



# A Technique for Arthroscopic-Assisted Ligamentum Teres Augmentation Using a Suture Tape Augmentation

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**Abstract:** Ligamentum teres (LT) tears are a pathologic condition being identified at increasing frequency because of growing use of hip arthroscopy. The exact role of the LT is not well understood, but it has been shown in recent biomechanical studies to contribute to hip stability. Patients with hip pain, instability, and/or mechanical symptoms with advanced imaging findings showing LT pathology may benefit from an LT augmentation. We present an arthroscopic-assisted LT augmentation technique, which can be performed as an isolated procedure or in conjunction with an arthroscopic labral repair and/or debridement, chondroplasty, and femoroplasty.

The ligamentum teres (LT), also known as the ligamentum capitis or the round ligament of the femur, is a structure within the hip joint, which has recently become of great interest.<sup>1-4</sup> The LT was originally thought to be a vestigial structure with no biomechanical role, but recent studies have shown that, indeed, the LT has a functional role in increasing hip stability particularly in adduction, flexion, and external rotation.<sup>1,5,6</sup> Pathology of the LT was originally classified by Gray and Villar in 1997 as grade 1 (full traumatic tear), grade 2 (partial tear), or grade 3 (degenerative tear).<sup>1,3,7</sup> Despite the lack of a full understanding of the LT, it is a documented source of hip pain.<sup>1,3</sup> In fact, the LT is cited as the third most common cause of hip pain in the athletic population.<sup>5,8</sup> Pathology of the LT is thought to be predominantly the result of subtle injuries including those from overuse or microinstability.<sup>1</sup> The prevalence of LT tears observed during hip arthroscopy ranges from 4% to 51%.<sup>1,3</sup>

Treatment of LT pathology is still evolving.<sup>5</sup> To date, most treatments have involved arthroscopic debridement and/or shrinkage to relieve pain as well as mechanical symptoms,<sup>4,5</sup> but a handful of arthroscopic LT reconstruction techniques have been published. This article describes an arthroscopic-assisted LT augmentation technique performed with a suture tape augmentation (Internal Brace; Arthrex, Naples, FL). This technique is intended for use in patients with minimal arthritis who have hip pain, instability, and/or mechanical symptoms. In addition, we recommend this technique for augmentation of partial tears of the LT, as well as full-thickness tears of the LT when tissue is still present, and for augmentation of an LT reconstruction. Preoperative advanced imaging findings may show LT pathology or may be inconclusive because advanced imaging often does not accurately detect LT pathology.

## Surgical Technique

### Patient Preparation

Before the operation is begun, blood is withdrawn from a peripheral vein for a platelet-rich plasma injection at the conclusion of the case. The operation is performed with the patient in the supine position on a radiolucent table with the addition of a Hip Positioning System with Active Heel Technology (Smith & Nephew, Andover, MA) under general anesthesia (Fig 1A). A wide perineal post is used to minimize risk to the pudendal nerve (Fig 1B). The ipsilateral arm is crossed over the body to increase accessibility to the surgical site (Fig 1C). Before preparation and draping of the hip in

