

Knotless “Suture Staple” Technique for Endoscopic Partial Thickness Abductor Tendon Repair



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Abstract: Transtendinous abductor tendon repair is a technique the authors described previously to diagnose and treat undersurface tears of the abductor tendons. In this surgical technique article, the authors describe a technique for knotless repair of undersurface tears of the abductor tendons that does not require a transtendinous split or suture passage through the abductor tendon. Because there is no suture passage through the abductor tendon or knot tying, the potential advantages include expeditious technique, compression of tendon against bony footprint, anatomic repair, and avoidance of knots facing the undersurface of the iliotibial band, which may lead to bursal irritation.

Lateral hip pain or greater trochanteric pain syndrome is common and may be debilitating. In recent years, abductor tendon pathology has been recognized as a major cause of greater trochanteric pain syndrome.^{1,2} The peak incidence of gluteal tears is in the fifth and sixth decades of life,³ and they are estimated to occur in 25% of late middle-aged women and 10% of men in

this age group.⁴ In general, tears of the gluteus medius occur more often than tears of the gluteus minimus.^{5,6} The tears can be intrasubstance (longitudinal), partial thickness, or full thickness,^{4,6} with partial-thickness tears are more common than full-thickness tears.⁶ Most commonly, the gluteus medius tendon begins as a partial-thickness tear at the undersurface of the anterior aspect lateral facet footprint on the greater trochanter and then propagates posteriorly to eventually become a full-thickness tear.^{4,7,8}

Symptoms of gluteus tendon tears include pain that is typically located in the lateral hip and may radiate to the thigh^{9,10} and is aggravated by weight bearing. This pain is typically insidious and chronic. In addition, a limp may be present caused by pain or abductor weakness. Physical examination typically reveals tenderness over the greater trochanter, abductor weakness, pain with resisted hip abduction, pain with resisted internal rotation, and Trendelenburg gait. Magnetic resonance imaging (MRI), ultrasound, and injections may aid in the diagnosis. MRI can detect tendinosis and partial- or full-thickness tears.¹¹ Treatment usually begins with conservative means including activity modification, anti-inflammatory medication, physical therapy, and local corticosteroid injections.¹²

Undersurface tears of the abductor tendon have been recently recognized as a subset of abductor tears and are often the point where the abductor tears begin.^{7,8} The transtendinous technique has allowed adequate visualization, debridement, bone preparation, and repair of these undersurface tears. The traditional manner in which the abductor tendons are repaired is with suture anchors between the leaflets of the

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transtendinous split, which are passed through the anterior and posterior leaflets of the tendon and then tied down.¹⁰ This requires passage of sutures through the tendon and tying arthroscopic knots on the superficial surface of the tendon, which can rub on the undersurface of the iliotibial (IT) band and may predispose to development of trochanteric pain postoperatively.

The purpose of this article is to describe a technique to treat partial-thickness undersurface tears of the abductor tendons that uses knotless anchors, obviates the need to split the tendon, and uses a micropuncture technique of the gluteus medius footprint as a substitute for the traditional decortication of the trochanter.

Surgical Technique

The technique is demonstrated in [Video 1](#).

Prepping and Draping

1. All appropriate equipment should be in the operating room before starting the case ([Table 1](#)).
2. The patient is supine on an arthroscopic traction table with a well-padded peroneal post to pull traction against when necessary.
3. The operative leg is draped proximal to the iliac crest and several inches posterior to the greater trochanter. It is helpful to ensure that the leg is in neutral rotation when prepping and draping the hip.
4. The leg is placed in about 15° to 30° of abduction to loosen the IT band to allow for more room in the peritrochanteric space.
5. Intraoperative fluoroscopy is used with the screen at the foot of the bed for easy surgeon visualization; the C-arm enters the surgical field from the contralateral side.
6. The image is centered over the greater trochanter.
7. The portals necessary for this operation are the anterolateral (AL) portal, midanterior portal, distal lateral accessory portal (DLAP), and a superior modification of the posterolateral (PL) portal that is created under direct visualization.

Trochanteric Bursectomy and Inspection of the Abductors

8. The DLAP is made initially.
9. A 5.0 hip access cannula (Arthrex, Naples, FL) is brought into the peritrochanteric space through the DLAP between the interval of the sartorius and the

tensor fascia lata. Visualization of the vastus lateralis fascia assures the scope is in the peritrochanteric space.

