



ADOLESCENT & CHILDREN:  
GOOD TIMING FOR BEST RESULTS

F-X GUNEPIN, B FRAISSE, T JULIENNE



# INTRODUCTION

Girl < 13 years old

Boy < 15 years old



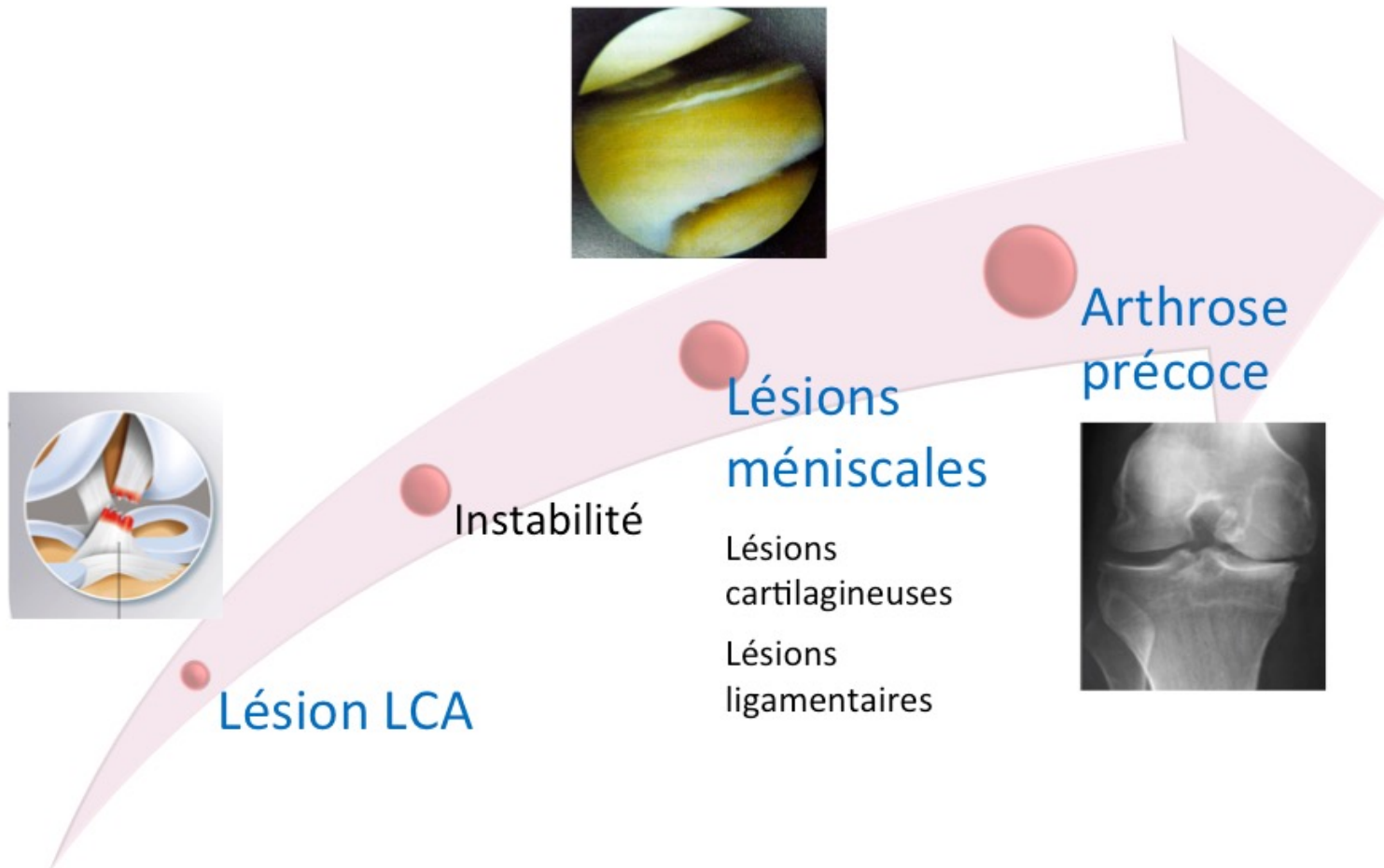
Access to sport earlier and earlier

- Knee: 1st joint injured in sports traumatology



*Adirim, Sports Med; 2003*

