MRI of the long head of the biceps tendon: a pictorial review.

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Learning objectives

- To understand the anatomy of the long head of the biceps tendon and its relationship to adjacent structures.

- To recognize pathology in the long head of the biceps tendon on standard MR images.
Background

The long head of the biceps tendon (LHBT) plays an important functional part during motion in the shoulder joint.

The course of the tendon is more complicated than the other shoulder tendons. Thus, the LHBT may pose a diagnostic challenge when reading standard MR images of the shoulder.

This pictorial review will show and explain the anatomy and the commonly encountered pathology in the LHBT. The anatomy of the rotator cuff tendons, labrum, bursae, capsule and bones is presumed known to the reader and will not be elaborated further here.
Findings and procedure details

The function of the LHBT in the shoulder is complex and still debated. It is thought to be a humeral head depressor, anterior and posterior stabilizer, limiter of external rotation and a lifter of glenoid labrum during shoulder motion.

Anatomy of the biceps tendon and ligaments

The LHBT is not a part of the rotator cuff. It usually arises from the superior glenoid labrum or the supraglenoid tubercle, or both. It courses obliquely along the anterior superior part of the humeral head to then turn caudally in the intertubercular sulcus (also called bicipital groove) (Fig. 1 on page 6). It is thickest at the attachment and at its thinnest as it leaves the intertubercular sulcus. The tendon has a synovial sheath, which is connected to the synovium in the glenohumeral joint. Distally it attaches to tuberositas radii. Common sites of LHBT rupture proximally are at the glenoid or at its thinnest point at the intertubercular sulcus.

From the attachment to the sulcus the LHBT is kept in its place by adjacent ligamentous structures: the superior glenohumeral ligament (SHGL) and the coracohumeral ligament (CHL) and fibers of the anterior capsule which fuse together at the greater and lesser humeral tuberosities.

The SGHL initially runs anterior and parallel to the biceps tendon, but as they both course laterally, the SGHL moves inferiorly to the biceps tendon (Fig. 2 on page 6).

CHL runs from the coracoid process to the humeral head in a band like fashion. It is initially superior to the biceps tendon, but as they course laterally toward the sulcus the CHL moves anterior to the biceps tendon (Fig. 3 on page 7). Due to manner in which the SGHL and CHL encase and support the LHBT, the combined structures are called the "biceps pulley" (Fig. 4 on page 8, Fig. 5 on page 9, Fig. 6 on page 9, Fig. 7 on page 10). These structures lie in a triangular area, the rotator interval. The rotator interval is bordered by the supraspinatus muscle superiorly, the coracoid process anteriorly and the subscapularis muscle inferiorly (Fig. 8 on page 10).

The proximal part of the normal LHBT is easily seen on oblique sagittal MRI, the middle part is visible on the coronal images and the distal part is visible both on coronal and axial images (Fig. 9 on page 11, Fig. 10 on page 12, Fig. 11 on page 13, Fig. 12 on page 14, Fig. 13 on page 15).
Pathology and imaging findings

A normal LHBT has dark signal on MRI. Except for magic angle effect, high signal is pathological. Tendinopathy, seen as high signal interstitially, is one of the most common pathological finding in the LHBT (Fig. 14 on page 16). Sometimes fluid is seen surrounding the LHBT in the sulcus, a finding closely related to a rotator cuff rupture. The biceps tendon itself may be intact (Fig. 15 on page 17, Fig. 16 on page 18).

A partial rupture of the LHBT is diagnosed if the tendon has increased interstitial signal and is thickened or if the signal intensity reaches the edge of a non-thickened tendon (Fig. 17 on page 19). The LHBT may also rupture longitudinally, which usually occurs at the level of the intertubercular sulcus (Fig. 18 on page 20, Fig. 19 on page 21). Ruptures of the LHBT may be proximal at the attachment, with intact fibers in the sulcus or distal, where no fibers are seen in the sulcus (Fig. 20 on page 23, Fig. 21 on page 22, Fig. 22 on page 24).

A LHBT subluxation must be differentiated from a true dislocation. If the LHBT lies on the medial ridge of the sulcus, rather then centrally located, it is a subluxation (Fig. 23 on page 25, Fig. 24 on page 26, Fig. 25 on page 27). If no part of the tendon is located in the sulcus, it is a true dislocation. A dislocation may be anterior, where the LHBT lies anterior to the subscapularis tendon, or dorsally which is associated with a subscapularis tendon rupture (Fig. 26 on page 28). A subluxation may cause rupture of the biceps pulley. This is best appreciated on oblique sagittal images and on arthrograms, but may sometimes be seen also on standard MRI (Fig. 27 on page 29, Fig. 28 on page 30).

Indications for post-operative imaging of the LHBT commonly are after tenodesis or tenotomy. Biceps tenodesis is when the LHBT is severed intra-articularly and fixed with devices on the humeral head. Biceps tenotomy is when the tendon is simply severed. The surgery is performed to release the pull the LHBT has on the superior labrum lesions (Fig. 29 on page 31). If a patient returns with an unsatisfactory clinical result after tenotomy, one should look for retained fibers of the LHBT, which the surgeon may have missed (Fig. 30 on page 32).
Fig. 1: Schematic presentation of the course of the LHBT (blue line) from the attachment site at the superior glenoid to the intertubercular sulcus and beyond.

