Editorial Commentary: Acetabular Labral Repair—Is A Knotless Anchor Better?

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Abstract: Knotless anchors have an important role in arthroscopic acetabular labral repair. Different anchors show 2 primary failure modes: suture breakage and suture pullout from the anchor ("eyelet failure"). Knotless anchors show minimal displacement at physiological loads and should perform well for arthroscopic labral repair. Surgeons should consider the suture-passing device size and use a device that creates as small of a labral hole as possible.

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Knotless suture anchors are commonly used in hip arthroscopy and offer some advantages over anchors that require knot tying. These advantages include their ease of use and quicker insertion time compared with tied knots. Although not clearly documented in the current literature, there are anecdotal reports of adhesions between a retained knot and the adjacent capsule or psoas tendon observed during revision hip arthroscopy. This has led some surgeons to suggest that a knotless suture anchor may decrease the creation of such adhesions.

In the article "Knotless Anchors in Acetabular Labral Repair—A Biomechanical Comparison," Safran, Behn, and Mardones[1] report data from a single-pull biomechanical test of 6 different knotless anchors suitable for acetabular labral repair and compare this with a hand-tied control. The anchors were not tested using a biological construct. Instead, polyurethane foam blocks were used to simulate the acetabular bone, and the labrum was simulated by a loop of 8 high-strength polyblend sutures. The control anchor construct was a standard anchor of similar type and size with hand-tied sutures using a Duncan loop. The tested anchors were subjected to a single load until failure rather than cyclic testing, which is more consistent with the clinical condition.

Data were collected on failure strength, construct stiffness, and failure mechanism for these 7 devices. "Clinical failure" was defined as 1 or 2 mm of displacement, so stiffness was calculated from the loading curve before the 2-mm displacement mark. Notably, some anchors (Stryker Knotlilus 3.5 and knotted Smith & Nephew BioRaptor 2.9) displaced at higher failure loads but with displacements beyond the 2-mm mark, raising the issue of comparing likes with likes and the clinical relevance of these higher numbers.

Load to Failure

On the basis of the load-displacement curves (Fig 3 in the article[1]), the Knotless BioRaptor, 2.8 PopLok (ConMed), and 3.3 PopLok failed at less than 100 N and the SpeedLock HIP anchor (Smith & Nephew) failed at slightly more than 100 N (confirmed in Table 2 in the article[1]). Importantly, all 4 of these anchors showed less than 2 mm of displacement at the time of failure. In contrast, the PushLock (Arthrex) displaced more than 2 mm when it failed at about 185 N. Both the Knotilus and hand-tied BioRaptor (control) anchors displaced significantly more than all the others (6 to 7 mm) before maximum failure loads (330 N and 306 N, respectively) were observed.

It is important not to misinterpret the high ultimate failure load data generated for the Knotilus and control BioRaptor anchors because at 2 mm of displacement, their loads were consistent with the other anchors. It is not an advantage to show a failure load of 330 or 306 N if that failure occurs at a displacement of 6 to 7 mm.

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Failure Mode

The Knotilus and BioRaptor (control) anchors failed by suture breakage, whereas all the others failed by the suture pulling out of the anchor with presumably intact knots. Safran et al.[1] correctly stated that "anchor design likely plays a strong role in the mode of failure." It may be that an anchor with a "breakaway" eyelet or a design that allows the suture to pull out rather than break at a clinically acceptable load level is safer than one with a higher load tolerance that results in the suture breaking first. Consider, as a surgeon, whether you would prefer to have a suture loop intact in the labrum or a loose suture migrating into the joint.

Suture anchors are used for the primary repair of the acetabular labrum as well as labral revision, grafting, and reconstruction. Labral augmentation that preserves healthy native labral fibers results in significantly better outcomes than segmental labral grafting[2] and is associated with significant improvement in patient-reported outcomes and function with a low rate of conversion to total hip arthroplasty.[3] The use of arthroscopic techniques to achieve a labral seal has been shown to significantly improve patient outcomes,[4] and postoperative computed tomography arthrography has shown that the repaired labra are well maintained at a minimum 2-year follow-up. In addition, decreased height and width of the labra do not affect the clinical outcomes.[5] These data indicate that suture anchor labral repair is both effective and practical.

Although a precise understanding of the physiological loads on a hip labral repair is unknown, some related data are available. As the Safran et al.[1] reference, Henak et al.[6] stated that the intact labrum supports 1% to 2% of an applied joint load in normal hips but is substantially greater in dysplastic hips. This is because the normal femoral head achieves equilibrium in the acetabular center whereas a dysplastic head achieves equilibrium near the lateral acetabular edge.[6] Considering an 80-kg individual with a normal hip, a 2% load is 1.6 kg, or 15.6 N. In a dysplastic hip with an 11% joint load, the load would be 86.1 N. Such a force level would be adequately resisted at the failure loads shown by these knotless anchors at the 1-mm displacement level. This would be especially true if multiple anchors were used in the repair that shared the load.

Some Thoughts

Although all the sutures associated with these anchors are composed, at least in part, of ultrahigh-molecular-weight polyethylene, the polyblend in the PushLock also contains braided polyester. This results in lower failure strength than sutures composed of only ultrahigh-molecular-weight polyethylene. However, this difference is not clinically significant especially considering the clinically applicable loads for a hip labral repair.

Some authors have suggested that the type of stitch placed in the hip labrum, as well as the size of the instrument passing that stitch, may be significant. Signorelli et al.,[7] using fresh-frozen cadaveric hips, reported that although a vertical mattress stitch and a cerclage labral repair stitch both showed significantly better medial-lateral stability during pivoting compared with a partial labrectomy, only the vertical mattress repair showed a significantly better performance in the proximal-distal direction. Of course, the absence of a difference in this testing may not mean that one does not exist.[7]

In contrast, Hapa et al.,[8] using a bovine labral model, reported that the horizontal mattress stitch showed lower ultimate failure loads than vertical or oblique mattress stitches (as has been shown in meniscal tissue). In addition, the device used to pass the suture was important. Smaller-diameter suture-passing devices resulted in less cyclic displacement and repair elongation than larger-diameter devices.[8]

Prominent suture knots associated with anchors may be a significant cause of adhesions. Hip arthroscopy with global acetabular overcoverage improved patient-reported outcomes and pain, but at the 2-year follow-up, secondary procedures were reported in 17% of patients, possibly owing to adhesions.[9] In another report, after revision labral reconstruction, 14% of patients required total hip arthroplasty and 7% had recurrent scarring.[10] Otherwise, labral reconstruction resulted in outcomes similar to those in patients not needing revision. Adhesions were a common finding during revision labral reconstruction.[10] This again underscores concerns about adhesions between a retained knot and the adjacent capsule or psoas tendon.

Take-Home Message

Clinical relevance is important. Although a knotless anchor offers potential advantages, questions remain as to whether the pullout strength or stiffness of these anchors has any clinical significance in repairing an acetabular labrum. Acetabular labral repair is not subjected to the same tension as an anchor used in a tendon repair. Unlike a gluteal or rotator cuff tendon, the labrum is not attached to a contracting muscle providing constant tension forces.

The data provided in the study by Safran et al.[1] are important and offer valid insights into how these particular anchors function. The authors observed that although most of these knotless anchors failed by suture pullout ("eyelet failure"), many showed minimal displacement at physiological loads. Surgeons should consider the suture-passing device size and use a device that creates as small of a labral hole as possible. These anchors should perform well in arthroscopic labral repair, and the knotless feature may decrease the potential for postoperative adhesions.

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