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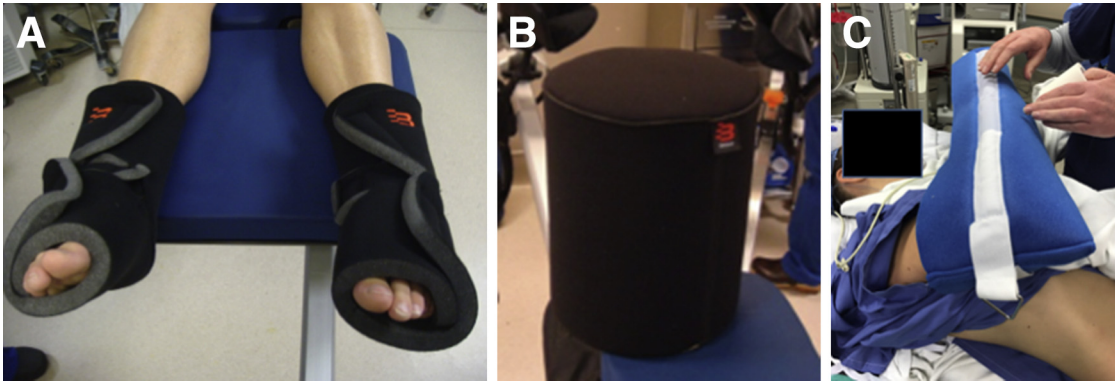
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**Fig 1.** (A) The operation is performed with the patient in the supine position on a radiolucent table with the addition of a Hip Positioning System with Active Heel Technology under general anesthesia. (B) A wide perineal post is used to minimize risk to the pudendal nerve. (C) The ipsilateral arm is crossed over the body to increase accessibility to the surgical site. The patient depicted is undergoing right hip surgery.

the standard sterile fashion, traction is applied to the hip and fluoroscopy is used to vent the hip joint with a 16-gauge needle (Fig 2 A and B). The needle is retracted, and the patient is prepared and draped in the standard sterile fashion (Fig 2C).

### Diagnostic Arthroscopy

Standard arthroscopy portals are established including an anterolateral viewing portal and mid-anterior working portal. By use of a 70° arthroscope, a capsulotomy is performed, and a diagnostic arthroscopy is used to evaluate labral, chondral, bony, and LT pathology. If a labral repair or debridement is required, it is performed before the LT augmentation to prevent the pathologic labrum from obstructing the view during the LT augmentation.

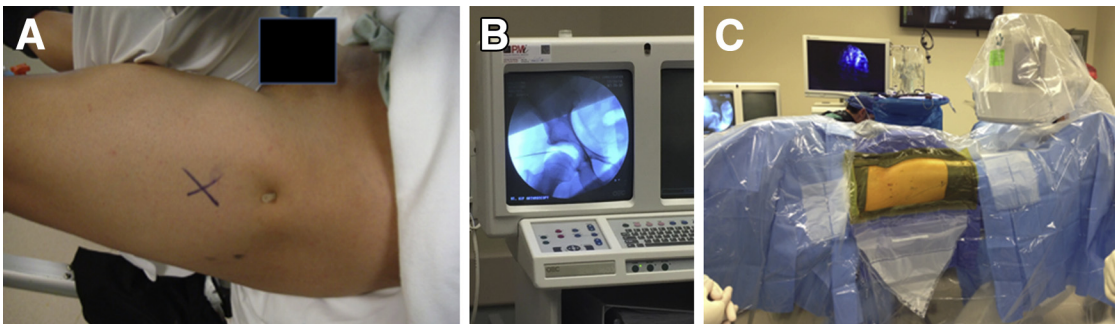
### Preparation of Cotyloid Fossa and Femoral Head and Neck

The combination of a 4-mm shaver with an Excalibur blade (Arthrex) and OPES electrocautery unit (Arthrex) is used to clear a space around the cotyloid fossa. Once visualization of the cotyloid fossa is adequate, a 3- to 4-cm incision is made in the lateral thigh to facilitate

