Risk of Revision and Reoperation after ACL Reconstruction. Comparison of Quadriceps Tendon, Patellar Tendon, and Hamstring Autografts Stratified by Patient Gender and Age: A cohort study of 27,715 Patients

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ACL Study Group
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Gregory B Maletis, MD
Heather A Prentice, PhD
Chelsea Reyes
Christopher R Lehman, MD
Justin S Yang, MD
Colin Mansfield, MD

Disclosure

I (and/or my coauthors) have nothing to disclose

Purpose:

To evaluate **risk for subsequent surgical procedures**, including revision and reoperation, for a cohort of primary anterior cruciate ligament reconstruction (ACLR) patients according to autograft selection

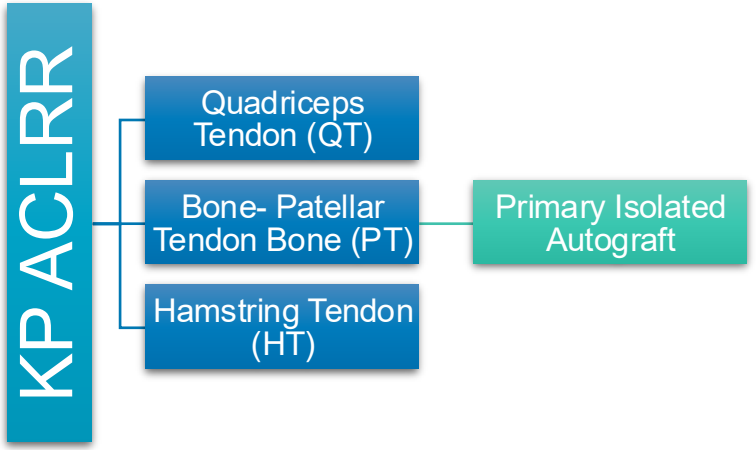
- Stratified by patient Age and Gender.
  - < 22yo and ≥ 22yo

Methods:

Design: Cohort study, 2012-2023

Data Source: Kaiser Permanente (KP) ACLR Registry (ACLRR).

Outcome of interest: Risk for revision and risk for ipsilateral reoperation according to autograft selection



Purpose:

To evaluate risk for subsequent surgical outcomes, including revision and reoperation, for a cohort of primary anterior cruciate ligament reconstruction (ACLR) patients according to autograft selection

- Stratified by patient Age and Gender.
  - < 22yo and ≥ 22yo

Statistics/Covariates:

Primary outcome: **Revision**

Secondary outcomes: **Re-operation** (stiffness, extensor disruption, meniscus reasons, cartilage reasons)

Covariates:

- Patient factors: Age, BMI, race, smoking status, ASA classification, activity at time of injury
- Procedure factors: cartilage injury reported, meniscus injury reported, tunnel drilling technique and operative time

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Statistics/Covariates:

Statistics

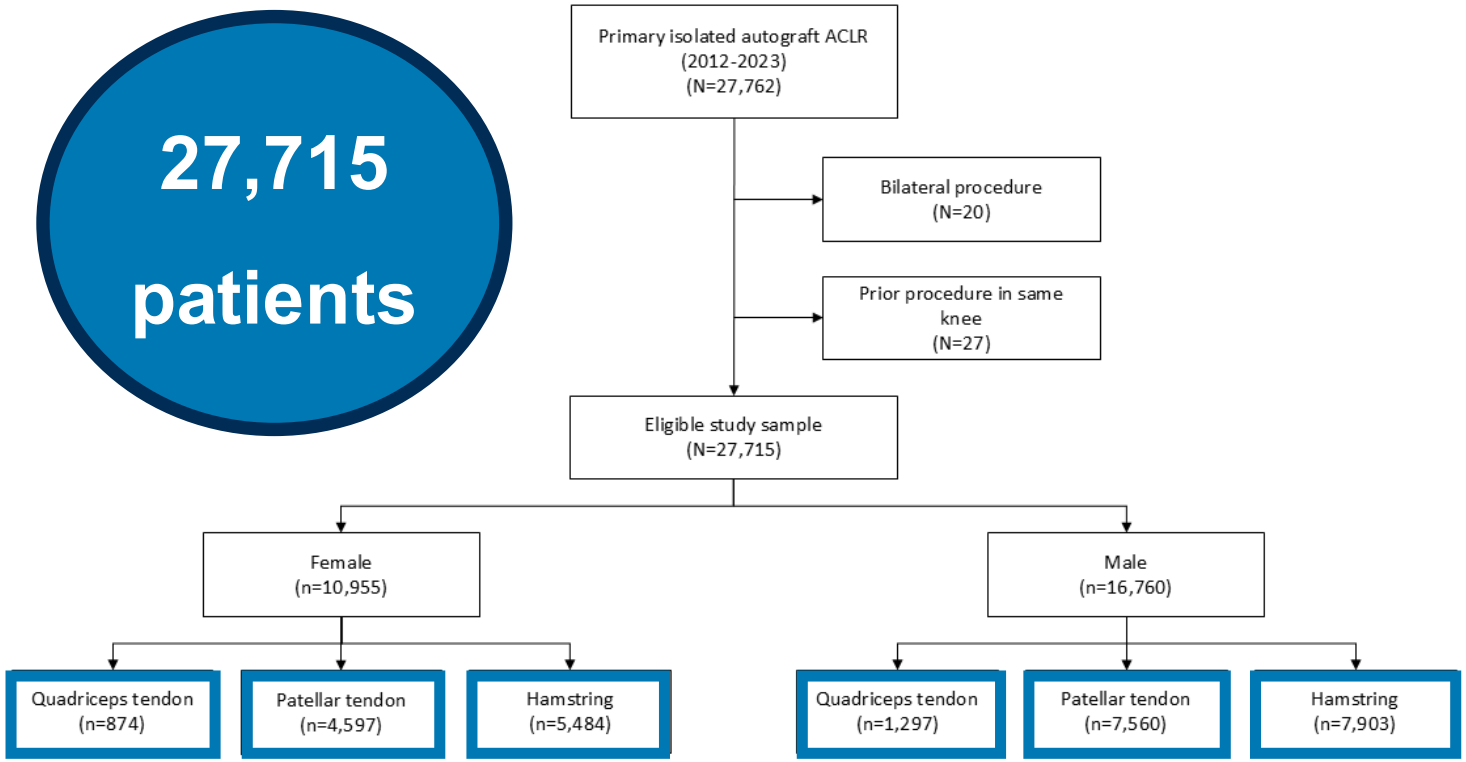
Hazard ratios (HR) and 95% confidence intervals (CI) are reported; $p<0.05$ was the threshold for statistical significance and all tests were two-sided. The **number needed to treat (NNT)** was also calculated from the regression analysis using the same covariates

Cumulative incidence of revision and reoperation with one minus Kaplan-Meier estimate, Multivariate Cox proportional hazards regression to evaluate associations, covariates selected into final multivariate model as confounders, regression models with cluster terms at surgeon level

Results:

There were 10,955 females and 16,760 males who underwent primary isolated ACLR; procedures were performed by 319 surgeons at 58 hospitals.

27,715 patients

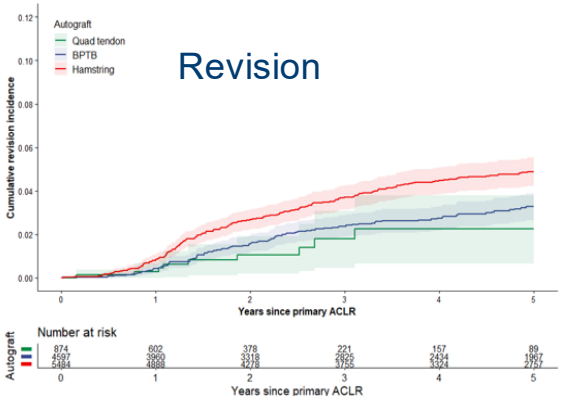


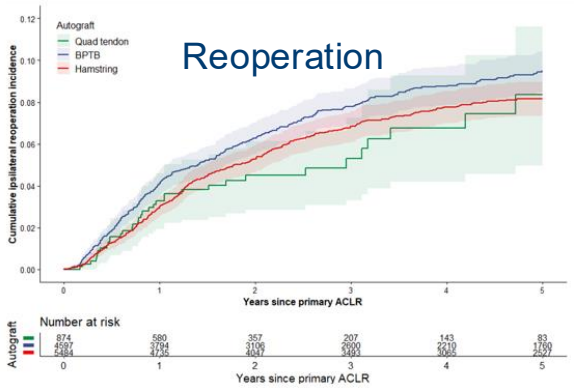
Total Autograft	• PT 12,157 • HT 13,387 • QT 2,171
Median Follow-up	• 4.7 years • Range 2-11 years
Mean Demographics	• Female: 23yrs, BMI 25.7 • Male: 25.5yrs, BMI 27.2

