ISAKOS CONGRESS 2025 | MUNICH GERMANY June 8–11

Partial Trans-Physeal All-Inside Anterior Cruciate Ligament Reconstruction In Skeletally Immature Adolescent Patients: 2-Years Minimum Follow-Up Clinical And Radiographic Results

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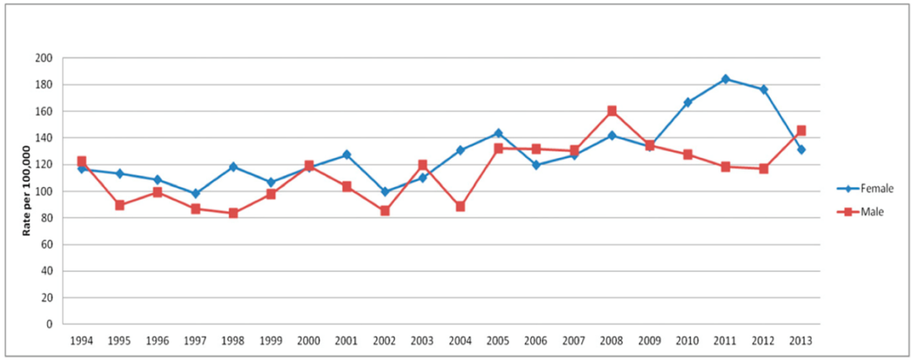
Faculty Disclosure Information

- Consultant for Arthrex Inc.

Introduction

Numerous epidemiological studies demonstrate an increase in the incidence of ACL injuries occurring in pediatric and adolescent patients



Factors contributing to this trend include: Increased sports participation, early specialization, year-round training.

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Swenson DM et al. Epidemiology of knee injuries among US high school athletes 2005/2006-2010/2011. Med Sci Sports Exerc. 2013

Popkin CA et al. Trends in management and complication of anterior cruciate ligament injuries in pediatric patients: a survey of the PRiSM society J Pediatr Orthop. 2018

Cruz et al. What's New in Pediatric Sports Conditions of the Knee? J Pediatr Orthop. 2018

Beck NA et al. What's ACL Tears in School-Aged Children and Adolescents Over 20 Years. Pediatrics. 2017

A paradigm shift

- Surge in operative treatment and ACL reconstruction in the last 20 years.
- Significant increase in pediatric ACL reconstructions, reflecting international trends.
- 5.7-fold increase in pediatric ACL reconstruction rates in the U.S. over a decade.
- Similar trends in Finland, Norway and Australia, with a 2-fold increase in reconstructions.
- Increased awareness? actual increase in incidence? or surgical preference?

Cancino B et al. Anterior cruciate ligament rupture in skeletally immature patient. JAOOS. 2022

Dodwell ER et al. 20 years of pediatric anterior cruciate ligament reconstruction in New York State. AJSM 2014

Shaw L, Finch CF. Trends in pediatric and adolescent anterior cruciate ligament tears in Victoria, Australia 2005-2015. Int J Environ Res Public Health. 2017

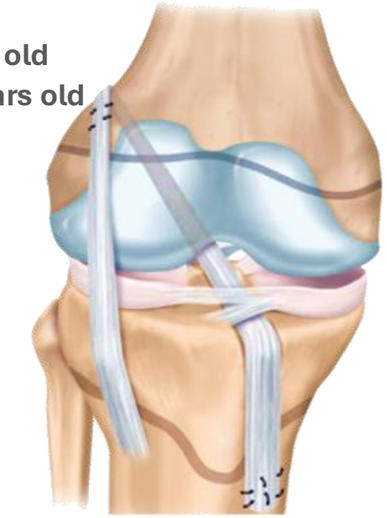
Weitz FK et al. The incidence of paediatric ACL injury is increasing in Finland. KSSTA 2020.