# DANGER: MISSING THE DIAGNOSIS



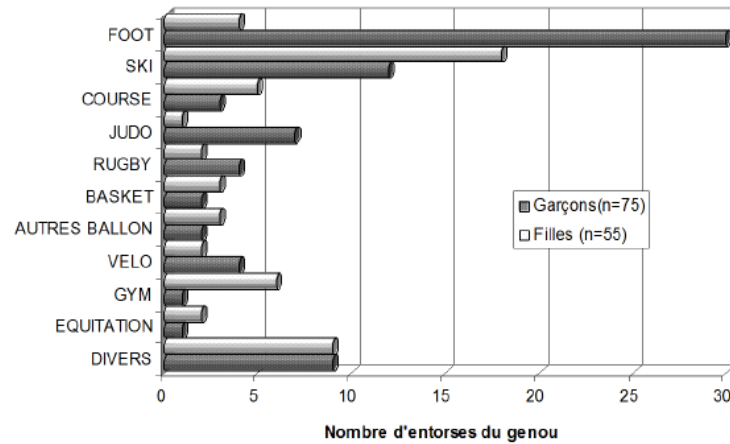
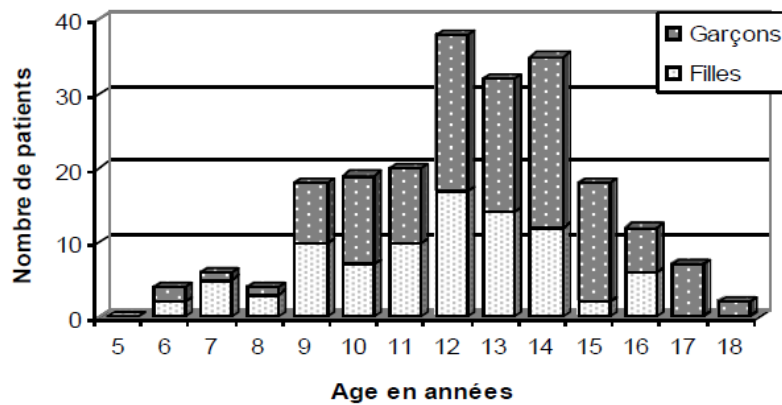
# KEY POINTS

- Rare before 9 years → but not impossible
- Clinical examination ++ → but not always easy
- Importance of MRI
- The child is a pivotal sportsman in daily contact

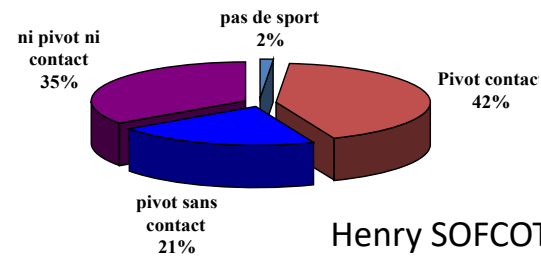
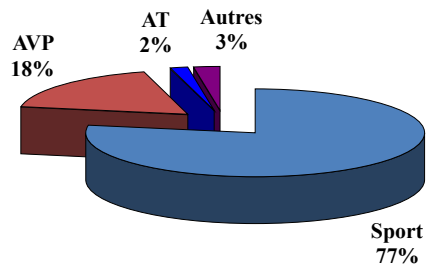


