

PEDIATRIC ACL RECONSTRUCTION

An anatomical illustration of a pediatric ACL reconstruction surgery. The image shows a 3D model of a child's knee joint. A femoral tunnel is visible in the distal femur, and a tibial tunnel is visible in the proximal tibia. A graft is being inserted from the femoral tunnel into the tibial tunnel. Two surgical instruments are shown: a long, thin metal rod on the left and a larger, more complex instrument on the right. The background is a light blue gradient.

Magic City
Sports Medicine
Conference

Josh Bowler, MD

May 18, 2024

OBJECTIVES

- Epidemiology of ACL injuries in pediatric patients
- Risk factors for pediatric ACL injuries
- Understand the non-surgical and surgical options for the young athlete with an ACL injury

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

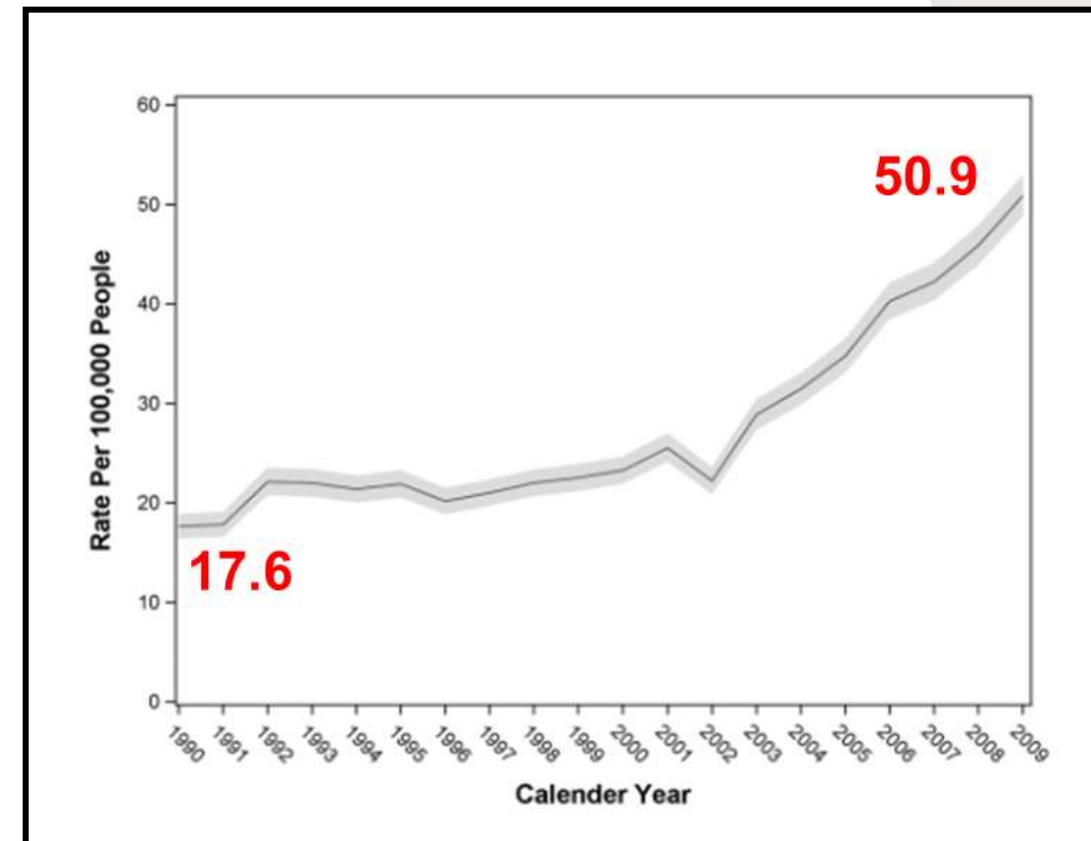
- Women's soccer and basketball are the riskiest sports for female athletes
 - Risk of ACL injury per season, 1.1% and 0.9%
 - Relative risk of 3.7 compared to men's soccer/basketball
- Men's football and lacrosse are the riskiest sports for male athletes
 - 0.8% and 0.4% risk of injury

Large Increase in Pediatric ACL Injuries?

- 38 million young athletes participate in sports annually in the US
- 2 million high school students treated for sports-related injuries per year
- Why this “new” epidemic of sports injuries?
 - Title IX
 - Year-round competition
 - Single sport concentration
 - More intense training
 - Awareness
 - Imaging

20 Years of Pediatric Anterior Cruciate Ligament Reconstruction in New York State

Emily R. Dodwell,^{*†} MD, MPH, Lauren E. LaMont,[†] MD, Daniel W. Green,[†] MD, Ting Jung Pan,[†] MPH, Robert G. Marx,[†] MD, and Stephen Lyman,[†] PhD
Investigation performed at Hospital for Special Surgery, New York, New York, USA



What Happens?

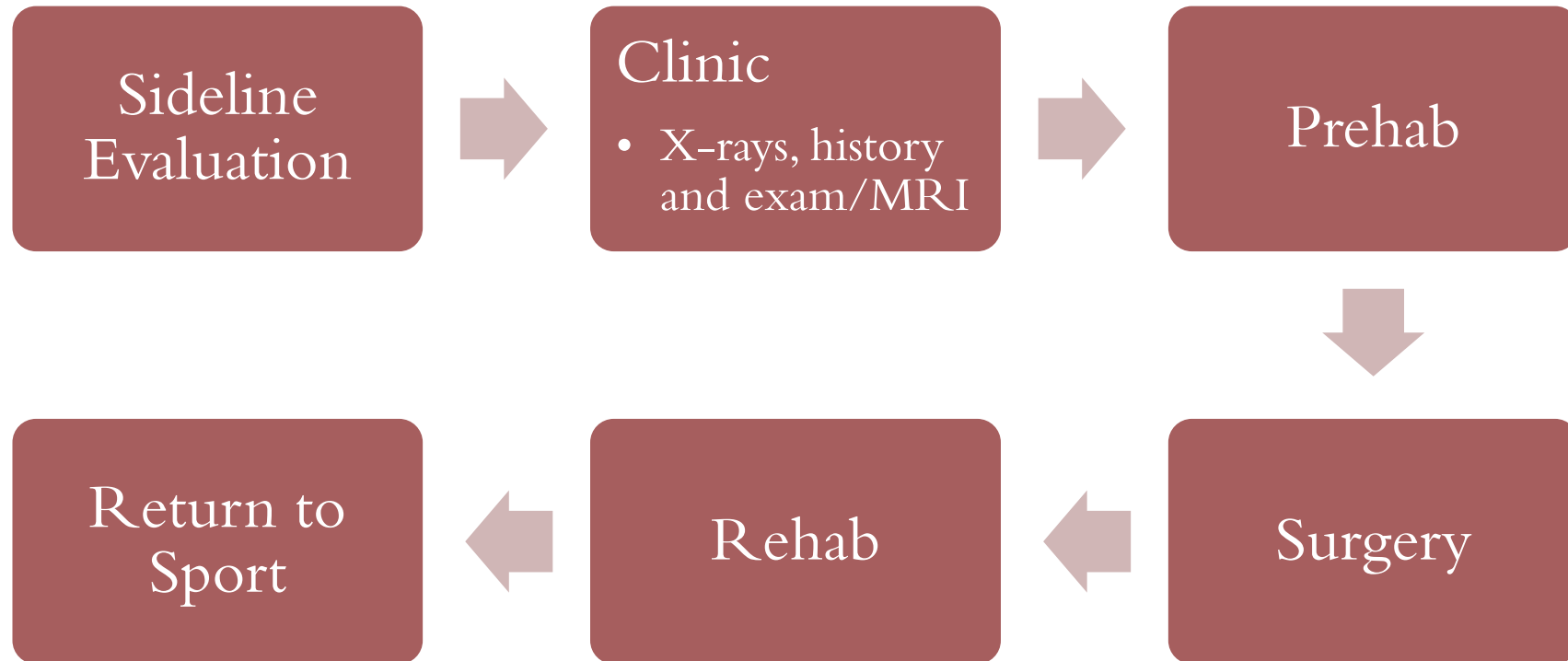


Mechanism of Injury



Straight to the Operating Room, Right?

