

Simple Soft Tissue Biceps Tenodesis



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Abstract: This article describes a simple all soft tissue technique for arthroscopic long head of the biceps tenodesis to the subscapularis tendon using posterior and anterior portals. The technique uses a PDS suture that assists in passing a braided suture through both the biceps tendon and the subscapularis to allow for the desired tenodesis. This technique is simple, safe, efficient, and less costly than other techniques.

Tendinopathy of the long head of the biceps (LHB) can be a cause of shoulder pain.¹ Many patients can be treated successfully with conservative management such as anti-inflammatories and cortisone injections, but in some cases, surgical treatment is necessary based on the degree of pathology and/or failed conservative management. Surgical management generally consists of either performing an LHB tenotomy or tenodesis. Tenotomy, ideally for older and obese patients, avoids having to provide additional fixation of the tendon, but this technique is associated with increased risk for muscle cramping and decreased cosmesis.¹ For the younger and more active patient, a tenodesis of the LHB reduces the risk of muscle cramping and improves cosmesis but necessitates additional steps to provide fixation of the LHB. The ideal technique for tenodesis is thoroughly debated, and the proceeding technique describes a simple and effective method for LHB tenodesis.

Surgical Technique

After a thorough physical examination, all patients undergo x-ray imaging of the affected shoulder as well as noncontrast magnetic resonance imaging to evaluate the LHB and any other concomitant shoulder pathology. Surgery is indicated in patients who have failed conservative management for greater than 6 months. This technique is ideally suited for older (>60 years old) and lower-demand patients, with an LHB that shows evidence of being unstable, subluxation, inflammation, or symptomatic SLAP lesions, and without concomitant subscapularis pathology.

In the preoperative holding area, a standard ultrasound-guided interscalene regional nerve block is administered by trained anesthesiologists. The patient is placed in a lateral decubitus position with use of a peg board, and all bony prominences are well padded. Then, 7 lb of weight is applied to the arm using a pulley system that applies traction to the glenohumeral (GH) joint (Fig 1). The shoulder is prepped and draped in a sterile fashion. Prophylactic antibiotics are administered. Standard timeout is initiated. Bony surface landmarks are palpated and marked with a sterile marker. The posterior portal is defined by finding the soft spot between the infraspinatus and teres minor approximately 2 cm inferior and 2 cm medial to the posterolateral border of the acromion. A spinal needle is introduced into the joint, and the joint is insufflated with 20 cc of sterile irrigation fluid. The syringe is removed, and fluid flow back from the needle confirms appropriate placement into the GH joint. The needle is removed and a skin incision is made using an No. 11 blade, and then the arthroscopy trocar is introduced into the joint. A diagnostic arthroscopy is performed.

An anterior portal is established, and a 5-mm metal cannula is introduced into the joint through the rotator interval (Fig 2). Intraarticular work such as

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Fig 1. The patient is placed in a lateral decubitus position on a peg board. The head and feet are labeled for orientation. All bony prominences are well padded. The left arm is attached to a pulley traction device and prepped and draped in the normal sterile fashion. The bony anatomic landmarks are marked as seen with the arrow.

debridement is then performed through this cannula. Next, this metal cannula is removed and exchanged for a smooth 5.75-mm cannula (Fig 3). Through this smooth cannula, a suture passer device is then used to penetrate the biceps tendon, and a PDS suture is passed through the LHB (Fig 4A) and unloaded into the joint (Fig 4B). The device is removed from the joint, leaving a large amount of PDS suture in the GH joint as well as maintaining a portion through the LHB and through the cannula. Next, a tissue-piercing device is introduced through the cannula and penetrated through the subscapularis tendon, and then the unloaded end of the PDS suture (end that is through the LHB) is captured using the bird's beak and pulled out of the cannula (Fig 5). There are now 2 ends of PDS out of the cannula (one end in the LHB and the other in the subscapularis). In one end of the PDS, a loop is created, and a limb of the Orthocord (Depuy Mitek) suture is strangulated in this loop. The other end of the PDS is then pulled, shuttling the Orthocord (Depuy Mitek) through the LHB and subscapularis tendons (Fig 6), and the PDS is removed.

The LHB is then tenotomized from its origin using electrocautery, maintaining the labrum (Fig 7).

