Technical Note

Arthroscopic Suprapectoral Biceps Tenodesis: A Knotless, Onlay, All-Suture Anchor Technique

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Abstract: Anterior shoulder pain is a common complaint often caused by pathology of the long head of the biceps such as biceps tendinitis, partial biceps tears, biceps instability, and SLAP lesions. Surgical treatment of biceps pathology includes tenotomy versus tenodesis, with tenodesis being favored in young, active patients owing to less cramping pain and superior outcomes in terms of shoulder function and cosmesis. Various surgical techniques for tenodesis of the long head of the biceps exist, with varying indications. Subpectoral biceps tenodesis is primarily indicated for zone 2 to 3 tendon pathology and revision biceps tenodesis. Secondary indications include overhead athletes, chronic biceps tendinopathy, and rotator cuff repair. Proximal arthroscopic biceps tenodesis performed "high in the groove" has been shown to preserve biceps length and reduce Popeye deformity compared with tenotomy. Knotless techniques are becoming popular; they provide low-profile fixation that limits knot abrasion and is not reliant on knot security for fixation. We present a variation of suprapectoral biceps tenodesis using knotless fixation in an onlay technique.

Anterior shoulder pain is a common complaint often caused by long head of the biceps (LHB) pathology such as biceps tendinitis, partial biceps tears, biceps instability, and SLAP lesions.[1] Surgical treatment of biceps tendinopathy includes tenotomy versus tenodesis, with tenodesis being favored in young, active patients owing to less cramping pain and superior outcomes in terms of shoulder function and cosmesis.[2,3] Current indications for arthroscopic biceps tenodesis include biceps tendinopathy with or without SLAP lesions in the absence of pain within the bicipital groove.[4] For arthroscopic biceps tenodesis, many fixation techniques exist, but there is no current gold standard. Both onlay and inlay techniques have previously been described using suture anchors, interference screws, buttons, or bony tunnels. Knotless techniques are becoming popular; they provide low-profile fixation that limits knot abrasion and is not reliant on knot security for fixation.[5] We present a variation of suprapectoral biceps tenodesis using knotless fixation in an

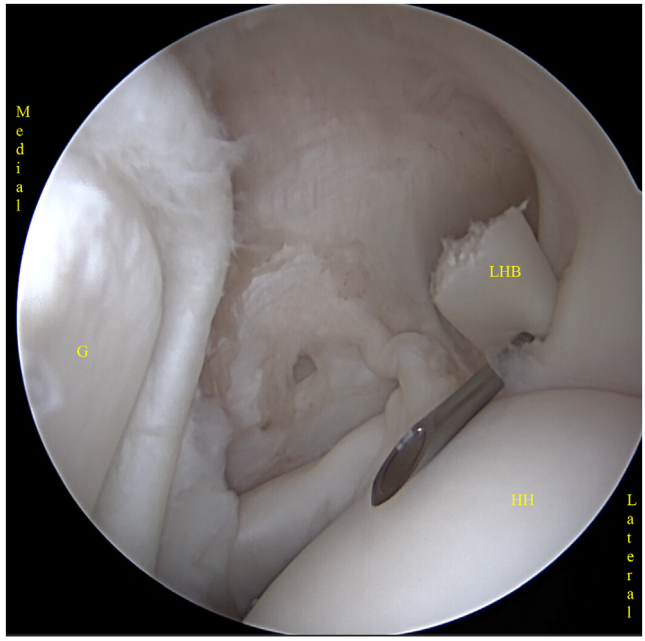

Fig 1. Arthroscopic view of intra-articular space from posterior portal in right shoulder with patient in beach-chair position showing spinal needle placement through biceps tendon to tag tendon, prevent retraction, and help with ease of identification within subacromial space. (G, glenoid; HH, humeral head; LHB, long head of biceps tendon.)