What Happens Next?



Clinic

- X-rays, history and exam/MRI

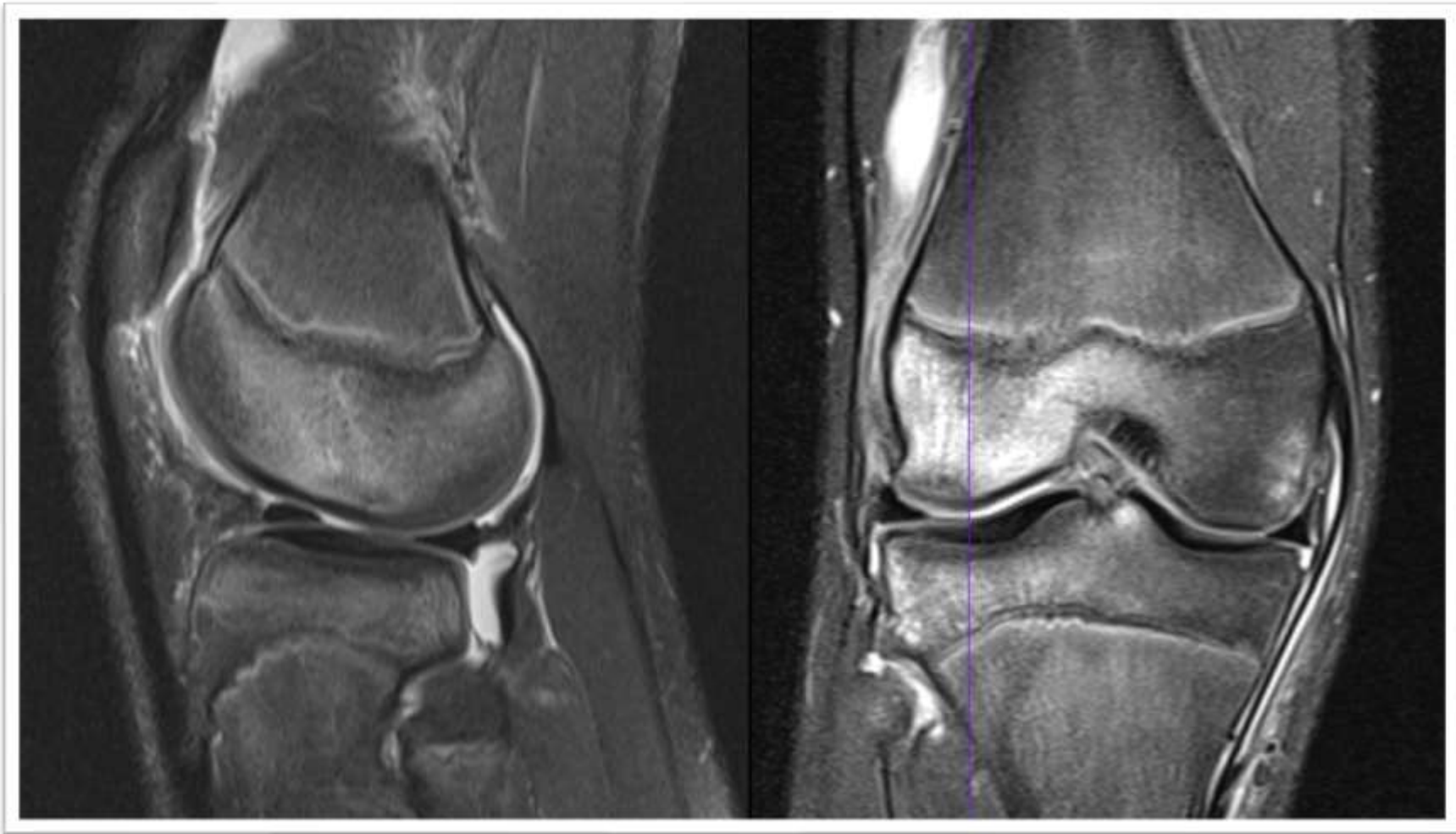
Growth Plates



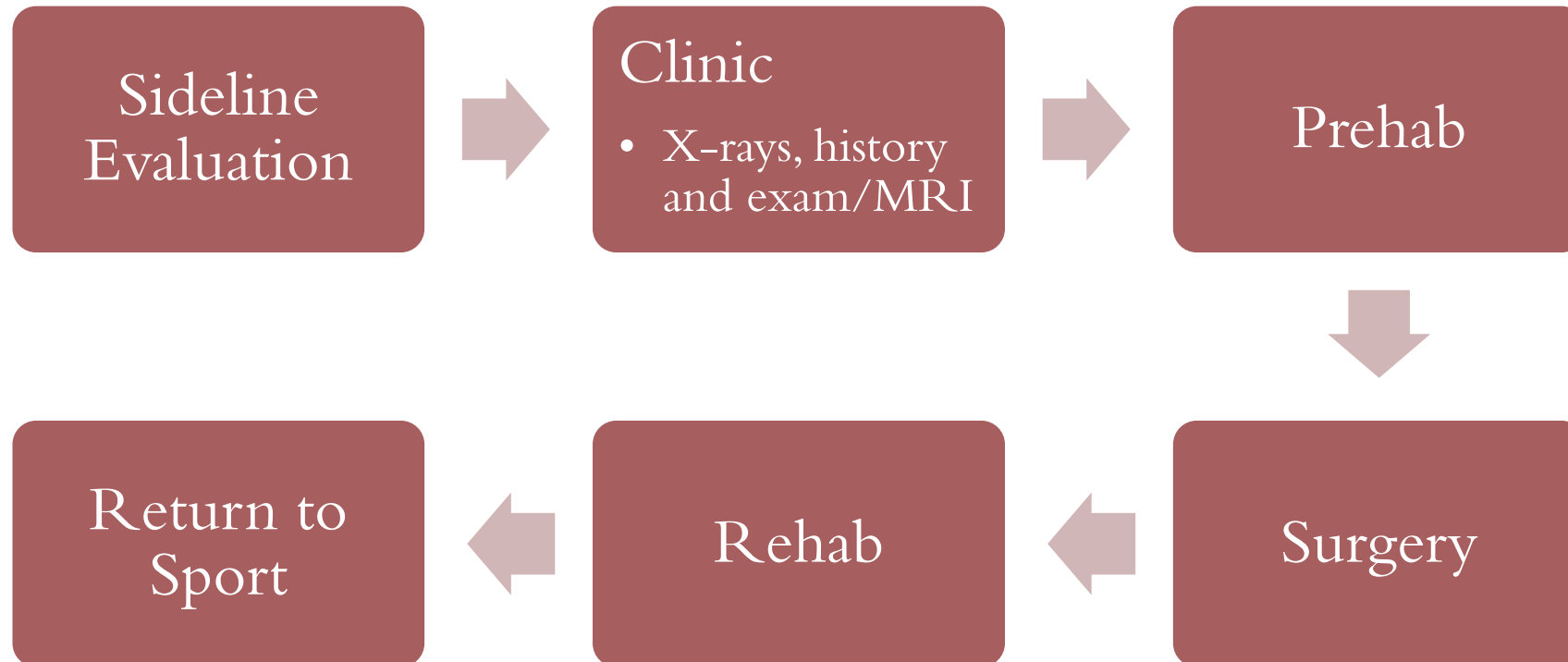
Clinic

- X-rays, history and exam/MRI

Growth Plates



Pediatric ACL Injury



Prehab

Achieving these parameters can improve function and strength postoperatively (even up to 2 years out from surgery)

