

HEY DOC, WHEN CAN MY ATHLETE GET BACK OUT THERE AFTER A KNEE INJURY?

AMP Coaches' Clinic
October 21, 2021



INTRODUCTION

Colorado, Utah, Nevada,

Brigham Young University

University of Nevada School of Medicine

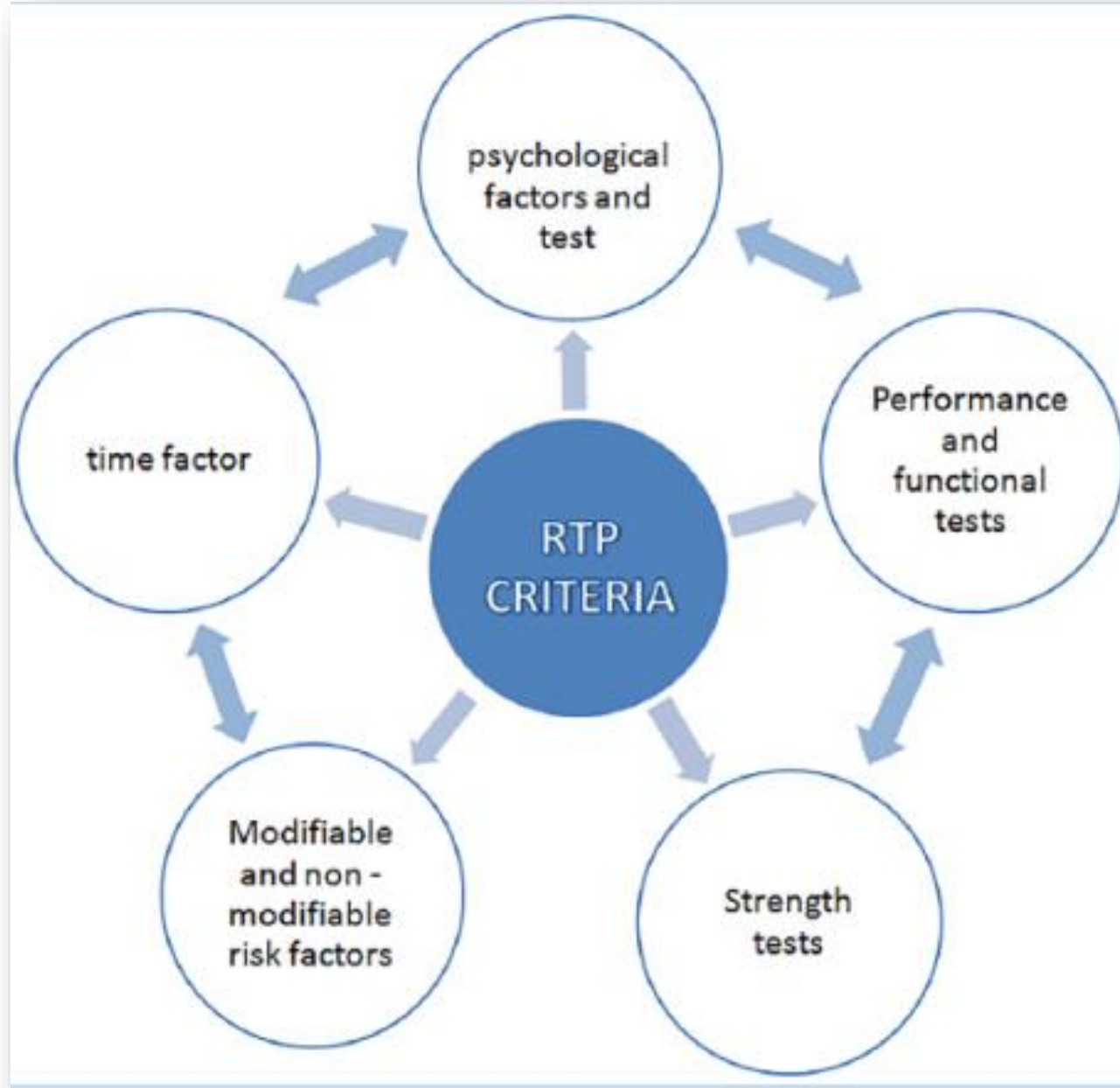
Baylor University Medical Center, Dallas
(Residency)

Ohio State University (Fellowship)

Ortho Montana/AMP

RETURN TO SPORT

- What it is and what it isn't:
 - Guidelines – yes
 - Comprehensive list – no
 - Individually Tailored - yes
 - Exact Dates on a Calendar – no
- Define a Successful Return to Sport



ACL Injuries

- More than 120,000 ACL injuries occur each year
 - Mostly during high school and college
- Incidence is increasing
 - Increased participation in high school and organized sports
- Female athletes at 2-3x increased risk of ACL injuries
 - Neuromuscular factors
 - Genetics
 - Narrow notch width
 - Mechanical alignment
 - Landing mechanics
 - Hormonal factors

Epidemiology

- Women's soccer and basketball are the riskiest sports for female athletes
 - Risk of ACL injury per season, 1.1% and 0.9%
 - Relative risk of 3.7 compared to men's soccer/basketball
- Men's football and lacrosse are the riskiest sports for male athletes
 - 0.8% and 0.4% risk of injury

Mechanism of Injury



Mechanism of Injury

- Extensive research has been performed evaluating limb position and ACL tears
- Typical non-contact injury
 - Female landing from a jump
 - Hip extended, internally rotated
 - Knee extended, valgus, tibia internally rotated
 - Foot planted