Kooy CEvW et al. Major Increase in Incidence of Pediatric ACL Reconstructions From 2005 to 2021: A Study From the Norwegian Knee Ligament Register. AJSM 2023

Surgical techniques

Pre-adolescents

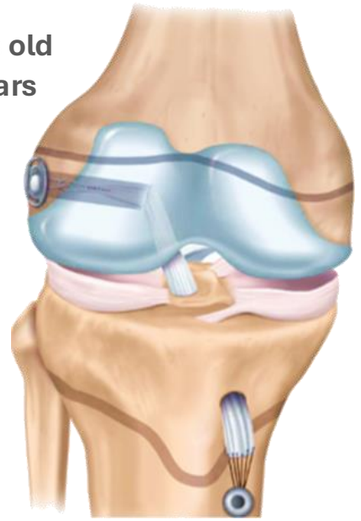
- Tanner 1 and 2
- Males ≤ 12 years old
- Females ≤ 11 years old



Fascia lata – based combined intra and extra-articular reconstruction

Early and middle adolescents

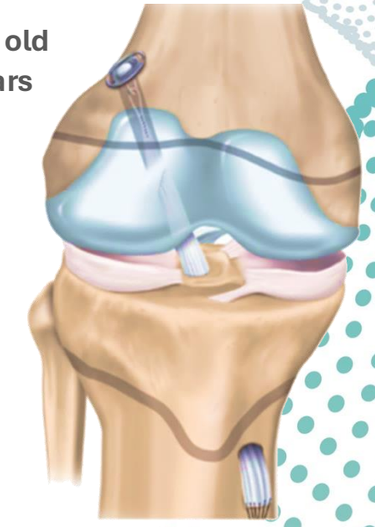
- Tanner 3 or 4
- Males 13-16 years old
- Females 12-14 years old



All-inside, All-epiphyseal

Late adolescents with closed physes

- Tanner 5
- Males >16 years old
- Females >15 years old



Trans-physeal

Kocher MS et al. (2005) Physeal sparing reconstruction of anterior crucaite ligament in skeletally immature prepubescent children adn adolescents J Bone Joint Surg Am

Cordasco FA, Mayer SW, Green DW. All-Inside, All-Epiphyseal Anterior Cruciate Ligament Reconstruction in Skeletally Immature Athletes: Return to Sport, Incidence of Second Surgery, and 2-Year Clinical Outcomes. Am J Sports Med. 2017

Petersen W et al. A systematic review of transphyseal ACL reconstruction in children and adolescents: comparing the transtibial and independent femoral tunnel drilling techniques. J Exp Orthop. 2023

But…

Significant increases in

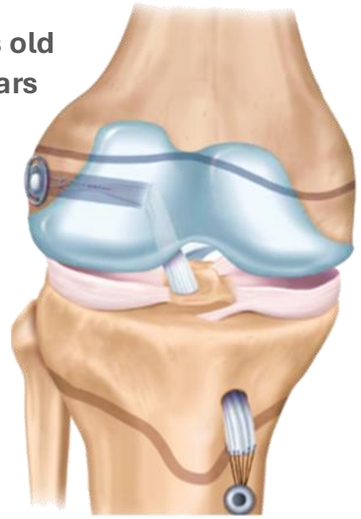
- operative time
- costs
- radiation exposure

Technical limitations

- button in the joint
- requires an additional femoral incision
- Risk of hyatrogenic lesions for
  - distal femoral physis
  - lateral collateral ligament
  - anterolateral ligament (ALL)
  - popliteus,
  - articular cartilage

Early and middle adolescents

- **Tanner 3 or 4**
- **Males 13-16 years old**
- **Females 12-14 years old**



All-inside, All-epiphyseal

Biomechanical perspective

- Failing to restore AP stability
- failing to provide rotational stability at some degrees of flexion

Clinical outcomes

- Different meta-analyses:

