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Arciero vs. LaPrade: A Biomechanical Comparison of Two Techniques for Knee Posterolateral Corner Reconstruction

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INTRODUCTION

- **The Posterolateral Corner (PLC) is an area of the knee that does not receive adequate research recognition despite its contribution to overall knee stability. (Figure 1) This has lead to the creation of multiple surgical reconstruction techniques. Two very commonly used techniques are the Arciero and LaPrade reconstructions.**

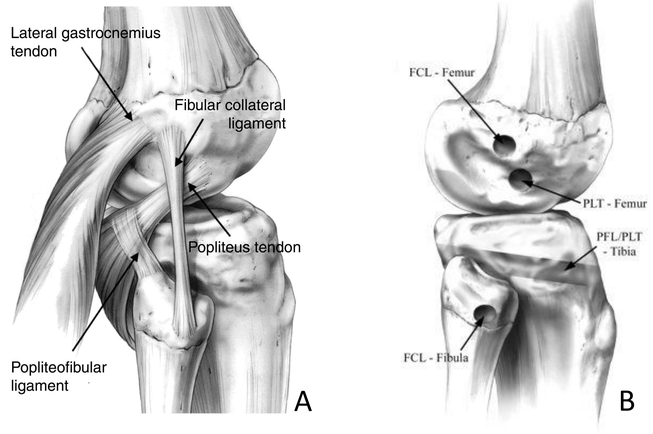

Figure 1: A. Anatomy of the posterolateral corner (PLC) highlighting the Fibular Collateral Ligament (FCL), Popliteus Tendon (PLT), Popliteofibular Ligament (PFL), and Lateral Gastrocnemius Tendon. **B.** Anatomy of the PLC showing origin and insertion points of the FCL, PLT, and PFL.

PURPOSE

- **The objective of this study was to identify which reconstruction technique best restores stability to a deficient PLC with the addition of an injury to the tibiofibular (Tib-Fib) ligament or anterior cruciate ligament (ACL)**

METHODS

- **Ten matched-paired, fresh-frozen cadaveric specimens from mid-femur to foot were used. The skin and subcutaneous fat was removed from all specimens and the foot was disarticulated at the tibiotalar joint.**
  - **One leg from each matched pair was randomized to receive the Arciero reconstruction while the contralateral leg received the LaPrade reconstruction**
  - **Post-reconstruction, five of the ten matched pairs underwent sectioning of the Tib-Fib ligament while the other five matched pairs had their ACL's sectioned**
- **The LaPrade technique: one end of a 22cm graft is fixed in the popliteus sulcus and run through a tibial tunnel. The second 22cm graft is anchored at the FCL femoral attachment site, runs through a fibular tunnel, and is passed through the tibial tunnel. Both grafts are tensioned, interference screws are placed in the tunnels, and grafts are secured in the tibia. This technique attempts to reconstruct the FCL, PLT, and PFL (Figure 2A).[2]**
- **The Arciero technique: a 22cm graft is placed through a fibular tunnel, tensioned, and fixed at both ends in the distal femur. Grafts were secured by interference screws in the fibula and femur tunnels. This technique attempts to reconstruct the FCL and PFL only (Figure 2B).[3]**
- **Prior to testing, a trained orthopaedic surgeon harvested the Semitendinous, Gracilis, and Achilles tendons from each specimen to use as allografts for the corresponding reconstructions**
- **A torque/force rod was fixed in the distal end of the tibial canal so that varus angulation (VA) and external rotation (ER) could be measured through the testing fixture. (Figure 3)**
- **A custom-made testing fixture was created to isolate and apply 10 Nm VA and 5 Nm ER at 0˚, 20˚, 30˚, 60˚, and 90˚ of flexion. (Figure 4)**