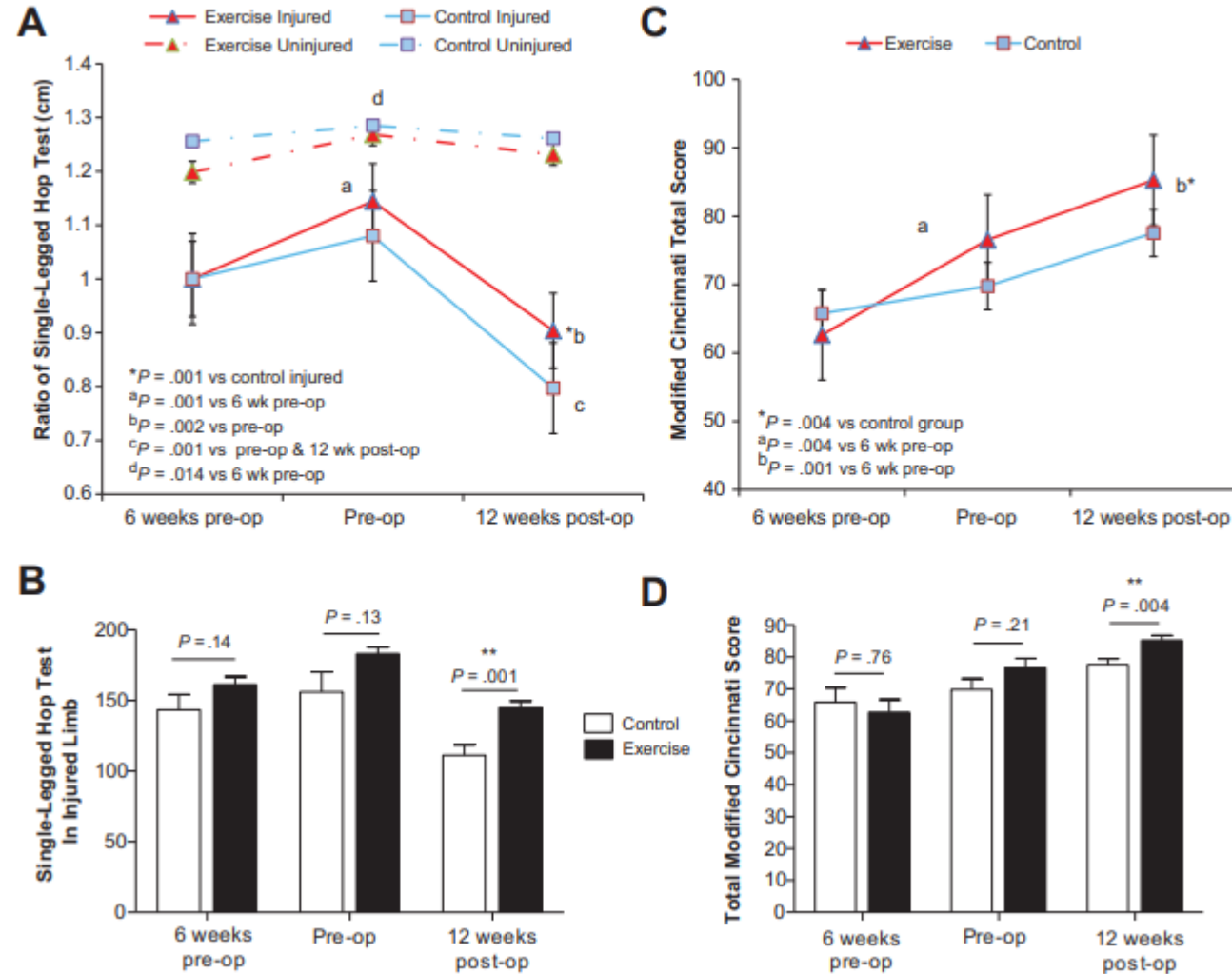
Evaluation

- History
 - Non-contact, jumping, cutting action, or direct impact
 - Feel a “pop” or say the knee “hyperextended”
 - Typically are unable to return to play
 - Swelling develops within hours of the injury
- Exam
 - Assess for effusion
 - Joint line tenderness
 - PCL, MCL, LCL, PLC
 - Lachman, Pivot shift, Anterior drawer
 - NV status

Effect of Prehabilitation on the Outcome of Anterior Cruciate Ligament Reconstruction

- 20 patients with ACL injuries randomized to no therapy vs preoperative PT for 6 weeks
- Prehab group
 - ROM
 - Quadriceps and hamstring strengthening
 - Effusion control
- All surgeries performed by a single surgeon using BTB autograft

Effect of Prehabilitation on the Outcome of Anterior Cruciate Ligament Reconstruction



Preoperative quadriceps strength is a significant predictor of knee function two years after anterior cruciate ligament reconstruction

- Prospective cohort of 60 patients who underwent ACL reconstruction
- Study goal
 - Identify variables that may predict knee function 2 years postoperatively

Functional outcome two years after ACL reconstruction	Deficit $\leq 20\%$ (n = 35)		Deficit $> 20\%$ (n = 25)		p Value
	Mean	SD	Mean	SD	
Cincinnati Knee Score	90.9	9.8	83.4	10.9	0.008
Quadriceps strength (index)	96.7	11.4	85.7	12.6	0.001
SF-36 BP sub score	86.2	18.9	80.5	20.9	0.296

