ISAKOS CONGRESS 2023 | Boston Massachusetts June 18–June 21

INOVA Sports Medicine

No Difference in Clinical Outcomes between Aperture and Suspensory Femoral-Sided Fixation following Anterior Cruciate Ligament Reconstruction with Bone-Patellar Tendon-Bone Autograft

Garrison A Hughes, BS, Cory A Riccio, MD, Christopher M Kuenze, PhD, ATC, Rachel E Cherelstein, BS, Mitchell A Nader, Tarun K Vippa, BS, Theodore N Rudic, BS, Kory BD Pasko, BS, Laura E Keeling, MD, Edward S Chang, MD

Inova Health System
Fairfax, VA, USA

Disclosures

Edward S. Chang, MD

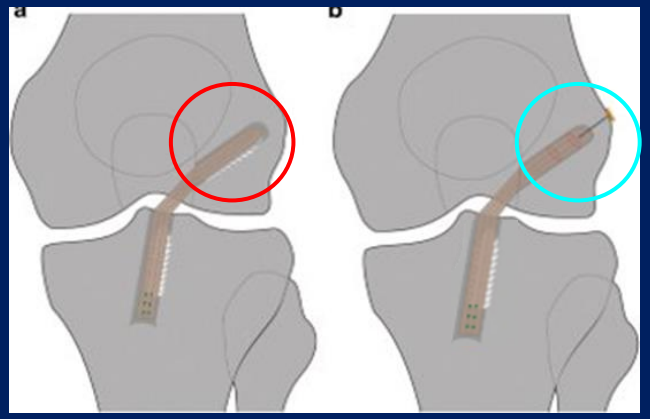
- Avanos – Consultant
- Arthrex – Education and research support

Background

- During ACL Reconstruction (ACLR), two of the most common methods for femoral graft fixation can be broadly categorized as suspensory and aperture
- Reliable fixation is vital to the stability of the newly implanted graft, and there is evidence to suggest that fixation method plays a significant role in revision rates
- However, multiple meta-analyses have yielded conflicting data as to which method is superior, and most have found no significant difference
- No Gold Standard
  - Intraoperative fixation determined by surgeon preference

Interference screw (aperture)

Cortical button (suspension)



Adapted from *Mayr et al*. (2020)

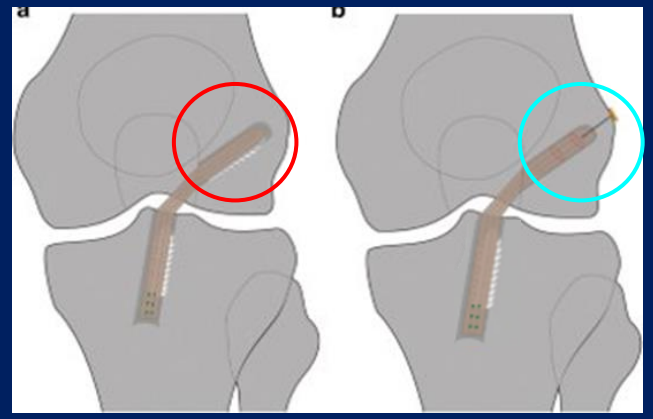
INOVA Sports Medicine

Background

- Bone-patellar tendon-bone (BPTB) autograft is widely considered the benchmark graft option for its long track record and low failure rates
- BPTB fixation has historically been achieved with an interference screw
- While efficacious, no recent studies have compared suspensory fixation to aperture fixation with respect to clinical outcomes for BPTB ACLR

Interference screw (aperture)

Cortical button (suspension)



Adapted from *Mayr et al*. (2020)

Background

Drawbacks of interference screw

- Graft laceration – biomechanical models demonstrate up to 25% reduction in tensile strength immediately after screw placement
- Decreased bone-graft contact, risk for posterior wall blowout

Suspensory Advantages

- Avoidance/mitigation of aforementioned risks
- Ease of use and high initial fixation strength

Suspensory Disadvantages

- Less rigid fixation
- Side-to-side ("windshield wiper") and vertical ("bungee") graft motion
- Potential for tunnel widening

INOVA Sports Medicine

Purpose: To compare the effect of femoral-sided fixation methods (interference screw vs. cortical button) on patient-reported knee function and reinjury rate in young, active patients undergoing ACLR with BPTB autograft.

Hypothesis: There will be no difference in clinical outcomes between suspensory and interference fixation.