Through the anterior cannula, standard arthroscopic knots are used to tenodesis the LHB to the subscapularis tendon, and the sutures are cut using an arthroscopic suture cutter (Fig 8). The final tenodesis is inspected with gentle rotation of the arm (Fig 9, Video 1). After this is completed, other pathology is addressed in the joint and the subacromial space. The joint is then drained of fluid, and 3-0 nylon sutures are used to close the portal sites and dry sterile dressings are applied. Unless other concomitant procedures are done (i.e., rotator cuff repair), the patient is given a sling for comfort and then made non weightbearing for 3 weeks with only active range of motion of the elbow and wrist, after which range of motion of the shoulder is initiated and no resistance training until 8 weeks post-operatively. After 8 weeks, physical therapy is advanced (Table 1).

Discussion

This technique describes the tenodesis of the LHB to the subscapularis tendon with use of braided suture. This technique is simple, quick, effective, and less costly than other described techniques. Additionally, this is a simple technique to use when in the lateral decubitus position as doing an open biceps tenodesis can be more difficult while in this lateral position as compared to the beach-chair position. Using this technique, the authors note that in some patients, this leads to a subtle sulcus deformity, but this is less obvious than that of a Popeye deformity and has not been reported by patients as an issue of cramping or cosmesis. This technique is ideal in

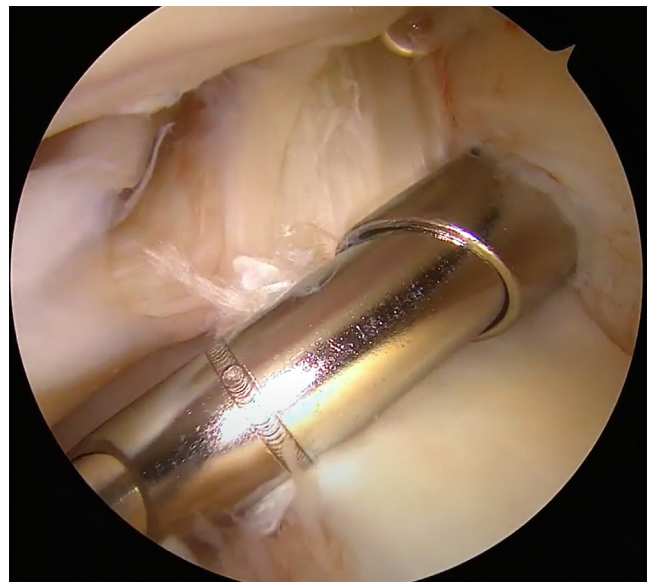


Fig 2. With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, a 5-mm metal cannula is introduced anteriorly through the rotator interval to allow for the smooth introduction of various instruments into the joint for initial evaluation.

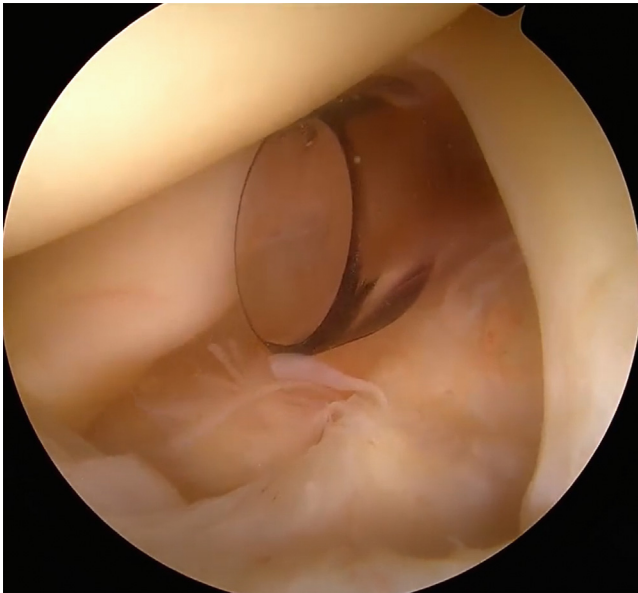


Fig 3. With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, a smooth 5.75-mm cannula is then exchanged with the 5-mm metal cannula anteriorly through the rotator interval, to allow for passage of instruments needed to perform the desired soft tissue tenodesis.

