Diagnosis, Evaluation, and Endoscopic Repair of Partial Articular Gluteus Tendon Avulsion

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Abstract: In addition to trochanteric bursitis, gluteus medius and minimus tears (GMMTs) can be a common source of insidious lateral hip pain and dysfunction. Partial-thickness GMMTs are much more common than full-thickness GMMTs but are frequently overlooked by both radiologists and orthopaedic surgeons. GMMTs are commonly identified on magnetic resonance imaging ordered for lateral hip pain unresponsive to conservative management. Imaging can show that high-grade partial articular gluteus tendon avulsion (PAGTA) can occur as either an isolated gluteus medius tear, an isolated gluteus minimus tear, or a combined GMMT. We describe how to identify PAGTA injuries with intraoperative assessment and identification of the interval between the gluteus medius and minimus tendons to allow access to the PAGTA without violating the bursal side of the tendon. PAGTAs can be repaired arthroscopically by single- or double-row suture anchor fixation depending on the size of the tear. The purpose of this article is to guide orthopaedic surgeons in the recognition of PAGTA with magnetic resonance imaging and dynamic examination to allow for accurate repair of GMMTs.

Greater trochanteric pain syndrome is a relatively common clinical entity and thought to be observed in 10% to 25% of the general population.[1] A recent study suggested that gluteus medius and minimus tears occur in 25% of middle-aged women and 10% of middle-aged men.[2] The vast majority of patients with spontaneous gluteus medius and minimus tears present with an insidious onset of direct lateral-sided hip pain due to intrinsic degeneration of the abductor tendons.[3] On examination, tenderness is generally centered over the greater trochanter and hip abduction weakness is usually appreciated.[4-6]

Tears of the medius and minimus were first described by Bunker et al.[7] and Kagan[8] in the late 1990s, with each independently coining the term "rotator cuff tears of the hip." Tears of these tendons occur most commonly at their respective footprints on the greater trochanter. They have been documented to occur in 1 of 3 primary manifestations: intrasubstance, partial, or complete.[7-9] The natural progression of gluteus medius tendinopathy is similar to the pathogenesis of tendon degeneration elsewhere in the body. This generally begins with bursitis before progressing down the spectrum of tendinitis, tendinopathy, partial-thickness tears, full-thickness tears, and massive tears.[10]

Domb et al.[9] described the concept of partial gluteus medius tears and a method of repair by incising the bursal side of the gluteus medius to access the articular side of the gluteus medius tendon. We present the concept of partial articular gluteus tendon avulsion (PAGTA) as either an isolated gluteus medius tear, an isolated gluteus minimus tear, or a combined gluteus medius and minimus tear. The interval between the gluteus medius and minimus tendons can be identified and allow access to the PAGTA without violating the

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bursal side of the tendon, as well as allow anatomic repair of the PAGTA.

Imaging Studies

Advanced imaging studies are obtained in patients with lateral-sided hip pain recalcitrant to nonsurgical treatment. Some authors prefer ultrasonography as the initial imaging modality but it is operator dependent and more difficult to interpret unless performed with high frequency. Ultrasound has been shown to have a sensitivity of 79% and a positive predictive value of 100%.[11] Most orthopaedic surgeons prefer magnetic resonance imaging (MRI) to diagnose gluteal tendon abnormalities. In addition to the identification of a gluteus medius and/or minimus tear, the benefit of MRI is that other extra-articular and intra-articular pathology can be recognized.