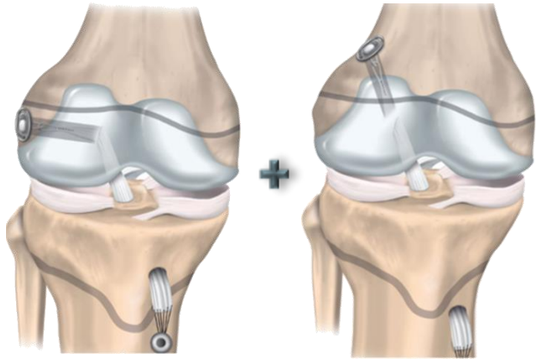
no clear superiority over the other techinques in:

- incidence of growth disturbances,
- graft survivorship
- PROMs

Aim : evaluate the efficacy and safety, assessed by clinical and radiologic outcomes, of ACLR in skeletally immature patients using an all-inside technique with limited transphyseal tunnel drilling

Skeletally immature patients

Early and middle adolescence (defined as ages 12-16, respectively).



All-inside «partial trans-physeal»

Methods

Clinical Evaluation

Minimum 2 years Follow up

- range of motion (ROM)
- pivot shift grade
- Lachman test
- s/s AP laxity with Rolimeter
- clinical assessment of limb length discrepancy and deformity.

PROMs

- IKDC
- KOOS
- Lysholm
- Tegner activity scale

Radiographic Evaluation

MRI

- Signal to noise quotient (SNQ)
- Tunnel enlargement
- Graft maturity
- Graft healing

X-Rays

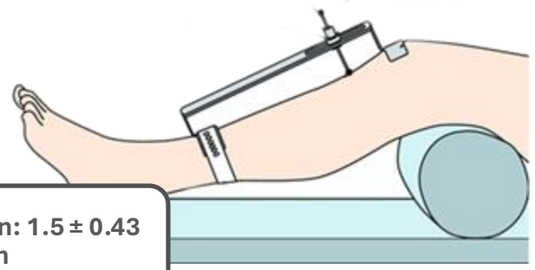
- Limb lenght
- mLDFA
- MPTA
- MAD

Results - clinical

FINAL POPULATION: 24

F.U.= 53.1 ± 21.1 (range, 28-90 months)

Age: 14.2 ± 1.2 years



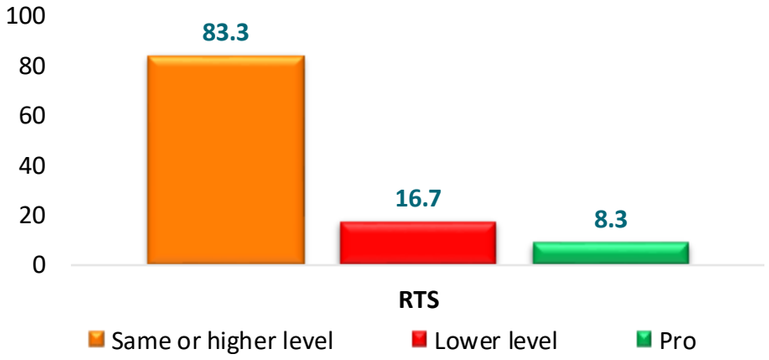
A-P translation: 1.5 ± 0.43 mm

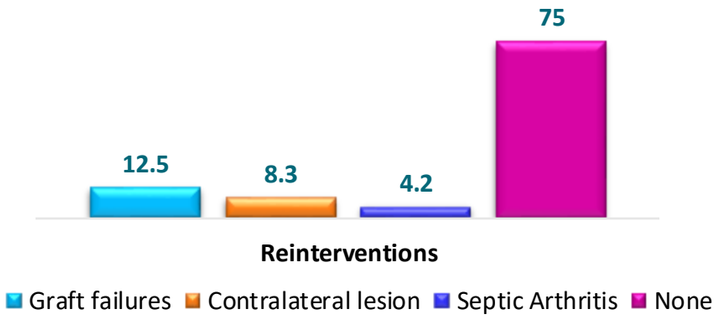
Pivot Shift grade, n (%)