Reduce pain and swelling

Activate and strengthen quadriceps

Normal ROM

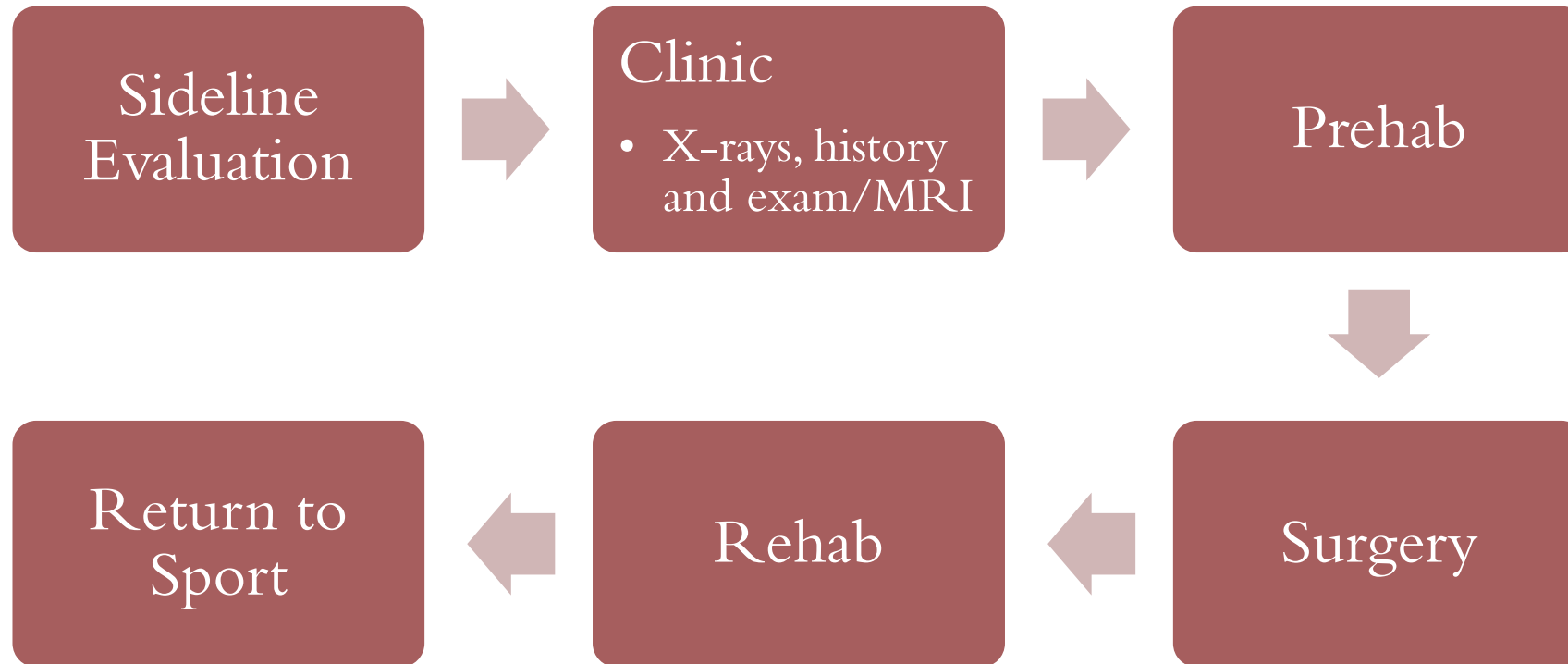
Normal gait

Evidence for the effects of prehabilitation before ACL-reconstruction on return to sport-related and self-reported knee function: A systematic review

Florian Giesche¹, Daniel Niederer², Winfried Banzer¹, Lutz Vogt²

- Higher increases of the maximal quadriceps torque from baseline to pre-reconstruction
- Less post-op decline at 12 weeks in the **single-leg hop** and quadriceps **strength**
- Higher self-reported **knee function** (pre-op and 2 years post-op)
- **Return to sport tended to be faster**
- **RTS rates were higher at 2 years post-op**


Pediatric ACL Injury



Surgery??

ACL Reconstruction in the Adolescent Athlete

Apr 14, 2011 • 15 likes • 5,356 views

 Hospital for Special Surgery [Follow](#)

Presented by Frank A. Cordasco, MD, MS, The Sports Medicine and Shoulder Service, Hospital for Special Surgery

The Dilemma Historically

Nonoperative
Treatment

Operative
Treatment

Delayed Reconstruction Risks:

- Ongoing instability
- Meniscus injury
- Cartilage injury

Restricted Activity until Skeletal
Maturity: **Compliance**

Early Reconstruction Risks:

- Growth disturbance
- Angular deformity

Non-Adult Type Reconstruction:
Less "Anatomic"
Possible Revision in Future,
"Bridge to Adult Type
Reconstruction"

Surgery??

- Non-operative treatment resulted in:
 - **Instability, 72%**
 - **Pain, 48.5%**
 - **Swelling, 34.7%**
 - **Late ACL Reconstruction 56.9%**
 - **Arthritis on X-ray, 21-85%**

(Marzo & Warren 1991)

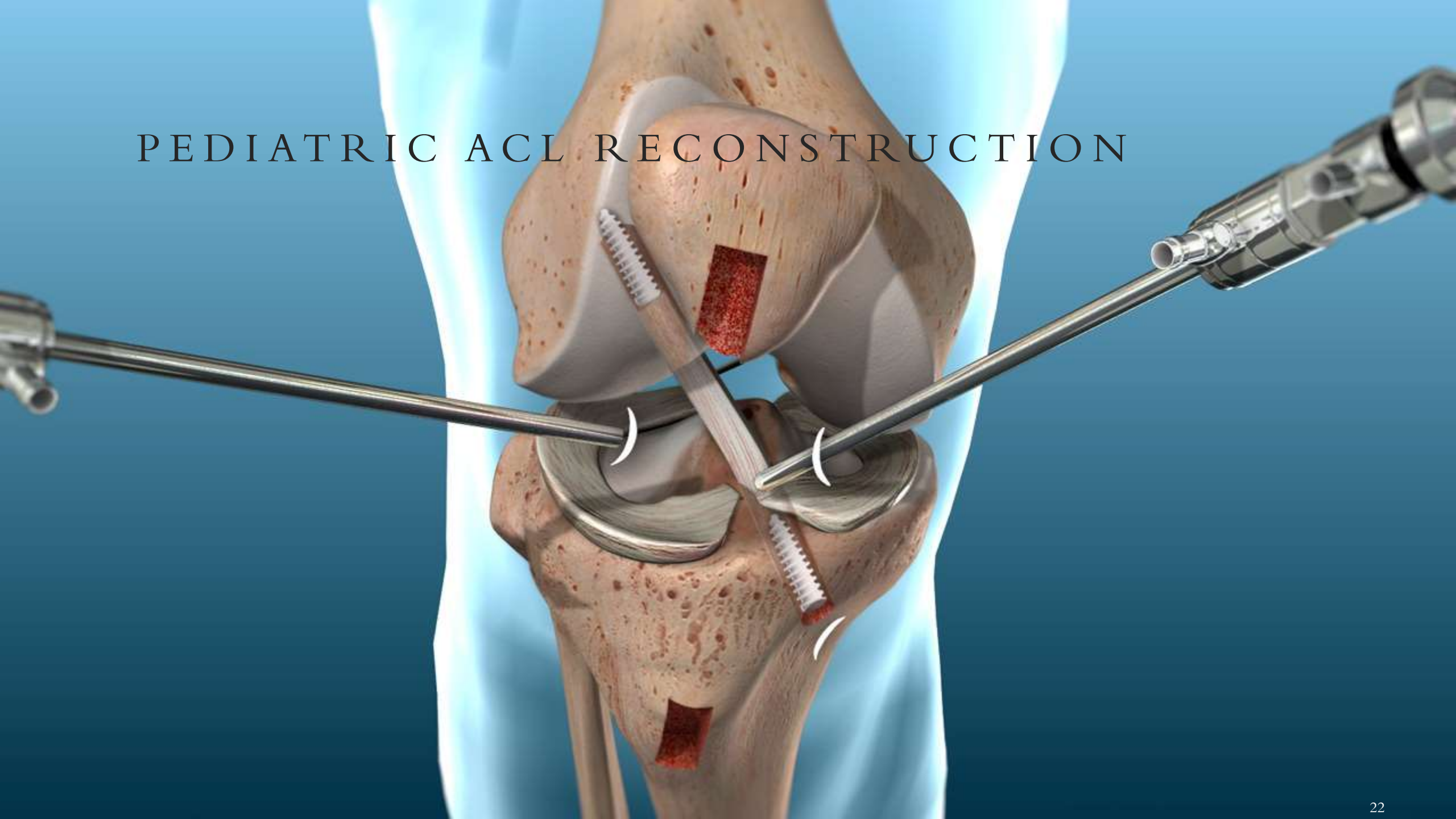
Surgery??

