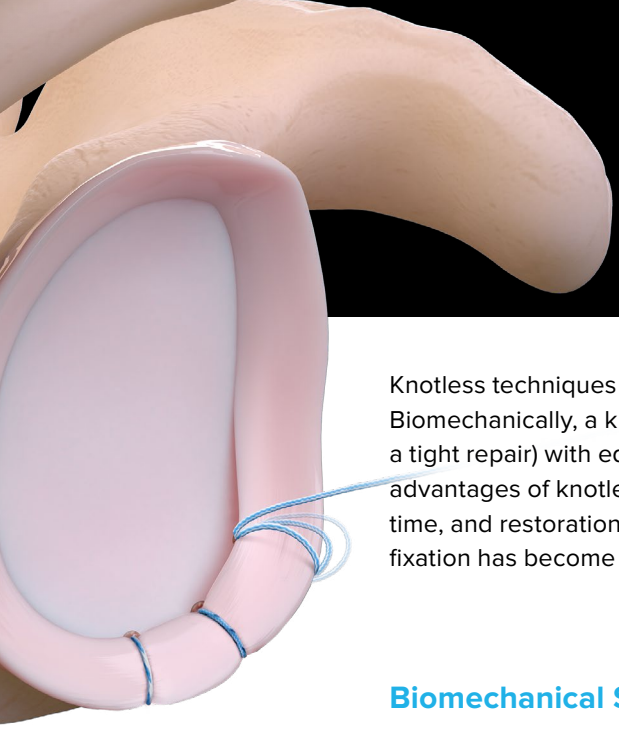

Knotless Labral Repair Scientific Update

Knotless techniques have become the standard for arthroscopic labral repair. Biomechanically, a knotless technique leads to improved loop security (maintenance of a tight repair) with equivalent load-to-failure compared to knotted constructs. Clinical advantages of knotless repair include decreased risk of knot migration, decreased operative time, and restoration of function. As technology has improved, the ability to achieve knotless fixation has become available in smaller anchors.

Biomechanical Studies

Hanypsiak BT, DeLong JM, Simmons L, Lowe W, Burkhart S

Knot strength varies widely among expert arthroscopists. *Am J Sports Med.* 2014;42(8):1978-1984. doi:10.1177/0363546514535554

- This study had 73 expert surgeons tie 5 knots using their preferred technique.
- The mean load-to-failure was 231 N. However, the range was 29 N to 360 N, and the standard deviation of the individual surgeon ranged from 6 N to 133 N.
- Variability persisted regardless of whether the surgeon performed more than or less than 200 arthroscopic cuff repairs per year.
- Only 37% of surgeons had an average load-to-failure within 20% of the mean, and only 18% of the individual knots had a load-to-failure within 20% of the mean.

Takeaway

There is considerable variability both between surgeons and within knots tied by surgeons using their go-to knot.

Denard PJ, Adams CR, Fischer NC, Piepenbrink M, Wijdicks CA

Knotless fixation is stronger and less variable than knotted constructs in securing a suture loop. *Orthop J Sports Med.* 2018;6(5):2325967118774000. doi:10.1177/2325967118774000

- In this study, 34 surgeons completed suture loops either by tying knots or creating a knotless construct with a 5.5 SwiveLock® anchor and #2 FiberWire® or FiberTape® suture.
- Load-to-failure was the highest with the knotless FiberTape technique (276 N compared to 161 N/151 N; $P < .001$).
- Load to 3 mm of displacement (indicating loss of loop security) was higher with the FiberTape technique (199 N) compared to the knotless FiberWire technique (90 N; $P < .001$) and knotted FiberWire technique (59 N; $P < .001$). The difference between the knotless FiberWire and knotted FiberWire techniques was also significant ($P = .024$).
- Based on an F test, variability was highest in the knotted group.

Takeaway

Based on the assessment of multiple surgeons, a knotless technique with suture tape leads to improved construct strength, loop security, and reliability compared to a knotted or knotless technique with #2 suture.

Arthrex®

Martetschläger F, Michalski MP, Jansson KS, Wijdicks CA, Millett PJ

Biomechanical evaluation of knotless anterior and posterior Bankart repairs. *Knee Surg Sports Traumatol Arthrosc.* 2014;22(9):2228-2236. doi:10.1007/s00167-013-2602-0

- In this study, 9 matched cadaver pairs were used to evaluate 3 anchor Bankart repair constructs using 2.9 mm PushLock® anchors:
  - Native state
  - Repair with #2 FiberWire® suture
  - Repair with LabralTape™ suture
  - There was no difference in load to 2 mm of displacement or load-to-failure between the native state and either repair state.