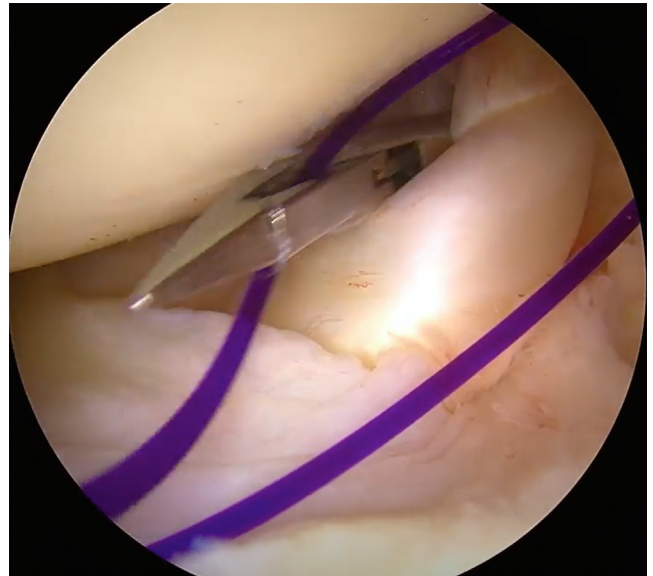


Fig 5. With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, a tissue-piercing device is introduced through the anterior cannula and penetrated through the upper border of the subscapularis (arrow). The PDS suture is retrieved and pulled back out of the cannula, creating 2 PDS ends in the cannula each through their corresponding soft tissue structures.

older patients who are lower demand and without concomitant subscapularis pathology.

The LHB is a known pain generator, and performing a tenotomy or tenodesis has been shown to improve symptoms.¹ Debate exists in which technique is optimal for patient outcomes, with tenotomy being reserved for older and lower-demand patients and tenodesis in younger, more active patients. Biceps tenotomy is less technically demanding, reduces intraoperative time, avoids possible complications associated with the

tenodesis procedure, and is associated with less post-operative restrictions for the patient. However, for the patient, there is an increased risk for muscle cramping and poor cosmesis such as the Popeye deformity, and these complications have been reported to occur in up to 13% of patients.² Despite this, a study by Meeks et al.³ found that 91% of patients who underwent a biceps tenotomy were satisfied or very satisfied with their surgery and 95% would have their surgery again.

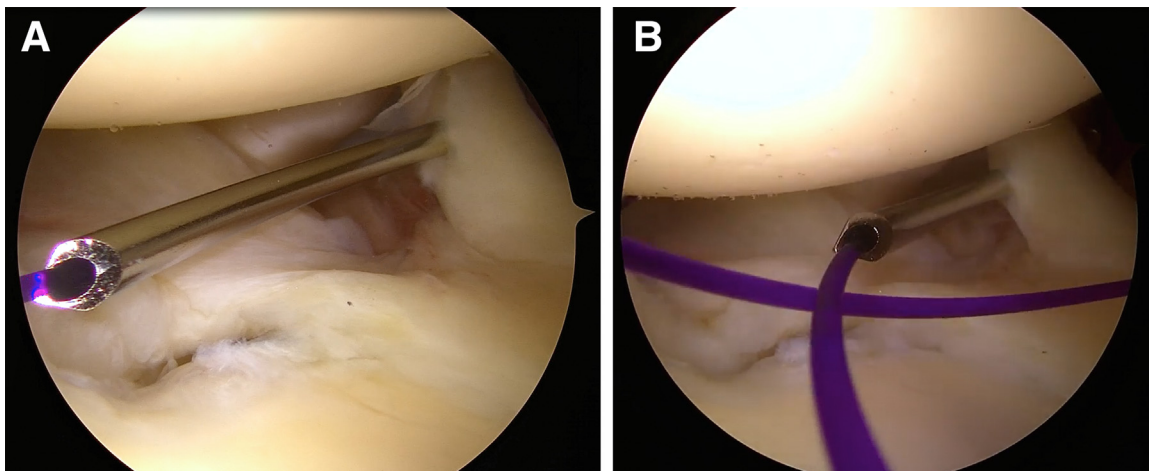


Fig 4. (A) With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, a suture passer device is used to penetrate the biceps tendon and a PDS suture is unloaded into the joint (arrow). (B) With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, a PDS suture is unloaded into the glenohumeral joint (arrow) and the device is removed, leaving the PDS suture in the joint and 1 limb end in the cannula.