10. The AL portal is created and a shaver is placed through the IT band.
11. A thorough trochanteric bursectomy is carried out to ensure adequate visualization of the tendon and future sutures.
12. The abductor tendon is thoroughly evaluated with a probe for undersurface delamination of the abductor tendons. If it is believed that there is a deficiency in the tendon that correlates with preoperative examination, MRI review, and intraoperative findings, the “suture staple” repair technique is initiated.

Preparation for Repair

13. The modified PL portal is localized using a spinal needle. This is usually about 2 to 4 cm proximal to the trochanter along the posterior edge. This portal should be tested for correct trajectory for future suture anchor placement with fluoroscopy before creation with a spinal needle.
14. Three 8.25-mm flexible Trim-It Custom Hip Cannulas (Arthrex) are customized to the appropriate length using detachable Trim-It Cannula Obturators (Arthrex) and placed through the modified PL, AL, and midanterior portals.

Footprint Micropuncture

15. A microfracture awl (Arthrex) is then inserted through the modified PL portal and the area of gluteus medius tendinopathy is visualized.
16. The limb can be rotated internally and externally to provide better access to the entire greater trochanter for posterior and anterior pathology, respectively.
17. The area of gluteus medius footprint and the surrounding area are then punctured with the microfracture awl ([Fig 1](#)). The technique is similar to the “crimson duvet” described by Snyder and Burns.¹³
18. The awl is typically driven into the bone to a depth of 3 to 5 mm with a light mallet after piercing the tendon.

Performing the Knotless Repair

19. The repair is carried out using Knotless SutureTaks (Arthrex).
20. A total of 4 anchors are required. Two anchors placed anteriorly on the abductor footprint, 1 proximal and 1 distal, and 2 placed posteriorly in a similar manner.
21. A 2.4-mm metal punch is used first to create a pilot hole for the anchor ([Fig 2A](#)).

Table 1. Equipment

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- 70° arthroscope
 - Three 8.25 × 9 Arthrex twist in cannulas
 - Four Arthrex Knotless SutureTaks
 - Arthrex 2.3-mm punch
 - Epinephrine (1 mg/3 L bag of fluid)
 - Arthrex 30° bird beak suture passer
 - Arthrex suture retriever
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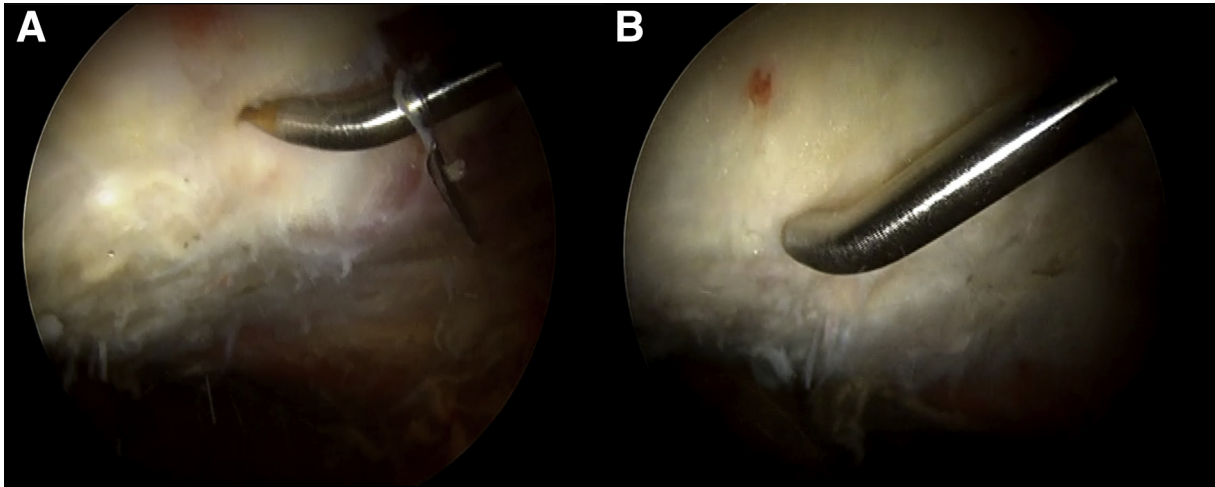


Fig 1. Left hip arthroscopy viewed from the distal lateral accessory portal with the patient in the supine position. (A) Microfracture awl is inserted and the area of gluteus medius tendinopathy is visualized. (B) The area of the gluteus medius footprint is punctured with the microfracture awl to introduce vascularity.