• 0	19 (90.5)
• 1+	2 (9.5)
• 2+	0
• 3+	0

PROMs

• KOOS	96 ± 3.8
• IKDC	91.5 ± 7.6
• Lysholm	93.9 ± 6.3





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Results - radiologic

MRIs:20

Mean SNQ 2.85 ± 0.91,

Tunnel widening 5.06% ± 44.6% (range, -52% to +69%)

Graft maturity

• I	50%
• II	50%
• III	0
• IV	0

Graft healing

• I	60%
• II	40%
• III	0
• IV	0

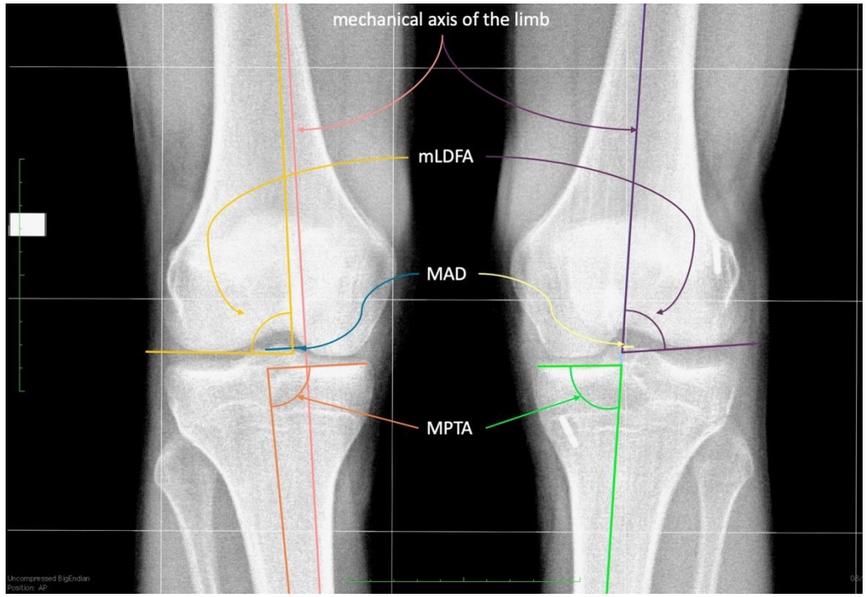
XRays:19

Mean LLD, 0.31 cm ± 0.58 cm

MPTA -0.05 ± 1.68

LDFA 1.8 ± 2.29°

MAD 5.5 mm ± 8.96 mm



Lower limb deformity incidence

• LLD (<10mm)	1/19 (6,25%)
• Valgus deformity (<5°)	12,5%
• Varus deformity (<5°)	0
• Total	18,75%

Cordasco et al.

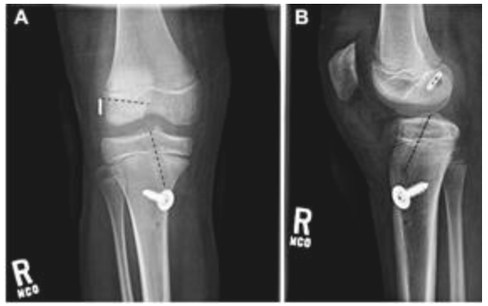
Patients: 23

FU ≥ 2 years

RTS ≥13.5 mesi

26.1%	8.7%	8.7%
Lower limb length discrepancy >5mm	Femoral hypermetria >15mm	Graft rupture rate

Chambers et al.



Patients: 24

FU 31.5 6 17.1 months

16.7%	66.7%	8.3%
Overall growth disturbance incidence	Growth disturbance incidence in younger patients	Graft rupture rate

Conclusions

100% Return to sport

10% Graft failure

10% Contralateral lesions

Despite the incidence of angular deformities and limb length discrepancies in 18.5% of patients, the severity of the growth disorder is generally mild and patients tolerate the difference well without the need for guided growth interventions.

Thank you

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