In our institution, the MRI study includes a coronal series of the entire pelvis, which is useful for comparing the affected hip with the opposite hip. We prefer to assess the T2-weighted coronal series to evaluate the lateral and superoposterior facets of the greater trochanter (Fig 1 A and B). The insertion of the gluteus minimus is best visualized on the T2-weighted axial series (Fig 1C). Kingzett-Taylor et al.[4] found T2-weighted MRI of the superior greater trochanter to be diagnostic for partial abductor tendon tears, with high sensitivity (73%) and specificity (95%), but the rate of false-positive findings was reported to be as high as 88% in one series.[12]

Surgical Technique

The patient is positioned supine, and general anesthesia is induced for complete muscle relaxation (Video 1). A well-padded perineal post is placed, and the patient's feet are securely fastened into boots. The pelvis is slightly translated toward the contralateral hip, and gentle joint distraction of approximately 1 cm is obtained on the symptomatic hip. Preparation and draping are performed in the standard sterile fashion, ensuring that the anterior superior iliac spine and the greater trochanter are readily accessible. The tip of the greater trochanter is identified, and an anterolateral portal is established approximately 1 cm anterior and 1 cm proximal to the anterior aspect of the greater trochanter (Fig 2A).

A spinal needle (Stryker Sports Medicine, Greenwood Village, CO) is introduced into the central compartment, followed by the insertion of a guidewire and a 4.5-mm metal cannula (Stryker Endoscopy, San Jose, CA). Diagnostic arthroscopy can then be performed to evaluate intra-articular abnormalities. If there is evidence of chondrolabral injury, a midanterior portal (MAP) is established to allow the surgeon to perform either selective chondrolabral debridement or repair. A spinal needle (Stryker Sports Medicine) is placed through the skin at the level of the vastus ridge and

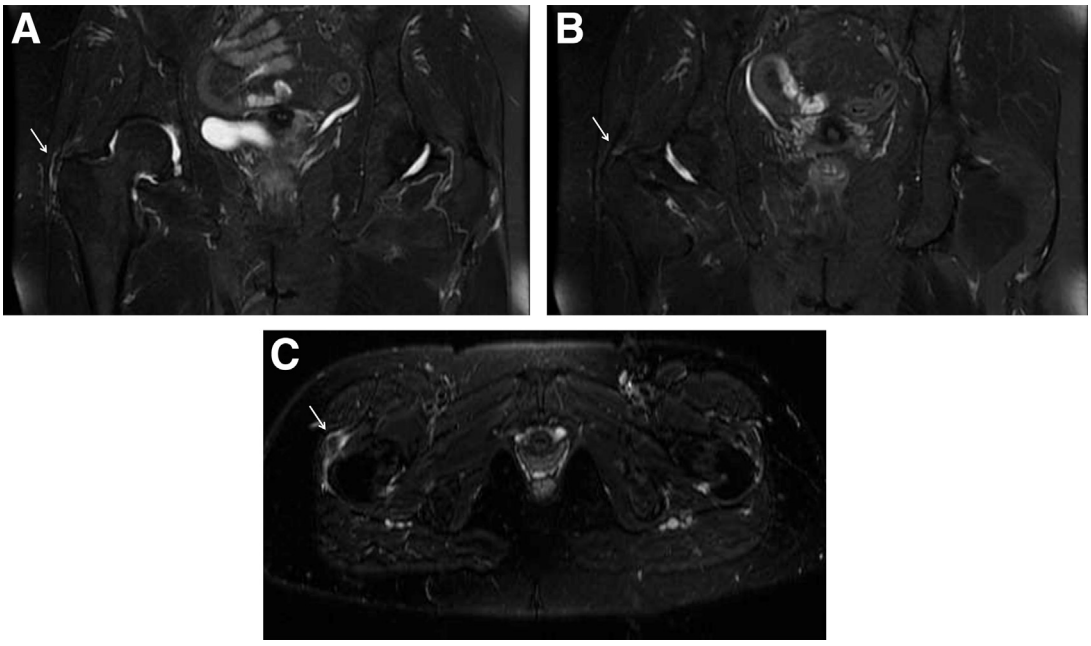

Fig 1. (A) Isolated partial-thickness gluteus medius tear. T2-weighted coronal series showing high signal at the insertion of the right gluteus medius tendon (arrow) at the level of the lateral footprint. (B) Isolated partial-thickness gluteus medius tear. T2-weighted coronal series of the right gluteus medius tendon showing that it does not extend to the superoposterior footprint (arrow). (C) Isolated partial-thickness gluteus minimus tear. T2-weighted axial series showing high signal at the insertion of the gluteus minimus (arrow) without involvement of the gluteus medius.

