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Biomechanical Comparison of Knotless All-Suture Anchors and Knotted All-Suture Anchors in Type II SLAP Lesions: A Cadaveric Study

Philip-C. Nolte, M.D., M.A., Kaare S. Midtgaard, M.D., Michael Ciccotti, M.D., Jon W. Miles, M.Sc., Kira K. Tanghe, B.S., Lucca Lacheta, M.D., and Peter J. Millett, M.D., M.Sc.

Purpose: To compare the biomechanical performance of knotless versus knotted all-suture anchors for the repair of type II SLAP lesions with a simulated peel-back mechanism. **Methods:** Twenty paired cadaveric shoulders were used. A standardized type II SLAP repair was performed using knotless (group A) or knotted (group B) all-suture anchors. The long head of the biceps (LHB) tendon was loaded in a posterior direction to simulate the peel-back mechanism. Cyclic loading was performed followed by load-to-failure testing. Stiffness, load at 1 and 2 mm of displacement, load to repair failure, load to ultimate failure, and failure modes were assessed. **Results:** The mean load to repair failure was similar in groups A (179.99 $\pm$ 58.42 N) and B (167.83 $\pm$ 44.27 N, $P = .530$). The mean load to ultimate failure was 230 $\pm$ 95.93 N in group A and 229.48 $\pm$ 78.45 N in group B and did not differ significantly ($P = .958$). Stiffness ($P = .980$), as well as load at 1 mm ($P = .721$) and 2 mm ($P = .849$) of displacement, did not differ significantly between groups. In 16 of the 20 specimens (7 in group A and 9 in group B), ultimate failure occurred at the proximal LHB tendon. Failed occurred through slippage of the labrum in 1 specimen in each group and through anchor pullout in 2 specimens in group A. **Conclusions:** Knotless and knotted all-suture anchors displayed high initial fixation strength with no significant differences between groups in type II SLAP lesions. Ultimate failure occurred predominantly as tears of the proximal LHB tendon. **Clinical Relevance:** All-suture anchors have a smaller diameter than solid anchors, can be inserted through curved guides, preserve bone stock, and facilitate postoperative imaging. There is a paucity of literature investigating the biomechanical capacities of knotless versus knotted all-suture anchors in type II SLAP repair.

Injury to the superior glenoid labrum was first described by Andrews et al.[1] in 1985. In the following years, Snyder et al.[2] classified this injury into 4 types and introduced the term "SLAP lesion." Approximately 50% of all SLAP lesions are type II SLAP lesions with an avulsion of the superior glenoid labrum

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from the supraglenoid tubercle, thus involving the insertion of the long head of the biceps (LHB) tendon.[3]

SLAP lesions are common in throwing and overhead athletes owing to chronic overuse but are also observed in acute trauma (e.g., fall onto an outstretched arm).[1,4,5] The mechanism of injury is thought to be maximum abduction and external rotation of the shoulder, which is similar to the late cocking phase of throwing.[6,7] During this movement, the LHB tendon twists and is exposed to a posteriorly directed strain. Burkhart et al.[6,7] were the first authors to establish the term "peel-back mechanism" for the aforementioned pathophysiological concept of SLAP lesions,[8] and the relevance of the peel-back mechanism to the development of type II SLAP lesions has been verified in biomechanical studies.[9,10]

Initial management of type II SLAP lesions is nonoperative and involves rest, activity modification, nonsteroidal anti-inflammatory medication, physical therapy, and corticosteroid injections.[11-14] When nonoperative management fails, operative treatment options include tenotomy or tenodesis of the LHB tendon or SLAP repair.[8,14-17] In young active patients, arthroscopic repair of type II SLAP lesions is the most commonly preferred operative treatment.[14,15,18]

Repair is performed using suture anchors adjacent to the LHB tendon anchor.[19,20] Commonly used solid suture anchors for SLAP repair necessitate relatively large bone tunnels (2.1-3.75 mm)[20-24] that are associated with cyst formation and can interfere with postoperative imaging.[25,26] Therefore, all-suture soft anchors were developed to obviate these effects and have been shown to provide high failure loads[27] with similar biomechanical characteristics to those of traditional tap-in[25,28] and screw-in anchors.[29] Furthermore, drilling and placement of the anchors through curved insertion guides are now possible because of their flexibility, which is particularly desirable in SLAP repairs.[19]

All-suture anchors are available with knotless or knotted suture fixation options. Compared with knotted all-suture anchors, knotless all-suture anchors obviate the technical difficulty and inconsistency of knot tying, knot slippage, and soft-tissue and cartilage abrasions due to knot stacks.[22] Furthermore, a knotless, "tensionable" all-suture anchor facilitates tensioning of the construct even after anchor placement.