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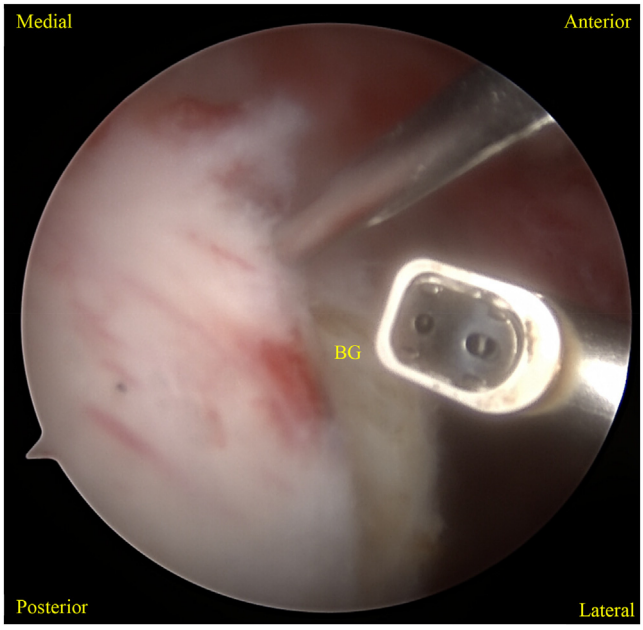

Fig 2. Arthroscopic view of subacromial space from lateral portal in right shoulder with patient in beach-chair position showing visualization of previously placed spinal needle, which assists with bicipital groove (BG) identification.

onlay technique that has been performed successfully at our institution.

Surgical Technique

Patient Positioning and Diagnostic Arthroscopy

The patient is placed in either the beach-chair or lateral position based on surgeon preference (Video 1). A standard posterior portal is created, and a 30° arthroscope is introduced. Diagnostic arthroscopy is performed, and an anteroinferior portal is created under direct visualization. Once appropriate biceps pathology is confirmed, a spinal needle is placed into the biceps to tag it and prevent retraction—and for ease of visualization in the subacromial space. A biceps tenotomy is then performed at the junction between the biceps and superior labrum (Fig 1).

Arthroscopic Biceps Tenodesis

The posterior portal is used to enter the subacromial space. A direct lateral working portal is created under direct visualization, and a thorough subacromial bursectomy is performed. The arthroscope is then moved to the lateral portal. The spinal needle tagging the biceps tendon is identified, and by use of an additional spinal needle, an accessory anterior-inferior portal is created in line with the bicipital groove. The previously tenotomized biceps tendon is found within its groove in the subacromial space (Fig 2), and a grasper is introduced from the posterior portal for manipulation of the tendon while groove debridement in performed from the accessory anterior portal with a radiofrequency device (Fig 3A). Debridement is extended distally until the fibrocartilage within the bicipital groove is seen (Fig 3B).

A 1.8-mm FiberTak anchor (Arthrex, Naples, FL) is placed at the distal aspect of the prepared groove (Fig 4A). A suture retriever is brought through the accessory anterior portal, and a loop of the repair