Graf BK et al Arthroscopy 1992	12 patients treated with brace, return to sports	60% further meniscal injury 12/12 recurrent instability
Mizuta et al. JBJS Br 1995	18 treated nonoperatively	16/18 fair/poor function 11/18 degenerative changes
Millett et al. Arthroscopy 2002	39 patients early vs delayed	Higher rate of medial meniscus tears in chronic: 36% vs 11%
Aichroth et al. JBJS Br 2002	23 treated nonoperatively	All unable to return to sport/activity level 10/23 OA changes
Henry et al. KSSTA 2009	Early vs Delayed reconstruction	Early group with: -Lower rate of medial meniscus tear (16% vs 41%)

Surgery??

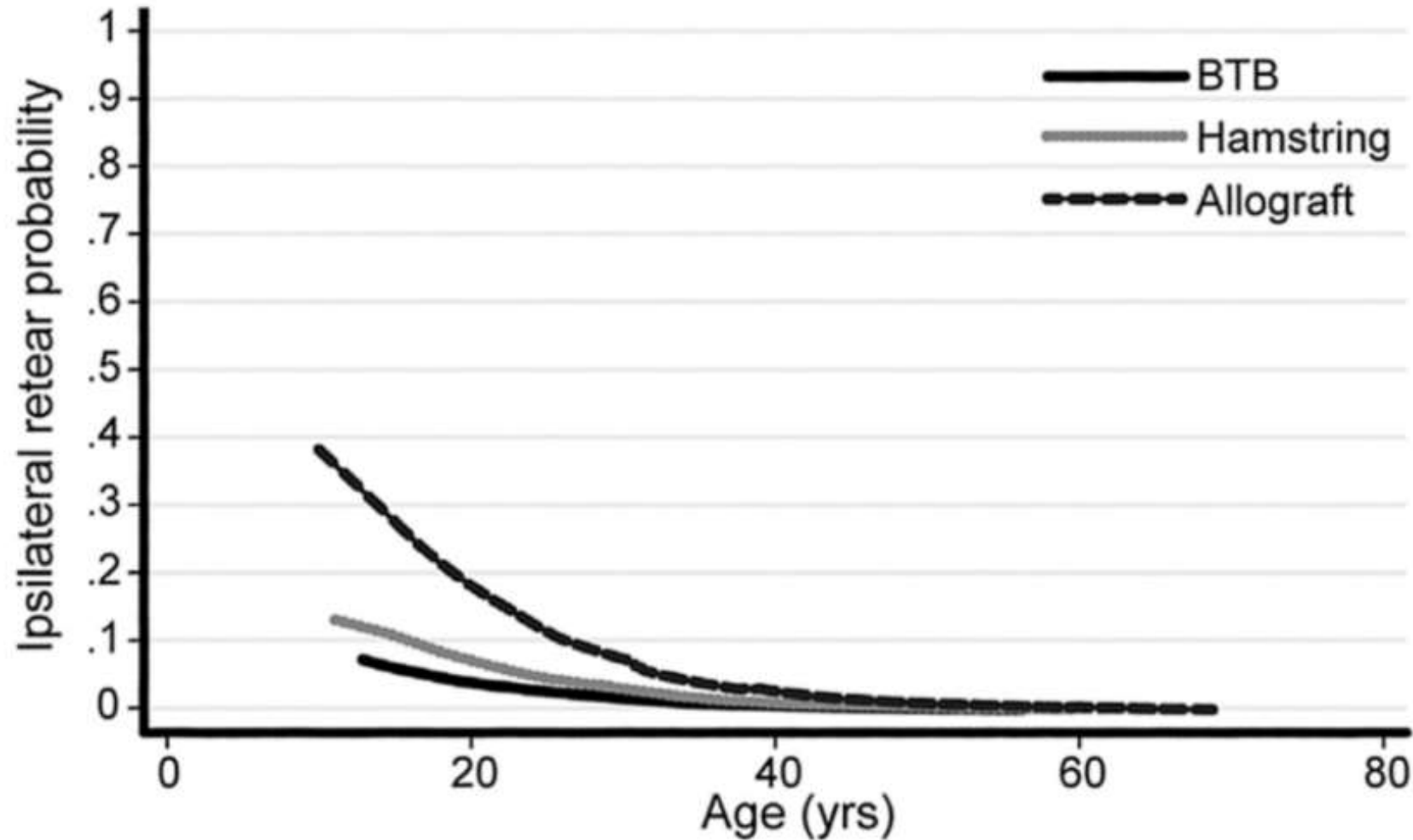
- Non-operative treatment does not allow for normal adolescent activity.
- Can control sport, but can't control free play.
- Poor Results...so we should fix it?