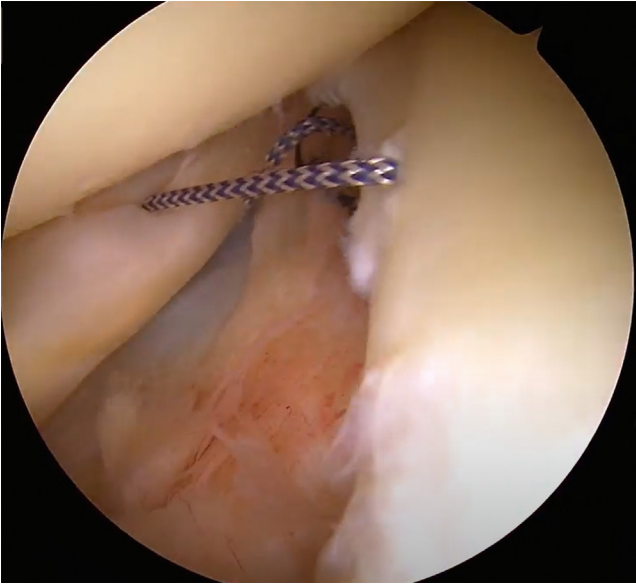


Fig 6. With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, a loop is created in 1 end of the 2 PDS suture limbs that are exiting the anterior cannula. An Orthocord (Depuy Mitek) is then strangled in the loop. The other end of the PDS is pulled, shuttling the Orthocord suture through the long head of the biceps and the subscapularis (arrow).

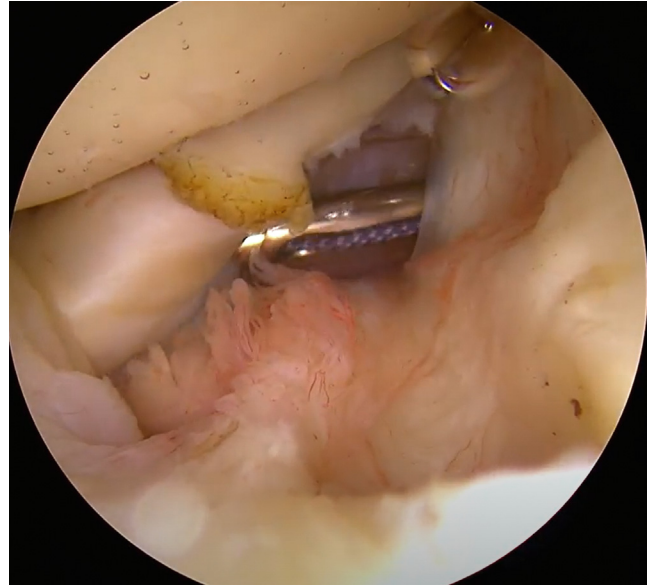


Fig 8. With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, standard arthroscopic knots are tied through the anterior cannula (arrow) and an arthroscopic suture cutter is used to remove the suture ends.

In comparison to biceps tenotomy, biceps tenodesis is more technically demanding and requires additional steps and time to be performed. However, performing a tenodesis maintains the biceps contour and thus reduces the Popeye deformity and improves cosmesis. Additionally, when tensioned correctly, the tenodesis

maintains the muscle tension and reduces the risk for muscle cramping. Despite these favorable outcomes, complications can occur and have been reported at an incidence of 2%.⁴ The tenodesis can be performed either arthroscopically or open and done either within the bicipital groove (proximal) or out of the groove (distal).



Fig 7. With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, electrocautery or bovie is used to release the long head of the biceps from its origin, leaving the labrum intact (arrow).