# EPIDEMIOLOGY

Boys > girls. Rare before 9 years. Etiologies



Bonnard C RCO 2007



Henry SOFCOT 2007

61 ACL/100 000 children/year. boys 96/100000/year girls 30/100000/year *Parkkari J Sport Med 2008*

# DIAGNOSIS

- Cracking
- Pain
- Impotence
- Effusion

➔ Evaluation for children  
of the sfa score



## Accueil



Appuyez sur le bouton ci-dessous pour  
commencer une nouvelle évaluation



Nouveau score

*Construction and validation of a functional diagnostic score in anterior cruciate ligament ruptures of the knee in the immediate post-traumatic period. Preliminary results of a multicenter prospective study*

Doi : 10.1016/j.rcot.2023.09.010

François-Xavier Gunepin <sup>a, \*</sup>, Romain Letartre <sup>b</sup>, Caroline Mouton <sup>c</sup>, Pierrick Guillemot <sup>d</sup>, Harold Common <sup>e</sup>,  
Patricia Thoreux <sup>f</sup>, Rémi Di Francia <sup>g</sup>, Nicolas Graveleau <sup>h</sup>

Société Francophone d'Arthroscopie (SFA) <sup>i</sup>

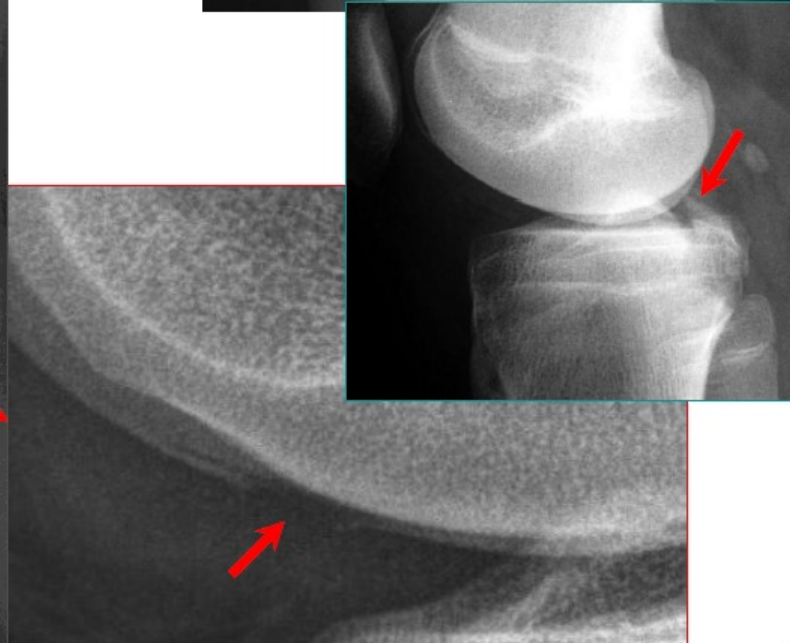
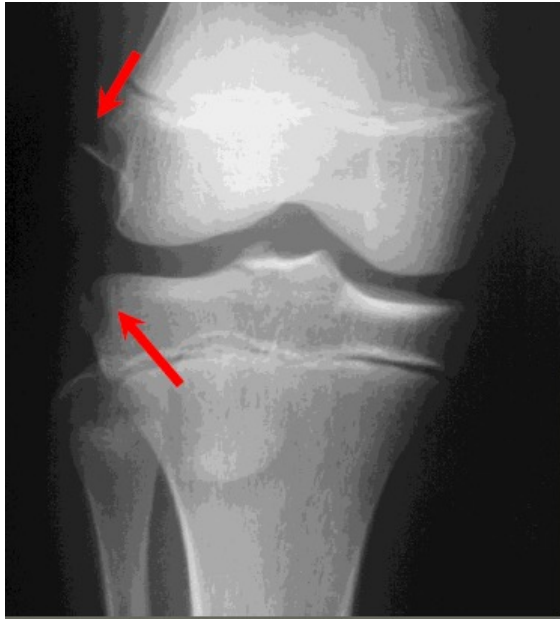
# ADULT ≠ CHILDREN