Functional outcome two years after ACL reconstruction	No injury (n = 30)		Injury (n = 30)		p Value
	Mean	SD	Mean	SD	
Cincinnati Knee Score	91.0	8.7	85.1	12.1	0.036
Quadriceps strength (index)	92.6	9.9	91.9	15.7	0.846
SF-36 BP sub score	89.5	13.4	78.2	23.6	0.028

Prehabilitation

- Reduce pain and swelling
- Activate and strengthen quadriceps
- Normal ROM
- Normalize gait
- Achieving these parameters can improve function and strength postoperatively (even up to 2 years out from surgery)

Rehabilitation Principles of the Anterior Cruciate Ligament Reconstructed Knee

Twelve Steps for Successful Progression and Return to Play

Box 1

Twelve steps critical to successful anterior cruciate ligament rehabilitation

1. Preparation of both the patient and their knee for surgery
2. Restore full passive knee extension
3. Reduce postoperative inflammation
4. Gradual restoration of full knee flexion
5. Restore complete patellar mobility
6. Individualize and adjust the rehabilitation program based on the status of the knee
7. Reestablish quadriceps activation
8. Restoration of dynamic functional stability of the knee complex
9. Knee stability and dynamic control must be provided from both above and below
10. Protect the knee both now and later
11. Objective return to running
12. Objective progressing beyond running and back to sport

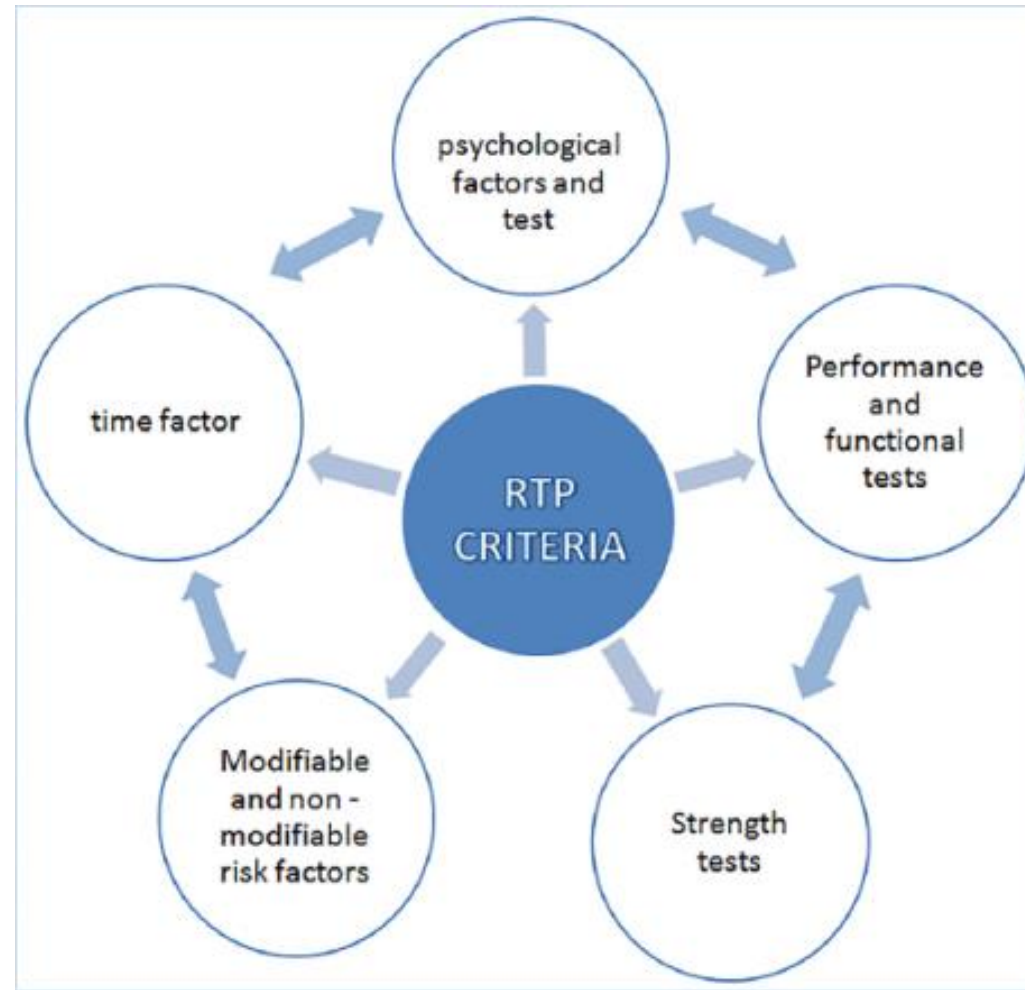
Anterior Cruciate Ligament Reconstruction Rehabilitation: MOON Guidelines

- Early weightbearing and restoration of normal motion
 - May reduce patellofemoral pain
- Postoperative bracing is not recommended
- Open chain exercises after 6 weeks post-op may improve strength without increasing graft laxity
- Neuromuscular training is included in the MOON protocol

Accelerated Versus Nonaccelerated Rehabilitation After Anterior Cruciate Ligament Reconstruction