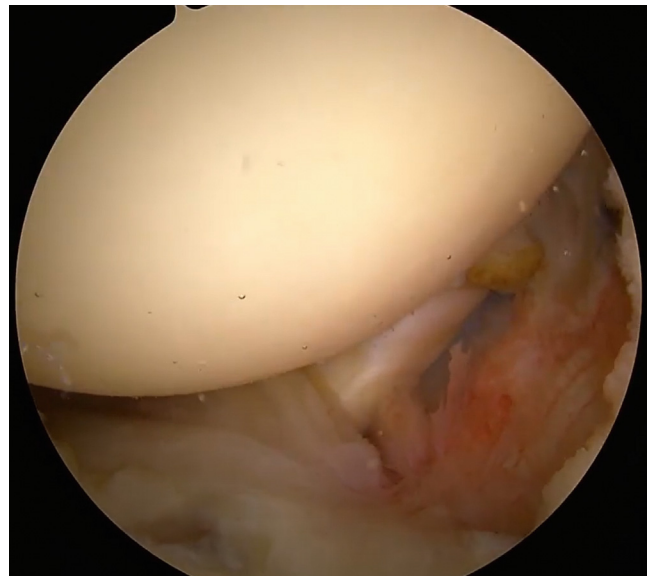


Fig 9. With the patient in the lateral decubitus position and viewing from a posterior portal in a left shoulder, the final tenodesis is inspected and gentle shoulder internal and external rotation confirms adequate fixation (arrow).

Table 1. Pearls and Pitfalls of the Described Long Head of the Biceps to Subscapularis Tenodesis

Pearls	Pitfalls
<ul style="list-style-type: none"> • Use a large enough cannula anterior to accommodate the PDS passing device • Perform suture passage more distal in the LHB to reduce the risk of the subtle sulcus that can occur with this technique • If needed, additional braided sutures can be used in the tenodesis • In hypertrophic tissue, passing the braided suture with an additional mulberry knot may be beneficial 	<ul style="list-style-type: none"> • Be cautious to not cause iatrogenic cartilage damage using the devices to advance the PDS suture • The goal is to slightly detent the tenodesis, as to result in a slight sulcus and not a Popeye deformity

LHB, long head of the biceps.

Various techniques for fixation are described and include and are not limited to all soft tissue fixation, anchor-based devices, bone tunnels, cortical buttons, and interference screws.¹ Regardless of the techniques used, good clinical outcomes can be expected.⁵

When comparing clinical outcome between biceps tenotomy vs tenodesis, a study by Belk et al.⁶ looked at level 1 studies and found no difference between the 2 techniques regarding Constant-Murley, visual analog scale, or American Shoulder and Elbow Surgeons scores but did find increased cosmetic deformity with tenotomy and improved forearm supination strength with tenodesis. When the LHB tenodesis is combined with other procedures such as rotator cuff repair, a meta-analysis by Leroux et al.⁷ found that there was less deformity after tenodesis and that the postoperative constant score was statistically better with tenodesis, but it was less than the minimally clinically important difference.

Regarding optimal surgical management for biceps tenodesis, some consider open subpectoral biceps tenodesis to be the gold standard. In a study by Corpus et al.,⁸ surgeons responding to various clinical scenarios preferred performing subpectoral biceps tenodesis, indicating the importance of removing the biceps from the groove to reduce the pain-generating pathology. However, this procedure inherently carries an increased morbidity due to its nature of being an open procedure. Some complications of the open subpectoral tenodesis include infection, hematoma, neurologic injuries, vascular injuries, and reflex sympathetic dystrophy.² Additionally, complications related to the method of fixation include persistent groove pain, proximal humerus fracture, implant failure, and bioabsorbable screw reaction.²

Studies have shown that with most techniques, favorable outcomes are expected,⁵ but each technique comes with various pearls, pitfalls, learning curves, and

various cost differences. The question remains, which technique reduces operating time, is least technically demanding, and reduces cost, all the while maintaining positive clinical outcomes.

The aforementioned LHB tenodesis technique is fast, is technically less demanding than other techniques, and can be performed at a lower cost as compared to techniques that necessitate the use of implants. Also, by using the tenodesis arthroscopically, additional incisions are not necessary, eliminating the morbidity of an open procedure. Despite these benefits, limitations and risks do exist with this technique. With use of one suture for the tenodesis, there is a risk for failure, but placing the suture in adequate tissue and using a good arthroscopic knot technique reduces this risk. Additionally, using this technique results in a slight biceps sulcus, which can influence cosmesis. The authors note that the optimal candidate for this technique is a patient who is lower demand and older than 65 years. Educating the patient about the risks and benefits of all surgical options as well as expectations is critical to optimize outcomes (Table 2). Techniques for tenodesing the LHB to soft tissue have been described in the literature.^{1,9,10} Apivatgaroon and Chernchujit⁹ described an all-arthroscopic technique for LHB tenodesis to the conjoint tendon with good clinical outcomes and low rate of Popeye deformity. The percutaneous intra-articular trans tendon technique