22. The punch is advanced through the tendon by twisting the punch to minimize any tendon damage.
23. The punch is then placed on the proximal footprint of the tendon and malleted into the trochanter under fluoroscopic guidance to ensure it is placed in the correct trajectory.
24. The anchor is placed through the tendon and into the hole created by the punch (Fig 2B). The posteroproximal anchor is placed first, followed by the anteroproximal anchor, then posterodistal, and finally the anterodistal anchor (essentially working farthest from the endoscope to nearest).
25. When placing posterior anchors, the leg should be internally rotated near its maximum to make sure the punch is perpendicular to the bone. When placing anterior anchors, the foot should be approximately neutral. They should both be placed under fluoroscopic guidance.
26. Each pair of anchors (2 proximal and 2 distal) will now be linked together compressing the underlying abductor tissue between the anchors down to the bone with the suture staple construct.

Linking Anchor Pairs

27. The Knotless SutureTaks anchors contain both a FiberWire suture and a FiberLink that also go through the anchor for shuttling purposes.
28. First, the FiberWire from the posteroproximal anchor as well as the FiberLink suture from the

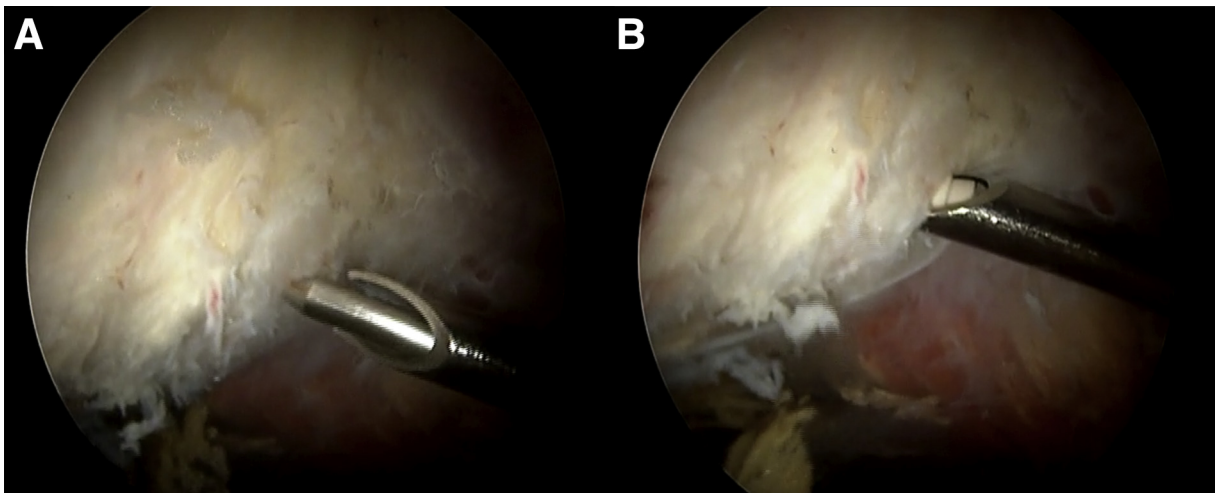


Fig 2. Left hip arthroscopy viewed from the distal lateral accessory portal with the patient in the supine position. (A) The 2.4-mm metal punch is used to create a pilot hole for the anchor. (B) The anchor is placed through the tendon and into the pilot hole. The posterodistal anchor is shown.

