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A Low-Profile, All-Suture Anchor Construct Provides Comparable Fixation to Both Spiked Washer and Bone Staple for Tibial-Sided Medial Collateral Ligament Reconstruction: A Cadaveric Biomechanical Study

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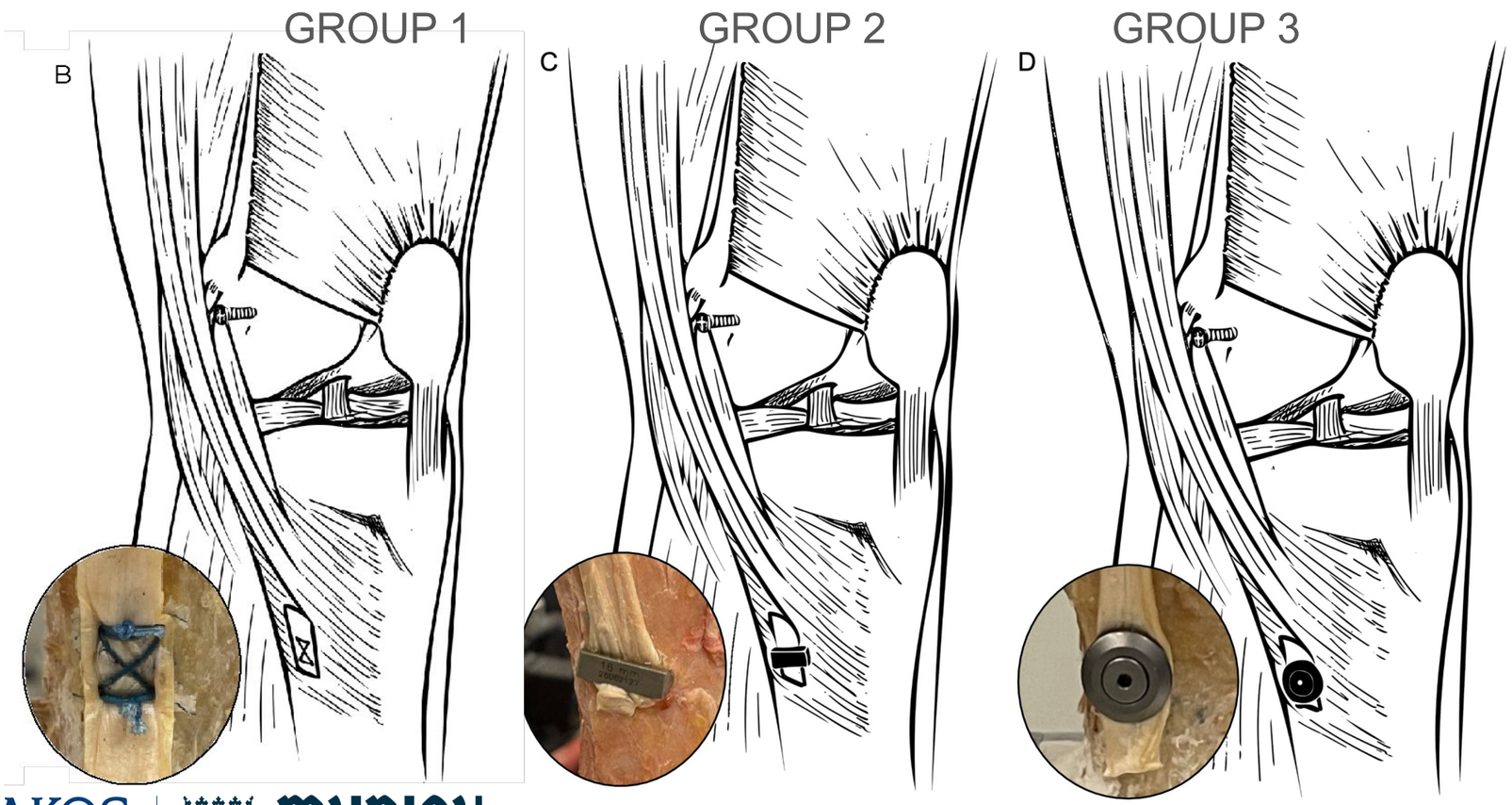
Faculty Disclosure Information

- I have no relevant financial relationships or conflicts of interest to disclose, as noted in our Financial Disclosure Statement.