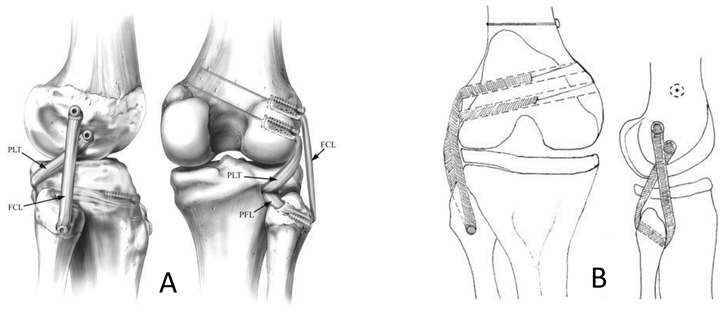

Figure 2: A. Lateral and posterior views of the LaPrade PLC reconstruction.[4] **B.** Anterior and lateral views of the Arciero PLC reconstruction.[5]

METHODS

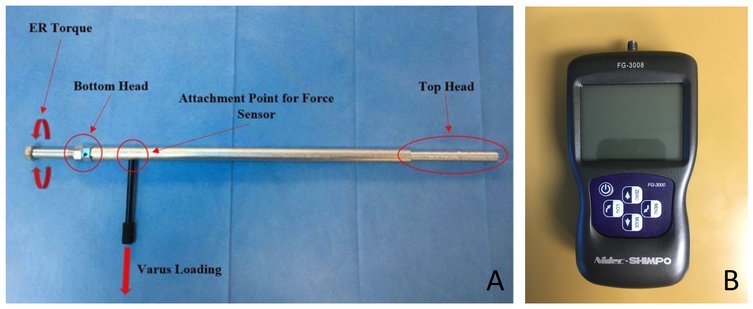

Figure 3: A. Torque/force rod used to apply VA and ER. The top head is fixed into the distal end of the tibial canal. **B.** A Nidec-SHIMPO FG-3008 digital force gauge was used measure varus loading at the point of attachment. A torque wrench set at 5 Nm was used to measure ER about the rod.

- **8 Optitrack motion capture cameras acquired VA and ER data through three rigid body marker sets placed on the tibial tuberosity, the anterior surface of the distal femur, and the arm of the testing fixture adjacent to its axis of rotation**
- **Initial measurements were taken of each specimen to determine their intact ligament state**
- **Measurements were subsequently taken post-sectioning of the PLC, post-reconstruction, and post-sectioning of the Tib-Fib and ACL**
- **Multivariate Analysis of Variance (MANOVA) was used to assess the mean differences over the five angles for each outcome measure.**
- **A Wilks' Lambda statistic and significance level of 5% was used to establish statistically significant differences**

Figure 4: Side view of a cadaveric specimen fixed in the custom-made testing fixture at 30^0 of flexion with the torque/rod fixed in the distal tibial medullary canal

RESULTS

- **For intact PLC testing, we found the ER and VA profiles of the Arciero and LaPrade groups to be statistically similar**
- **A significant difference was found between intact and post-sectioning ER and VA profiles (P<0.0001 and P=0.0165, respectively; Figure 5)**
- **There was no significance difference between the Arciero and LaPrade groups post-reconstruction in ER or VA (P=0.4842 and P=0.8509, respectively)**
- **There was no significant difference post Tib-Fib sectioning in ER or VA (P=0.2293 and P=0.1778, respectively)**
- **There was no significant difference post ACL sectioning in ER or VA (P=0.8496 and P=0.1962, respectively)**

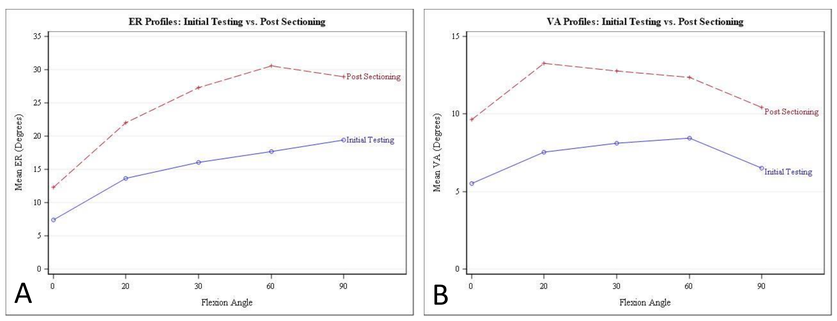

Figure 5: Initial testing vs. post-sectioning profiles (mean values for both groups at each angle). **A.** ER. **B.** VA.