PEDIATRIC ACL RECONSTRUCTION



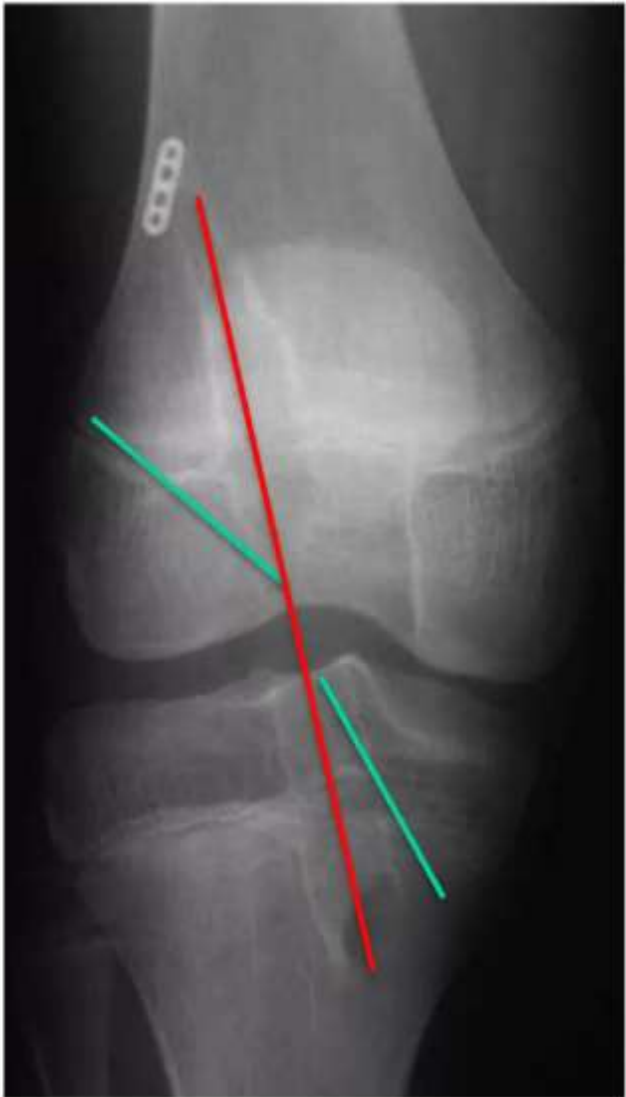
Surgery

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



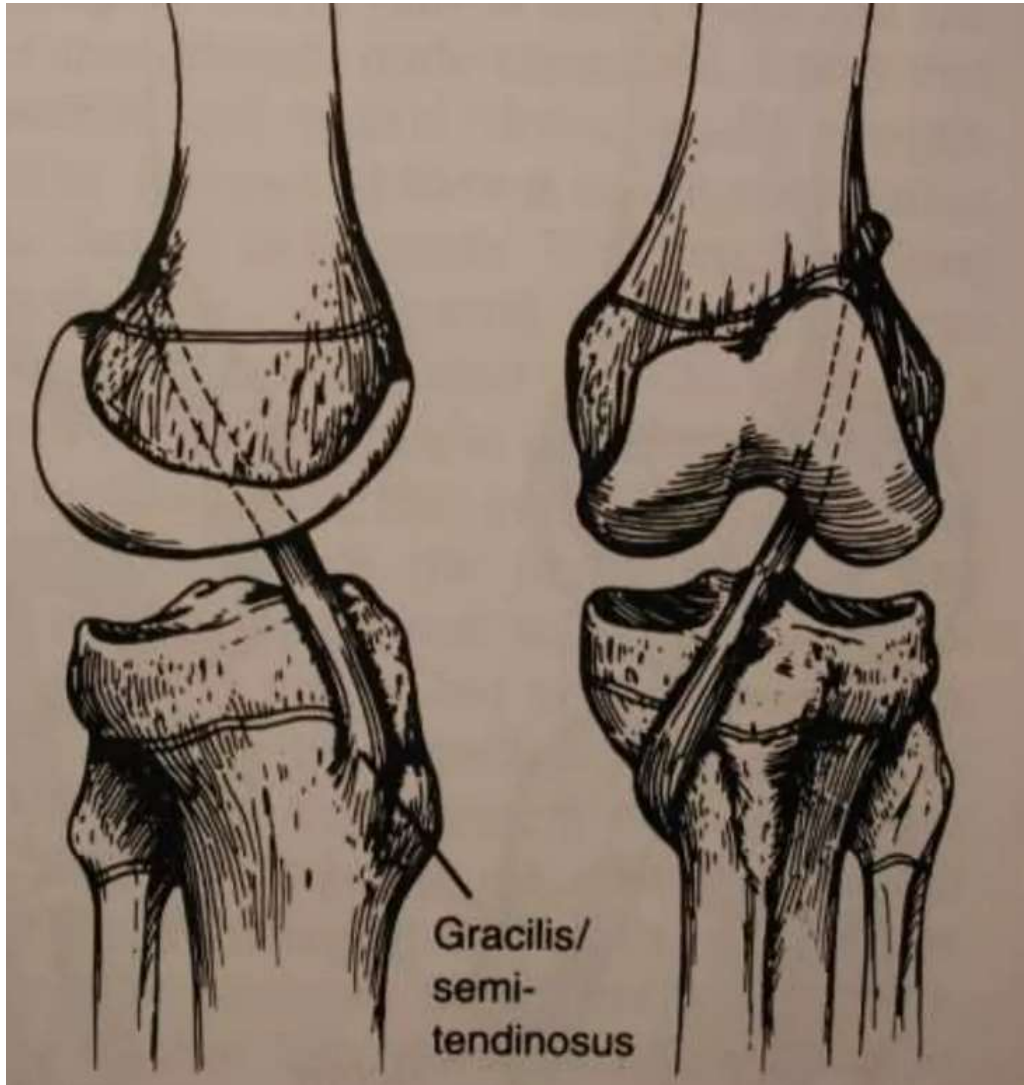
Surgery

Trans-Physeal



Surgery

Extra-Epiphyseal



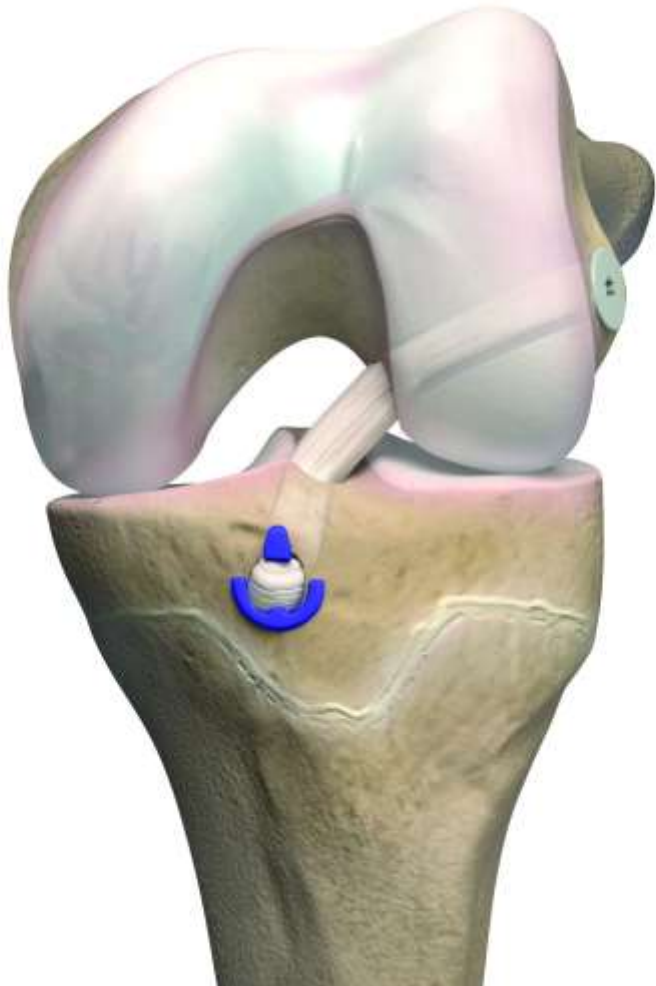
Surgery

Extra-Epiphyseal



Surgery

All-Epiphysal



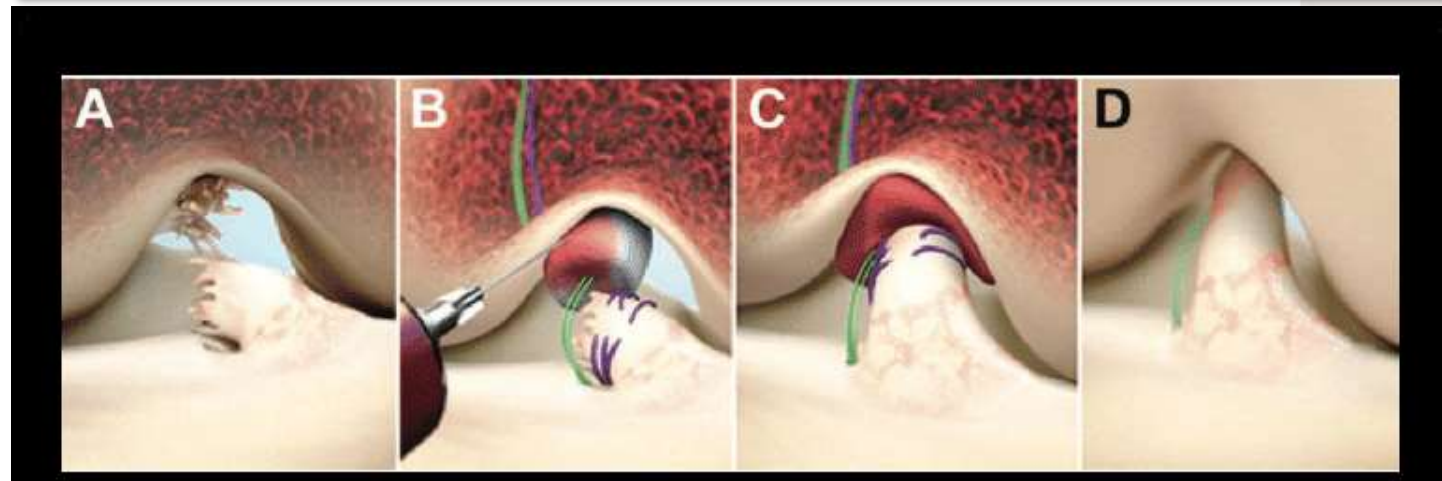
Surgery

Hybrid Physeal-Sparing