OBJECTIVES

To compare the biomechanical performance of an **all-suture anchor construct** to that of both a **spiked washer & cancellous screw**, and a **bone staple** in tibial-sided superficial medial collateral ligament (sMCL) reconstruction.



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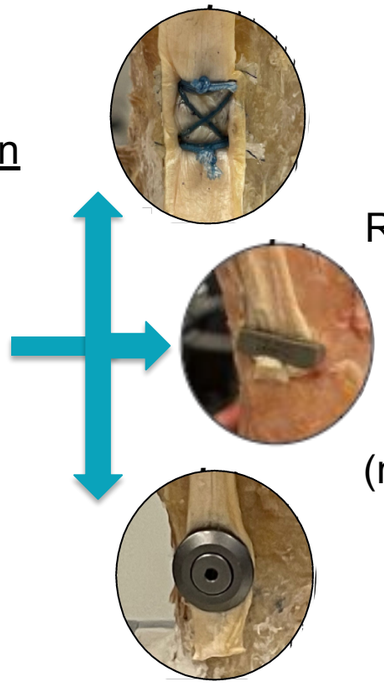
MATERIAL AND METHODS

A **time-zero cadaveric biomechanical**. Differences between groups were analyzed using one-way analysis of variance (ANOVA).

<u>sMCL reconstruction</u>

n = 24 human cadaveric tibia

(fresh-frozen *peroneus longus allografts*)



Randomized to one of **three treatment groups** for tibial fixation (n = 8, per group)

Servohydraulic uniaxial testing machine: **1,000 cycles at 20–50N**, and **Maximum LTF**

Variables:
1. **Maximum load-to-failure (LTF)**
2. **Elongation after cyclic loading**
3. **Elongation at maximum LTF**
4. **Mode of failure**

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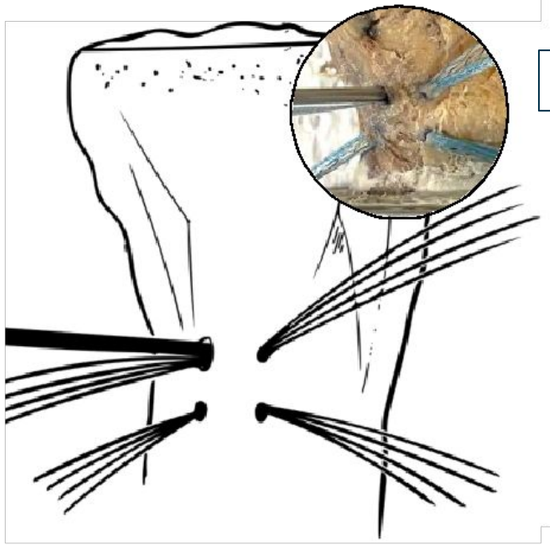
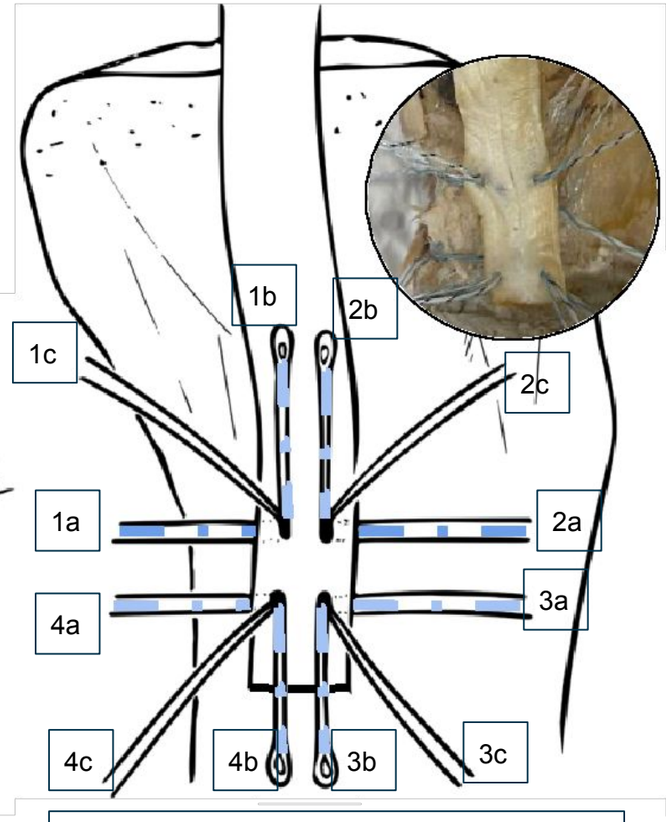
MATERIAL AND METHODS

