesion, the authors believe that additional diagnostic observations may help improve the detectability of SLBT lesions in conventional MRI scans. Furthermore, this sign may reflect the medial and caudal instability of the long head of the biceps tendon.

In our study, the use of conventional MRI criterion combined with detour sign detection yielded a sensitivity of 83.3–94.4% for the diagnosis of an SLBT. Use of the detour sign alone resulted in a comparable sensitivity of 83.3%, which was better than the previously reported sensitivity of 36–64% using MR arthrography.[22]

Only 3 (16.7%) false-negative lesions were noted among 18 SLBT without detour signs. In these cases, subluxation was seen during arthroscopy without an increase in intra-articular LBT signal or diameter. The reason for these false-negative MRI findings is unknown; however, one possible explanation is that these cases might represent Type I SLBT, in which the LBT seems to displace mainly in the superior direction while leaving the subscapularis tendons intact. Therefore, the authors believe that the extent of medial LBT displacement in Type I lesions may be less than that of Type II lesions. In our study, subscapularis tendons were preserved in all three false-negative cases. Future study is needed to investigate whether there is a difference in the diagnostic performance of the detour sign in Type I and Type II SLBT lesions.

The majority of intra-articular LBT lesions accompanied by a detour sign demonstrated diffuse thickening with a high signal intensity on proton density images, suggesting LBT degeneration. Buck et al[20] stated that mucoid type was the most common form of LBT degeneration with signal alteration on MRI. Braun et al[23] concluded that the thickness of the LBT in cases involving an anteromedial pulley tears was significantly greater when compared with cases without pulley tears. Fusiform thickening of the intra-articular LBT, known as an hourglass deformity, has been considered to be a possible cause of pulley tears.[10] Disruption of this pulley is likely to occur during the movement of a thickened LBT within a narrowly stenosed pulley. Once the pulley is disrupted, patients with SLBT show considerable LBT excursion upon forward flexion of the arm.

When we applied the conventional criterion to axial imaging, the sensitivity for the diagnosis of SLBT was low, at 44.4–55.6%. These results are similar to those of an earlier study in which a wide range of sensitivities were described among three observers.[22] One possible explanation for lower or variable sensitivities includes the medial eccentricity of the LBT in the bicipital groove of the shoulder. Buck et al[17] described reaching the maximal medial eccentricity of the LBT in asymptomatic volunteers in neutral position, which may pose a difficulty for radiologists in differentiating between SLBT and LBT eccentricity.

In the present study, subscapular tendon tears were observed in 37.5% of patients with supraspinatus tendon tears and in 63.2% of patients with SLBT. This is consistent with prior reports of a significant association between rotator cuff tears and SLBT.[1,8] Lafosse et al[8] reported that about 48% of the subscapularis tears had anterior LBT instability and about 31% of the supraspinatus tendon tears had posterior LBT instability. Therefore, using the detour sign, we can increase the sensitivity of detecting SLBT and can expect its strong association with rotator cuff tears.

Our work had some limitations. First, it was retrospective in nature and the sample size was small. Second, we did not use the MR arthrography protocol to assess the diagnostic performance of the detour sign, a strategy that has been known to yield very accurate results.[22] Further comparison studies are needed to determine whether the diagnostic performance of the detour sign combined with the conventional MRI protocol is comparable with that of the MR arthrography protocol. Third, we did not evaluate for an association between pulley lesions and SLBT. Biceps pulley lesions can lead to instability of the LBT and cause partial articular-sided tears of the supraspinatus and subscapularis tendons.[1,22] Our study was designed not to include the evaluation of pulley lesions because MR arthrography is an essential part of a pulley lesion assessment. The authors coined the term detour sign to facilitate the diagnosis of SLBT lesions with a conventional MRI protocol instead of using MR arthrography, which is invasive in nature and can cause post-arthrographic pain.[24,25] Fourth, our study did not include a pain-free control group; it only included patients with shoulder pain who underwent a shoulder MRI and arthroscopy, which could introduce a selection bias and would likely lower the false-positive rate of our study. However, it is both impractical and unethical to perform arthroscopy on healthy volunteers; therefore, it may be impossible to resolve this issue. Lastly, the time interval between MRI and arthroscopy was very wide—up to 175 days, *i.e.* almost 6 months. This may have led to false-negative cases of the detour sign.

In conclusion, the detour sign accompanied by LBT degeneration may be regarded as an additional MRI finding that may help increase the diagnostic performance of the conventional MR protocol for SLBT.

FUNDING

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