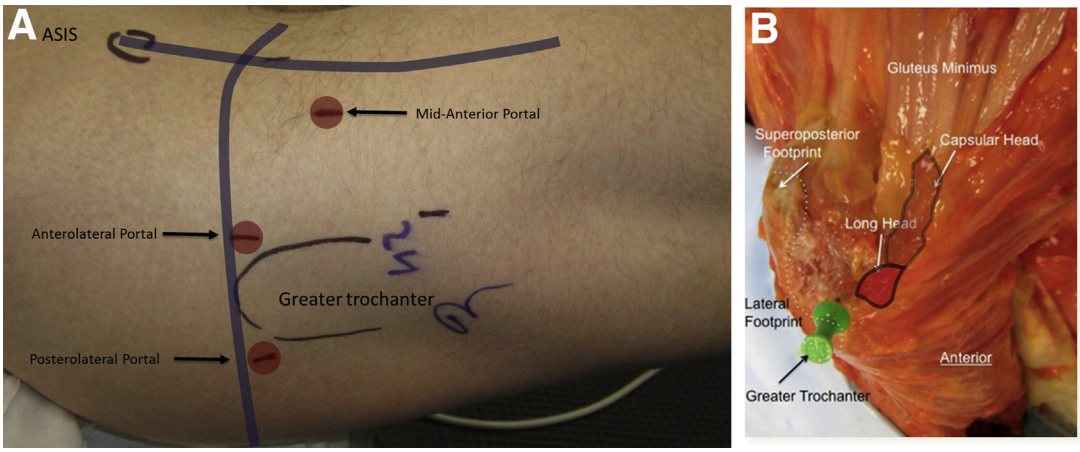

Fig 2. (A) Portal placement for right-sided partial articular gluteus tendon avulsion repair with the patient in the supine position. The midanterior viewing portal is located at the level of the vastus ridge. In addition to the anterolateral working portal and posterolateral portal, percutaneous portals may be used for anchor placement or suture management. (ASIS, anterior superior iliac spine.) (B) Interval between the gluteus medius and minimus tendons in a cadaveric specimen. The partial articular gluteus tendon avulsion tears are found between the lateral footprint of the gluteus medius and the long head of the gluteus minimus.

directed superiorly and medially toward the anterior triangle of the hip (Fig 2A). A guidewire (Stryker Sports Medicine) is advanced through the spinal needle, and a 5.0-mm metal cannula (Stryker Endoscopy) is passed over the guidewire. An arthroscopic shaver (Stryker Endoscopy) can be used to debride degenerative chondrolabral tissue.

Next, traction is released, and the lower limb is placed in complete extension and 15° to 20° of abduction with the foot in maximum internal rotation. The peritrochanteric space is entered with use of a 5.0-mm metal cannula (Stryker Endoscopy) through the MAP; the cannula is directed between the iliotibial band and the lateral aspect of the proximal part of the greater trochanter and is then swept from proximal to distal, opening the potential space. A 70° arthroscope (Stryker Endoscopy) is placed through the cannula and is used to visualize the distal aspect of the peritrochanteric space by aiming the arthroscope as well as the light source distally.

With use of a Wissinger rod through the anterolateral portal, a 5.0-mm metal cannula (Stryker Endoscopy) is positioned between the tip of the greater trochanter and the iliotibial band. A 4.5-mm shaver (Stryker Endoscopy) is introduced through the cannula, and a thorough bursectomy is performed until the gluteus maximus tendon is identified distally, the iliotibial band is identified laterally, the undersurface of the gluteus maximus is identified proximally, and the longitudinal fibers of the vastus lateralis are identified medially.