- F Chotel RCO 2007:
  - ➔ Hemarthrosis in 30% of benign sprained lesions
- Differential diagnostics:
  - Patella dislocation: Valgus, recurvatum, harmless trauma
  - Osteochondral lesions



# FIRST X-RAY

Meilleur ancrage osseux  
des ligaments et cartilage  
de l'enfant





# MRI

- **3 direct signs:**

ACL discontinuity or not seen

Abnormal MRI signal

Blumensaat angle  $>10^\circ$

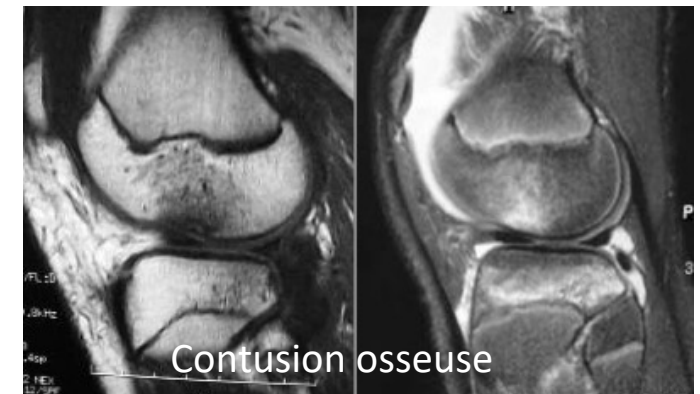
- **4 indirect signs:**

Lateral condyle contusions