INOVA Sports Medicine

Methods

Study Design: cross-sectional retrospective cohort study

Inclusion Criteria:

- Primary, unilateral ACLR with BPTB autograft
- Femoral fixation with interference screw or cortical button
- Tibial fixation with interference screw
- ≥1yr post-ACLR at the time of survey completion

Exclusion Criteria:

- Secondary or revision ACLR
- Bilateral ACL injury
- Multi-ligamentous reconstruction

Outcome Measures: International Knee Documentation Committee Subjective Knee Evaluation (IKDC) scores, secondary ACL injury (graft failure)

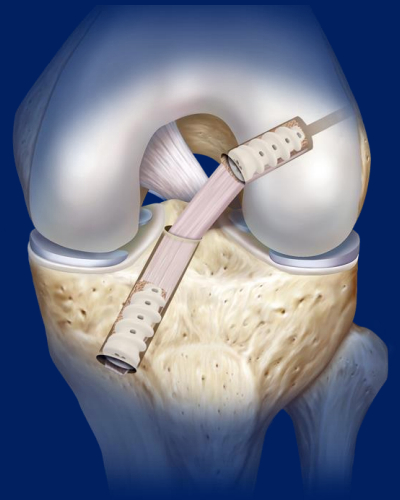
Plan of Analysis: patient-reported outcomes compared with independent samples t-test; graft failures and distribution of patient sex compared with chi-squared test

Methods - Surgical Approach

BPTB graft harvested at 10mm width, 20x10mm bone plugs from patella and tibia

Aperture Fixation

- Femur- Interference Screw
- Tibia- Interference Screw



Procedures were performed by one of five orthopedic surgeons at a single medical center between 2016-2019

Suspensory Fixation

- Femur- Adjustable Cortical Button
- Tibia- Interference Screw

Results

226 patients met inclusion criteria

73 patients completed the IKDC in its entirety
- 24 respondents received interference screw
- 49 respondents received cortical button

Mean follow-up: 30.4 months

Patient-reported knee function did not vary between groups

Graft failure rates not significantly different

Table 1. Between group comparison of patient demographics and patient-reported knee function

	Interference Screw N = 24	Cortical Button N = 49	p-value
Age (years)	22.0±7.1	19.7±5.9	0.15
Sex (M/F)	11M / 13F	26M / 23F	0.56
BMI (kg/m²)	23.6±3.2	24.3±3.9	0.47
IKDC Score	82.2±14.1	81.2±14.8	0.79
Graft Failures	2 (8.3%)	3 (6.1%)	0.73

M = male; F = female; IKDC = International Knee Documentation Committee Subjective Knee Evaluation Form