- Double blind RCT comparing rehab protocols in BTB ACL reconstructions
 - 19 vs 32 week protocols
- Accelerated protocol patients with greater thigh strength at 3 months
 - No differences at any time point after this
- Both groups with similar clinical exams, patient satisfaction, function, and thigh strength at 2 year follow up

Return to Sport



Return to Sport

- Full, painless ROM symmetric to contralateral leg
- No reactive effusion with sport-specific activity
- Normalized gait
- >90% isokinetic strength compared to uninjured leg
- Appropriate neuromuscular control
- Functional hop test
 - Limb symmetry index >90%

Return to Sport

- Fear is a common reason why athletes don't return to sport
 - “If you were in bad car accident on the highway, why would you drive on that road again?”
- Patient psychology has been a focal point relating to return to sport research
- Psychological readiness has been identified as an important part of the rehabilitation process

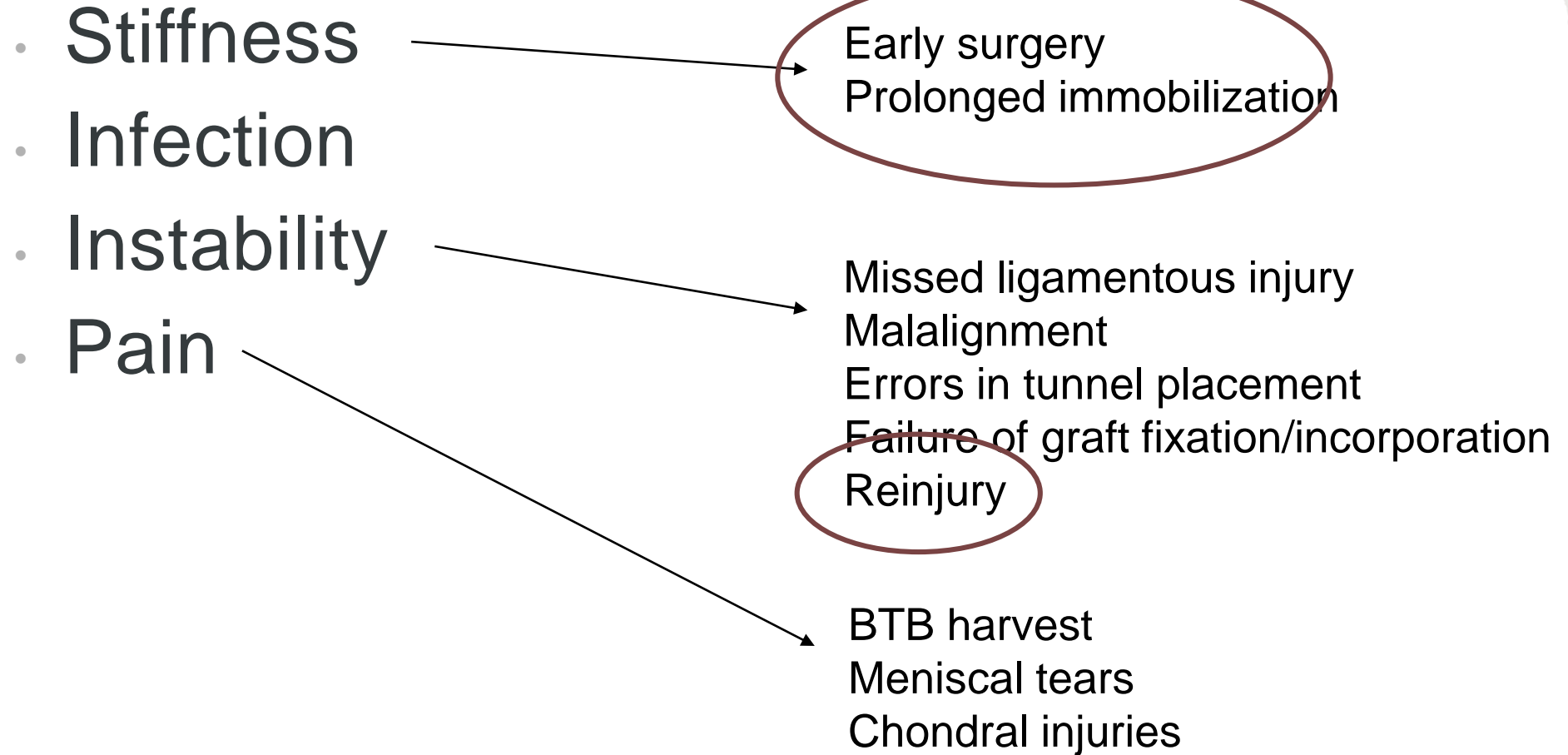
Psychological predictors of anterior cruciate ligament reconstruction outcomes: a systematic review

- Systematic review seeking to identify psychological factors that may affect outcomes after ACLR
- 8 studies included for analysis
- Self-efficacy, self-motivation, and optimism were predictive of rehab compliance, return to sport, self-rated knee symptoms
- Perceived social support positively predicts compliance and knee symptoms
- Preoperative stress can negatively affect postoperative outcomes