The purpose of this study was to compare the biomechanical performance of knotless versus knotted all-suture anchors for the repair of type II SLAP lesions with a simulated peel-back mechanism. We hypothesized that the tensionable, knotless all-suture anchor repair would have similar initial fixation strength to that of the knotted all-suture anchor repair.

Methods

Specimen Preparation

We tested 20 fresh-frozen male human cadaveric shoulders (10 matched pairs; mean age, 58.8 years; age range, 51-64 years; body mass index, 18-35). The specimens used in this study were donated to a tissue bank for medical research and then purchased by our institution. The use of cadaveric specimens did not require institutional review board approval at our institution. The exclusion criteria were a history of shoulder injury or surgery, osteoarthritis, degenerative joint disease, osteoporosis, and metastasis to the scapula; however, none of the specimens met these criteria. All specimens were assessed by 2 orthopaedic surgeons (P-C.N. and K.S.M.). Bone mineral density measurement was not performed, but only specimens from male, relatively young cadavers (aged < 65 years) were used to mitigate this potential confounder. Each shoulder pair was randomly distributed between 2 fixation groups, either knotless all-suture anchors (group A) or knotted all-suture anchors (group B), such that each group had an equal number of left and right shoulders. This was done to minimize the effect of anatomic variations between the right and left shoulders while also allowing for pair-wise comparisons.

The skin and soft tissue were removed from the shoulder, leaving only the LHB tendon and glenoid labrum intact, and the humerus was disarticulated from the glenohumeral joint. At this point, the 2 aforementioned orthopaedic surgeons examined the specimens for macroscopic abnormalities of the LHB tendon, the biceps tendon anchor, and the glenoid labrum. The LHB tendon was then cut 7 cm distal to the LHB anchor insertion. Starting 3 cm from the biceps anchor insertion, the LHB was sutured with No. 2 FiberWire (Arthrex, Naples, FL) over a length of 4 cm using a Krackow-type running, locking stitch configuration to allow for better purchase of the soft-tissue clamp.[30]

Subsequently, a standardized type II SLAP lesion was created in all specimens by the same orthopaedic surgeon (P-C.N.) using methodology that has been previously described in the literature.[22,23,30] To achieve this, a sharp dissection was performed at least 5 mm medial to the glenoid rim, extending 7 mm posterior and 7 mm anterior to the outer edges of the LHB insertion. Thus, a consistent type II SLAP lesion with an extension of 5 mm medially and approximately 20 mm in anteroposterior extension (length of the LHB included) was obtained (Fig 1A).[23] The acromion and coracoid process underwent osteotomy, and the scapula was sawed to fit in a 6.1-cm-diameter cylindrical mold. The remainder of the scapula was potted in polymethyl methacrylate (FrickeDental, Streamwood, IL) with the