Results:

At 5-year follow-up, the crude incidence of revision for our entire group was 2.7% for QT, 3.0% for PT, and 4.5% for HT ACLR

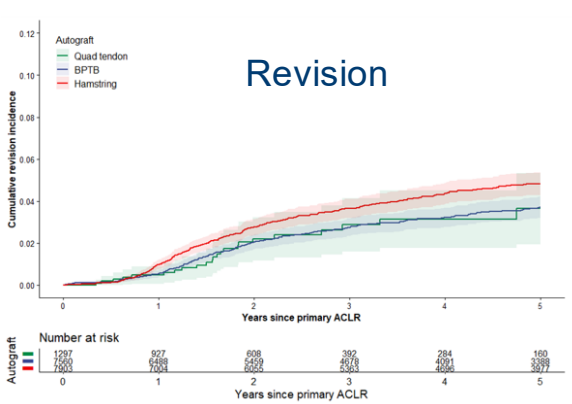
Females

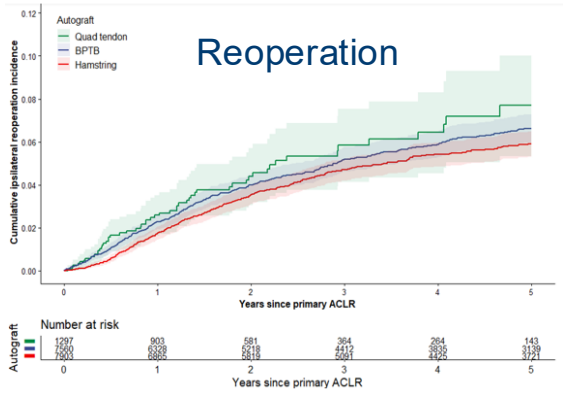




- ***QT vs PT** ACLR:* No difference in revision risk (HR=0.76, 95% CI=0.36-1.59) and no difference in reoperation risk (HR=0.83, 95% CI=0.57-1.23).
- ***QT vs HT** ACLR:* **Lower revision risk** (**HR=0.44**, 95% CI=0.24-0.83) and no difference in reoperation risk (HR=0.94, 95% CI=0.63-1.38).
- ***PT vs HT** ACLR:* **Lower revision risk** (**HR=0.57**, 95% CI=0.44-0.73) and no difference in reoperation risk (HR=1.09, 95% CI=0.93-1.28).

Males





- ***QT vs PT** ACLR:* No difference in revision risk (HR=0.94, 95% CI=0.57-1.54) and no difference in reoperation risk (HR=1.14, 95% CI=0.72-1.81).
- ***QT vs HT** ACLR:* No difference in revision risk (HR=0.72, 95% CI=0.49-1.07) and no difference in reoperation risk (HR=1.31, 95% CI=0.88-1.97).
- ***PT vs HT** ACLR:* **Lower revision risk** (HR=0.79, 95% CI=0.65-0.97) and no difference in reoperation risk (HR=1.14, 95% CI=0.96-1.35).

Discussion - Revision

Strongest association found in young female athletes <22yo

Female

- ☐ < 22 yo **HT vs QT**: 2.3x higher risk
- ☐ < 22 yo **HT vs PT**: 1.8x higher risk
- ☐ **QT vs PT**: No difference

Male

- ☐ **HT vs QT**: No difference
- ☐ **HT vs PT**: 1.3x higher risk
- ☐ **QT vs PT**: No difference

≥ 22yo Female: no significant difference PT vs HT vs QT

Male: No age-based revision risk in graft selection

Discussion – Re-operation

Stiffness, Extensor Disruption, Meniscus, Cartilage

Female

- **QT vs HT**: No difference
- **PT vs HT**: No difference
  < 22 1.5 x higher risk for stiffness
- **QT vs PT**: No difference

