SUTURE ANCHOR VS DRILL TUNNEL PRIMARY ACL REPAIR: AN IN VITRO COMPARISON OF GAP FORMATION

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DISCLOSURES

• Gregory DiFelice, MD:
  – Consulting Income: Arthrex, Inc.,

• Jeffrey DeLong, BS: None

• Christine Villegas, MBS: None

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INTRODUCTION

• Primary ACL suture repair techniques fell out of favor decades ago due to unpredictable and varied outcomes\textsuperscript{1-20}

• Traditional primary ACL repair approaches attempted to repair all types of tears regardless of tear pattern via long, morbid, open procedures followed by long leg cast immobilization.\textsuperscript{1-20}

• Using a modern day approach, the senior surgeon (GD), has developed an arthroscopic suture anchor repair for proximal avulsion type tears identified preoperatively by MRI.

• This technique dramatically reduces the morbidity of the procedure, and has shown early success when used specifically on proximal tears.
PURPOSE

• Comparison of in vitro gap formation of primary ACL repair on simulated proximal avulsion type tears

Modern knotless suture anchor Vs. Traditional bone-tunnel bone-bridge with suture-button fixation

• 1° Hypothesis – Suture repair would not result in significant gap formation with either bone tunnels or suture anchors after 100 cycles of simulated active motion

• 2° Hypothesis – No difference in gap formation with suture repair utilizing either bone tunnels or suture anchors after 100 cycles of simulated active motion.
METHODS

• 6 matched-pairs
  • 3M/3F
  • Avg. age, 52.3 ± 3.3 years (range, 48-56 years)
• Simulated proximal ACL tear with scalpel
• Half suture repair through drill holes, tied over button
• Half suture repair to knotless suture anchors (4.75 mm)
• Simulated active ROM by cycling knee from 90° flexion to full extension via mechanically activating the quadriceps tendon
• Gap measured with high resolution photography at 0, 5, 50, 100 cycles
• Pairwise comparisions performed to determine significant difference in gap formation
Knotless suture anchor fixation

(1) Suture passage begins at intact portion of ACL (2) Fiberwire passage progresses in each bundle towards the avulsed end (3) Once both sutures are passed, control of stump is achieved (4) Drill holes placed in femoral footprint from simulated accessory inferomedial portal (5) Fixation of 2 suture anchors into ACL bundle footprints (6) Final Primary ACL repair construct with 2 knotless anchors.
Bone-tunnel bone-bridge with suture-button fixation

(1) Suture passage begins at intact portion of ACL (2) Fiberwire passage progresses in each bundle towards the avulsed end (3) Once both sutures are passed, control of stump is achieved (4) Drill holes into femoral bundle footprints via simulated accessory inferomedial portal (5) Sutures tied over cortical suture-button (6) Final Primary ACL repair construct with suture-button
RESULTS

- No significant difference in gap formation at 5, 50 or 100 cycles (p = 0.110, p = 0.835, p = 0.625, respectively)

- Average cyclic displacement:
  - Bone Bridge: .20 / .81 / .83
  - Knotless Anchors: .40 / .72 / 1.11

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Discussion

• Sherman’s landmark ACL repair paper showed that patients with proximal tears and good tissue quality tended to have better outcomes than the group overall.  

• Modern day, arthroscopic suture anchor repair resisted gap formation in vitro at least as well as historic procedure using a simulated active motion model.

• <1 mm gap formation is likely to be clinically insignificant as this will fill with clot quickly after surgery.
Discussion

• MRI enables preoperative identification of those tears that may be amenable to repair, and technological advances allow minimal morbidity repair procedures to be performed. Perhaps, ACL repair should be reconsidered only in carefully selected, proximal tear types?

• Further study is warranted.
LIMITATIONS

• Does not account for dynamic in vivo structural interactions and biomechanics of other associated ligamentous and muscular structures

• Kinematics may be greatly affected by muscular activation and interactions

• Post-mortem cadaveric knee model

• Unknown combined effects of weight bearing rehabilitation protocols and biologic healing on final strength and stiffness

• Small sample size
CONCLUSIONS

• Gap formation for both fixation methods for primary ACL repair after 100 cycles of simulated active motion was approximately 1mm

• No significant difference in gap formation noted between repair techniques.

• Equivalent gap formation existed among primary ACL repair utilizing knotless suture anchors versus primary ACL repair utilizing a bone-bridge and suture-button
REFERENCES