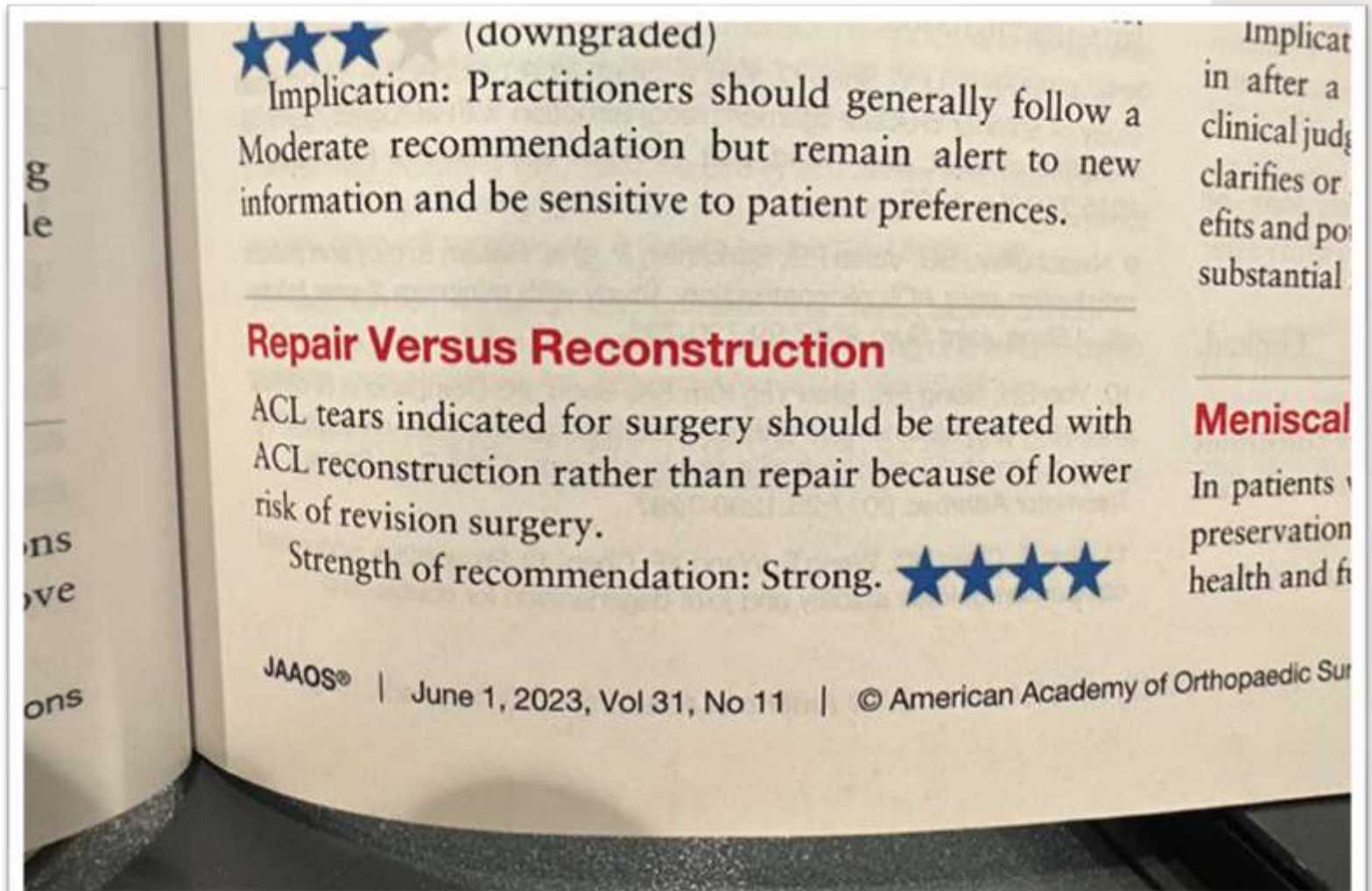
Surgery

Other Options? ACL Repair

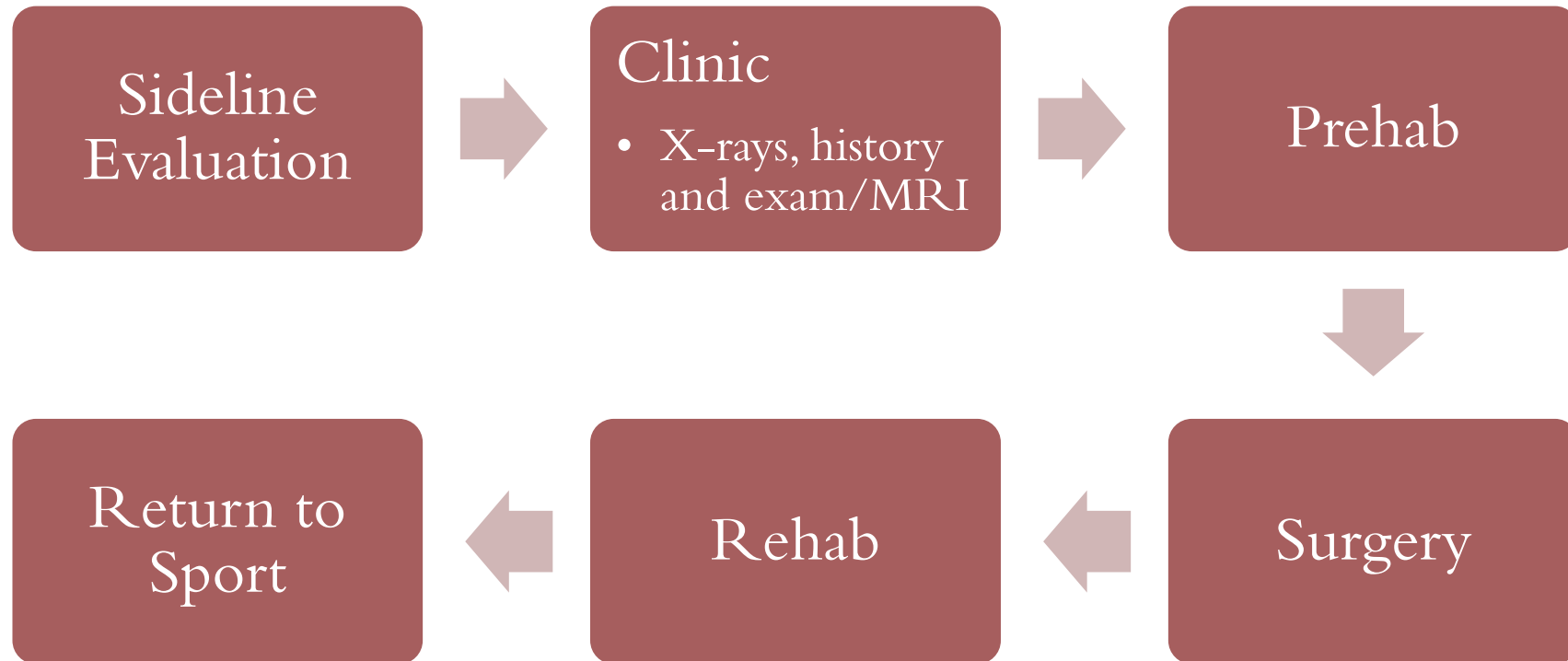


Surgery

Other Options? ACL Repair



Pediatric ACL Injury



Rehabilitation Principles of the Anterior Cruciate Ligament Reconstructed Knee

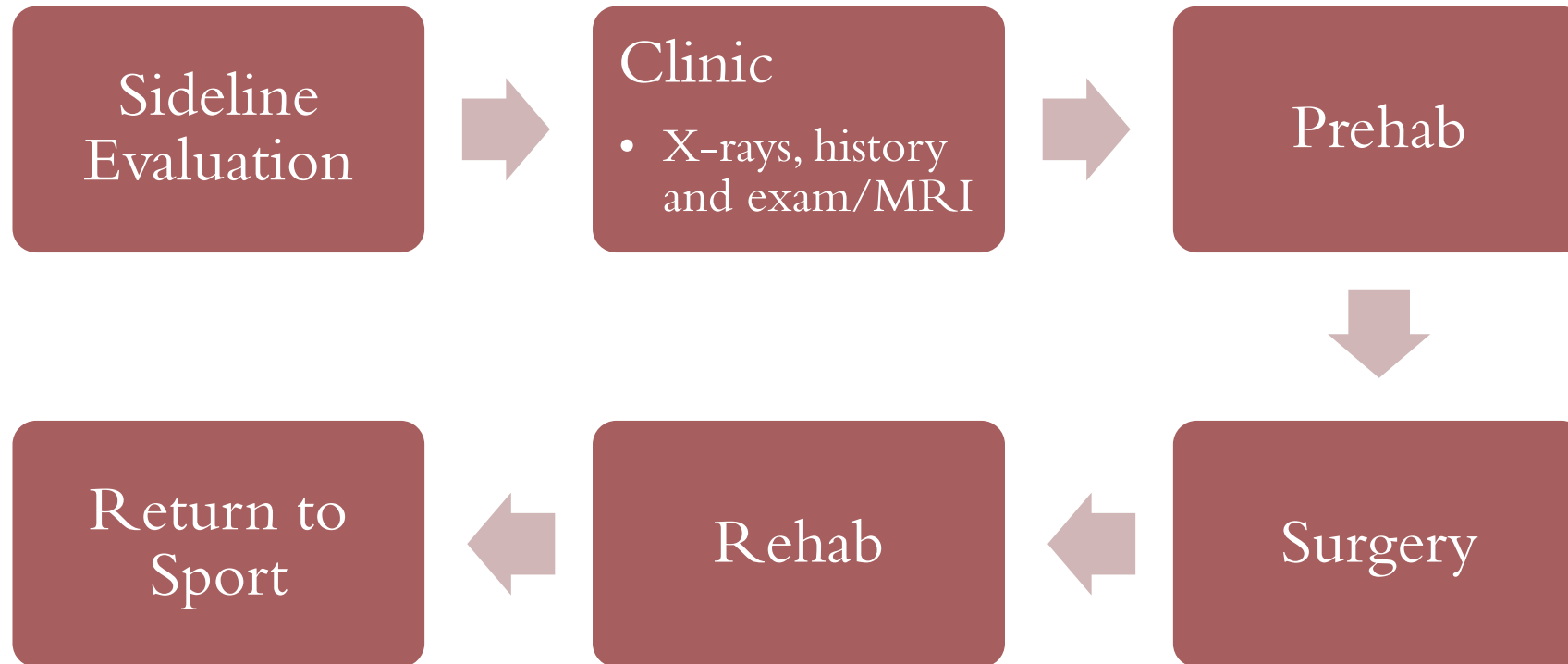
Twelve Steps for Successful Progression and Return to Play

Box 1

Twelve steps critical to successful anterior cruciate ligament rehabilitation