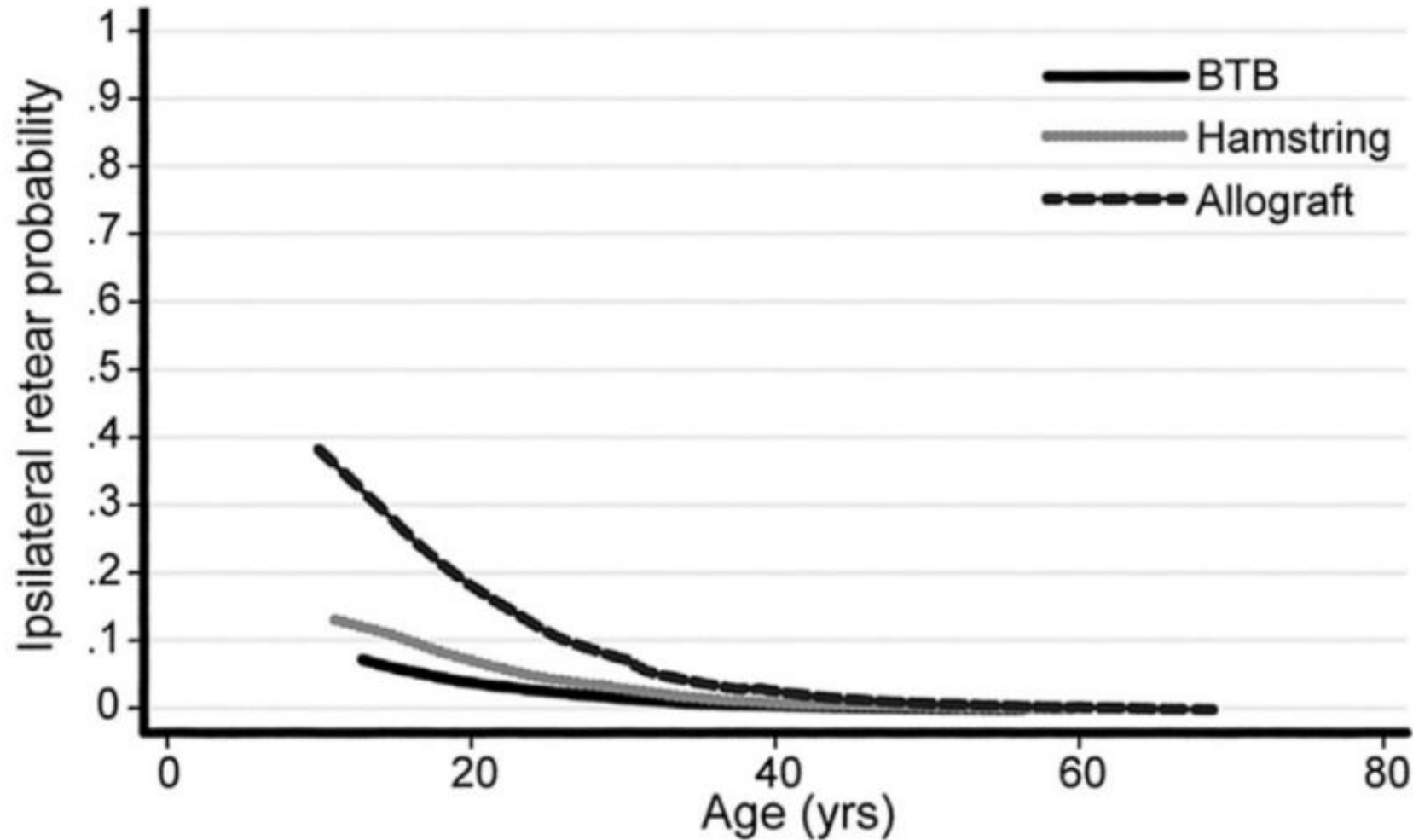
Ten-Year Outcomes and Risk Factors After Anterior Cruciate Ligament Reconstruction

- Prospective cohort evaluating PRO and risk factors for failure following ACLR
- 1320 patients with 10 year follow up data included
- Analyzed IKDC and KOOS outcome scores

Complications



Risk Factors and Predictors of Subsequent ACL Injury in Either Knee After ACL Reconstruction



Risk Factors and Predictors of Subsequent ACL Injury in Either Knee After ACL Reconstruction

- Risk factors for ipsilateral retear
 - Younger age
 - 9% decrease in retear rate with age
 - Higher activity level
 - 11% increase in retear rate for each one point increase on Marx activity scale
 - Allograft

Complications

Young athletes return too early to knee-strenuous sport, without acceptable knee function after anterior cruciate ligament reconstruction

Susanne Beischer^{1,2}  · Eric Hamrin Senorski^{1,2} · Christoffer Thomeé² · Kristian Samuelsson^{3,4} · Roland Thomeé^{1,2}

Conclusion: The majority of young athletes make an early return to knee-strenuous sport after a primary ACL reconstruction, **without recovering their muscle function**. To set realistic expectations, clinicians are recommended to ensure that young athletes receive information about not to return before muscle function is recovered and that this may take longer time than 12 months.

Complications

Risk of Secondary Injury in Younger Athletes After Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis

Amelia J Wiggins¹, Ravi K Grandhi², Daniel K Schneider³, Denver Stanfield⁴, Kate E Webster⁵, Gregory D Myer⁶

These combined data indicate that nearly **1 in 4** young athletic patients who sustain an ACL injury and return to high-risk sport will go on to sustain another ACL injury at some point in their career, **and they will likely sustain it early in the return-to-play period.** The high rate of secondary injury in young athletes who return to sport after ACLR equates to a **30 to 40 times greater risk of an ACL injury compared with uninjured adolescents.** These data indicate that activity modification, improved rehabilitation and return-to-play guidelines, and the use of integrative neuromuscular training may help athletes more safely reintegrate into sport and reduce second injury in this at-risk population.