Takeaway

A knotless labral repair with 3 anchors can restore labral biomechanics to that of the native state.

Funakoshi T, Hartzler R, Stewien E, Burkhart S

Remplissage using interconnected knotless anchors: superior biomechanical properties to a knotted technique? *Arthroscopy.* 2018;34(11):2954-2959. doi:10.1016/j.arthro.2018.06.030

- In this study, 7 matched cadaver pairs were used to compare 2 remplissage repair techniques that create a double-mattress suture between the anchors:
  - A knotted double-pulley construct with two 3.0 mm SutureTak® anchors
  - A linked knotless construct with two 3.9 mm Knotless Corkscrew® anchors
- Load-to-failure was higher in the knotless construct (788 N compared to 488 N; $P = .003$).
- The mode of failure varied based on the construct.
  - In the knotted group, it occurred via suture breakage or slippage in 6 of 7 cases (tendon tearing).
  - In the knotless group, failure occurred via anchor pullout or tendon tearing, with no cases failing due to knot slippage or breakage.

Takeaway

- A knotless construct with 2 interlinking anchors might improve the biomechanical performance of remplissage.
- An interlinked construct transfers the weak link in fixation to the tissue and bone (no failures occurred via suture slippage as in knot tying).

Kim SH, Crater RB, Hargens AR

Movement-induced knot migration after anterior stabilization in the shoulder. *Arthroscopy.* 2013;29(3):485-490. doi:10.1016/j.arthro.2012.10.011

- This study involved 10 consecutive 3-anchor knotted Bankart repairs, which were performed to evaluate knot migration following cyclic loading.
- Knots were placed as far anteriorly as possible at the time of repair.
- Following cyclic loading, knots were significantly close to the anchor (closer to the articular surface).
- Also following loading, the knots faced the joint in 5 of 10 inferior knots, 7 of 10 middle knots, and 6 of 10 superior knots.
- Knot loosening also occurred in 4 of 10 inferior knots and 1 middle knot.

Takeaway

There is substantial potential for knot migration toward the glenoid following Bankart repair. This may have implications for postoperative development of arthritis due to knot-cartilage abrasion.

Arthrex®

Lacheta L, Brady A, Rosenberg SI, Dornan GJ, Dekker TJ, Anderson N, Altintas B, Krob JJ, Millett PJ

Biomechanical evaluation of knotless and knotted all-suture anchor repair constructs in 4 Bankart repair configurations. *Arthroscopy.* 2020;36(6):1523-1532. doi:10.1016/j.arthro.2020.01.046

- In this study, 30 cadavers were used to compare knotless and knotted 3-anchor Bankart repairs in different stitch configurations.
  - 6 cadavers used to test native state
  - 6 simple-configuration knotted constructs with FiberTak® anchors
  - 6 simple-configuration knotless constructs with Knotless FiberTak anchors
  - 6 horizontal-mattress-configuration knotted constructs with FiberTak anchors
  - 6 horizontal-mattress-configuration knotless constructs with Knotless FiberTak anchors
- There was no difference between knotless and knotted constructs in load-to-failure.
- Strain of the native state was most closely reproduced by the knotless mattress configuration, which was the only repair that did not result in increased strain compared to the native state.
- Suture slippage occurred in only 11% of the knotless constructs compared to 30% of the knotted constructs.

Takeaway

- A knotless Bankart repair with Knotless FiberTak anchors results in biomechanical performance equal to a knotted construct with low rates of suture slippage (maintenance of loop security).
- Knotless horizontal-mattress configurations increase biomechanical performance compared to simple suture configurations. This configuration is capable of achieving strain levels not statistically different from the native state.

Yanke AB, Allahabadi S, Wang Z, Credille KT, Shewman E, Bonadiman JA

Biomechanical Analysis of Anteroinferior Bankart Repair Anchor Types. *Am J Sports Med.* 2023;51(10):2642-2649. doi:10.1177/03635465231180621

- 21 cadavers were randomized to Bankart repair with 3 constructs:
  - 7 knotless soft-body anchor repairs with 3 Knotless FiberTak anchors
  - 7 knotted soft-body anchor repairs with FiberTak anchors
  - 7 hard-body anchor repairs with 2.9 mm PushLock® anchors
- Load-to-failure was highest in the Knotless FiberTak group ($P = .25$).
- Knot or mechanism failure was 0% in the Knotless FiberTak group and 38% in each of the other 2 groups ($P = .008$).