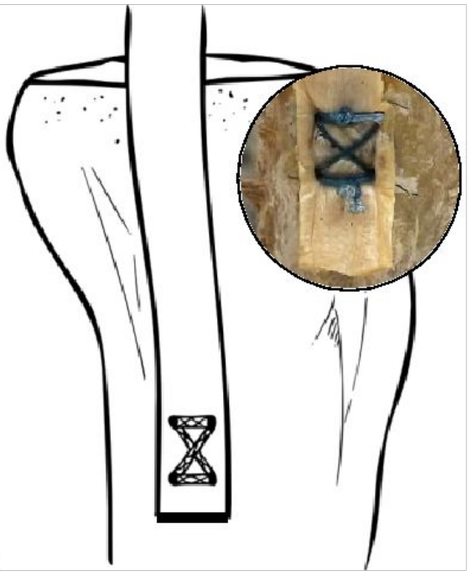
Schematic of the "hourglass" configuration for suture-anchor fixation using four Knotless 2.6mm FiberTak® RC:



A. Insertion of the soft anchor, after predrilling, using the rigid guide.



B. SutureTape from anchor 1c is passed through the loop at 2b and then pulled through the anchor and tensioned with 2a. This process is repeated for anchors 2, 3, and 4.



C. After trimming the loose ends, the result of graft fixation is shown.

RESULTS

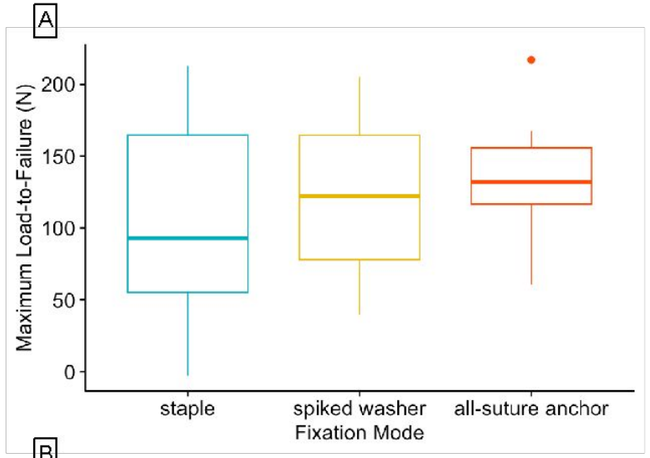
No statistically significant differences were observed across the groups (see below)

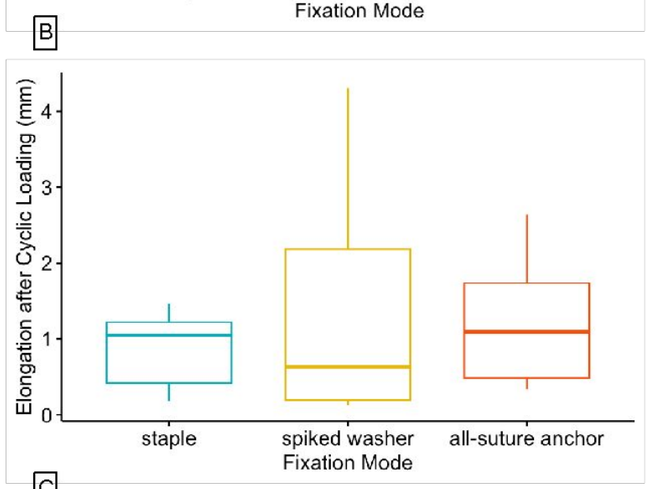
Mean elongation after cyclic loading (p = 0.73) was:
- 1.1 ±0.7mm in the all-suture anchor group
- 0.6 ±1.2mm in the spiked washer group
- 1.1 ±0.6mm in the staple group