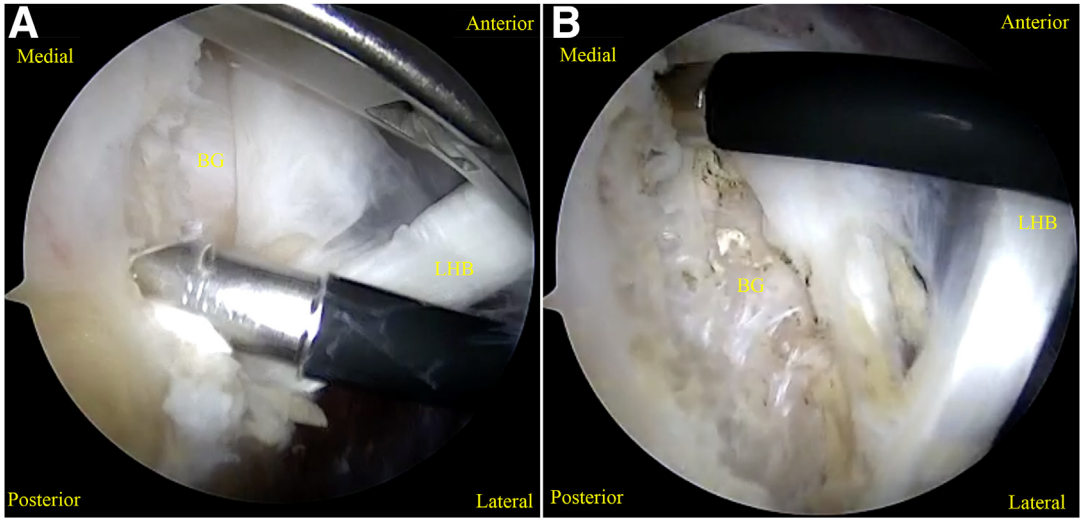

Fig 3. (A, B) Arthroscopic view of subacromial space from lateral portal in right shoulder with patient in beach-chair position. A grasper is used from the posterior portal to manipulate the biceps tendon (A) while a radiofrequency ablator from the accessory anterior portal is used to clear the bicipital groove (BG) down to the level of fibrocartilage (B). (LHB, long head of biceps tendon.)