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Fig. 2: Schematic presentation of the LHBT (blue) and the course of the SGHL (yellow) from the superior glenoid to the humeral head. It starts parallel to the LHBT, but ends inferior to it.

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**Fig. 3:** Schematic presentation of the CHL (red band) runs from the coracoids process to the humeral head. The LHBT (blue) and SGHL (yellow) are seen beneath it.

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Fig. 4: Schematic presentation of how the LHBT, SGHL and CHL change their locations as they course laterally, at the level of line a, b and c (see the next images).

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Fig. 5: Proximally the LHBT (blue) is inferior to the CHL(red) and posterior to the SGHL(yellow).

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**Fig. 6:** In the middle part the LHBT (blue) is inferior-posterior to the CHL (red) and posterior to the SGHL (yellow)

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**Fig. 7:** Distally the LHBT (blue) is posterior to the CHL (red), and posterior-superior to the SGHL (yellow)

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**Fig. 8:** Sagittal oblique MRI of the rotator interval: the area inside the green triangle, with the LHBT (blue arrow), SGHL (yellow arrow) and CHL (red arrow).

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Fig. 9: A normal LHBT as depicted on sagittal oblique MRIs (arrows).

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**Fig. 10:** A normal LHBT as depicted on sagittal oblique MRIs (arrows).

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**Fig. 11:** A normal LHBT (blue arrow) on a coronal image. As the tendon curves over the head, there is magic angle effect proximally on a coronal image (lighter arrow).

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**Fig. 12:** A coronal MRI. Normal LHBT as it attaches on the superior glenoid (thick blue arrow), it is also seen in the sulcus (thin blue arrow). Green arrow, the supraspinatus tendon.

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**Fig. 13:** The LHBT on an axial image as it lies centrally in the intertubercular sulcus.

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Fig. 14: High signal in the LHBT and thickened tendon on a sagittal oblique image (blue arrow), tendinopathy. The patient had previously had a trauma with subluxation and resulting inverted Hill-Sachs impression.

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Fig. 15: Axial image. Fluid in the synovial sheath around the LHBT in the intertubercular sulcus.

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Fig. 16: Same case as in fig. 15, an associated full thickness partial rupture in supraspinatus tendon (arrow).

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**Fig. 17:** An oblique sagittal image. Partial rupture in the LHBT with high signal reaching to the edge of the tendon inferiorly (arrow).

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Fig. 18: A longitudinal split in the LHBT on a coronal image, where the tendon is split into two bundles (arrows).

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Fig. 19: Same patient as in 18. A longitudinal split in the LHBT on an axial image, where the tendon is split into two bundles (arrows).

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**Fig. 21:** Same patient as in 20. Fibers are still seen in the intetubercular sulcus (grey arrow).

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**Fig. 20:** A total rupture of the LHBT proximally at the attachment on a coronal image; no fibers are seen at the glenoid (blue arrow).

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Fig. 22: Axial image. Total distal ruptures of the LHBT, no fibers are seen in the sulcus, there was also a rupture of the subscapularis tendon.

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**Fig. 23:** Axial image, a subluxated tendon, with the tendon resting on the medial ridge of the sulcus (blue arrow).

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Fig. 24: Same patient as 23. A subluxated tendon, seen anterior to the humeral head on axial images (blue arrow).

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Fig. 25: Same patient as in 23 and 24. A subluxated tendon seen anterior to the humeral head on axial images (blue arrow). It is still attached to the glenoid (green arrow).

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Fig. 26: Axial image. A dislocated of the LHBT (blue arrow) resting anteriorly to the subscapularis tendon (grey arrow), the sulcus is empty (short blue arrow).

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Fig. 27: The rotator interval, seen on oblique sagittal image. A normal SGHL (grey arrow) and CHL (red arrow) is seen.

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Fig. 28: Same patient as in 27. A biceps pulley lesion, seen on oblique sagittal images, there is a defect inferiorly (green arrow), a lesion of the biceps pulley.

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Fig. 29: A schematic representation of the labrum (green circle) and biceps (blue), the wavy red line represents a labral rupture. The pressure of the LHBT on the labral tear is relieved by cutting the tendon.

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**Fig. 30:** Axial image. No fibers should be seen in the sulcus after tenotomy, blue arrows point at remaining fiber here, which explained the poor clinical outcome after surgery.

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Conclusion

Knowledge of the anatomy of the long head of the biceps tendon and understanding its relationship to the adjacent ligamentous structures is necessary to recognize pathology of the tendon on MR images.

Tendinopathy is most common. Fluid around the tendon is associated with cuff ruptures. Subluxations may cause pulley lesions, dislocations always do. No tendon fibers should be seen in the sulcus after tenotomy.

The long head of the biceps tendon is well depicted on standard MR images.
References


