Factors Predicting Delayed Return to Play after Anterior Cruciate Ligament Repair

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Presentation #39

Atrium Health Wake Forest Baptist

AANA23 ANNUAL MEETING NEW ORLEANS MAY 4-6, 2023

Wake Forest® School of Medicine

Disclosures

- Mark Glover: Nothing to Disclose
- Nihir Parikh: Nothing to Disclose
- Taylor Abouhaif: Nothing to Disclose
- Jefferey St. Jeor: Nothing to Disclose
- Danielle Rider: Nothing to Disclose
- Garrett Bullock: Nothing to Disclose

Thanks to the Wake Forest School of Medicine Department of Orthopaedic Surgery & Rehabilitation as well as Nina Cruz-Diaz and Erica Hartzell for their help.

- Nicholas Trasolini: Nothing to Disclose
- Brian Waterman:
  - AAOS: Board or committee member
  - American Orthopaedic Society for Sports Medicine: Board or committee member
  - Arthrex, Inc: Research support
  - Arthroscopy: Editorial or governing board; Publishing royalties, financial or material support
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Background

- Anterior Cruciate Ligament (ACL) is common, affecting 1/29 female and 1/50 male athletes
- Shortest return to play (RTP) most common factor of concern
- Factors associated with athletes' abilities to RTP is an area of active debate

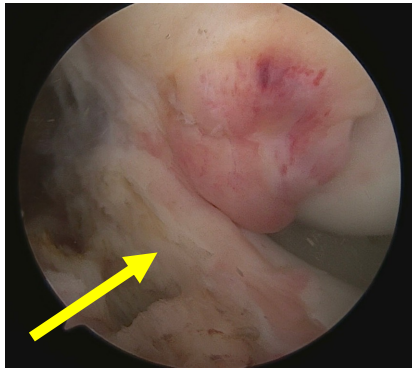
Montalvo. *BrJSM*. 2019
Bein . *IJSPT.* 2015

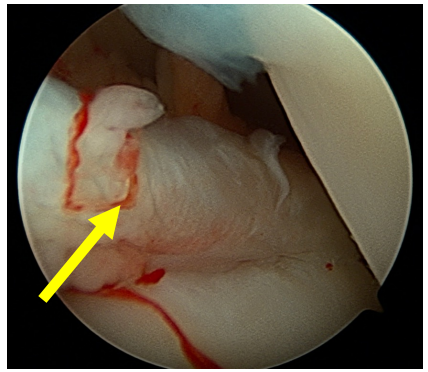
Purpose

Identify factors that predict a delayed return to play in competitive athletes who were able to return to their sport.

Hypothesis:

Multi-ligament knee injuries (MLKI), meniscal involvement, and prior knee surgery would predict a prolonged RTP time for competitive athletes





Methods

Study Design:

- **Type**: Retrospective Review
- **Participants**: 112 athletes
- **Timeline**: October 1st, 2014 to October 1st, 2021
- **Location**: Tertiary referral academic center
- **Surgeons**: 3
- **Minimum Follow Up**: 6-months

Inclusion:

- ACL reconstruction with a documented return to play at the same level as their reported pre-injury sport.

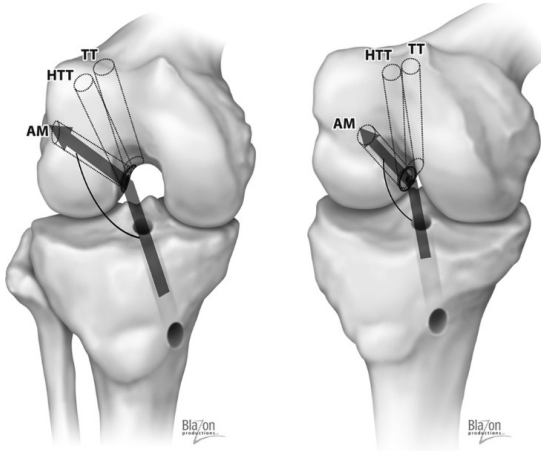
Exclusion:

- Not involved in organized athletics
- Incomplete post-operative physical therapy course
- Did not return to play

Methods

Prognostic Factors:

- Gender
- Prior knee surgeries
- MLKI surgery
- Meniscus involvement
- Operative technique
  - Anteromedial, All-inside
- Graft Type
  - Quadriceps/Bone-Patella-bone (BTB)/Hamstring autograft, Allograft
- Competition Level
  - Middle School, High School, College, Recreational
- Continuous Variables
  - Age, BMI



STaR TRIAL

Jennings. *OJSM*. 2017

Methods

Statistical Analysis:

- Missing data was moderate

Variable	Number Missed	Percent Missed
Time from Injury to Surgery	17	14.4
Gender	6	5.1
Race	6	5.1
Comorbidities	6	5.1
Surgeon	6	5.1
BMI	6	5.1
Laterality	6	5.1
Length of Follow Up	6	5.1

Variable	Number Missed	Percent Missed
Multi-Ligament Injury	6	5.1
Meniscus	6	5.1
Revision	6	5.1
Prior Knee Surgery	6	5.1
Operative Technique	6	5.1
Graft Type	6	5.1
Competition Level	6	5.1
Time to Return to Sport	6	5.1

Methods

Statistical Analysis:

- Continuous variables calculated as mean ± standard deviation and count variables as percent (%)
  - Poisson regressions for nominal prognostic factors
  - Continuous log transformed linear regressions for prognostic factors
- Prognostic factors univariably assessed due to potential for collider bias
- All statistical computing completed in R Core Team (2021)