Complications

Risk of Secondary Injury in Younger Athletes After Anterior Cruciate Ligament Reconstruction: A Systematic Review and Meta-analysis

Amelia J Wiggins¹, Ravi K Grandhi², Daniel K Schneider³, Denver Stanfield⁴, Kate E Webster⁵, Gregory D Myer⁶

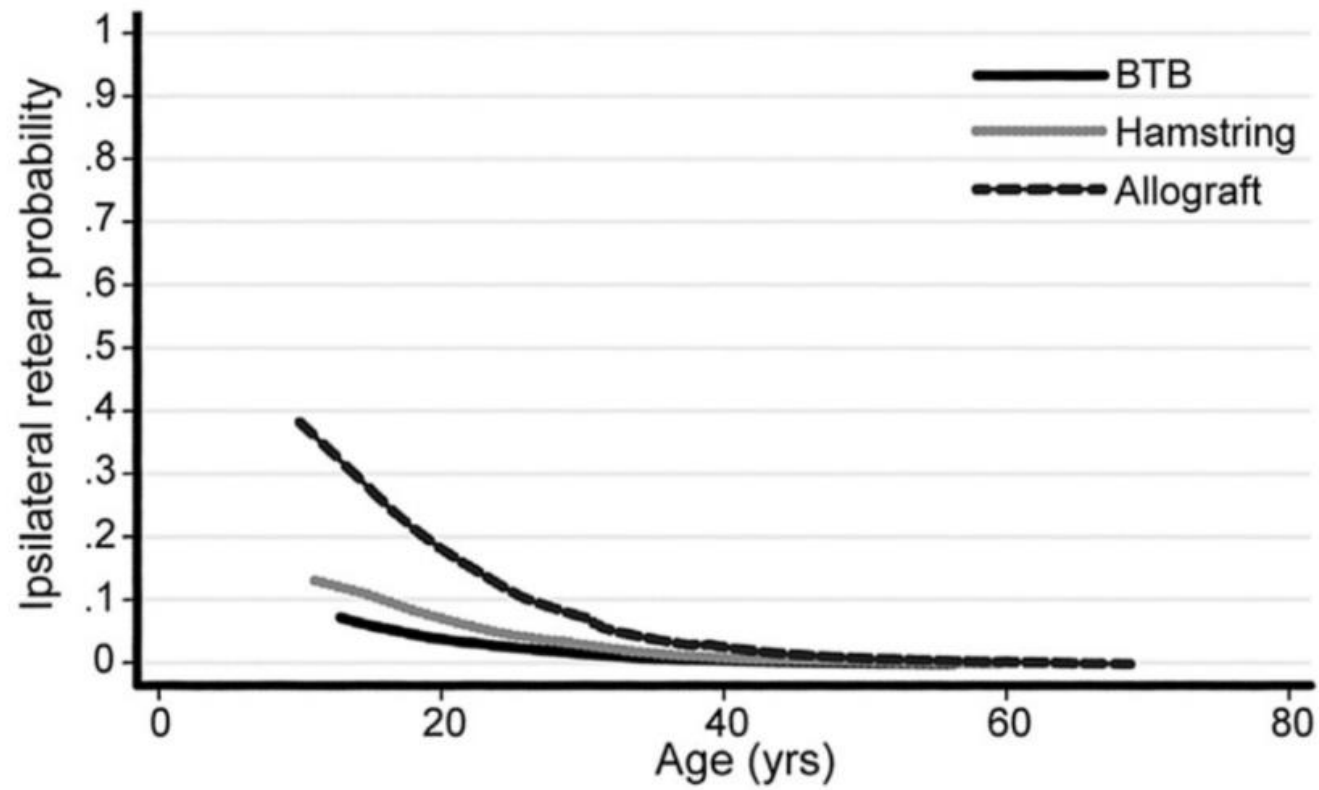
These combined data indicate that nearly **1 in 4** young athletic patients who sustain an ACL injury and return to high-risk sport will go on to sustain another ACL injury at some point in their career, **and they will likely sustain it early in the return-to-play period.** The high rate of secondary injury in young athletes who return to sport after ACLR equates to a **30 to 40 times greater risk of an ACL injury compared with uninjured adolescents.** These data indicate that **activity modification, improved rehabilitation and return-to-play guidelines, and the use of integrative neuromuscular training** may help athletes more safely reintegrate into sport and reduce second injury in this at-risk population.

ACL GRAFT AND CONTRALATERAL ACL TEAR RISK WITHIN TEN YEARS FOLLOWING RECONSTRUCTION

- Systematic review evaluating risk of graft tear and contralateral ACL injury
- 9 studies with ~2600 patients and 10 year minimum follow up
- Graft failure rate
 - 7.9%
- Contralateral ACL injury
 - 12.5%

Summary

- Injury prevention programs can work, especially in younger athletes
- Prehabilitation is important for postoperative knee function
- Psychological readiness is an important part of the rehab process
- Recognize the predictors of inferior outcomes
- Younger age and higher activity levels increase risk of ipsilateral graft tear and contralateral ACL injury
- Return to sport prior to functional muscle recovery leads to significantly higher re-injury rates