Step 1: Identification of PAGTA

The arthroscope (Stryker Endoscopy) can be placed in the anterolateral portal to allow for direct visualization of the abductor tendons by directing the arthroscope and the light source anterosuperiorly. The gluteus medius and minimus muscle bellies and tendon insertion should then be easily visualized; however, visualization of articular-sided partial-thickness tears presents a unique challenge because the bursal side is generally intact. In contrast to incising the gluteus medius tear from the bursal side,[5] we prefer to identify the PAGTA tears between the lateral footprint of the gluteus medius and the long head of the gluteus minimus (Fig 2B, Table 1). After bursectomy, the tear pattern can be recognized by use of a probe to palpate the bursal side of the tendon. We will carefully rotate the hip from maximum internal rotation to external rotation, and the bursal side of the PAGTA will be carefully evaluated for evidence of redundancy or blistering (Fig 3A). An additional technique to identify undersurface tears is the bubble sign test. This test involves placing a spinal needle (Stryker Sports Medicine) into the area of the tendon of highest concern and injecting approximately 10 mL of saline solution. If the tendon is detached underneath, the tendon will expand like a bubble, showing that it is detached underneath. We will use the preoperative MRI scan to determine if the tear is an isolated gluteus medius tear, isolated gluteus minimus

Table 1. Pearls and Pitfalls of Partial Articular Gluteus Tendon Avulsion Repair

Pearls
Identify partial articular gluteus tendon avulsion tears between the lateral footprint of the gluteus medius and the long head of the gluteus minimus.
Use the bubble sign test to locate subtle tears.
Pitfalls
Do not increase the tear size of the gluteus medius to access it from the bursal side.

tear, or combined gluteus medius and minimus tear. We advocate identifying the interval between the gluteus medius and minimus tendons (Fig 3B), which is similar to the interval between the supraspinatus and subscapularis in the shoulder. A probe (Stryker Endoscopy) can be used to determine the extent of the PAGTA because the gluteus medius tear generally involves the entire lateral footprint (Fig 3C).

Step 2: Access to Gluteus Medius and Minimus Interval

Once the location of the interval is identified, an arthroscopic shaver (Stryker Sports Medicine) can be used to debride the bursal side of the gluteus medius and minimus interval. Through the MAP, a tissue penetrator (Arthrex, Naples, FL) can be used with a traction suture (No. 2 Zipline; Stryker Sports Medicine) to retract the gluteus medius tear proximally, and the sutures are clamped with a hemostat through the anterolateral portal. Another traction stitch can be placed in the gluteus minimus to retract the tear distally so that the entire footprint can be visualized (Fig 3D), and the sutures are clamped with a hemostat through the MAP.

Step 3: Preparation of Greater Trochanter

Through the MAP, an arthroscopic shaver (Stryker Endoscopy) can be used to debride the tear edges, which may be required to facilitate tendon repair for high-grade partial tears. With use of an arthroscopic grasper (Arthrex), the tendon mobility is assessed to determine that it can be approximated onto the gluteus medius footprint without excessive tension. With use of a 5.0-mm cylindrical burr (Stryker Endoscopy), the greater trochanter is decorticated to facilitate healing.

Step 4: Gluteus Medius Suture Anchor Placement

The number of anchors and repair configuration depend on the size of the tear. For small gluteus medius tears, a single-row repair with 1 or 2 suture anchors is preferred. For large and massive tears, a double-row suture bridge technique is the preferred fixation construct.

A spinal needle (Stryker Sports Medicine) is used through a posterolateral portal (PLP), which is 1 cm posterior and 1 cm proximal to the tip of the posterolateral aspect of the greater trochanter, to percutaneously plan for anchor placement, and the appropriate anchor punch or tap is used into the greater trochanter. Next, one 5.5-mm double-loaded biocomposite anchor (Bio-Corkscrew; Arthrex) with No. 2 high-strength sutures (No. 2 Zipline; Stryker Sports Medicine) is placed at the lateral footprint of the gluteus medius (Fig 3E).

Step 5: Passage of Sutures Through Gluteus Medius and Minimus Tendons

Next, an 8.5 × 110−mm plastic cannula (Smith & Nephew, Andover, MA) is placed in the MAP, and a tissue penetrator (Arthrex) is used to retrieve suture from the anchor and each of the sutures is passed through the gluteus medius tendon (Fig 3F). Through the PLP, a loop retriever (Arthrex) is used to manage sutures until they are ready to be tied.