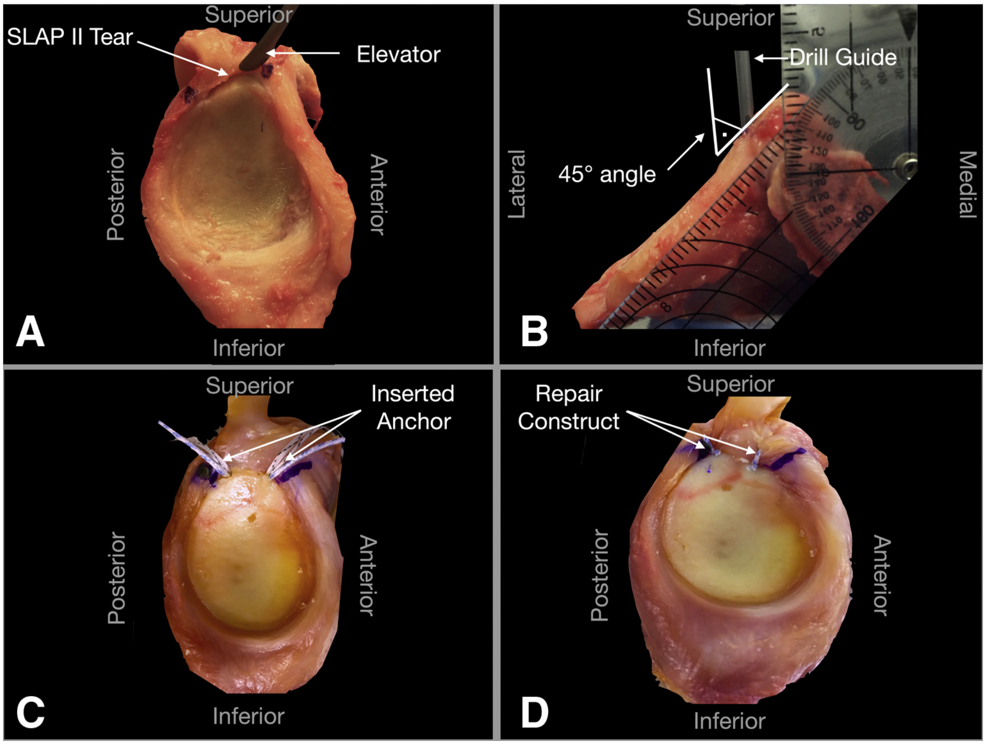

Fig 1. Tear creation and repair of type II SLAP lesion in right shoulder with all-suture anchors. (A) Creation of SLAP II tear. (B) Drilling at 45° angle to glenoid face. (C) Location of all-suture anchor placement (1.8-mm FiberTak). (D) Repair of SLAP II tear with all-suture anchor (1.8-mm FiberTak).

articular surface of the glenoid facing up, parallel to the face of the cylindrical potting. A saline solution spray was used throughout preparation and testing to keep the specimens hydrated.

Repair Technique

Type II SLAP lesions in group A were repaired using tensionable, knotless all-suture anchors (Knotless FiberTak, 1.8 mm, with No. 2 FiberWire CL; Arthrex)

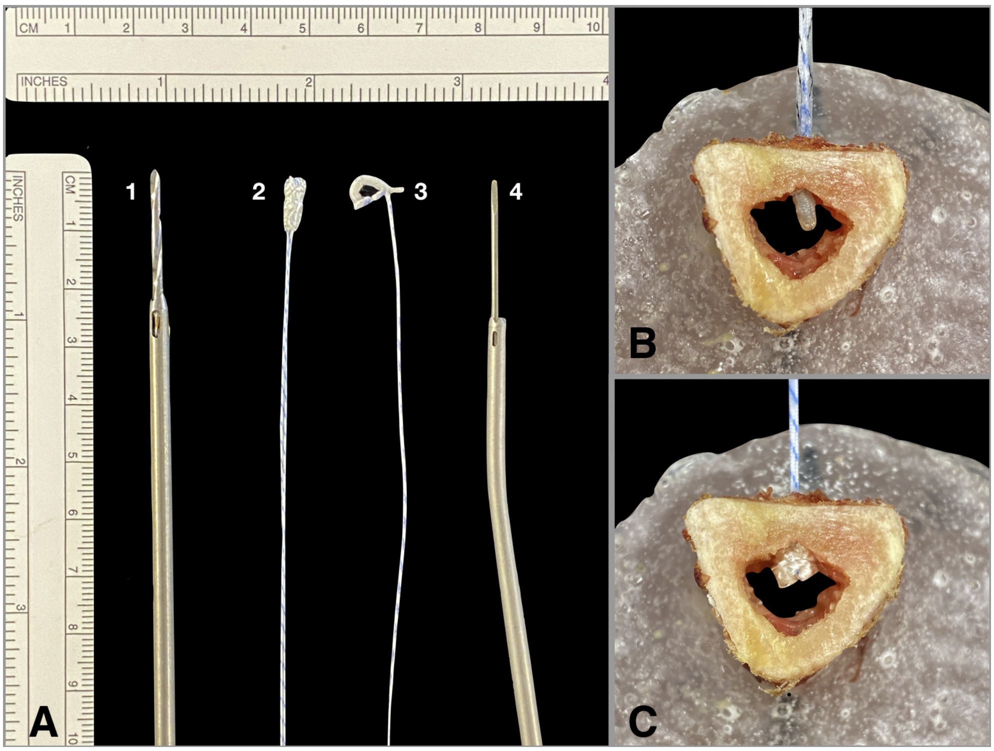

Fig 2. (A) Types of drills and anchors used, as well as mode of all-suture anchor deployment: (1) drill for 1.8-mm Q-Fix, (2) 1.8-mm Q-Fix all-suture anchor, (3) 1.8-mm knotless FiberTak, and (4) drill for 1.8-mm knotless FiberTak. (B) Exemplary all-suture anchor tensioning of 1.8-mm knotless FiberTak on distal humerus after osteotomy. (C) Exemplary all-suture anchor tensioning of 1.8-mm Q-Fix on distal humerus after osteotomy.