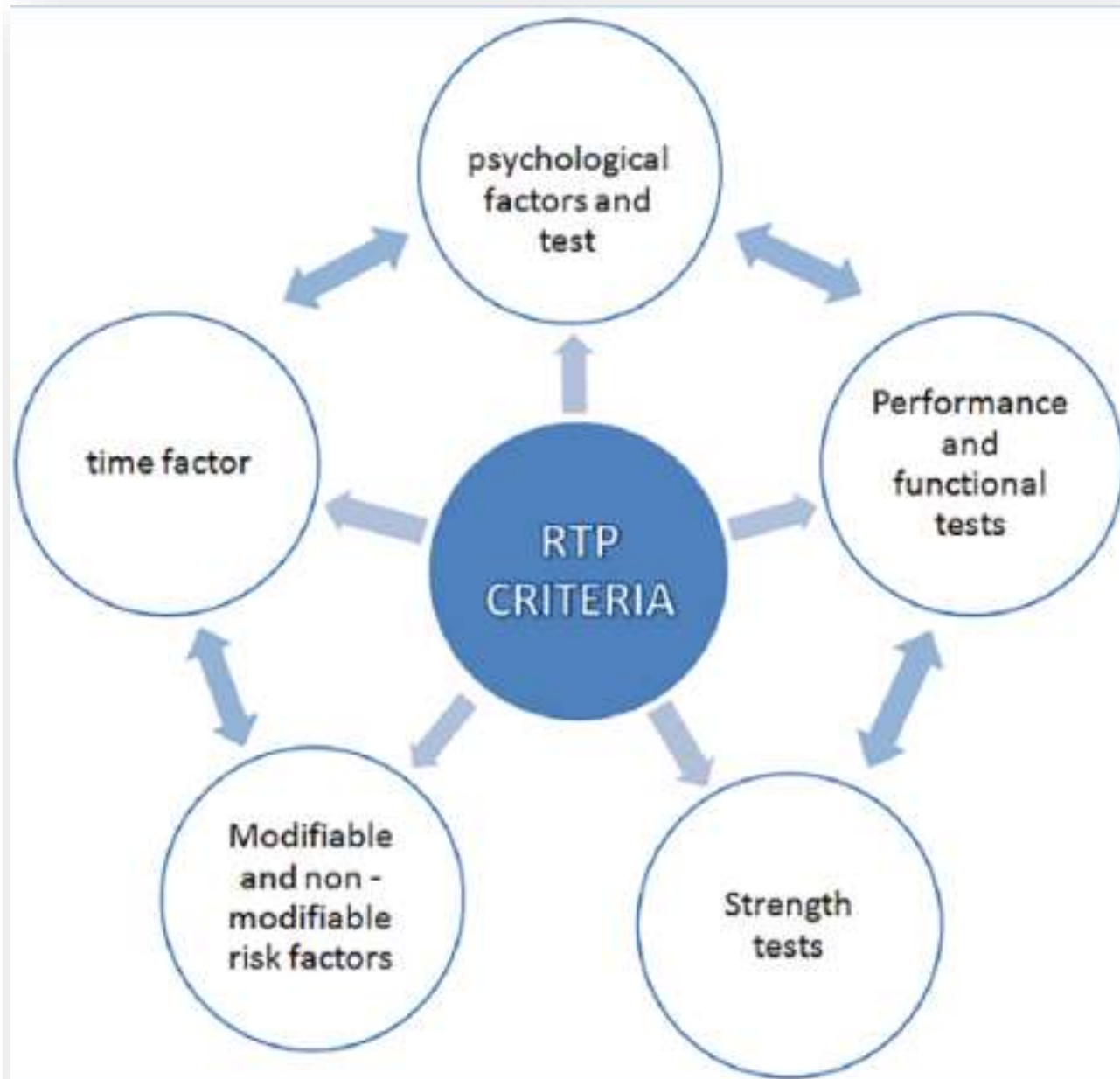
1. Preparation of both the patient and their knee for surgery
2. Restore full passive knee extension
3. Reduce postoperative inflammation
4. Gradual restoration of full knee flexion
5. Restore complete patellar mobility
6. Individualize and adjust the rehabilitation program based on the status of the 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