RESULTS

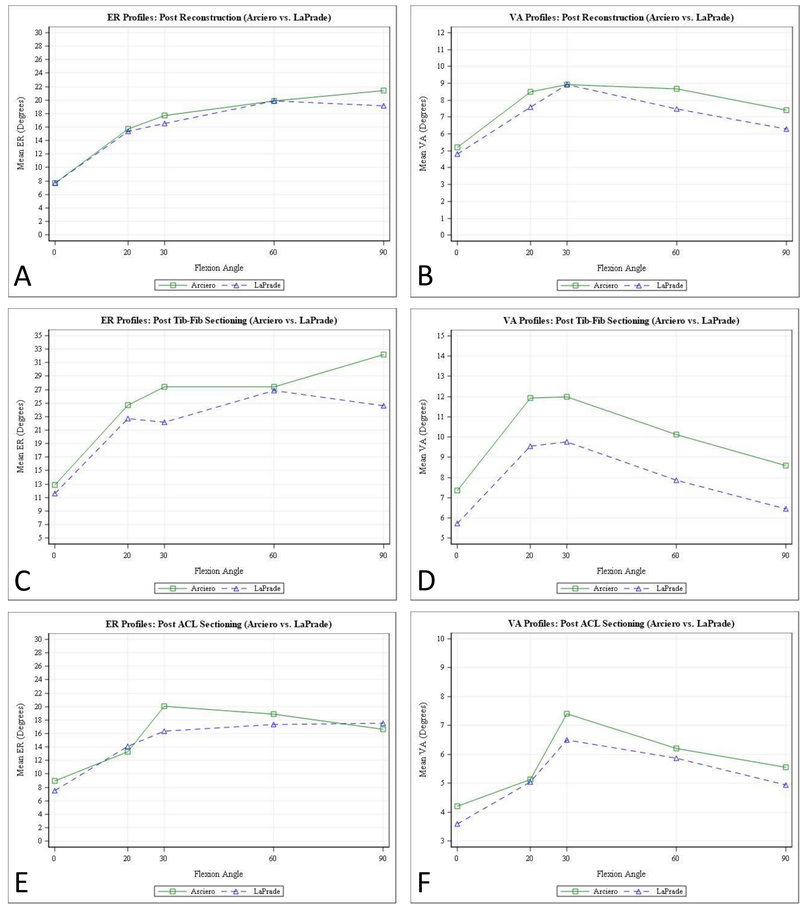

Figure 6: Arciero vs. LaPrade ER and VA profile comparisons. **A.** ER Post-Reconstruction, **B.** VA Post-Reconstruction, **C.** ER Post-Tib-Fib Sectioning, **D.** VA Post-Tib-Fib Sectioning, **E.** ER Post ACL Sectioning, **F.** VA Post ACL Sectioning.

CONCLUSIONS

- **A matched-paired study showed significant knee instability with simulated deficient PLC**
- **A direct biomechanical comparison between Arciero and LaPrade PLC reconstructions showed that both techniques had the ability to return the knee to its intact state with regard to stability**
- **Neither technique outperformed the other in tests to regain ER or VA stability**
- **Subsequent sectioning of the Tib-Fib or ACL ligament showed a statistically similar level of instability in Arciero and LaPrade groups relative to their reconstructed state; Tib-Fib sectioning had a greater effect on stability**
- **A post-hoc test for parallelism showed the two techniques were parallel in measures of VA post-reconstruction, post-Tib-Fib, and post-ACL sectioning, implying that a larger sample size may elucidate a difference between techniques**

CLINICAL RELEVANCE

- **A comparison of Arciero and LaPrade reconstructions allows for surgeons to select the technique they prefer based on their preference and training without concern for surgical outcomes affecting knee stability**

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