(Fig 2A). These all-suture anchors comprise a polyester sheath (anchor) loaded with a repair suture (No. 2 FiberWire) that is made of a core with several small strands of ultrahigh-molecular-weight polyethylene (UHMWPE) covered by braided UHMWPE and polyester suture.[31] By use of the manufacturer's insertion instruments, 2 bone tunnels were drilled into the articular margin at a 45° angle to the glenoid face directly anterior and posterior, respectively, to the LHB tendon insertion (Figs 1B and 2A).[21] The anchors were then inserted and tensioned, allowing for anchor expansion (Figs 1C and 2B). Subsequently, a suture-shuttling device (30° Straight QuickPass Lasso; Arthrex) was used to penetrate and shuttle the repair suture underneath the superior labrum. The repair suture was inserted through the loop of the shuttle suture and manually tensioned, resulting in self-locking of the repair suture within the bone tunnel.[19] The suture limbs were then cut flush using a scalpel (Fig 1D).

In group B, repairs were performed using knotted all-suture anchors (Q-Fix, 1.8 mm, with No. 2 Magnumwire suture; Smith & Nephew, Andover, MA) (Fig 2A). These all-suture anchors comprise a UHMWPE anchor that is loaded with a suture (No. 2 Magnumwire) made of braided UHMWPE.[31] By use of the manufacturer's insertion instruments, 2 bone tunnels were drilled in the same manner described earlier, and the anchors were deployed using a device inherent to this type of anchor (Figs 1 B and C and 2A). By twisting the top of the device, the anchors were pushed into the bone tunnel and subsequently tensioned against the cortex (Fig 2C). The suture-shuttling device was then used to penetrate the labrum and shuttle the repair suture underneath the superior labrum. The medial suture strand was used as a post, and 2 throws in the same direction were placed, followed by a throw in the opposite direction. Finally, 3 half-hitches with alternating posts and directions of throws were applied, and the suture limbs were cut flush.[30] All repairs were performed by the same surgeon (P-C.N.).

Biomechanical Testing

Specimens were tested in a randomized order determined a priori. The specimen was rigidly secured to the base of a dynamic tensile testing machine (Instron ElectroPuls E10000 [load cell capacity, ±10 kN]; Instron, Norwood, MA) in a custom fixture such that the glenoid was perpendicular to the testing bed with the anterior border facing downward. A soft-tissue clamp was fixed to the face of the actuator and used to securely grasp the suture-reinforced LHB tendon over a length of 4 cm with the vector of the LHB tendon pointing 90° posterior to the glenoid face to re-create the peel-back mechanism (Fig 3).[22,30]

Testing consisted of a cyclic loading phase followed by a pull to failure. Throughout testing, force and displacement data were collected. All tendons were initially placed in tension less than 5 N prior to the start of data collection. At the start of each trial, the tension ramped up from its initial force to 5 N of tension over a period of 5 seconds, was held for 1 second, and transitioned to cyclic loading. This was performed to remove any slack from the construct. Next, the tendons were cyclically loaded from 5 to 20 N for 10 cycles at 1 Hz.[22] After the last cycle, the specimens were pulled to failure starting at 5 N at a speed of 1 mm/s. Load-to-failure testing was recorded with a video camera to verify the final mode of failure post hoc.