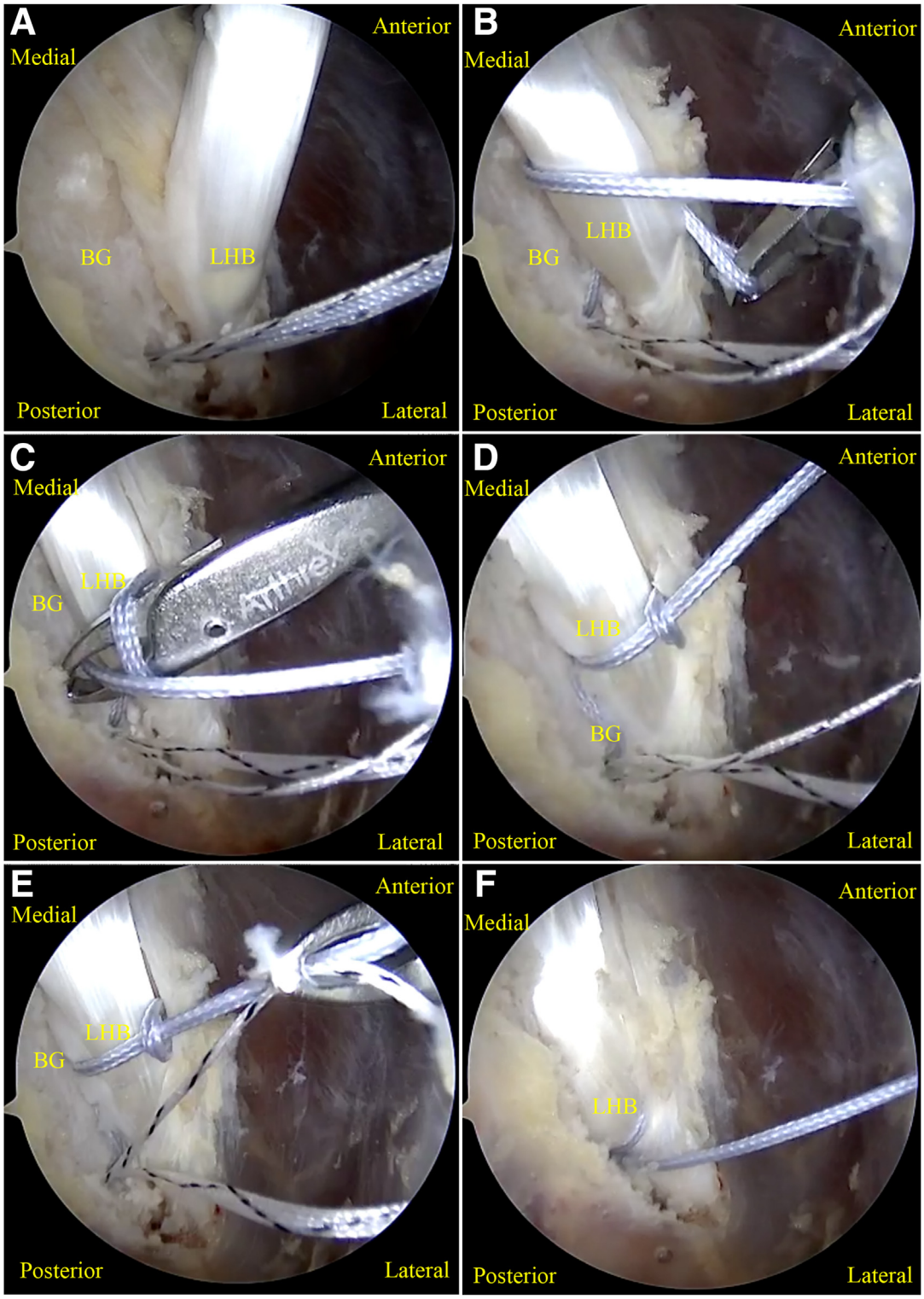

Fig 4. Arthroscopic view of subacromial space from lateral portal in right shoulder with patient in beach-chair position. (A) A 1.8-mm FiberTak anchor is placed at the distal aspect of the prepared groove. (B) A suture retriever is brought through the accessory anterior portal, and a loop of the repair suture is created under the biceps. (C, D) The suture retriever is placed through the loop (C), and the remainder of the repair suture is brought over the top of the biceps and through the loop, creating a luggage-tag stitch (D). Throughout this process, an intraoperative assistant manipulates the biceps tendon into appropriate position with a grasper from the posterior portal. (E) The repair suture and shuttle suture are retrieved in unison via the accessory anterior portal to avoid the creation of a soft-tissue bridge. (F) The repair suture is converted through its anchor with the shuttle suture. The suture tail is cut. (BG, bicipital groove; LHB, long head of biceps tendon.)

Fig 5. Arthroscopic view of subacromial space from lateral portal in right shoulder with patient in beach-chair position showing final fixation of biceps tendon with three 1.8-mm knotless anchors. (LHB, long head of biceps tendon.)

suture is created under the biceps (Fig 4B). The suture retriever is then placed through the loop (Fig 4C), and the remainder of the repair suture is brought over the top of the biceps and through the loop, creating a luggage-tag stitch (Fig 4D). Throughout this process, an intraoperative assistant manipulates the biceps tendon into an appropriate position with a grasper from the posterior portal. The repair suture and shuttle suture are then retrieved in unison via the accessory anterior portal to avoid the creation of a soft-tissue bridge (Fig 4E). The repair suture is converted through its anchor with the shuttle suture (Fig 4F). The suture tail is cut.

This process is repeated for a second anchor and third anchor more proximally until acceptable fixation is achieved (Fig 5). We have used both 2- and 3-anchor constructs successfully. Additionally, one or all repair sutures can be passed in an intrasubstance manner through the tendon itself with a BirdBeak device (Arthrex) or similar penetrating grasper if intrasubstance rip-stop fixation is preferred (Fig 6). Knotless suture anchors from various vendors can be used if a different colored suture is desired to avoid any suture mismanagement. Excess tendon is excised proximally and removed via the posterior portal by the assistant. The portals are closed in standard fashion.

Postoperative Rehabilitation

Patients are required to wear a sling for 4 weeks after biceps tenodesis. They can remove the sling to perform shoulder pendulum exercises and elbow passive range of motion. Otherwise, rehabilitation protocols are dictated by concomitant procedures (e.g., rotator cuff repair).

Discussion

Various surgical techniques for LHB tenodesis exist, with varying indications. Subpectoral biceps tenodesis is primarily indicated for zone 2 to 3 tendon pathology and revision biceps tenodesis, with secondary indications including overhead athletes, chronic biceps tendinopathy, and rotator cuff repair.[6] The pros of open subpectoral biceps tenodesis include its simplicity and utility in the revision scenario.[7] The cons of open subpectoral tenodesis may include poor cosmesis compared with arthroscopic techniques, higher wound-healing complication rates, and rare nerve injuries.[7] Proximal arthroscopic biceps tenodesis performed "high in the groove" has been shown to preserve biceps length and reduce Popeye deformity,[8] although early studies showed high revision rates.[9] However, a large case series by Brady et al.[4] showed good outcomes and revision rates as low as 0.4% for residual biceps tendon pathology. Current indications for arthroscopic biceps tenodesis include biceps tendinopathy with or without SLAP lesions in the absence of pain within the bicipital groove.[4]