Step 6: Gluteus Minimus Suture Anchor Placement

If the gluteus minimus is also involved, then another suture anchor is placed at the midpoint of the long head of the gluteus minimus footprint. Generally, the gluteus minimus anchor can be placed through the MAP. The appropriate anchor punch or tap is used into the greater trochanter. Next, one 5.5-mm double-loaded biocomposite anchor (Bio-Corkscrew) with No. 2 high-strength sutures is placed at the lateral footprint of the gluteus medius (Fig 3G). Through the MAP, a tissue penetrator is used to penetrate the gluteus minimus and to retrieve suture from the anchor for each of the sutures.

Step 7: Arthroscopic Knot Tying

Typically, 2 sets of horizontal mattress stitches are passed per anchor and are retrieved with a loop suture retriever (Arthrex) through the MAP. Next, each set of sutures can be tied with use of reverse half-hitches and alternating posts (Fig 3 H and I).

Step 8: Double-Row Suture Bridge Configuration

An 8.25-mm crystal cannula (Arthrex) is placed in the PLP, and 1 limb from each stitch is retrieved with a loop suture retriever (Arthrex). The surgical assistant should hold the cannula in position while the anchor punch is used to create the bone tunnel for the lateral-row anchor. The sutures are passed through the posterior lateral-row anchor (SwiveLock; Arthrex), and the anchor is inserted in the bone tunnel and screwed into place. Next, the foot is externally rotated to position the anchor slightly anterior, and the remaining sutures are retrieved through the PLP. Again, the surgical assistant should hold the cannula in position while the anchor punch is used to create the bone tunnel for the lateral-row anchor. The sutures are passed through the anterior lateral-row anchor (SwiveLock), and the anchor is inserted in the bone tunnel and screwed into place. The final appearance should show anatomic repair of the torn gluteus medius and minimus tendons over the respective anatomic footprint on the greater trochanter (Fig 3J). The hip is then rotated to ensure secure anatomic reduction and fixation of the torn PAGTA.