Outcome Measures

All data were processed using a custom MATLAB script (MATLAB R2019b; The MathWorks, Natick, MA). Stiffness (in newtons per millimeter) of each construct was determined using an average of the linear

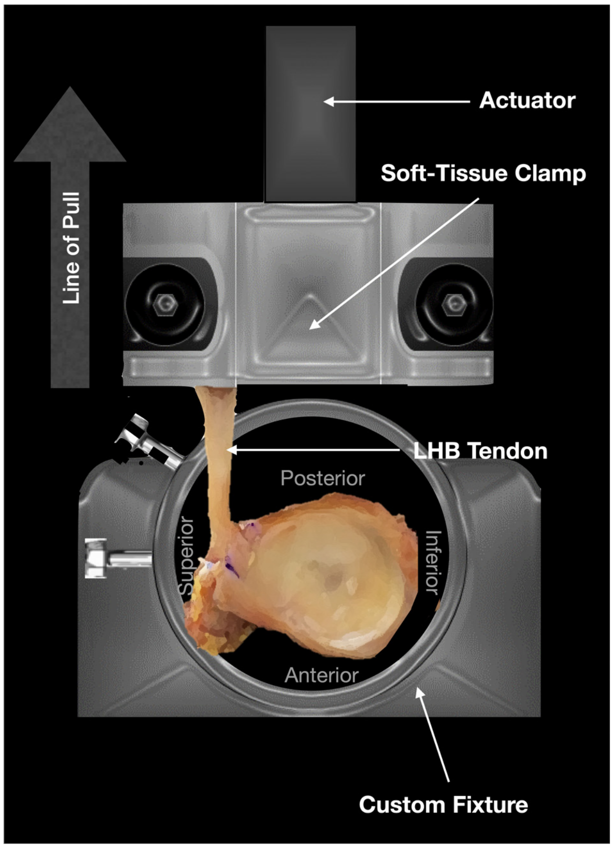

Fig 3. Testing setup with left shoulder in apparatus. The specimen was rigidly secured to the base of a testing machine in a custom fixture such that the glenoid was perpendicular to the testing bed with the anterior border facing downward. A soft-tissue clamp was fixed to the face of the actuator and used to securely grasp the suture-reinforced long head of the biceps (LHB) tendon over a length of 4 cm with the vector of the LHB tendon pointing 90° posterior to the glenoid face to re-create the peel-back mechanism.

regressions of the force-versus-displacement curves of each specimen during its 10 cycles of cyclic loading. Load to displace the construct by 1 and 2 mm was determined during load-to-failure testing. Load to repair failure was defined as the highest load before a decrease in load of 5 N or more occurred during load-to-failure testing. Load to ultimate failure was defined as the maximum force observed throughout the load-to-failure stage. Using video documentation, 2 authors (K.S.M. and M.C.) then independently assessed the ultimate failure modes. If discrepancies in the observed failure modes existed, they were discussed with a mediator (P-C.N.) and a decision was obtained. The failure mode was categorized as anchor pullout, rupture at the proximal LHB tendon, or slippage of the labrum through the loop.

Statistical Analysis

On the basis of previous research, a sample size of 10 specimens per group was considered sufficient.[22,23,30,32,33] To evaluate whether the outcome measures of the study (stiffness, load at 1 and 2 mm of displacement, load to repair failure, and load to ultimate failure) were affected by the anchor type (knotless vs knotted all-suture anchor), a paired *t* test was performed. Statistical analysis was carried out using SPSS software (version 26; IBM, Armonk, NY).

Results

Means, standard deviations, and 95% confidence intervals of outcome measures are shown in Table 1. Stiffness, load at 1 mm of displacement, and load at 2 mm of displacement did not differ significantly between anchors in group A and those in group B ($P > .05$) (Table 1).

The mean load to repair failure, defined as the highest load before a decrease in load of 5 N occurred, was similar in groups A (179.99 ± 58.42 N) and B (167.83 ± 44.27 N, $P > .05$) (Table 1). The load to ultimate failure was 230 ± 95.93 N in group A and 229.48 ± 78.45 N in group B and did not differ significantly ($P > .05$) (Table 1).

In 16 of the 20 specimens (7 in group A and 9 in group B), failure ultimately occurred at the proximal LHB tendon adjacent to the biceps anchor (Fig 4A). In 2 of 20 specimens (1 in group A and 1 in group B), failure occurred via slippage of the labrum through the suture loop. Two anchor pullouts were observed (group A only) (Fig 4B). Failure modes and outcomes for each failure mode are summarized in Table 2. No failure occurred at the soft-tissue clamp.

Discussion

The most important finding of this study was that knotless, tensionable all-suture anchors had similar biomechanical properties to those of knotted all-suture anchors when repaired type II SLAP lesions were subjected to peel-back loading of the LHB tendon. No statistically significant differences were seen in any outcome measurements. The predominant mechanism of ultimate failure was a tear of the proximal LHB tendon. It is interesting to note that anchor pullout was observed in 2 of 10 specimens in the knotless all-suture anchor group and 0 of 10 specimens after knotted all-suture anchor placement.