Pediatric ACL Injury



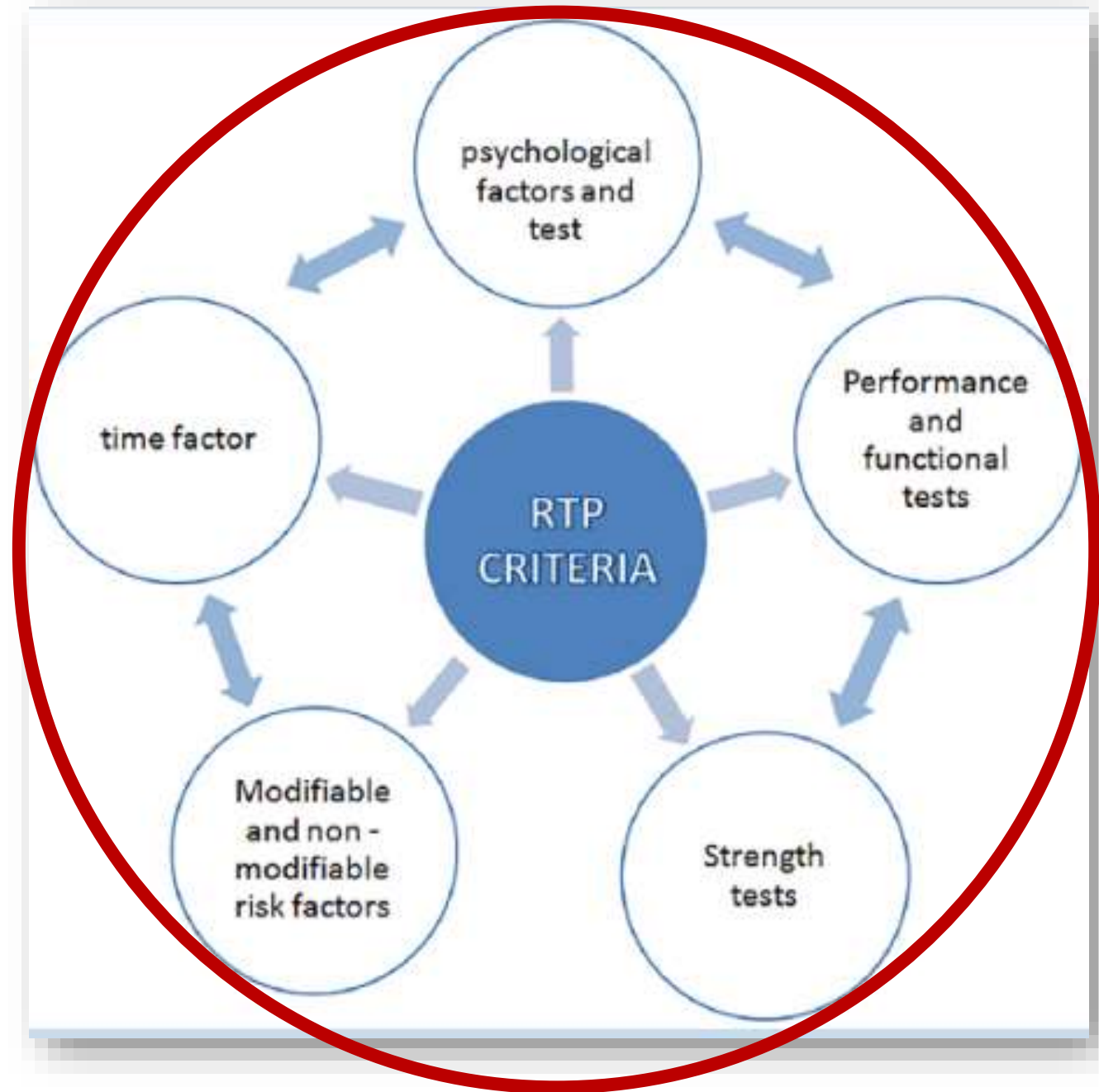
Return to Sport

- 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?

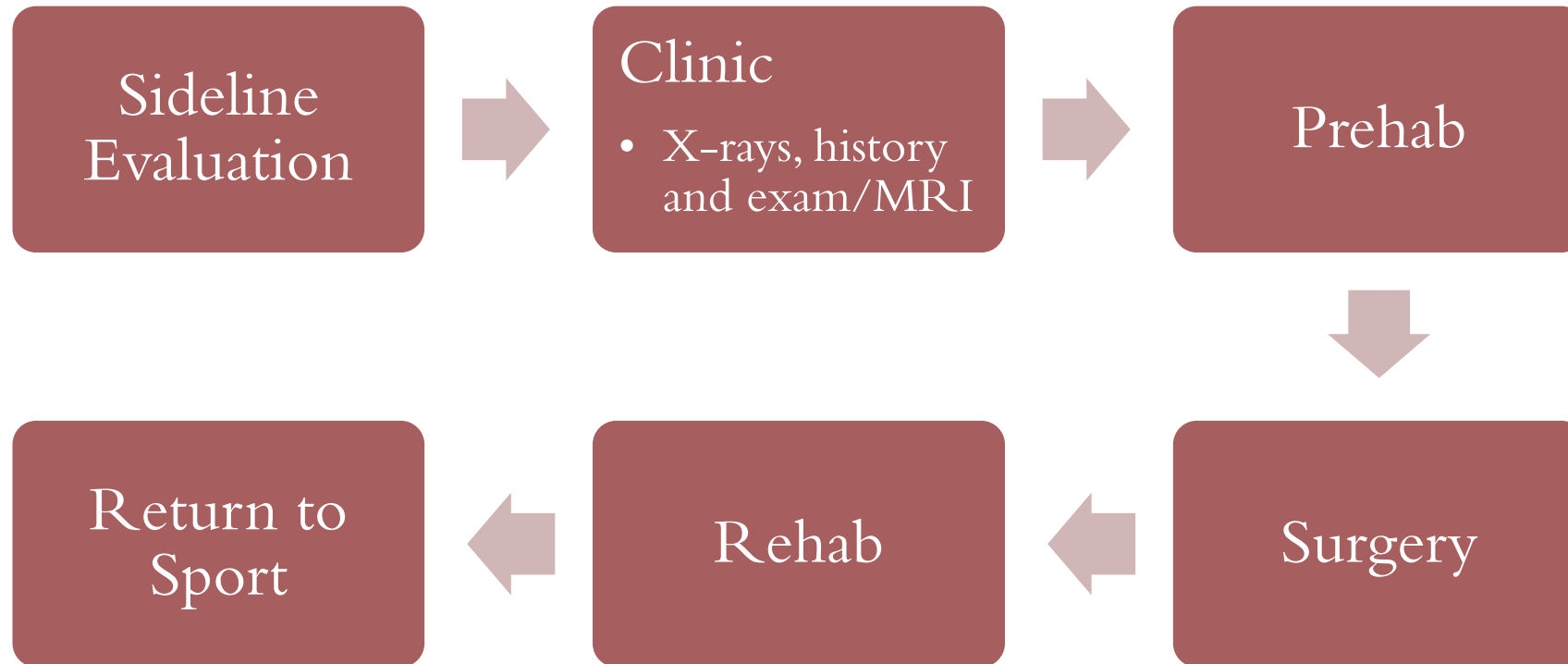


Return to Sport

- 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?
 - Able to compete at the same level
 - Without pain or swelling
 - Minimizing re-injury
 - With enjoyment of sport



Pediatric ACL Injury



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.

Pediatric ACL Injury – Summary

- Pediatric ACL tears do poorly with non-operative treatment
- Operative Treatment Must Account For:
 - Graft Choice (Soft tissue AUTOgraft)
 - Growth Plate (Extra-physeal vs. all-epiphyseal vs. Hybrid)
 - Appropriate Graft Placement (Maintain proper knee mechanics)
 - Preoperative Rehabilitation (Better/faster recovery)
 - Postoperative Rehabilitation (Goal to return to desired activity without pain or limitation)
- Pediatric ACL Reconstructions have a high failure rate, especially if the patient returns before they are ready for all aspects of return to sport.

QUESTIONS?