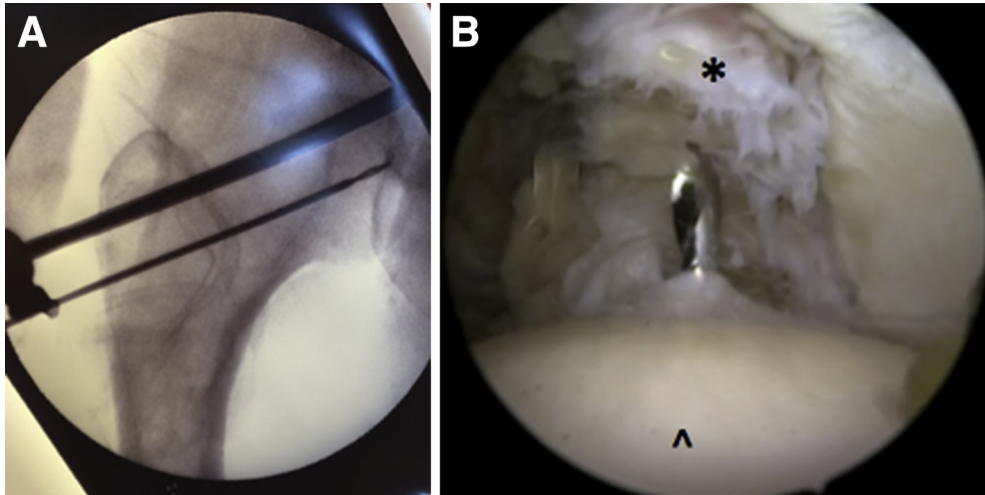
passage of the drill. Under fluoroscopic visualization, a 2.3-mm drill pin (Arthrex) is used as a guidewire and is drilled through the femur with a starting point proximal to the lesser trochanter to avoid a stress riser (Video 1, Fig 3). Fluoroscopy is also used to ensure the pin is exiting at the fovea. Then, a 4-mm reamer is used to ream over the guide pin through the center of the femoral head and neck. The arthroscope is used to directly visualize the femoral head, and care is taken not to plunge past the femoral head into the acetabular dome.

### Intra-articular Placement of Suture Tape Augmentation

A No. 2 FiberSnare (Arthrex) is shuttled through the femur into the hip joint (Fig 4). A posterolateral portal is established. A KingFisher grasper (Arthrex) is then used to retrieve the No. 2 FiberSnare, which has been delivered by way of a No. 2 FiberStick (Arthrex) through the posterolateral portal. The No. 2 FiberSnare suture is held out of the way by an assistant while the cotyloid fossa is drilled with a 2.3-mm spade-tip drill bit (Arthrex) through the posterolateral portal (Fig 5A). Care is taken to avoid injury to the obturator artery by



**Fig 2.** (A, B) Before preparation and draping of the hip in the standard sterile fashion, traction is applied to the hip and fluoroscopy is used to vent the operative hip joint with a 16-gauge needle. A left hip is shown. (C) The needle is retracted, and the patient is prepared and draped in the standard sterile fashion.



**Fig 3.** (A) The C-arm is used intraoperatively on a cadaveric specimen in the supine position to obtain an anteroposterior view of the right hip. This image confirms the central location of the guide pin within the femoral head and neck. (B) The right hip of a cadaveric specimen in the supine position as viewed with a 70° arthroscope through the anterolateral portal, showing the 4-mm spade-tip drill pin traversing the femur (arrowhead), heading toward the cotyloid fossa (asterisk).

aiming the drill bit more posteriorly and inferiorly on the cotyloid fossa (Fig 5B). A proximal biceps button (Arthrex) with doubled-over FiberTape (Arthrex) is inserted into the acetabulum. The 2 limbs of the FiberTape and the No. 2 FiberSnare are retrieved through the posterolateral working portal (Fig 5C). Outside of the joint, the 2 limbs of the FiberTape are passed through the loop in the No. 2 FiberSnare. Attention is turned within the joint for visualization of the 2 limbs of the FiberTape being dunked into the femur when pulling on the No. 2 FiberSnare from the lateral trochanteric incision. The FiberSnare can then be discarded. Traction is released.

#### Extra-articular Fixation of Suture Tape Augmentation

Distal to the exit point in the femur, the lateral femoral wall is prepared for placement of a 4.75-mm PEEK (polyether ether ketone) SwiveLock (Arthrex). The leg is placed in 10° of extension and 50° of external rotation for tensioning (Fig 6A). Excess suture after SwiveLock anchor placement is trimmed away to complete the augmentation (Fig 6B). A final fluoroscopic image is obtained to evaluate the final construct.

