

ACL Reconstruction In Skeletally Immature Patients

Knee Update 2016
Gelsenkirchen, Germany

June 3-4, 2016
K. Donald Shelbourne, MD



Introduction

- ACL tears in skeletally immature athletes has increased as participation in youth sports has increased
- Treatment approach to ACL injuries in youth ACL patients has evolved

Introduction

- Distal femoral physis contributes 70% of total femoral length
- Proximal tibial physis contributes 55% of total tibia length
- Surgeons have been reluctant to use conventional ACL reconstruction transphyseal technique due to the perceived risk of physeal damage and possible limb length discrepancy

Treatment Approach

- Reports of nonoperative treatment show a high rate of recurrent instability and further meniscus injury
- Timing of surgery and surgical technique is still controversial
- Trend has been to offer surgical treatment with Extra-epiphyseal or All-epiphyseal techniques instead of transphyseal techniques, especially for the very young with wide-open growth plates

Treatment Approach

- If transphyseal technique is used, soft-tissue grafts are typically used
- The thought is that some type of surgery must be done to establish stability and so patient can return to sports
- Yet, even in adults, some reports show only 50% of patients return to the same sport

My approach

- My philosophy is that patient should undergo 1 surgery at the proper time to obtain the best long-term result
- Would rather limit athletic activities until patient can undergo ACL reconstruction with B-PT-B graft than try other less successful procedures
- Perform the surgery that has the best chance for long-term success
- Bone-PT-Bone graft has better stability outcomes than soft-tissue graft, especially in young competitive athletes

My approach

- Consider these factors for timing of surgery
 - Tanner stage
 - Onset of menarche
 - Ossification of tibial tubercle on lateral radiograph

Open growth plates

- Patients with wide open growth plates can undergo ACL reconstruction with PTG once they reach Tanner stage 2-3
- Procedure can be performed to avoid bone being placed across the physes



10 Year-Old Male at Time of Injury

- 10-year old in 5th grade of school
- Played soccer, basketball, and track
- Injured playing soccer

10-year Old Male at Time of Injury



Wide open growth plates
Tanner stage 1



No calcification of
tibial tubercle

10 Year-Old Male at Time of Injury

- Treatment plan – avoid sports that mostly likely would cause giving way
- Switched to swimming and ice hockey
- Other sports to recommend:
 - Running, tennis, swimming, hockey, baseball

10 Year-Old Male at Time of Injury

- Patient returned at age 11
- Wanted to try to play football at a camp
- Was now Tanner stage 2
- Recommended he could try football camp in activities that avoided contact
- Patient was able to participate in football camp
- He also was able to play recreational basketball with friends without giving way

10 Year-Old Male at Time of Injury

- Patient returned at age 12
- Wanted to have surgery if possible to be able to return to competitive sports
- Patient now at Tanner stage 3

Same Patient: Age 12 at time of Surgery



Tanner Stage 3



Some calcification
of tibial tubercle

Youth ACL Patients

- Skeletally immature patients tear their ACL at varying ages
- Our goal is to educate them on importance of changing activities to prevent giving way (i.e. prevent meniscus/articular cartilage damage)
- Most can still play sports at low recreational level
- This conversation with the patient and parents can take a great deal of time
- Sometimes has to be repeated at subsequent visits
- Can perform surgery at Tanner Stage 3 and when tibial tubercle is calcified

Surgical Technique

- Arthroscopic surgery to examine and treat meniscus tears
- Mini-arthrotomy two-incision technique
- Slightly shorter than normal bone piece harvested from the patella
- Patellar bone piece placed in the tibial tunnel at the level of the joint proximal to the physis

Surgical Procedure

- Extra length of the tendon was taken up in the femoral tunnel
- Tibial bone plug placed in the femoral tunnel proximal to the physis



Surgical Procedure

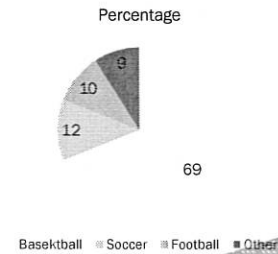
- Graft is fixed with buttons and sutures
- Knee is moved through full range of motion several times for tensioning



Patient Population

- 139 patients between 1987-2012
- Mean surgery age, 14 years (range 12-16)
- Tanner Stage
 - 46 patients Tanner 2-3
 - 93 patients Tanner 4
- Time between initial evaluation and surgery, Mean 6 ± 8 months; (range 1 - 51 months)

Patient Population: Sport Causing Injury



Patient Population

- Meniscus Tears at Surgery
 - Saved medial meniscus in 92%
 - Saved lateral meniscus in 86%

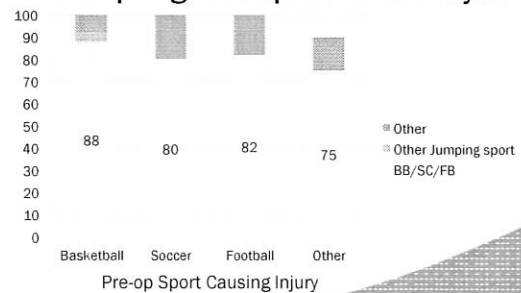
Results

- Minimum 2-year results for 110 patients
- Range of motion: 6° of hyperextension to 148° of flexion
- KT1000 man-max difference between knees: $1.7 \text{ mm} \pm 1.5 \text{ mm}$
 - 90% $\leq 3 \text{ mm}$
 - 10% at 4 mm

Results

- Quadriceps strength
- Most had graft from contralateral knee
- Strength at 2 years post-op compared to pre-op normal knee
 - ACL-reconstructed knee- Mean 154%
 - Opposite graft knee - Mean 153%
 - Mean side-to-side at 2 years - 100%
 - Increased values represent natural increase in strength with maturity but shows return to normal bilaterally

Results: Post-op Highest Sport Level Played



Results: Subjective Scores

Subjective Survey	Mean 2-Year Score
Cincinnati Rating Scale	95.9 ± 9.7
IKDC	93.7 ± 7.5

Conclusions

- BPTB can be safely and successfully used in all patients with at least Tanner 3 or greater physical maturity
- Return to sports occurs in high percentage of patients - >80% for basketball, football and soccer
- Knee symmetry is re-established and maintained