Altman. Breast Cancer Res Treat. 1998

Results

- **Average Age:** 19.6 (± 7.8) years
- **Mean RTP time**: 8.9 (± 2.6) months
  - **Range**: 5.2 months to 17.1 months
- **Mean Follow-up**: 3.76 (± 1.6) years
- **Most athletes were**:
  - High school level (53%)
  - Hamstring Autograft (50%)
  - All-Inside Approach (62%)

Variable	Measure
Total Patients (n)	112
BMI (Average ± SD)	25.1 ± 5.7
Age in years (Average ± SD)	19.6 ± 7.8
RTP (Average ± SD)	8.9 ± 2.6
Reported Gender (%)	
Male	55
Female	45
Reported Race (%)	
White	65
Black	22
Hispanic or Latino	8
Other	5
Surgeon (%)	
1	58
2	27
3	15

Variable	Measure
Approach (%)	
All Inside	62
Anteromedial	34
Unspecified	4
Graft Type (%)	
Hamstring Autograft	50
Patellar Tendon Autograft	25
Quadriceps Tendon Autograft	18
Allograft	7
Level of Participation (%)	
Middle School	10
High School	53
Collegiate	16
Recreational	21

Results

- **Predict Delayed RTP**: MLKI surgery, meniscus involvement, anteromedial approach, Quadriceps and BTB autografts, age
- **Predict Expedited RTP**: Male gender, Allograft, College level athletes
- **No association**: Prior knee surgery, High school level athletes, BMI

Variable	Estimate (% change)	95% Confidence Interval	P-value
Gender (Male)	0.95	0.92, 0.97	**< 0.001**
Prior Knee Surgery	0.96	0.93, 1.01	0.062
Multi-ligament Surgery	1.14	1.09, 1.19	**< 0.001**
Meniscus Involvement	1.10	1.07, 1.13	**< 0.001**
Operative Technique (Antero-medial)	1.14	1.11, 1.16	**< 0.001**
Graft type (% change related to Hamstring Autograft)			
Quadriceps	1.16	1.13, 1.20	**< 0.001**
Bone-Patella Tendon-Bone	1.04	1.01, 1.07	**< 0.001**
Allograft	0.93	0.89, 0.98	**< 0.001**
Competition Level (% change in relation to Middle School)			
High School	0.97	0.93, 1.01	0.079
College	0.95	0.91, 0.99	**0.022**
Recreational	0.84	0.80, 0.88	**< 0.001**
Continuous Variables			
Age (% increase)	-0.20	-0.4, -0.1	**0.024**
BMI (% increase)	-0.20	-0.5, 0.1	0.118

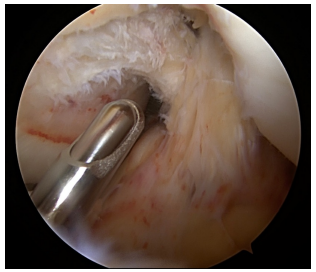
Discussion

Qualified hypothesis: MLKI surgery, meniscal involvement and other factors predicted a delayed RTP

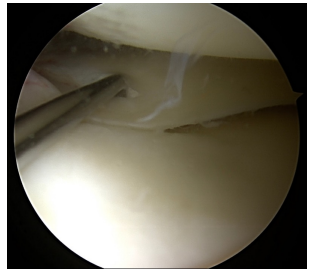
- Prior knee surgery had no predictive value
- **Worst prognostic factors**: MLKI surgery (14% delay), quadriceps autograft (16% delay), anteromedial approach (14% delay)

- **This study:**
  - Supports hamstring autograft superior RTP times to quadriceps and BTB autografts.
    - But may increase re-rupture rate
  - Adds to literature on RTP by level of play
    - College athlete predicts expedited RTP

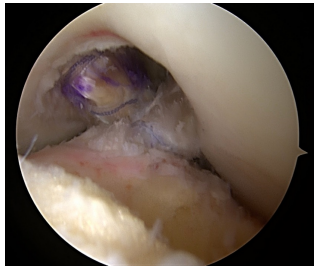
PCL & ACL Disruption



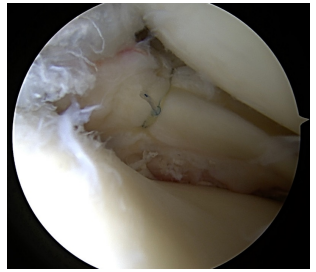
Concomitant Lat. Meniscus Tear



Final construct ACL/PCL



Lat. Meniscus Repair



Malige. Clin Biomech. 2022
Smith. J Orthop Sports Phys Ther. 2020
Bakshi. Sports Health. 2018

Limitations

- **Measurement Bias**: misrepresenting true RTP time
  - Athlete may be cleared, but not return to play due to psychological factors
- **Nonresponder Bias**: Athletes with no documented RTP time were not included in this study to identify characteristics of those who did have a RTP time
- Univariate analysis to avoid collider bias may not account for approach determined by graft type selection
  - E.g. quadriceps autograft with all-inside approach and independent tunnel for BTB autograft.

Conclusion

- Mean RTP time was 8.9 (± 2.6) months
- MLKI surgery, meniscal involvement, anteromedial approach, BTB/quadriceps autograft are predictive of a longest delayed RTP
- Help guide athlete expectations following surgery

Thank You