In this paper, we describe a variation of onlay suprapectoral biceps tenodesis that uses all-suture anchor knotless fixation. There are multiple pearls that can ensure successful application of this technique, as well as pitfalls that may lead to complications (Table 1). This procedure has been accomplished with both 2- and 3-anchor constructs successfully. Additionally, the middle or distal anchor can be placed through the biceps tendon to function as a rip stop if desired. The pros of this technique include low-profile fixation that limits knot abrasion, no reliance on knot security, and clear visualization (Table 2). Cons may include postoperative stiffness in the early postoperative period, a learning curve for the surgeon, and the inability of this procedure to treat bicipital groove pain (Table 2).[7]

No current gold standard exists for biceps tenodesis. Most often, a bony rather than soft-tissue fixation technique is performed, which uses suture anchors, knotless anchors, interference screws, buttons, or bony tunnels. The "loop-and-tack" technique uses a suture anchor placed in the bicipital groove. The pros of the loop-and-tack technique include positive biomechanical and clinical results, reduced risk of Popeye deformity, and no need to find the biceps tendon in the subacromial space.[10] However, cons include challenging visualization, risk of intraoperative suture pullout, and reliance on suture anchor fixation until tendon scars within the groove.[10-13] A newer "tack-and-loop" technique places the anchor device first,