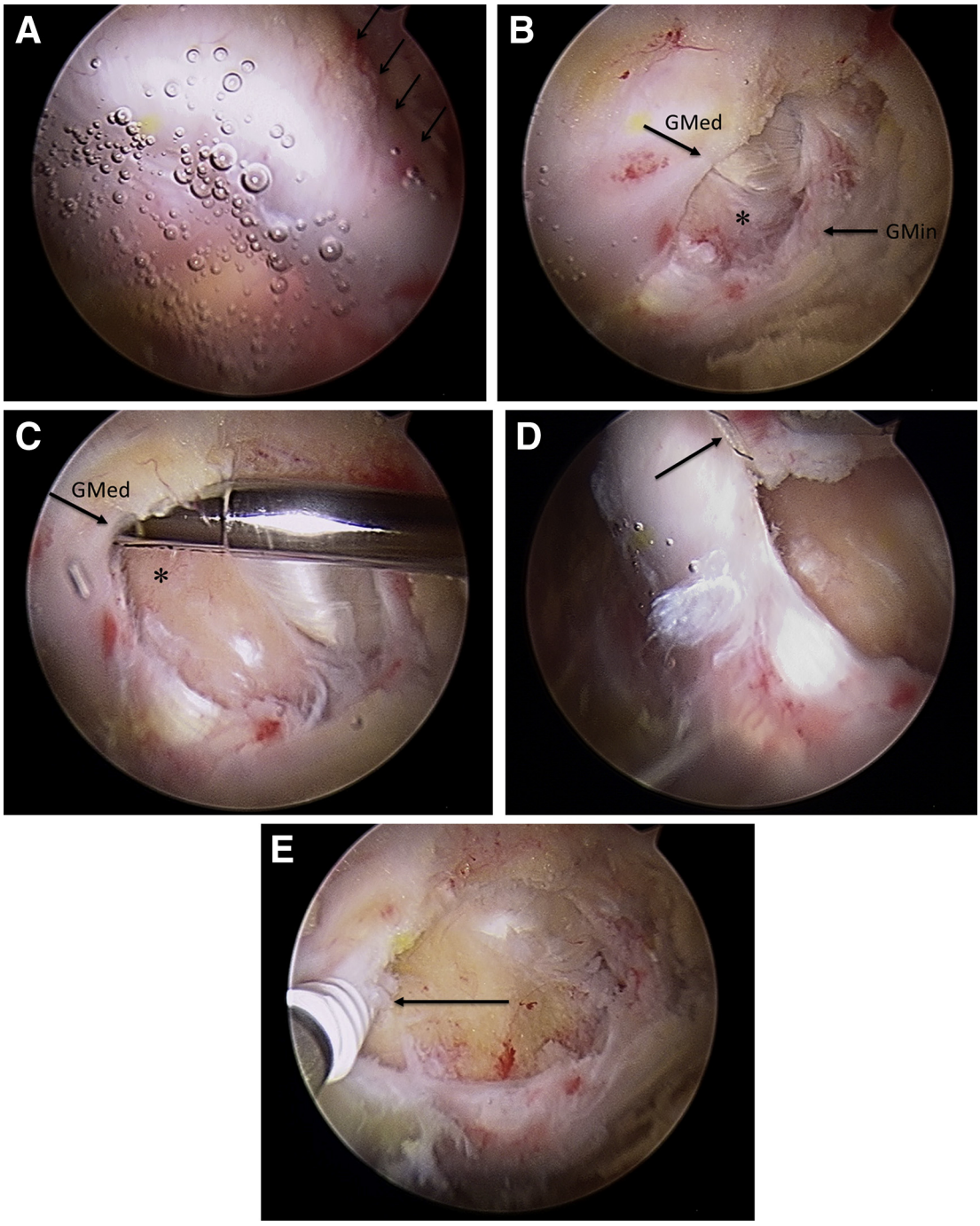

Fig 3. (A) Identification of right gluteus medius tear. Viewing through the midanterior portal, with internal rotation of the foot, the high-grade partial-thickness gluteus medius and minimus tear can be identified by the redundancy (arrows) of the torn tendon. (B) Interval between the right gluteus medius and minimus tendons, viewing from the midanterior portal. Once the area of torn tendon is identified, debridement of the superficial tendon at the interval (asterisk) will reveal the high-grade partial-thickness gluteus medius (GMed) and gluteus minimus (GMin) tears. (C) Determining the extent of the right gluteus medius (GMed) tear. Viewing through the midanterior portal, the interval is identified (asterisk); high-grade partial-thickness tears generally extend through the entire lateral footprint. (D) Traction suture placement. Viewing through the midanterior portal, a traction suture (arrow) can be used to retract the tear so that the entire extent of the gluteus medius tear can be accessed and repaired. (E) Right gluteus medius repair. A suture anchor (arrow) is placed at the superolateral extent of the lateral footprint of the right gluteus medius. (F) Suture placement. Sutures (arrows) can be positioned through the gluteus medius in a horizontal mattress configuration to allow for a double-row construct. (G) Gluteus minimus repair. A suture anchor (arrow) can be placed at the midpoint of the long head of the gluteus minimus footprint. (H) Gluteus medius repair. Medial-row fixation of the gluteus medius tendon (arrows) is performed. (I) Gluteus minimus repair. Medial-row fixation of the gluteus minimus tendon (arrows) is performed. (J) Double-row suture bridge construct (arrows) incorporating the right gluteus medius and minimus.