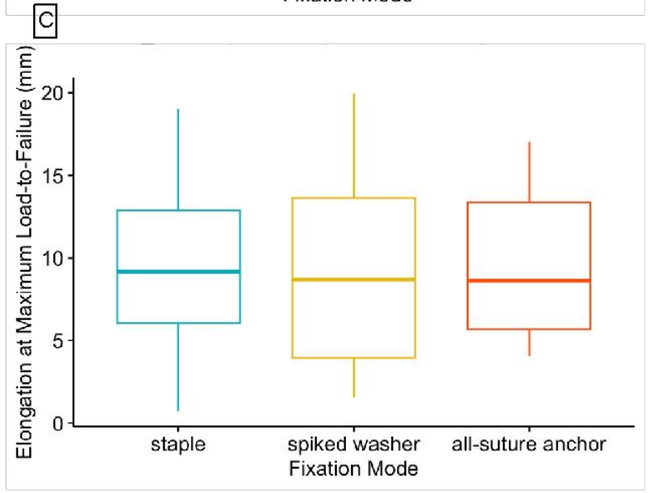
Mean maximum load-to-failure (p =0.605) was:
- 132.1 ±40.2N for the all-suture anchor group
- 120.8 ±54.9N for the spiked washer group
- 123.9 ±64.1N for the staple group

Mean elongation at maximum load-to-failure (p = 0.605) was:
- 8.6 ±4.1mm for the all-suture anchor group
- 8.7 ±5.4mm for the spiked washer group
- 10.8 ±6.3mm for the staple group

The **mode of failure** for all specimens was **tendon pull out**.