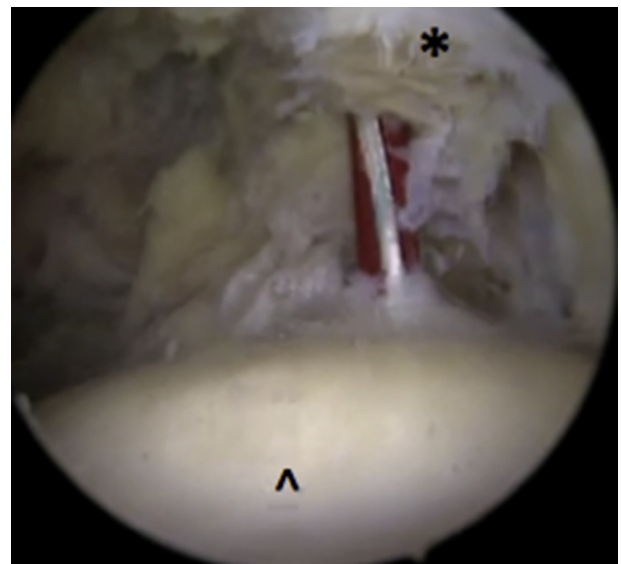
#### Closure

If a femoroplasty is necessary, it is performed after the LT augmentation. A capsular repair is then completed in the standard fashion. Platelet-rich plasma drawn at the initiation of the case is injected extra-articularly to prevent capsular adhesions. The wounds are copiously irrigated and closed, followed by placement of a sterile dressing in the standard fashion. The patient is then placed in a Rebound hip brace

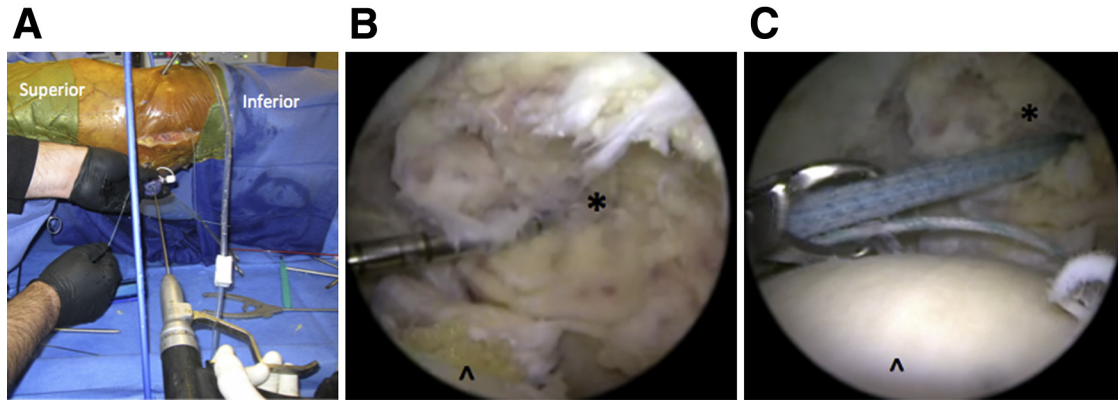
(Ossur, Foothill Ranch, CA). Postoperatively, the patient follows a physical therapy protocol identical to that of an arthroscopic labral repair, which includes foot-flat weight bearing at 50% of body weight for 3 weeks after surgery.

### Discussion

Increasing use of hip arthroscopy has led to increased recognition of the LT, as well as associated LT



**Fig 4.** Intraoperative image from the anterolateral viewing portal of a right hip in the supine position showing the FiberSnare passing through the reamed hole in the femur (arrowhead). The cotyloid fossa (asterisk) is shown for orientation.