Table 2. Risks and Limitations for Different Techniques for Biceps Tenodesis

Procedure	Risks/Limitations
Arthroscopic soft tissue biceps tenodesis	<ul style="list-style-type: none"> • Subtle biceps sulcus • Soft tissue/suture failure • Ideal for lower demand patients >65 years old
Arthroscopic biceps suprapec tenodesis (anchor based)	<ul style="list-style-type: none"> • Increased cost with use of implant • Persistent groove pain • Soft tissue/suture or implant failure
Open subpec biceps tenodesis	<ul style="list-style-type: none"> • Increased cost with use of implant • Morbidity of open procedure • Longer procedure time • Neurovascular injury • Risk of infection • Soft tissue/suture or implant failure
Open suprapec biceps tenodesis	<ul style="list-style-type: none"> • Increased cost with use of implant • Morbidity of open procedure • Longer procedure time • Neurovascular injury • Risk of infection • Soft tissue/suture or implant failure

has been described using spinal needles percutaneously to pass horizontal mattresses to tie the LHB to the transverse humeral ligament and rotator interval tissue.¹⁰ As for the structural integrity of the soft tissue repair, soft tissue tenodesis of the LHB has been validated in the literature to be comparable to anchor-based and interference screw-type techniques.^{10,11}

In conclusion, the described soft tissue LHB tenodesis technique is safe and effective and is useful to surgeons to add to their armamentarium to treat LHB disease.

References

1. Lalezarian SP, Agarwalla A, Liu JN. Management of proximal biceps tendon pathology. *World J Orthop* 2022;13(1):36-57.
2. Virk MS, Nicholson GP. Complications of proximal biceps tenotomy and tenodesis. *Clin Sports Med* 2016;35(1):181-188.
3. Meeks BD, Meeks NM, Froehle AW, Wareing E, Bonner KF. Patient satisfaction after biceps tenotomy. *Orthop J Sports Med* 2017;5(5):2325967117707737.
4. Nho SJ, Reiff SN, Verma NN, Slabaugh MA, Mazzocca AD, Romeo AA. Complications associated with subpectoral biceps tenodesis: Low rates of incidence following surgery. *J Shoulder Elbow Surg* 2010;19(5):764-768.
5. AlQahtani SM, Bicknell RT. Outcomes following long head of biceps tendon tenodesis. *Curr Rev Musculoskelet Med* 2016;9(4):378-387.
6. Belk JW, Kraeutler MJ, Houck DA, Chrisman AN, Scillia AJ, McCarty EC. Biceps tenodesis versus tenotomy: A systematic review and meta-analysis of level I randomized controlled trials. *J Shoulder Elbow Surg* 2021;30(5):951-960.
7. Leroux T, Chahal J, Wasserstein D, Verma NN, Romeo AA. A systematic review and meta-analysis comparing clinical outcomes after concurrent rotator cuff repair and long head biceps tenodesis or tenotomy. *Sports Health* 2015;7(4):303-307.
8. Corpus KT, Garcia GH, Liu JN, et al. Long head of biceps tendon management: A survey of the American Shoulder and Elbow Surgeons. *HSS J* 2018;14(1):34-40.
9. Apivatgaroon A, Chernchujit B. All-arthroscopic long head of the biceps transfer: An optional technique for soft-tissue biceps tenodesis. *Arthrosc Tech* 2020;9(5):e611-e615.
10. Hartigan DE, Beran MC, Fleischli JE, D'Alessandro DF, Zheng NN. Biomechanical evaluation of two arthroscopic biceps tenodesis techniques: Proximal interference screw and modified percutaneous intra-articular transtendon. *Am J Orthop (Belle Mead NJ)* 2016;45(5):E261-E267.
11. Lopez-Vidriero E, Costic RS, Fu FH, Rodosky MW. Biomechanical evaluation of 2 arthroscopic biceps tenodeses: Double-anchor versus percutaneous intra-articular transtendon (PITT) techniques. *Am J Sports Med* 2010;38(1):146-152.