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DISCUSSION

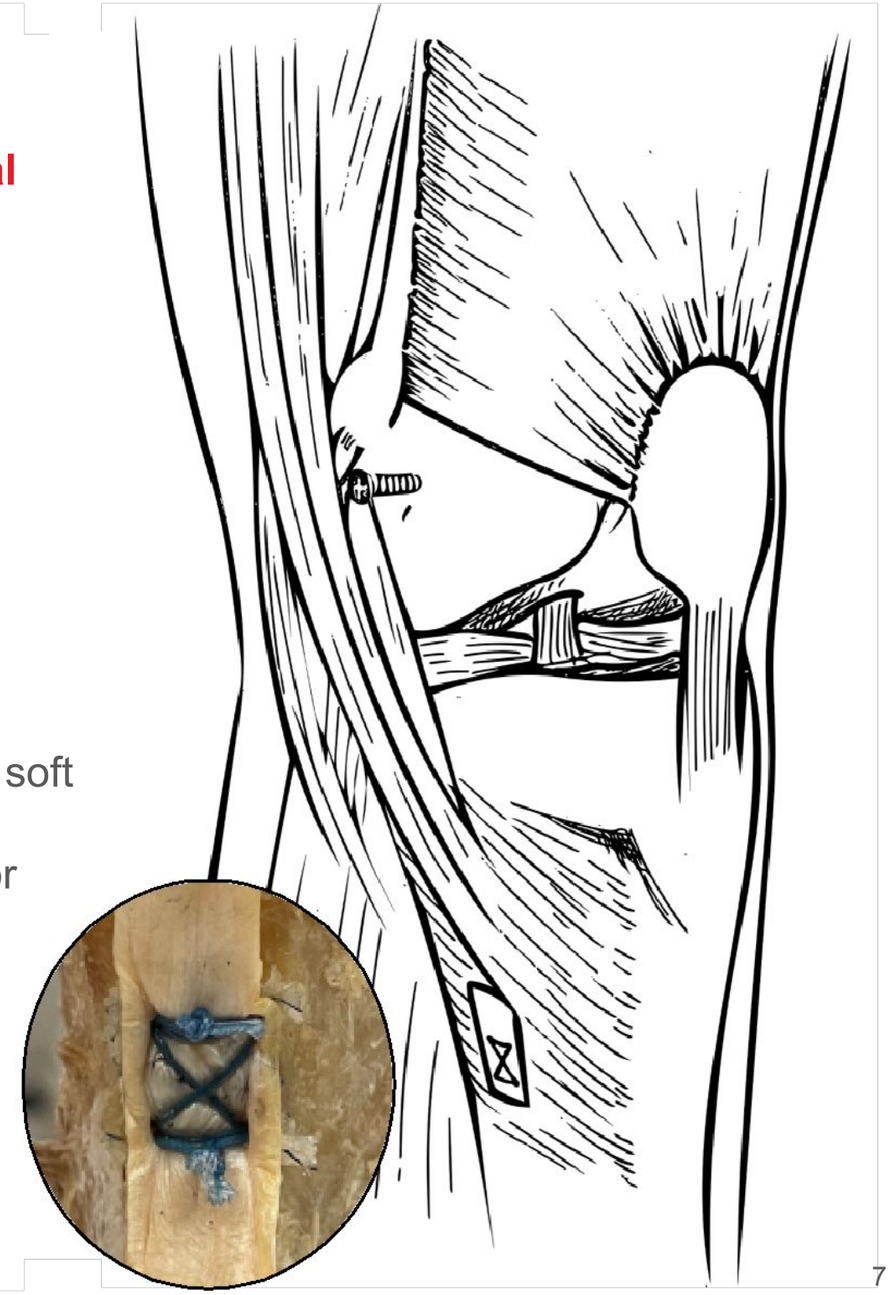
All-suture anchor construct showed **similar biomechanical performance** to staple and spiked washer for distal sMCL fixation.

Equivalent results in:

- Elongation after cyclic loading
- Maximum Load-to-Failure (LTF)
- Elongation at LTF
- Failure mode

Key Clinical **Advantages**:

- **Low Profile**: Reduces implant prominence & potential soft tissue irritation.
- **No Hardware Removal**: Eliminates need (and cost) for secondary surgery.
- **Cortical Fixation**: Well-suited for strong tibial cortical bone attachment.



DISCUSSION

Addressing limitations of existing methods for sMCL tibial fixation (staples, washers, tunnels) can cause:

- **Implant irritation**
- **Fracture risk**
- **Challenges in multi-ligament cases.**

Cost considerations: *Higher initial cost*

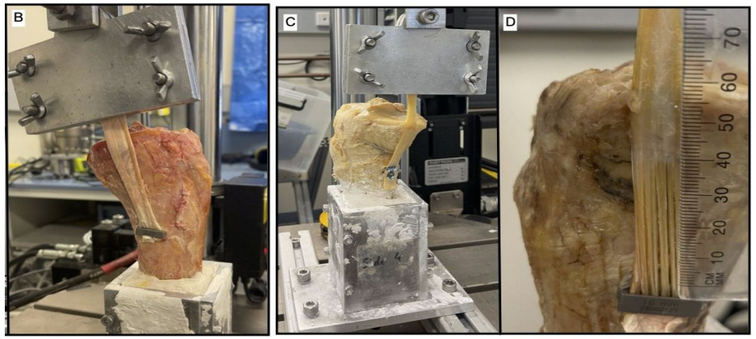
- All-suture anchor (~ 1,768 AUD)
- Screw and washer (~ 116 AUD)
- Staples (~ 125 AUD)

Potential Long-Term Savings:

- Avoids possible metal **hardware removal** surgery costs (**~$4,000 AUD**).