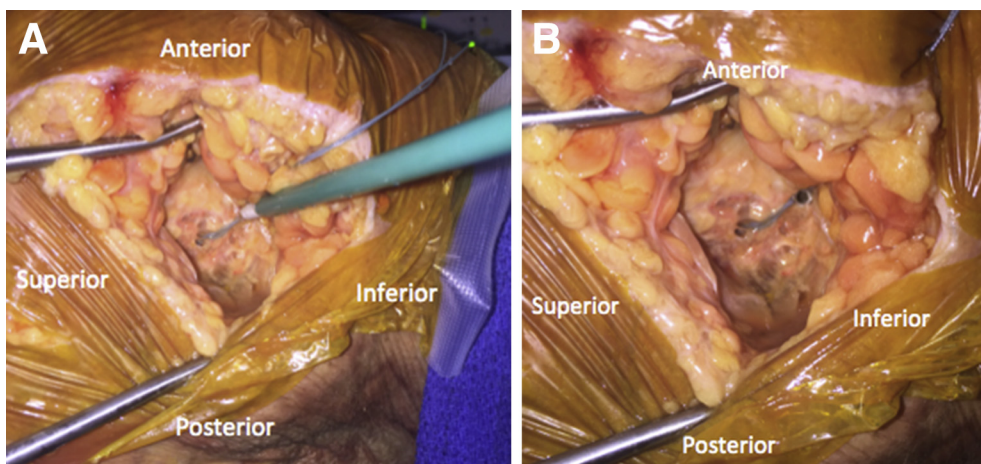


**Fig 5.** (A) An assistant holds the No. 2 FiberSnare passing suture out of the way while the cotyloid fossa is drilled with a 2.3-mm spade-tip drill bit through the posterolateral incision of a right hip in the supine position. (B) The obturator artery is avoided by aiming the drill bit more posteriorly and inferiorly on the cotyloid fossa (asterisk). The femur (arrowhead) is shown for orientation. (C) After the proximal biceps button with a doubled-over FiberTape is inserted into the acetabulum, the 2 FiberTapes from the proximal biceps button and the No. 2 FiberSnare are retrieved through the posterolateral working portal. The femur (arrowhead) and cotyloid fossa (asterisk) are shown for orientation.

pathology.<sup>1,4,5,8</sup> These findings have initiated anatomic, epidemiologic, biomechanical, and clinical studies on the LT. Specifically, in 2011 Botser et al.<sup>1</sup> reported an LT tear rate of 51% in 558 hip arthroscopies. Subsequently, in 2013 Domb et al.<sup>2</sup> arthroscopically evaluated 463 hips and showed that 226 of 463 (49%) had either a full- or partial-thickness tear of the LT. Likewise, they found an association between LT tears and acetabular bony morphology as well as age; patients with acetabular retroversion, a high lateral coverage index, and age younger than 30 years were shown to less frequently have tears of the LT. In addition, studies have shown LT tears are associated with labral tearing as well as cartilaginous lesions about the hip.<sup>1,5</sup> Ultimately, the aforementioned studies have suggested that tears of the LT are prevalent in persons undergoing hip arthroscopy. Moreover, there are certain nonmodifiable patient characteristics, as well as associated intra-articular hip pathology, that may predispose patients to the development of LT tears.

More recently, in 2014 Martin et al.<sup>6</sup> used 12 hips from 6 fresh-frozen cadavers to evaluate the role of the LT in 18 different hip positions of combined abduction-adduction and extension-flexion. They showed that after the LT was resected, 11 of 18 hip positions had a greater than 6° increase in hip rotation. Specifically, in 8 of 18 positions, the LT played a statistically significant role in the amount of internal or external rotation ( $P < .0014$ ). Of these 8 positions, 6 involved either 90° or 120° of hip flexion. This cadaveric study led to the belief that the main function of the LT is controlling hip rotation predominantly in flexion. In 2014 Philippon et al.<sup>9</sup> evaluated the structural properties of the native LT and concluded that the LT may have an important role as a static stabilizer about the hip. These studies have shown that, contrary to what was previously thought about the LT, the LT may have a role in hip stability that should not be ignored.