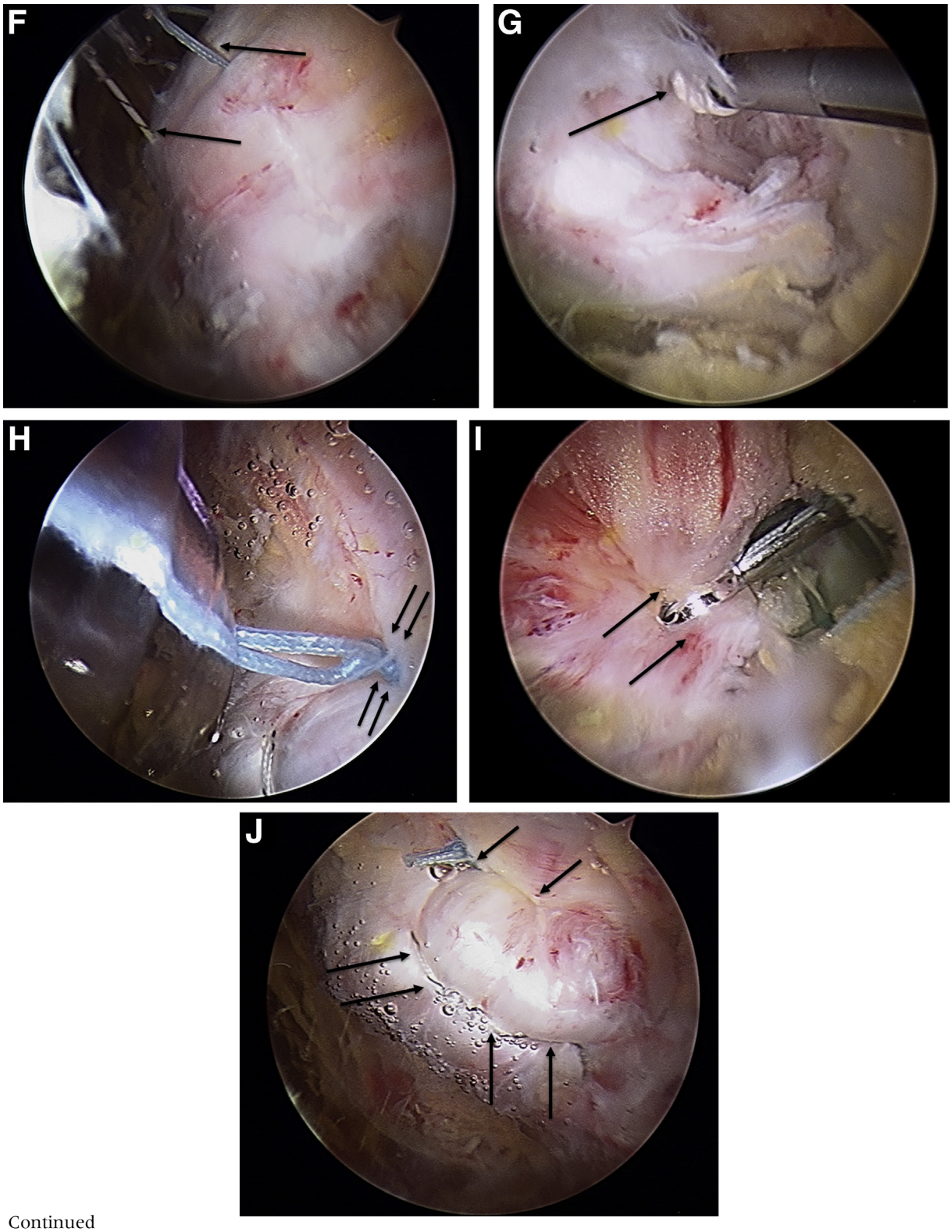

Fig 3. Continued

Table 2. Advantages and Risks of Partial Articular Gluteus Tendon Avulsion Repair

Advantages
Technique allowing for identification and anatomic repair of abductor tendons
Minimally invasive arthroscopic approach
Risks
Inherent risks of surgery (infection, nerve injury)
Incomplete repair of partial tear

Discussion

Hip abductor tears are an increasingly recognized problem in the middle-aged population. Proper clinical evaluation leading to arthroscopic intervention in which the pathology can be visualized and repaired can lead to significant improvements in pain, strength, and validated patient-reported outcome scores.