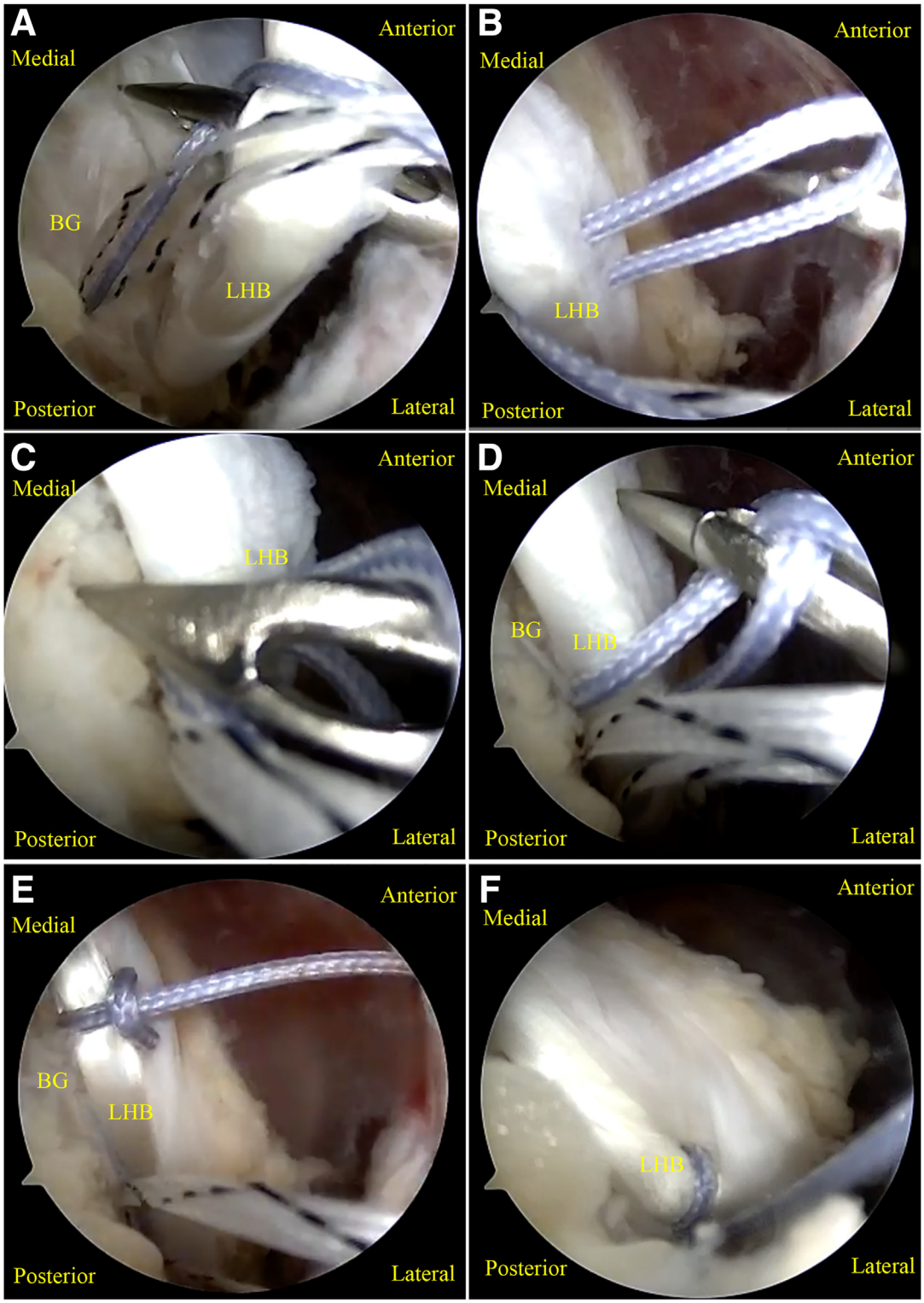

Fig 6. Arthroscopic view of subacromial space from lateral portal in right shoulder with patient in beach-chair position showing intrasubstance rip-stop fixation of biceps tendon by piercing tendon with penetrating grasper (A), creating loop of repair suture atop tendon (B), delivering grasper through loop (C), grasping remainder of repair suture (D), creating luggage-tag stitch (E), and converting repair suture through anchor (F). (BG, bicipital groove; LHB, long head of biceps tendon.)

Table 1. Pearls and Pitfalls of Knotless Arthroscopic Suprapectoral Biceps Tenodesis Technique

Advantages
Arthroscopic technique with decreased morbidity compared with open subpectoral technique
All-suture anchors theoretically create less long-term cystic change
Knotless mechanism avoids excess suture-related irritation from knot stacks
Disadvantages
Onlay fixation rather than inlay
Will not address bicipital groove pain

Table 2. Advantages and Disadvantages of Knotless Arthroscopic Suprapectoral Biceps Tenodesis Technique

Pearls
Tag the biceps with a spinal needle to avoid retraction and assist with subacromial visualization.
Manipulate the biceps with a grasper via the posterior portal.
Retrieve the repair and shuttle stitches together in a suture retriever pass prior to anchor conversion to avoid a soft-tissue bridge.
Note that 2- and 3-anchor constructs have been clinically successful.
Create an accessory anterior-inferior portal with a spinal needle in line with the bicipital groove.
Pitfalls
Place 1 anchor at a time to avoid suture tangling.
Ensure that no groove pain is present preoperatively.

improving visualization.[11] Other techniques perform fixation higher within the bicipital groove.[5,14] Recently, knotless techniques have become more popular.[5] It is our belief that knotless, all-suture fixation achieved in an onlay technique within the subacromial space provides a more anatomic "in-groove" tenodesis while avoiding the morbidity of open incisions or knot stacks. Further research is needed to determine differences in clinical outcomes over the short and long term.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: J.A.R. is on the *Arthroscopy* Editorial Board and Social Media Board. C.W.N. is a board or committee member of the American Academy of Orthopaedic Surgeons, American Orthopaedic Society for Sports Medicine, and AANA; is a paid presenter or speaker for Arthrex; is on the editorial or governing board of *Arthroscopy*; receives publishing royalties and financial or material support from *Arthroscopy*; is a paid consultant for Guidepoint Consulting; is a paid presenter or speaker for Vericel; and receives other financial or material support from AO Foundation. S.F.D. is a board or committee member of the American Orthopaedic Society for Sports Medicine and AANA; is a paid presenter or speaker for AO North America; receives research support from Arthrex; is on the editorial or governing board of *Arthroscopy*; and receives publishing royalties and financial or material support from Springer. All other authors (W.G.H., D.R.W.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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