References

1. Aga, C., Risberg, M. A., Fagerland, M. W., Johansen, S., Trøan, I., Heir, S., & Engebretsen, L. (2018). No Difference in the KOOS Quality of Life Subscore Between Anatomic Double-Bundle and Anatomic Single-Bundle Anterior Cruciate Ligament Reconstruction of the Knee: A Prospective Randomized Controlled Trial With 2 Years' Follow-up. *The American Journal of Sports Medicine*, 46(10), 2341-2354. doi:10.1177/0363546518782454
2. Aglietti, P., Giron, F., Losco, M., Cuomo, P., Ciardullo, A., & Mondanelli, N. (2010). Comparison between Single- and Double-Bundle Anterior Cruciate Ligament Reconstruction. *The American Journal of Sports Medicine*, 38(1), 25-34. doi:10.1177/0363546509347096
3. Beynnon, B. D., Johnson, R. J., Naud, S., Fleming, B. C., Abate, J. A., Brattbakk, B., & Nichols, C. E. (2011). Accelerated Versus Nonaccelerated Rehabilitation After Anterior Cruciate Ligament Reconstruction. *The American Journal of Sports Medicine*, 39(12), 2536-2548. doi:10.1177/0363546511422349
4. Davies, G. J., Mccarty, E., Provencher, M., & Manske, R. C. (2017). ACL Return to Sport Guidelines and Criteria. *Current Reviews in Musculoskeletal Medicine*, 10(3), 307-314. doi:10.1007/s12178-017-9420-9
5. Duchman, K. R., Lynch, T. S., & Spindler, K. P. (2017). Graft Selection in Anterior Cruciate Ligament Surgery. *Clinics in Sports Medicine*, 36(1), 25-33. doi:10.1016/j.csm.2016.08.013
6. Dunn, W. R., Spindler, K. P., Annunziato, A., Wolf, B. R., Andrish, J. T., Bergfeld, J. A., . . . Dittus, R. S. (2010). Predictors of Activity Level 2 Years after Anterior Cruciate Ligament Reconstruction (ACLR). *The American Journal of Sports Medicine*, 38(10), 2040-2050. doi:10.1177/0363546510370280
7. Eitzen, I., Holm, I., & Risberg, M. A. (2009). Preoperative quadriceps strength is a significant predictor of knee function two years after anterior cruciate ligament reconstruction. *British Journal of Sports Medicine*, 43(5), 371-376. doi:10.1136/bjism.2008.057059
8. Everhart, J. S., Best, T. M., & Flanigan, D. C. (2013). Psychological predictors of anterior cruciate ligament reconstruction outcomes: A systematic review. *Knee Surgery, Sports Traumatology, Arthroscopy*, 23(3), 752-762. doi:10.1007/s00167-013-2699-1
9. Greenberg, D. D., Robertson, M., Vallurupalli, S., White, R. A., & Allen, W. C. (2010). Allograft Compared with Autograft Infection Rates in Primary Anterior Cruciate Ligament Reconstruction [Abstract]. *Journal of Bone and Joint Surgery*, 92-A(14), 2402-2408.
10. Holm, I., Øiestad, B. E., Risberg, M. A., & Aune, A. K. (2010). No Difference in Knee Function or Prevalence of Osteoarthritis after Reconstruction of the Anterior Cruciate Ligament with 4-Strand Hamstring Autograft versus Patellar Tendon—Bone Autograft. *The American Journal of Sports Medicine*, 38(3), 448-454. doi:10.1177/0363546509350301
11. Irrarázaval, S., Albers, M., Chao, T., & Fu, F. H. (2017). Gross, Arthroscopic, and Radiographic Anatomies of the Anterior Cruciate Ligament. *Clinics in Sports Medicine*, 36(1), 9-23. doi:10.1016/j.csm.2016.08.002
12. Jones, M. H., Oak, S. R., Andrish, J. T., Brophy, R. H., Cox, C. L., Dunn, W. R., . . . Spindler, K. P. (2019). Predictors of Radiographic Osteoarthritis 2 to 3 Years After Anterior Cruciate Ligament Reconstruction: Data From the MOON On-site Nested Cohort. *Orthopaedic Journal of Sports Medicine*, 7(8), 232596711986708. doi:10.1177/2325967119867085
13. Kaeding, C. C., Léger-St-Jean, B., & Magnussen, R. A. (2017). Epidemiology and Diagnosis of Anterior Cruciate Ligament Injuries. *Clinics in Sports Medicine*, 36(1), 1-8. doi:10.1016/j.csm.2016.08.001
14. Kaeding, C. C., Pedroza, A. D., Reinke, E. K., Huston, L. J., Spindler, K. P., Amendola, A., . . . Wright, R. W. (2015). Risk Factors and Predictors of Subsequent ACL Injury in Either Knee After ACL Reconstruction. *The American Journal of Sports Medicine*, 43(7), 1583-1590.