Anterior tibial translation

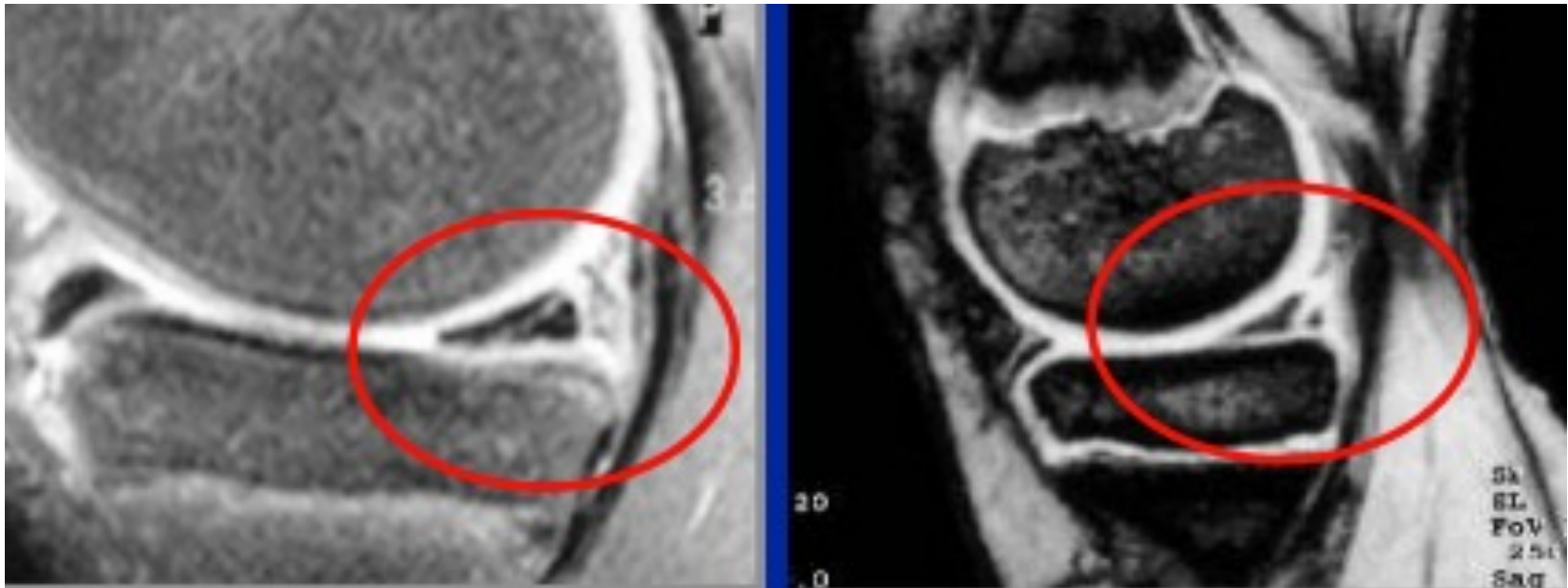
PCL angulation  $< 115^\circ$

Posterior root discovery LM



# MENISCUS +++

50% of intra-ligamentous ACL tears  
have an associated meniscal lesion



# THE QUESTION

## POSTPONING RECONSTRUCTION UNTIL GROWTH ENDS: WHAT CONSEQUENCES?

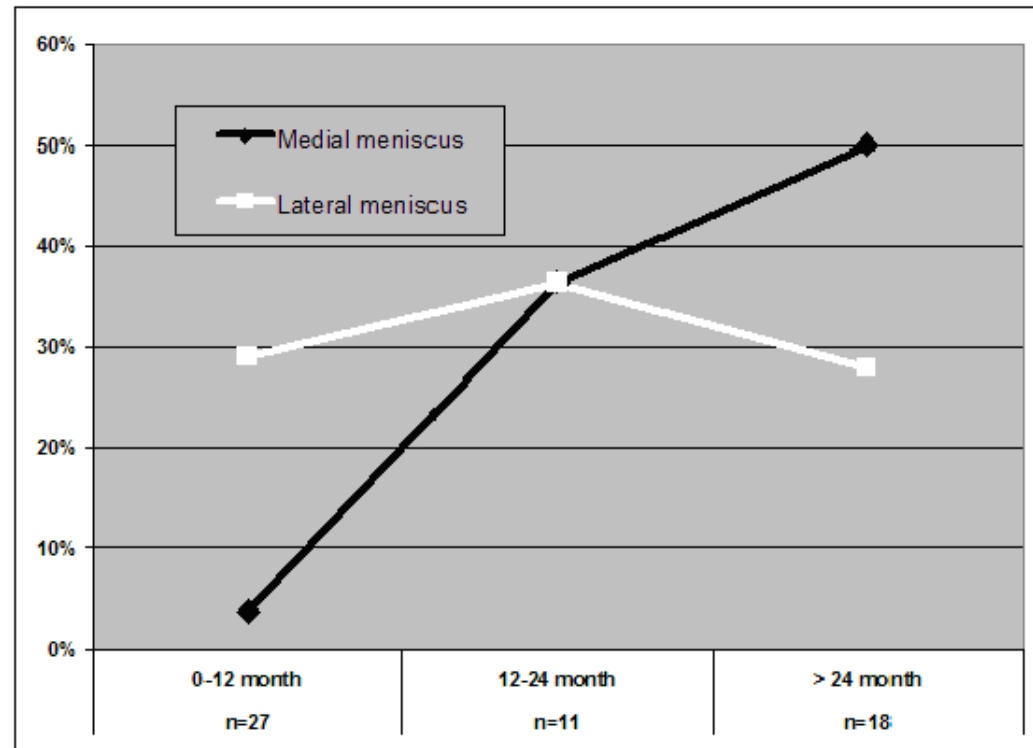


### Henry KSSTA 2009: 2 groups

- Early surgery for an immature skeleton
- Conservative treatment then closed physis surgery