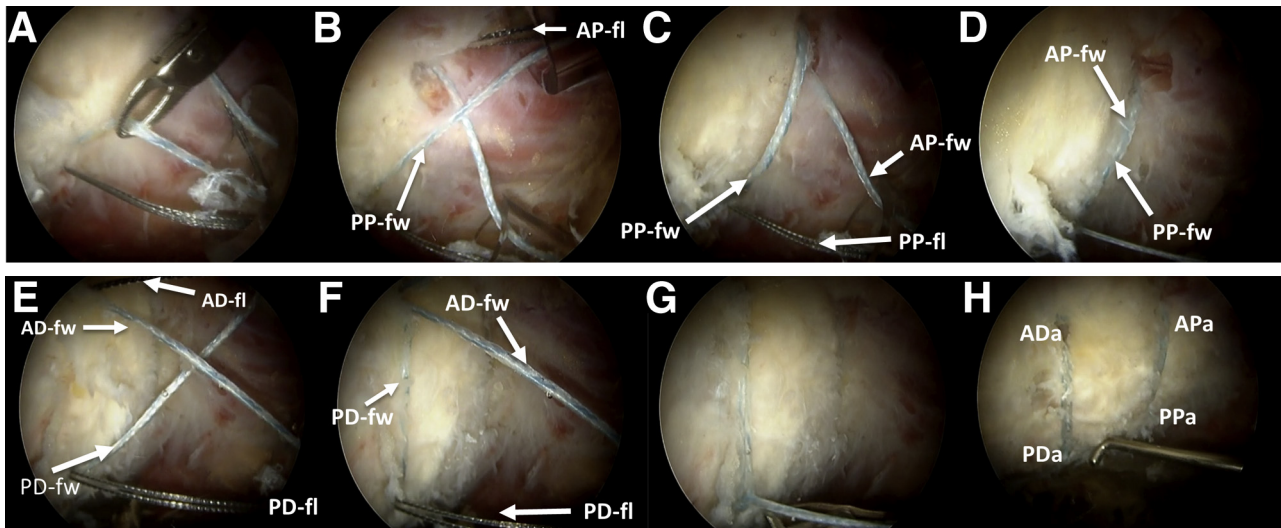


Fig 3. Left hip arthroscopy viewed from the distal lateral accessory portal with the patient in the supine position (A) First, the FiberWire suture from the posteroproximal (PP-fw) anchor is pulled out the anterior cannula. (B) The FiberLink from the anteroproximal (AP-fl) anchor is also pulled through the anterior cannula. (C) The FiberWire suture from the PP-fw anchor is placed through the loop of the FiberLink shuttle of the AP-fl anchor and the PP-fw is shuttled through the AP-fl anchor. (C) The anteroproximal FiberWire suture (AP-fw) and the posteroproximal FiberLink (PP-fl) sutures are pulled out through the posterior cannula. (D) The AP-fw suture is then shuttled through the PP-fw anchor via the PP-fl, creating the proximal staple. The process for the proximal pair of anchors is repeated for the distal set of anchors. (E) The posterodistal FiberWire suture (PD-fw) is passed through the FiberLink shuttle wire of the anterodistal (AD-fl) anchor through the anterior cannula. (F) The FiberLink from the posterodistal anchor (PD-fl) and the anterodistal FiberWire suture (AD-fw) are pulled out the posterior portal. (G) The AD-fw is then shuttled through the posterior anchor using the PD-fl. (H) The final construct of the double knotless suture staple demonstrating the linkage of the posteroproximal anchor (PPa) with the anteroproximal anchor (APa), as well as the posterodistal anchor (PDa) with anterodistal anchor (ADa).

anteroproximal anchor are pulled through the anterior cannula (Fig 3 A and B).

29. The FiberWire from the posteroproximal anchor is then passed through the loop of the FiberLink of the anteroproximal anchor and the FiberLink is used to shuttle the FiberWire of the posteroproximal anchor (Fig 2) through the anteroproximal anchor (Fig 3C).
30. The same process is repeated with the FiberWire from the antero-proximal anchor and the FiberLink from the posteroproximal anchor. The result is a pair of sutures linking the 2 anchors, compressing the tissue between them (Fig 3D).
31. The whole process for the proximal pair of anchors is repeated in the same manner for the distal couple of anchors (Fig 3E-G)

The final configuration is illustrated in Figure 3H. This produces a construct that links each couple of suture anchors together to form the suture staple construct.

An alternative knotless configuration using the Knotless SutureTak anchors is to place the 4 anchors in the same positions described previously but coupling them in a cross configuration, the posterodistal with the anteroproximal and the posteroproximal with the anterodistal. Using the same technique for passing the sutures will create an X-shaped configuration

compressing the tendon tissue against the bone as illustrated in Figure 4.

Discussion

This article describes 2 techniques for knotless suture staple repair of a partial-thickness undersurface tear of the abductor tendons (Table 2). Several techniques for repair of the torn gluteus tendon have been reported. Open techniques include the use of soft-tissue anchors as described by Davies et al.¹⁴ Bunker et al.¹⁵ used intraosseous sutures and decortication of the greater trochanter to achieve a bleeding bone bed that would promote tendon to bone healing.