Several studies have examined the use of solid suture anchors, stitch configurations, and locations of anchor placement in the repair of type II SLAP lesions.[21-23,30,32,33] DiRaimondo et al.[23] investigated solid knotted suture anchors with 2 different stitch techniques (simple stitch and horizontal mattress stitch) and tissue tacks; repair failure was defined by glenolabral displacement of 2 mm with the use of an optical measurement system. They found mean repair failure

Table 1. Outcome Measurements of Knotless All-Suture Anchors (Group A) and Knotted All-Suture Anchors (Group B)

Measurement	Mean	SD	95% CI Lower	95% CI Upper	*P* Value
Stiffness, N/mm					.980
Group A	0.09	0.02	0.08	0.10	
Group B	0.09	0.02	0.07	0.11	
Load to 1 mm of displacement, N					.721
Group A	17.23	5.15	13.55	20.91	
Group B	18.08	5.08	14.45	21.72	
Load to 2 mm of displacement, N					.849
Group A	35.24	11.60	26.95	43.54	
Group B	36.04	9.57	29.19	42.88	
Load to repair failure, N					.530
Group A	179.99	58.42	138.20	221.79	
Group B	167.83	44.27	136.16	199.50	
Load to ultimate failure, N					.958
Group A	230.71	95.93	162.09	299.34	
Group B	229.48	78.45	173.36	285.60	

CI, confidence interval; N, newton; SD, standard deviation.

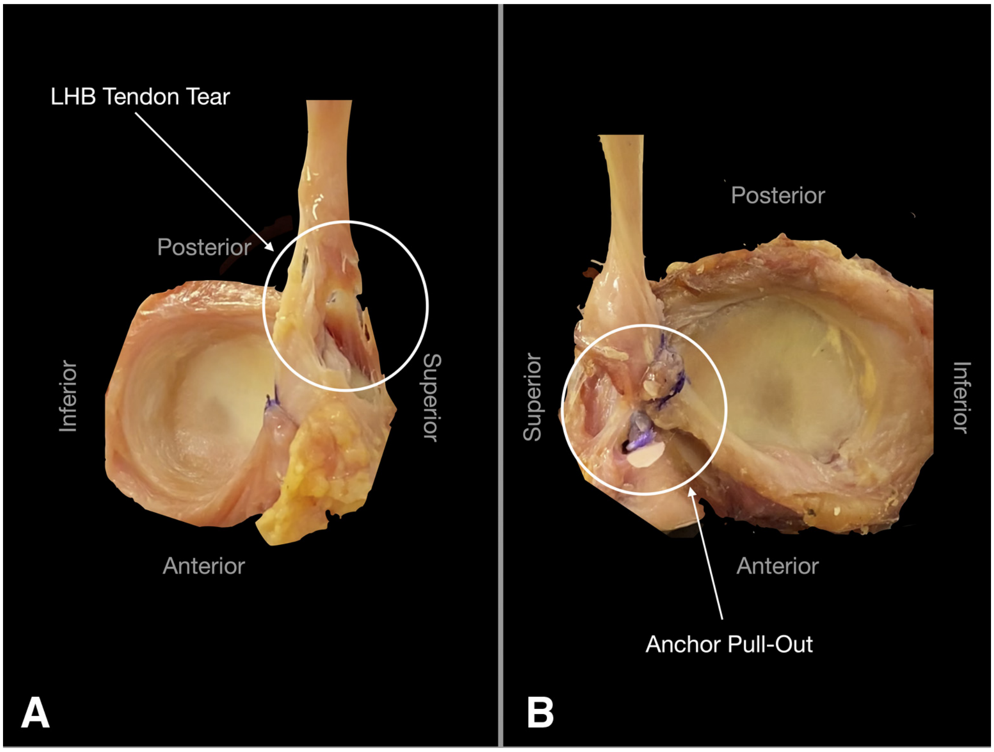

Fig 4. Failure modes. (A) Tear of proximal long head of biceps (LHB) tendon in right shoulder. (B) Anchor pullout in left shoulder.