References

15. Kaplan, Y., & Witvrouw, E. (2019). When Is It Safe to Return to Sport After ACL Reconstruction? Reviewing the Criteria. *Sports Health: A Multidisciplinary Approach*, 11(4), 301-305. doi:10.1177/1941738119846502
16. Lai, C. C., Ardern, C. L., Feller, J. A., & Webster, K. E. (2017). Eighty-three per cent of elite athletes return to preinjury sport after anterior cruciate ligament reconstruction: A systematic review with meta-analysis of return to sport rates, graft rupture rates and performance outcomes. *British Journal of Sports Medicine*, 52(2), 128-138. doi:10.1136/bjsports-2016-096836
17. Li, R. T., Lorenz, S., Xu, Y., Harner, C. D., Fu, F. H., & Irrgang, J. J. (2011). Predictors of Radiographic Knee Osteoarthritis After Anterior Cruciate Ligament Reconstruction. *The American Journal of Sports Medicine*, 39(12), 2595-2603. doi:10.1177/0363546511424720
18. Madhan, A. S., & Patel, N. M. (2020). The Anterolateral Ligament of the Knee. *JBJS Reviews*, 8(6). doi:10.2106/jbjs.rvw.19.00136
19. Magnussen, R. A., Meschbach, N. T., Kaeding, C. C., Wright, R. W., & Spindler, K. P. (2015). ACL Graft and Contralateral ACL Tear Risk within Ten Years Following Reconstruction. *JBJS Reviews*, 3(1), 1. doi:10.2106/jbjs.rvw.n.00052
20. Mathew, M., Dhollander, A., & Getgood, A. (2018). Anterolateral Ligament Reconstruction or Extra-Articular Tenodesis. *Clinics in Sports Medicine*, 37(1), 75-86. doi:10.1016/j.csm.2017.07.011
21. Musahl, V., Herbst, E., Burnham, J. M., & Fu, F. H. (2015). The Anterolateral Complex and Anterolateral Ligament of the Knee. *Journal of American Academy of Orthopaedic Surgeons*, 26(8), 261-267. doi:10.5435/JAAOS-D-16-00758
22. Piefer, J. W., Pflugner, T. R., Hwang, M. D., & Lubowitz, J. H. (2012). Anterior Cruciate Ligament Femoral Footprint Anatomy: Systematic Review of the 21st Century Literature. *Arthroscopy: The Journal of Arthroscopic & Related Surgery*, 28(6), 872-881. doi:10.1016/j.arthro.2011.11.026
23. Pinczewski, L. A., Lyman, J., Salmon, L. J., Russell, V. J., Roe, J., & Linklater, J. (2007). A 10-Year Comparison of Anterior Cruciate Ligament Reconstructions with Hamstring Tendon and Patellar Tendon Autograft. *The American Journal of Sports Medicine*, 35(4), 564-574. doi:10.1177/0363546506296042
24. Ryan, J., Magnussen, R. A., Cox, C. L., Hurbanek, J. G., Flanagan, D. C., & Kaeding, C. C. (2014). ACL Reconstruction. *The Journal of Bone & Joint Surgery*, 96(6), 507-512. doi:10.2106/jbjs.m.00299
25. Salzler, M. J., & Harner, C. D. (2014). Tunnel Placement for the ACL During Reconstructive Surgery of the Knee. *JBJS Reviews*, 2(4), 1. doi:10.2106/jbjs.rvw.m.00054
26. Schreiber, V. M., Eck, C. F., & Fu, F. H. (2010). Anatomic Double-bundle ACL Reconstruction. *Sports Medicine and Arthroscopy Review*, 18(1), 27-32. doi:10.1097/jsa.0b013e3181bf6634
27. Shaarani, S. R., O'Hare, C., Quinn, A., Moyna, N., Moran, R., & O'Byrne, J. M. (2013). Effect of Prehabilitation on the Outcome of Anterior Cruciate Ligament Reconstruction. *The American Journal of Sports Medicine*, 41(9), 2117-2127.
28. Spindler, K. P., Huston, L. J., Chagin, K. M., Kattan, M. W., Reinke, E. K., Amendola, A., . . . Wright, R. W. (2018). Ten-Year Outcomes and Risk Factors After Anterior Cruciate Ligament Reconstruction: A MOON Longitudinal Prospective Cohort Study. *The American Journal of Sports Medicine*, 46(4), 815-825. doi:10.1177/0363546517749850

References

29. Spindler, K. P., Parker, R. D., Andrish, J. T., Kaeding, C. C., Wright, R. W., Marx, R. G., . . . Harrell, F. E. (2012). Prognosis and predictors of ACL reconstructions using the MOON cohort: A model for comparative effectiveness studies. *Journal of Orthopaedic Research*, 31(1), 2-9. doi:10.1002/jor.22201
30. Tjong, V. K., Murnaghan, M. L., Nyhof-Young, J. M., & Ogilvie-Harris, D. J. (2013). A Qualitative Investigation of the Decision to Return to Sport After Anterior Cruciate Ligament Reconstruction. *The American Journal of Sports Medicine*, 42(2), 336-342. doi:10.1177/0363546513508762
31. Wilk, K. E., & Arrigo, C. A. (2017). Rehabilitation Principles of the Anterior Cruciate Ligament Reconstructed Knee. *Clinics in Sports Medicine*, 36(1), 189-232. doi:10.1016/j.csm.2016.08.012
32. Wright, R. W., Haas, A. K., Anderson, J., Calabrese, G., Cavanaugh, J., Hewett, T. E., . . . Wolf, B. R. (2014). Anterior Cruciate Ligament Reconstruction Rehabilitation. *Sports Health: A Multidisciplinary Approach*, 7(3), 239-243. doi:10.1177/1941738113517855
33. Wylie, J. D., Marchand, L. S., & Burks, R. T. (2017). Etiologic Factors That Lead to Failure After Primary Anterior Cruciate Ligament Surgery. *Clinics in Sports Medicine*, 36(1), 155-172. doi:10.1016/j.csm.2016.08.007

QUESTIONS?