Takeaway

Knot or mechanism failure is lower with the use of a tensionable knotless construct (1.8 Knotless FiberTak) compared to either tying knots or knotless interference fixation between suture and a hard-body anchor.

Arthrex®

Clinical Studies

Bents EJ, Brady PC, Adams CR, Tokish JM, Higgins LD, Denard PJ

Patient-reported outcomes of knotted and knotless glenohumeral labral repairs are equivalent. *Am J Orthop (Belle Mead NJ).* 2017;46(6):279-283.

- The SOS™ database was used to compare 321 knotted labral repairs (anterior, posterior, and SLAP repairs) to 489 knotless labral repairs.
- Patient-reported outcomes were the same between techniques regardless of type of labral repair.
- Operative time was lower in the knotless group.
  - 8 minutes lower for anterior labral repairs
  - 24 minutes lower for posterior labral repairs
  - 8 minutes lower for SLAP repairs

Takeaway

A knotless technique decreases operative time without compromising patient-reported outcomes. This may have important cost-saving implications given the high expense of operative time.

Thal R, Nofziger M, Bridges M, Kim JJ

Arthroscopic Bankart repair using knotless or BioKnotless suture anchors: 2- to 7-year results. *Arthroscopy.* 2007;23(4):367-375. doi:10.1016/j.arthro.2006.11.024

- In this study, 73 Bankart repairs performed with a knotless technique were reviewed at a range of 2 to 7 years postoperatively.
- The mean postoperative ASES score was 96 points.
- Postoperative recurrence was only 6.9%.

Takeaway

A knotless technique for Bankart repair is associated with acceptable rates of postoperative recurrent instability. Recurrent instability in this series was at or below that reported in the series in which knots were tied.

Ng DZ, Kumar VP

Arthroscopic Bankart repair using knot-tying versus knotless suture anchors: is there a difference? *Arthroscopy.* 2014;30(4):422-427. doi:10.1016/j.arthro.2014.01.005

- This was a prospective, randomized study of Bankart repairs performed at one institution.
  - 45 knotted repairs with 3.0 mm SutureTak® anchors
  - 42 knotless repairs with 2.9 mm PushLock® anchors
- No difference in postoperative functional outcome
- No difference in postoperative instability
  - 1 patient in each group had recurrence

Takeaway

Level 1 evidence demonstrates no difference in recurrence with a knotless technique compared to a knotted technique for anterior Bankart repair.

Arthrex®

de Groot SJ, Arner JW, Smith CN, Bradley JP

Arthroscopic SLAP IIb repair using knot-tying versus knotless suture anchors: is there a difference? *Am J Orthop (Belle Mead NJ).* 2018;47(12):10.12788/ajo.2018.0101. doi:10.12788/ajo.2018.0101

- This study is a retrospective comparison of knotless to knotted SLAP repairs reviewed at minimum 2-year follow-up.
  - 42 had knotted repairs
  - 32 had knotless repairs
- Return-to-play was higher in the knotless group, although this did not reach statistical significance (93.5% compared to 90.2%; *P* = .94).
- Knotless anchors were less likely to require revision but did not reach significance (9% compared to 17%; *P* = .50).

Takeaway

A knotless technique leads to at least equivalent return-to-play levels following arthroscopic SLAP repair, and such a technique may reduce the risk for revision.

Cordasco FA, Lin B, Heller M, Asaro LA, Ling D, Calcei JG

Arthroscopic shoulder stabilization in the young athlete: return to sport and revision stabilization rates. *J Shoulder Elbow Surg.* 2020;29(5):946-953. doi:10.1016/j.jse.2019.09.033

- Prospective evaluation of 67 Bankart repairs in young athletes
  - 21 years or younger at the time of surgery
  - Athletes were included if they had 3 or fewer dislocations prior to repair
  - Repairs were performed with knotless (PushLock) anchors and a mattress suture configuration
  - A minimum of 3 anchors and a mean of 3.6 anchors were used for repair
- 94% of patients had no postoperative instability
- 88% returned to their previous sport with 75% returning at the same level

Takeaway

A knotless technique with a mattress suture configuration and a minimum of 3 anchors leads to a low level of recurrence in a young athletic population.