### Increased medial meniscal lesions

- **Risky option for the medial meniscus**

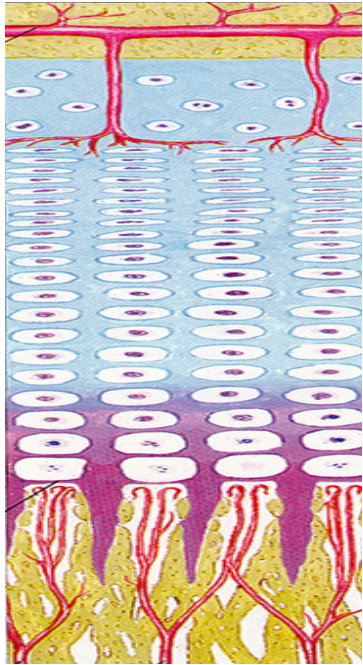


do not forget  
50% of children with a meniscal  
lesion are asymptomatic

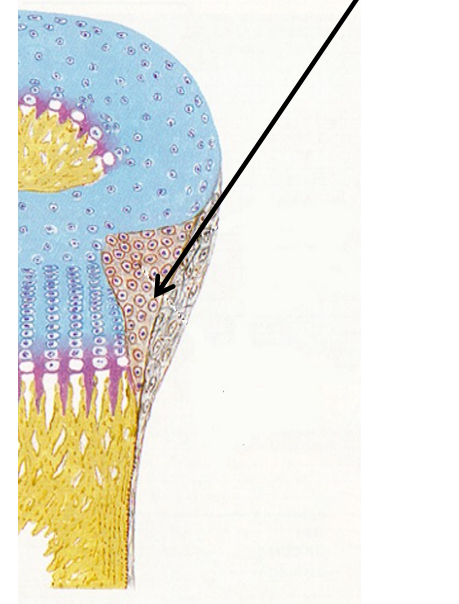
# WHAT ARE RISK OF THE ACL SURGERY FOR CHILDREN

**the growth plate**

**Epiphysis**



**perichondrial ferrule**



Seil R CD ESSKA 2000

**Metaphysis**

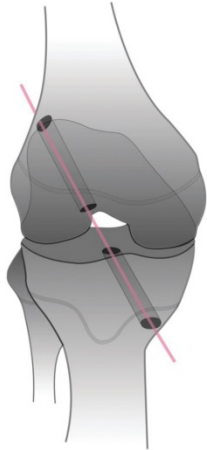
# Surgery → Risk of epiphysiodesis

- No BTB on open physis
- No material bridging the physis (screws, bone rod)
- Rather soft tissue reconstruction (hamstring)