Male

- **QT vs HT:** ≥ 22 1.6x higher risk
  < 22 higher risk for stiffness and cartilage
- **PT vs HT**: ≥ 22 1.4x higher risk
  and 1.6x higher risk for stiffness
- **QT vs PT**: No difference

QT Stiffness:

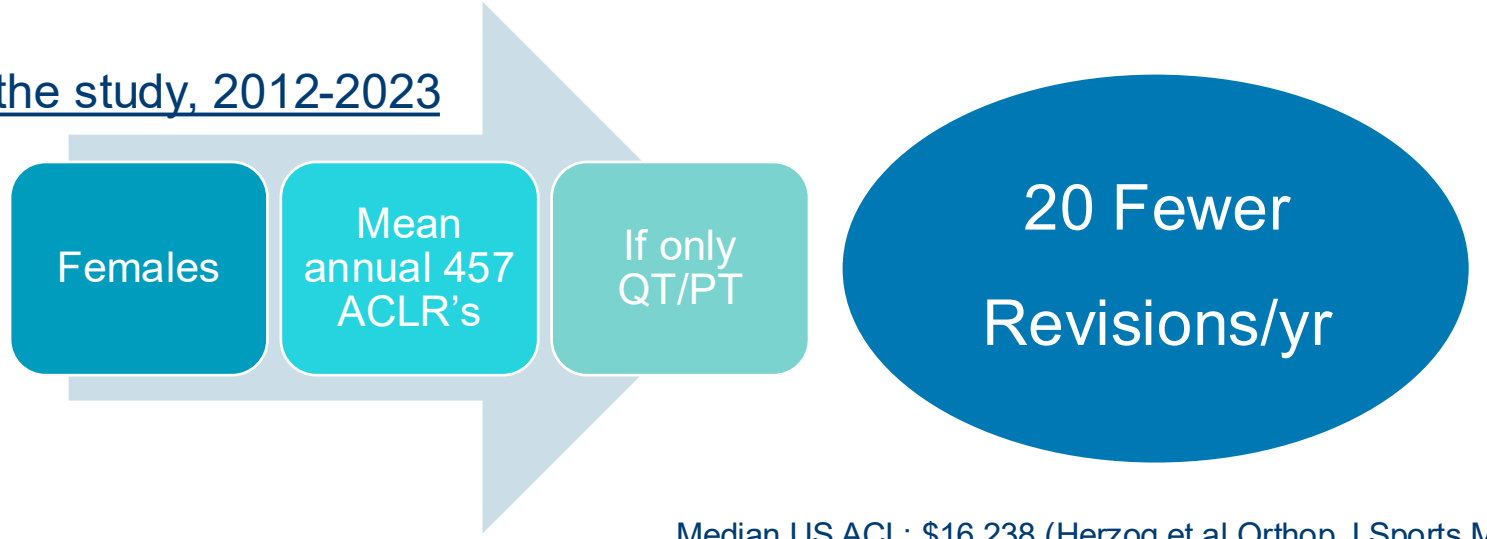
- ***No increase in females.***
- ***+Increase male <22, vs HT***

QT vs PT: No difference gender/age

Number Needed to Treat (NNT)

- If performing ACLR in young females, a surgeon would have to perform 24 ACLR with QT and 23 ACLR with PT to prevent 1 revision compared to HT.
- In young males a surgeon would have to perform 42 ACLR with QT and 63 ACLR with PT to prevent one revision compared to use of HT, respectively.

Over the years of the study, 2012-2023



Median US ACL: $16,238 (Herzog et al Orthop J Sports Med 2017)

Lifetime Cost US: $38,121 (Mather et al JBJS 2013)

Limitations

- Revision does not = Failure
- Surgical technique and rehabilitation were not standardized
- Graft diameter was not evaluated
- Clinical exam and PRO's not evaluated
- Observational studies can't determine causality

Strengths

- Large cohort 27,715 patients
- High internal validity
- Representative of US population
- Multiple surgeons and hospitals

Conclusion

- ❑ HT significantly higher risk of revision (2.3x and 1.8x vs QT/PT), in young female athletes <22 yo
- ❑ In males, HT 1.3x higher risk of revision vs PT
- ❑ No significant difference age/gender QT vs PT
- ❑ Increased risk stiffness PT vs HT and QT vs HT in < 22 males

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This data can be used to help pick the most appropriate graft based on the patient's individual risk profile


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THANK YOU!