Endoscopic techniques for gluteus tendon repair include the one described by Voos et al.⁷ for tears that can be seen from the peritrochanteric compartment. A bursectomy was performed that enabled visualization of the torn tendon. Then they debrided the edges of the tear and attached the tendon to its footprint in the greater trochanter with the use of suture anchors under fluoroscopic guidance. They reported on a cohort of 10 patients in whom this technique was used, and all patients had pain resolution and regained full hip abduction strength. At 1 year, Modified Harris Hip Scores averaged 94 points and Hip Outcomes Scores averaged 93 points.⁸

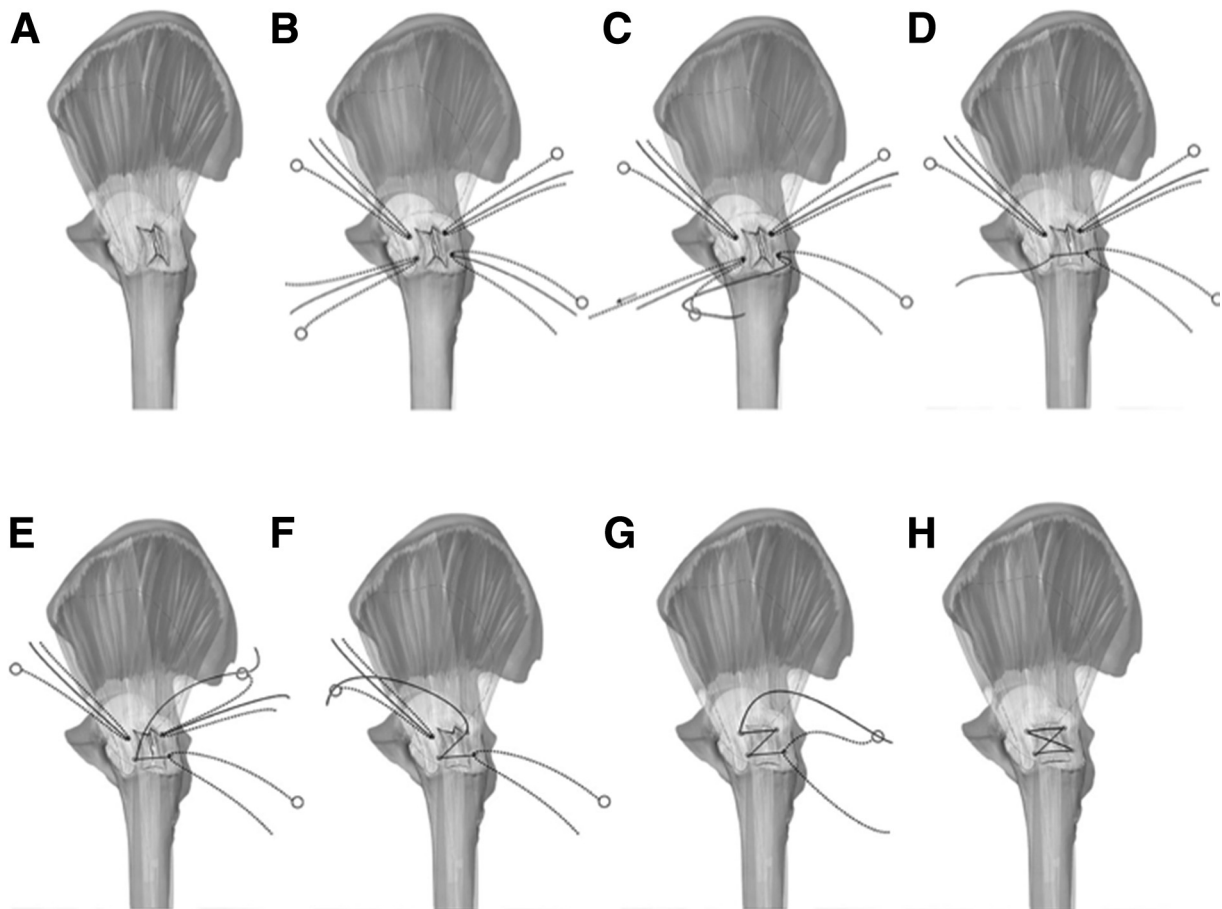


Figure 4. Alternative suture configuration. (A) partial thickness tear is located endoscopically. (B) Four Arthrex knotless SutureTaks are then placed through the tendon and into trochanteric bone under fluoroscopic guidance. Two in the anterior leaflet and two in the posterior leaflet as demonstrated (C). The suture shuttling process is now begun. The fiberwire from the posterodistal anchor is shuttled through the anterodistal anchor utilizing the FiberLoop from the anterodistal anchor (D). After the suture has been shuttled (E). The Fiberwire from the anterodistal anchor is then shuttled through the posteroproximal anchor using the posteroproximal FiberLoop (F). The Fiberwire from the postero-proximal anchor is shuttled through the anteroproximal anchor using the anteroproximal FiberLoop (G). Then finally the anteroproximal Fiberwire is shuttled through the posterodistal anchor using the posterodistal FiberLoop (H). The final construct, demonstrating compression of the abductor tissue down to freshly decorticated trochanteric bone.