Results

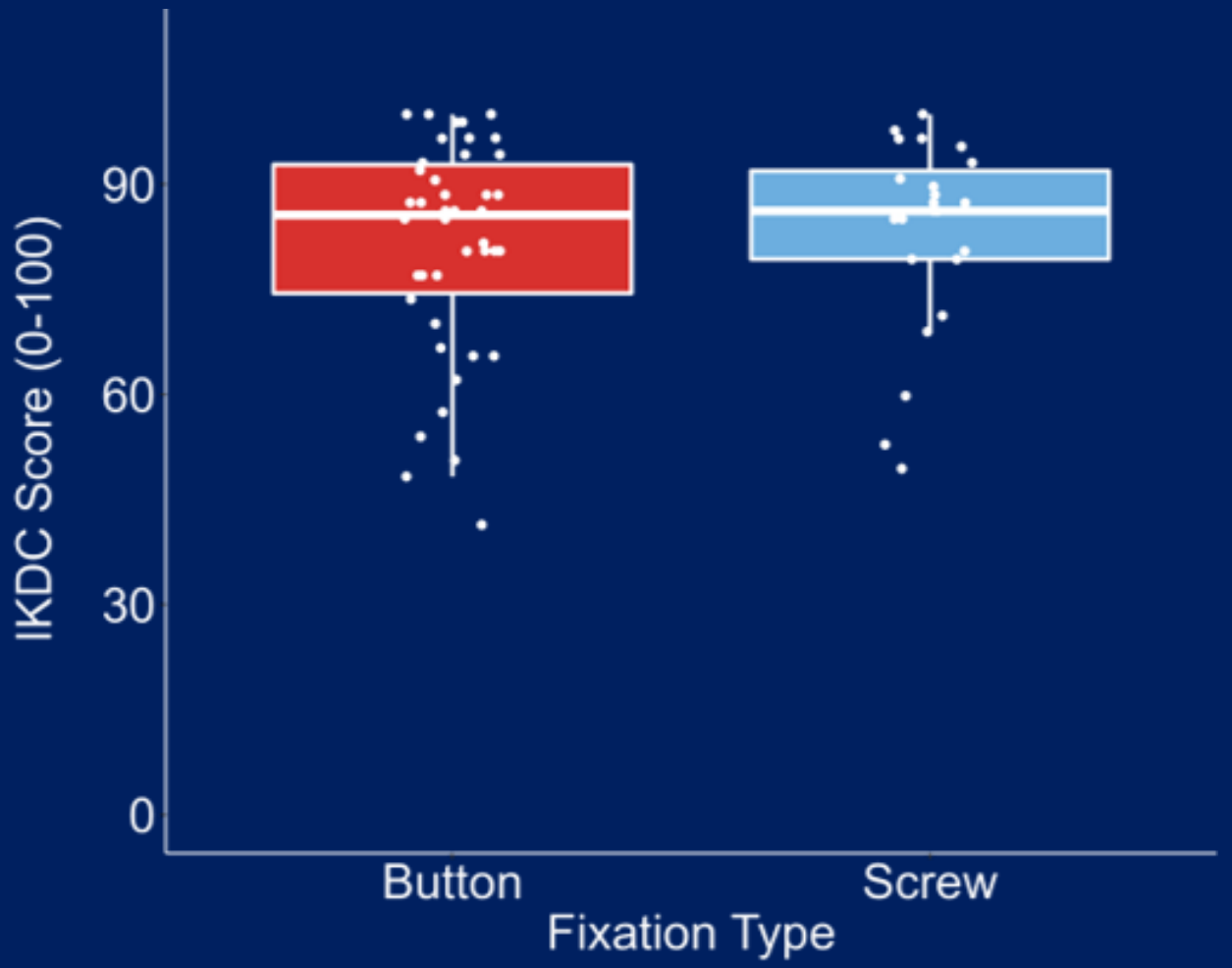


Figure 1. Between fixation device comparison of International Knee Documentation Committee Subjective Knee Evaluation Scores (IKDC). Box and whiskers plot of IKDC scores for suspensory (left, red) and aperture (right, blue) fixation exhibiting similar distributions at a mean follow-up period of 30.4 months post-ACLR.

INOVA Sports Medicine

Discussion

- Literature comparing suspensory and aperture fixation is dominated by soft tissue grafts (mostly hamstring tendon)
- With changing practices and increased prevalence of cortical buttons, it is important to investigate potential clinical differences relative to traditional interference screws following ACLR
- Combining the benefits of BPTB ACLR (bone-to-bone healing, low failure rate, good return-to-sport) with suspensory advantages (strong initial fixation, reduced tunnel trauma & graft laceration) could help optimize patient recovery
    - Single-arm study of suspensory fixation previously found strong CT evidence of bone integration and negative pivot shift in all 34 cases at one year s/p ACLR with BPTB
- Our findings suggest that femoral cortical buttons are equally effective as interference screws for achieving good subjective knee function while limiting reinjury risk
- More research in larger patient populations is needed to determine if the theoretical advantages of graft suspension are clinically important

INOVA Sports Medicine

Conclusion

- In patients undergoing ACLR with BPTB autograft, there were no significant differences between groups who received femoral fixation with interference screw or cortical button with respect to clinical outcomes or graft failure rates at intermediate term follow-up (~2.5 years).
- This suggests that both methods may be suitable for young, active patients.

INOVA Sports Medicine

References

1. Sanders TL, Maradit Kremers H, Bryan AJ, et al. Incidence of Anterior Cruciate Ligament Tears and Reconstruction: A 21-Year Population-Based Study. *Am J Sports Med*. 2016;44(6):1502-1507. doi:10.1177/0363546516629944

2. Eysturoy NH, Nissen KA, Nielsen T, Lind M. The Influence of Graft Fixation Methods on Revision Rates After Primary Anterior Cruciate Ligament Reconstruction. *Am J Sports Med*. 2018;46(3):524-530. doi:10.1177/0363546517748924

3. Buerba RA, Boden SA, Lesniak B. Graft Selection in Contemporary Anterior Cruciate Ligament Reconstruction. *J Am Acad Orthop Surg Glob Res Rev*. 2021;5(10):e21.00230. Published 2021 Oct 25. doi:10.5435/JAAOSGlobal-D-21-00230

4. Sawyer GA, Anderson BC, Paller D, Heard WM, Fadale PD. Effect of interference screw fixation on ACL graft tensile strength. *J Knee Surg*. 2013;26(3):155-159. doi:10.1055/s-0032-1324808

5. Teng Y, Zhang X, Da L, et al. Whether sutures reduce the graft laceration caused by interference screw in anterior cruciate ligament reconstruction? A biomechanical study in vitro. *BMC Musculoskelet Disord*. 2021;22(1):571. Published 2021 Jun 22. doi:10.1186/s12891-021-04457-5

6. Robin BN, Jani SS, Marvil SC, Reid JB, Schillhammer CK, Lubowitz JH. Advantages and Disadvantages of Transtibial, Anteromedial Portal, and Outside-In Femoral Tunnel Drilling in Single-Bundle Anterior Cruciate Ligament Reconstruction: A Systematic Review. *Arthroscopy*. 2015;31(7):1412-1417. doi:10.1016/j.arthro.2015.01.018

7. Zeng C, Lei G, Gao S, Luo W. Methods and devices for graft fixation in anterior cruciate ligament reconstruction. *Cochrane Database Syst Rev*. 2018;2018(6):CD010730. Published 2018 Jun 29. doi:10.1002/14651858.CD010730.pub2

8. Taketomi, Shuji et al. “Secure fixation of femoral bone plug with a suspensory button in anatomical anterior cruciate ligament reconstruction with bone-patellar tendon-bone graft.” *Joints* vol. 3,3 102-8. 28 Jan. 2016.