Fixation method	Implants	Advantages	Disadvantages
Interference Screws (bone tunnel)	Biodegradable or Metal Screws	↓ Graft-tunnel micromotion ↓ Tunnel Widening ↓ Graft creep	Risk of screw-tunnel divergence Graft damage Cancellous fixation Graft slippage
Suspensory Devices (bone tunnel)	Adjustable Loop Cortical Suspensory Button	Minimally invasive ↑ Tension between graft/bone interface Cortical fixation	↑ Graft-tunnel micromotion ¨Windshield wiper phenomenon¨ Tunnel widening Tunnel convergence
Extracortical (onlay fixation)	Screw and Spiked Washer and Bone Staple	Stable Inflexible fixation ↓ costs	Implant convergence Pes anserine irritation Fracture risks
Bone Anchors (onlay fixation)	Suture or Metal Anchors	Maintenance of tension Flat insertion point	Pull-out Tunnel convergence
Autograft with Preserved Insertion (Pes Anserinus)	Gracilis or ST	Minimally invasive ↓ costs	In some cases of MLKI, not possible Non-anatomical insertion

↓ = decreased; ↑ = increased; MLKI = multiligamentous knee injury



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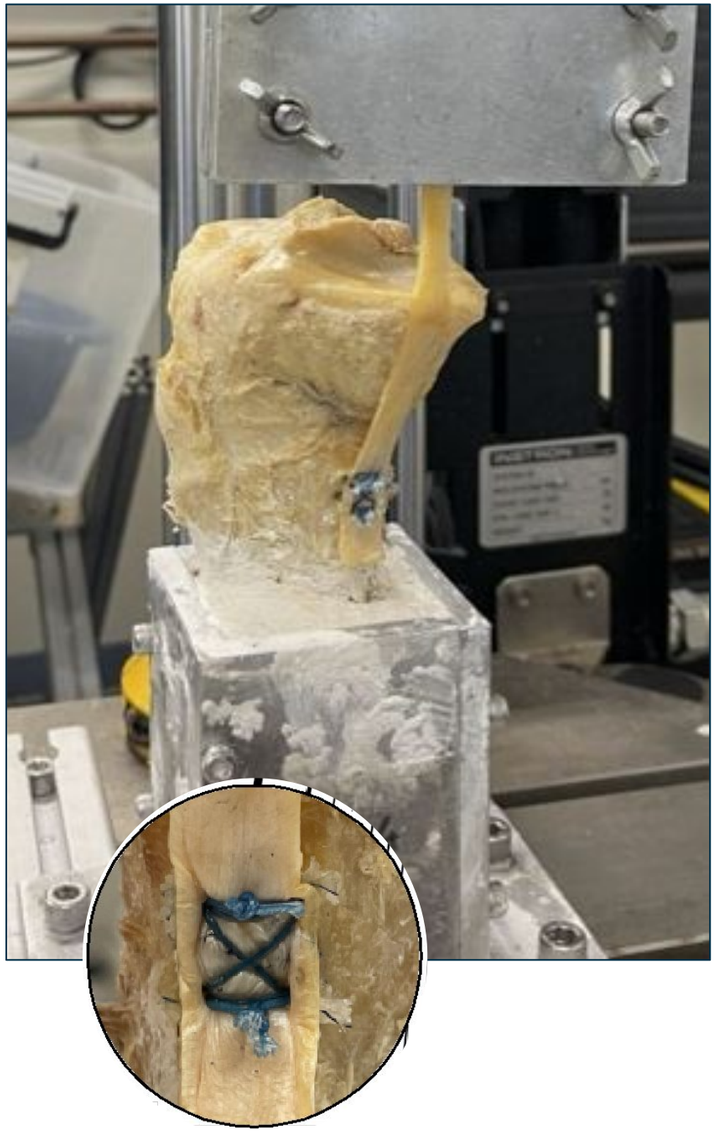
CONCLUSIONS

The **all-suture anchor construct** showed:

Comparable biomechanical performance

to both the spiked washer and bone staple for tibial-sided sMCL reconstruction in this time-zero cadaveric model.

Further research is needed to **explore clinical applicability and assess** potential **benefits** compared to current treatment options.



Level of Evidence: Level V.

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