Case series of endoscopic gluteus medius tendon repair have shown the efficacy of the technique at minimum patient follow-ups of greater than 2 years.[13,14] Voos et al.[13] reported that all 10 patients undergoing repair showed 100% resolution of pain and return of full strength in hip abduction at 25 months. Of the 10 patients, 7 reported that their hip was normal and 3 reported that their hip was nearly normal. Domb et al.[14] showed an average improvement in patient-reported outcome scores of more than 30 points with satisfaction reported as good to excellent in 14 of 15 patients. Although this technique carries the inherent risks of surgery, it affords the opportunity for anatomic repair of abductor tears, which has been shown to decrease pain and improve function in the literature (Table 2).

PAGTAs are difficult to diagnose with MRI and endoscopic evaluation is challenging given the location of the pathology. We present the PAGTA as either an isolated gluteus medius tear, an isolated gluteus minimus tear, or a combined gluteus medius and minimus tear. The interval between the anterior aspect of the lateral footprint of the gluteus medius and the posterior aspect of the long head of the gluteus minimus is a native anatomic division that can be used to access these PAGTAs without violating the native bursal side of the tendon. These PAGTAs generally involve the entire extent of the tendon footprint and need to be identified so that a comprehensive repair strategy can be used.

References

1. Segal NA, Felson DT, Torner JC, et al. Greater trochanteric pain syndrome: Epidemiology and associated factors. *Arch Phys Med Rehabil* 2007;88:988-992.
2. Robertson WJ, Gardner MJ, Barker JU, Boraiah S, Lorich DG, Kelly BT. Anatomy and dimensions of the gluteus medius tendon insertion. *Arthroscopy* 2008;24:130-136.
3. Cvitanic O, Henzie G, Skezas N, Lyons J, Minter J. MRI diagnosis of tears of the hip abductor tendons (gluteus medius and gluteus minimus). *AJR Am J Roentgenol* 2004;182:137-143.
4. Kingzett-Taylor A, Tirman PF, Feller J, et al. Tendinosis and tears of gluteus medius and minimus muscles as a cause of hip pain: MR imaging findings. *AJR Am J Roentgenol* 1999;173:1123-1126.
5. Chandrasekaran S, Lodhia P, Gui C, Vemula SP, Martin TJ, Domb BG. Outcomes of open versus endoscopic repair of abductor muscle tears of the hip: A systematic review. *Arthroscopy* 2015;31:2057-2067.e2.
6. Alpaugh K, Chilelli BJ, Xu S, Martin SD. Outcomes after primary open or endoscopic abductor tendon repair in the hip: A systematic review of the literature. *Arthroscopy* 2015;31:530-540.
7. Bunker TD, Esler CN, Leach WJ. Rotator-cuff tear of the hip. *J Bone Joint Surg Br* 1997;79:618-620.
8. Kagan A II. Rotator cuff tears of the hip. *Clin Orthop Relat Res* 1999:135-140.
9. Domb BG, Nasser RM, Botser IB. Partial-thickness tears of the gluteus medius: Rationale and technique for transtendinous endoscopic repair. *Arthroscopy* 2010;26:1697-1705.
10. Mascarenhas R, Frank RM, Lee S, Salata MJ, Bush-Joseph C, Nho SJ. Endoscopic treatment of greater trochanteric pain syndrome of the hip. *JBJS Rev* 2014;2:e2.
11. Westacott DJ, Minns JI, Foguet P. The diagnostic accuracy of magnetic resonance imaging and ultrasonography in gluteal tendon tears—A systematic review. *Hip Int* 2011;21:637-645.
12. Kong A, Van der Vliet A, Zadow S. MRI and US of gluteal tendinopathy in greater trochanteric pain syndrome. *Eur Radiol* 2007;17:1772-1783.
13. Voos JE, Shindle MK, Pruett A, Asnis PD, Kelly BT. Endoscopic repair of gluteus medius tendon tears of the hip. *Am J Sports Med* 2009;37:743-747.
14. Domb BG, Botser I, Giordano BD. Outcomes of endoscopic gluteus medius repair with minimum 2-year follow-up. *Am J Sports Med* 2013;41:988-997.