In 2010, Domb et al.¹⁰ published the endoscopic transtendinous approach for undersurface partial-thickness gluteus medius repair which allowed good visualization, debridement, bone preparation, and repair of these undersurface tears. The abductor tendons were repaired with suture anchors passed through the anterior and posterior leaflets of the tendon and then tied

down. This required passage of sutures through the tendon and required tying arthroscopic knots on the superficial surface of the tendon, which can rub on the undersurface of the IT band and may predispose to development of trochanteric pain postoperatively.

Both of the techniques described in this article use knotless technology, and without knots, the surgeon

Table 2. Keys to Successful Suture Staple Repair of the Abductor Tendon

- Run systolic blood pressure <100 mm Hg, and use epinephrine in inflow if bleeding is a problem.
- Use diagnostic arthroscopy with diligent probing of the abductor insertion to look for area of deficiency noted with preoperative magnetic resonance imaging.
- Use the punch under direct visualization and fluoroscopic guidance. Move quickly from the punch to the anchor so that the tract through the tendon and bone remain aligned.
- Do not try to punch all 4 holes and then place the anchors, because this will cause bleeding that will make anchor placement difficult.
- When placing posterior anchors, place the leg in nearly maximal internal rotation.
- Proper suture management is key because the surgeon will have 12 limbs of suture at the beginning. Take the FiberLoop and FiberWire out of the cannula nearest the anchor the FiberWire is being shuttled through for the most direct line of pull for the FiberLoop.

Table 3. Indications, Advantages, and Disadvantages of This Technique of Endoscopic Suture Staple Repair of the Abductors

Indications	<ul style="list-style-type: none"> • Greater trochanteric pain syndrome not relieved with conservative treatment • Magnetic resonance imaging indicating partial thickness undersurface tear of the abductor tendons
Advantages	<ul style="list-style-type: none"> • Great compression of abductor tissue • Knotless minimizes undersurface iliotibial band irritation • Small bioabsorbable suture anchors • Multiple holes in the bone can release biologically stem cells to repair sight • No suture passage • No tendon splitting
Pitfalls	<ul style="list-style-type: none"> • Bleeding secondary to uncontained peritrochanteric space and multiple holes placed in the bone + epinephrine, systolic blood pressure <90 mm Hg • Immediately after creating hole for anchor, place anchor • Holes in the abductor tendons + twist 2.3-mm punch to minimize tendon damage, and use small anchor

negates any IT band irritation from suture tails. A knotless technique also negates the need for knot tying and suture passage through the tendon, which can decrease surgical time. In addition, these techniques do not require violating the tendon fibers by creating a split, which has the advantage of keeping the tendon intact and may also shorten surgical time. The suture anchor construct gives broad compression of the abductor tendon onto the trochanteric footprint, theoretically increasing the likelihood of healing secondary to more tendon contacting the bone. Linking couples of anchors together increases the strength of the repair by having the anchors share the load. Increasing the number of holes in the bone for suture anchor placement may allow more marrow elements to escape and possibly assist in tendon healing (Table 3).

The disadvantages of this technique are that bleeding can be an issue at times when placing 4 holes into the trochanter. We recommend keeping systolic blood pressure around 90 mm Hg, using epinephrine in the inflow, diligently coagulating bleeders, and having canulas in all portals with the exception of the viewing portal to restrict outflow. To place the anchor into bone, the tendon must be penetrated with a punch. We attempt to minimize any damage to the tendon by twisting the punch through the tendon to develop a plane between abductor fibers. The Knotless SutureTaks do not have the pullout strength of a larger corkscrew anchor. This is combatted by linking the anchors together so they all share the load. Performing the transtendinous split allows the surgeon to decorticate the

bone of the greater trochanter, which cannot be performed in this technique. The authors attempt to mitigate this perceived disadvantage by placing multiple small perforation in the cortex as well as 4 anchors in the trochanter to increase the egress of marrow elements.

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