loads of 111 ± 8 N in the suture anchor group and 95 ± 13 N in the tissue tack group; however, no statistically significant difference was detected. These loads are lower than those in our study (179.99 ± 58.42 N in group A and 167.83 ± 44.27 N in group B). The reason might be not only that the measurement technique was different (optical measurement) and solid anchors were used but also that the direction of the force applied was perpendicular to the glenoid surface, thus re-creating a different mechanism in comparison to the peel-back mechanism used in our study.[6,7] However, in 2008, Morgan et al.[30] were the first authors to apply the peel-back mechanism to a biomechanical study investigating 2 different suture configurations in type II SLAP repairs. In their study, group 1 consisted of 2 knotted solid suture anchors placed into the glenoid at the anterior and posterior borders of the LHB tendon using a simple suture configuration. Group 2 consisted of 2 knotted solid suture anchors placed into the glenoid posterior to the LHB tendon, also using a simple suture configuration. The load to repair failure was 43.66 ± 5.24 N in group 1 and 40.70 ± 8.17 N in group 2, with no significant difference observed. The failure load was distinctively lower than in the studies described earlier, perhaps owing to the greater weakness of the biceps anchor when exposed to a posterior force vector.[10]

Table 2. Failure Modes and Outcome Measures by Failure Mode for Knotless All-Suture Anchors (Group A) and Knotted All-Suture Anchors (Group B)

Failure Mode	n	Stiffness, N/mm	Load to 1 mm, N	Load to 2 mm, N	Load to Repair Failure, N	Load to Ultimate Failure, N
Slippage of labrum through loop						
Group A	1	0.08	19.07	38.47	223.38	264.79
Group B	1	0.11	17.09	33.28	199.77	291.29
Total	2					
Anchor pullout, mean ± SD						
Group A	2	0.08 ± 0.02	15.68 ± 8.99	27.92 ± 9.43	152.26 ± 6.12	176.47 ± 40.36
Group B	0	NA	NA	NA	NA	NA
Total	2					
LHB tendon tear, mean ± SD						
Group A	7	0.08 ± 0.01	17.25 ± 4.92	36.66 ± 12.88	181.72 ± 67.37	241.34 ± 110.57
Group B	9	0.08 ± 0.01	18.20 ± 5.36	36.22 ± 10.13	164.28 ± 45.42	222.61 ± 79.96
Total	16					

N, newton; SD, standard deviation.

Baldini et al.[33] examined pullout strength and mode of failure using 1 or 2 knotted solid suture anchors in the repair of type II SLAP lesions. They found ultimate loads to failure comparable to ours (278 ± 101.5 N for a single anchor and 242.5 ± 96.5 N for double anchors); however, they did not examine load to failure of the construct. Similarly to our study findings, the most frequent mode of failure was tearing of the LHB tendon.

There are disadvantages that come with knotted solid suture anchors. Although commonly performed, the procedure of knot tying is not always an easy task, may be inconsistent,[34] and is less standardized than with knotless anchors. Furthermore, knotless suture anchors have the benefit of reducing the risk of soft-tissue and cartilage abrasions due to knot stacks.[22,35] Previously, knotless anchors were used for the treatment of anterior glenohumeral instability; however, they were introduced for the use of SLAP repair in 2004 by Yian et al.[35] Uggen et al.[21] showed in a biomechanical study that knotless solid suture anchors are sufficient to restore capsulolabral anatomy in type II SLAP repair. However, Sileo et al.[22] found that the repair construct when using knotless solid suture anchors (70 ± 22.3 N) was weaker than when using standard knotted solid suture anchors (104 ± 33.6 N) when the LHB tendon was exposed to a force perpendicular to the glenoid face. In this study, we did not find a statistically significant difference in biomechanical fixation strength between the tested knotless and knotted all-suture anchors when all failure modes were combined. A possible reason may be the improved locking mechanism ("Chinese finger trap") within the knotless all-suture anchor used in our study compared with the locking mechanism (fixation of suture between bone tunnel and anchor) of the solid knotless anchors used by the aforementioned authors.[22]

However, the modes of failure differed noticeably. Although failure occurred via proximal LHB tendon tears in most specimens (16 of 20), it occurred through slippage of the labrum in 1 specimen in each group (2 of 20) and through anchor pullout in 2 specimens in the knotless group (2 of 10) (Table 2). Furthermore, the load to repair failure and the load to ultimate failure were lower than the values observed for the other failure mechanisms (Table 2). A possible explanation may be the different nature of subcortical fixation between the knotless and knotted anchors used in this study (Fig 2). Although we are not aware of any existing direct comparisons of the anchors used in this study, the knotted anchor (1.8-mm Q-Fix) has shown one of the highest fixation strengths when compared with other all-suture anchors.[27]