Furthermore, there have been 2 histologic studies that have linked the LT as a transmitter of



**Fig 6.** (A) A 4.75-mm PEEK SwiveLock is placed in the standard fashion in the right lateral femur. This is performed after the leg is placed in 10° of extension and 50° of external rotation and traction has been released. (B) Completed arthroscopic-assisted ligamentum teres augmentation with suture tape augmentation.

**Table 1.** Pearls and Pitfalls of Arthroscopic-Assisted Ligamentum Teres Augmentation Using Suture Tape Augmentation

<b>Pearls</b>
Intraoperative fluoroscopy assists with placement of the drill bit centrally through the femoral head and neck.
When drilling for the intra-articular, cotyloid proximal biceps button, the surgeon should avoid the obturator artery by aiming the drill bit posteriorly and inferiorly on the cotyloid fossa.
<b>Pitfalls</b>
The surgeon should use caution when reaming the femoral head and neck so as not to plunge into the acetabular floor.
The surgeon should be sure to hold tension on the suture-augmentation construct, release traction, and place the leg in a neutral position (although the ideal position of the leg for tensioning of the graft is still not known when placing the SwiveLock on the lateral femur).

somatosensory affected signals to both the spinal and cerebral systems. Specifically, type IV nerve endings, which include nociceptors and mechanoreceptors, are found in the LT.<sup>1,4,9</sup> These studies have suggested that the LT may be a cause of preoperative hip pain, as well as persistent hip pain after concomitant intra-articular hip pathology has been addressed arthroscopically.<sup>9</sup>

In addition, in 2014 de Sa et al.<sup>8</sup> performed a systematic review that included 9 studies with 87 patients who had undergone reconstruction of a torn LT with autografts, allografts, or synthetic grafts. These patients had been followed up for 1.5 to 60 months. Return to sport or regular activities was observed in 89% of patients, and there was a 40% increase in functional scores from preoperatively to postoperatively. Ultimately, de Sa et al. concluded that debridement of partial LT tears provides short-term relief after failed conservative management. Moreover, they concluded that type I LT tears (full thickness) benefit from some form of reconstruction. Despite these data supporting addressing LT pathology, outcome and biomechanical data after management of LT pathology are limited and more research is needed.<sup>5</sup>

In summary, the aforementioned literature provides data leading to the belief that the ability to treat pathology of the LT through suture tape augmentation may be useful in certain populations. Pearls and pitfalls of the described technique are shown in Table 1, and a full list of advantages and limitations is shown in Table 2. To our knowledge, there is not a technique published on LT augmentation. The LT augmentation technique published in this article provides a method to address LT tears causing instability, mechanical symptoms, and pain in a considerable percentage of patients undergoing hip arthroscopy. Specific populations that may benefit from this procedure are patients who have partial tearing of the LT, patients with

**Table 2.** Advantages and Limitations of Arthroscopic-Assisted LT Augmentation Using Suture Tape Augmentation

<b>Advantages</b>
The arthroscopically assisted procedure allows small incisions, as well as ease of passage of instruments and sutures.
Our technique provides a method to address LT tears causing instability, mechanical symptoms, and pain in a considerable percentage of patients undergoing hip arthroscopy.
Specific populations that may benefit from this procedure are patients who have partial tearing of the LT, patients with full-thickness tears of the LT in which tissue is still present, and patients who have undergone an LT reconstruction that may benefit from reinforcement of the suture tape augmentation.
<b>Limitations</b>
Additional biomechanical and clinical studies are needed on this LT augmentation technique.
As with any procedure involving hip arthroscopy, there may be a steep learning curve.

LT, ligamentum teres.

full-thickness tears of the LT in which tissue is still present, and patients who have undergone an LT reconstruction that may benefit from reinforcement of the suture tape augmentation. Additional biomechanical and clinical studies are needed on this LT augmentation technique.

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