An interesting finding was that, when we compared the 2 knotless anchors that failed by pullout with the contralateral shoulders, the load to repair failure was lower for both knotted anchors (156.59 N and 147.94 N for 1.8-mm FiberTak vs 130.40 N and 126.49 N for 1.8-mm Q-Fix), and the load to ultimate failure was lower for 1 knotted anchor that failed by rupture of the LHB tendon (205.01 N for 1.8-mm FiberTak vs 202.31 N for 1.8-mm Q-Fix). This raises the question of what ultimate anchor strength is really needed to repair SLAP type II lesions. There is no need for the anchor to be stronger than the biceps tendon, and loop and knot security may be more important than ultimate pullout strength.

All previously discussed biomechanical studies used solid suture anchors. Metallic anchors interfere with postoperative imaging,[36] and in the case of pullout or bony erosion with anchor prominence, anchor arthropathy may be the result[37]; as such, their use has decreased. Biodegradable suture anchors, on the other hand, are associated with cyst formation and osteolysis, which is especially unfavorable in revision cases in which sufficient bone stock is of utmost importance.[38] All-suture anchors are among the latest developments in anchor design and have been shown to provide high initial fixation strength with a minimal amount of bone removal.[27] Because of their flexibility, insertion through curved guides is possible, sparing the rotator cuff during arthroscopic repair.[19,39] Drill tunnels needed for the placement of all-suture anchors are distinctly smaller than those used for classic solid suture anchors, thus preserving bone stock and reducing the risk of fracture.[40] In addition, all-suture anchors have been shown to result in satisfactory clinical outcomes[41,42] and postoperative imaging without severe bony reactions after Bankart repair.[41] A possible disadvantage of using all-suture anchors is that bone tunnels are indeed smaller but also longer (22 mm for 1.8-mm Q-Fix and 23 mm for 1.8-mm FiberTak), thus posing a potential risk of suprascapular nerve injury.[39,43] However, penetration of the drill through the medial cortex was not observed in our study.

In this study, we found high initial fixation strength for both knotted and knotless all-suture anchors. As such, we observed only 4 of 20 failures occurring during ultimate failure testing that were directly related to the anchor (anchor pullout and slippage of the labrum through the suture loop) but observed 16 of 20 failures at the proximal LHB tendon. This finding suggests that the repair itself may not be the weakest link in a type II SLAP repair performed with all-suture anchors when subjected to the peel-back mechanism.

Limitations

Certainly, our study is not without limitations. First, this was a biomechanical study, and we can only make assumptions on the time-zero fixation strength without the contribution of biological healing to the ultimate strength of the repair. Second, the creation of type II SLAP tears has been described by DiRaimondo et al.[23] and adapted by several studies thereafter,[22,30,32] but the superior labrum−biceps anchor complex has a high variability and the created SLAP tear can differ between individuals even when the protocol is followed. Furthermore, SLAP repairs were performed open, similarly to previous studies,[22,23,30,32] although clinically they are performed arthroscopically. Third, even though our specimens were from relatively young cadavers (mean age, 58.8 years); this is not the typical population in which type II SLAP lesions occur or SLAP repairs are performed. To adjust for different tissue and bone qualities, we used male-only, matched specimens.

In addition, a posteriorly directed force, parallel to the glenoid face, was created to re-create the peel-back mechanism, given that the biceps anchor has been shown to be most vulnerable in this position.[6,7] Whereas studies have used a peel-back mechanism,[30] most used a line of pull that was directed 90° perpendicular to the glenoid face. Although we think that the peel-back mechanism is more relevant, this is not the only force vector to which the biceps anchor is exposed in vivo.

Finally, we did not use an optical measurement system but rather determined repair failure as the highest load achieved before a decrease in force of 5 N occurred. Several studies have defined repair failure as glenolabral displacement of 2 mm or more.[22,23,30,32] However, to our knowledge, there is no scientific rationale regarding what degree of displacement of a SLAP repair should be considered a failure.[33,44]

Conclusions

Knotless and knotted all-suture anchors displayed high initial fixation strength with no significant differences between groups in type II SLAP lesions. Ultimate failure occurred predominantly as tears of the proximal LHB tendon.

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