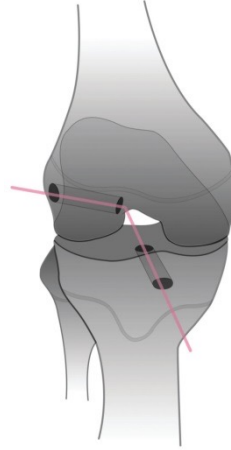


# Expert technical choice

Transphysaire



Epiphysaire



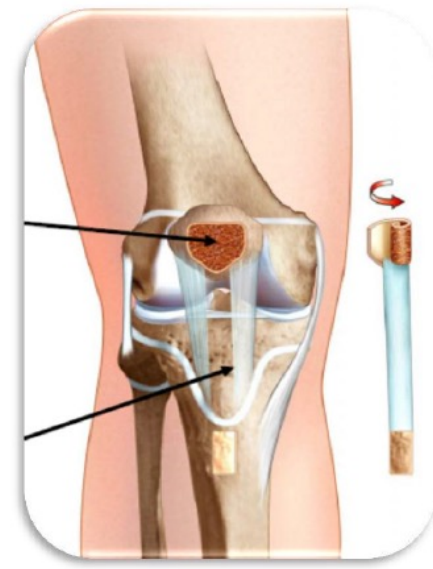
Quadriceps



DIDT



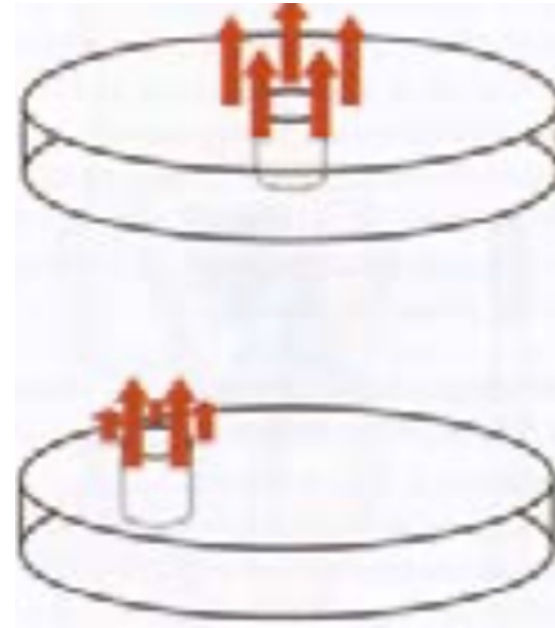
Tendon rotulien  
SANS blocs osseux



*Coll Chotel*

# Consequences of epiphysiodesis

- Central :
  - Shortening
- Peripheral
  - Angular deviation
- Tibial Tuberosity:
  - Recurvatum



In young children, the growth spurt can rupture the epiphysiodesis bridge

This is less true at the end of growth which is therefore surgically more at risk

# Do we have to wait though?

## **Temporal relation of meniscal tear incidence, severity, and outcome scores in adolescents undergoing anterior cruciate ligament reconstruction**

Stephen D. Zoller<sup>1</sup> · Kristin A. Toy<sup>2</sup> · Peter Wang<sup>3</sup> · Edward Ebrahimzadeh<sup>1,4</sup> · Richard E. Bowen<sup>1,5</sup>

→ significant increase in medial meniscal tear incidence

[Am J Sports Med](#). 2015 Feb;43(2):275-81. doi: 10.1177/0363546514559912. Epub 2014 Dec 12.

## **Correlation of meniscal and articular cartilage injuries in children and adolescents with timing of anterior cruciate ligament reconstruction.**

[Anderson AF](#)<sup>1</sup>, [Anderson CN](#)<sup>2</sup>.

→ Delayed ACL reconstruction increased the risks of secondary meniscal and chondral injuries in this population of pediatric patients



# MIRWALD METHOD:

**estimate the individual age** at the time of the growth spurt

## Mirwald's method

- Estimate biological age using a mathematical formula which takes into account chronological age and the ratio between sitting height and standing height.
- During the growth spurt, it is the extremities that grow first, then the trunk
- Average age at growth spurt: 12.0 years for girls / 13.8 years for boys



## Assessment

- Difference ( $\Delta$ ) between the mean age and the estimated age at the time of the growth spurt.

## Categories

- Early development ( $\Delta \geq +1$  year)
- Average development ( $\Delta =$  between -1 and +1 year)
- Late development ( $\Delta \leq -1$  year)

## Advantages and disadvantages

- Little equipment needed
- Duration (only 5 min per athlete)
- Increasing imprecision of results as we move away from the growth spurt

[https://www.swissolympic.ch/dam/jcr:f0ca6243-9a7f-44c0-9b1d-915d024104aa/01\\_PISTE\\_Merkblatt\\_Biologischer\\_Entwicklungsstand\\_FR.pdf](https://www.swissolympic.ch/dam/jcr:f0ca6243-9a7f-44c0-9b1d-915d024104aa/01_PISTE_Merkblatt_Biologischer_Entwicklungsstand_FR.pdf)

# SFA SYMPOSIUM ADVISE

- Distance > 3 mm from the perichondrial ferrule
- Intraoperative X-ray identification of the physes
- Tunnel less than 9 mm
- Vertical tibial tunnel (>60°)
- Fixation distant from the physis

– *Recommandations*

- Distance > 3 mm de la virole périchondrale
- Repérage radio des physes
- Tunnel < 9 mm et tunnel tibial vertical (viseur 60°)
- Remplissage complet du tunnel par greffe tendineuse
- Éloigner les implants de la physe

## Fascia lata technic (Jaeger)

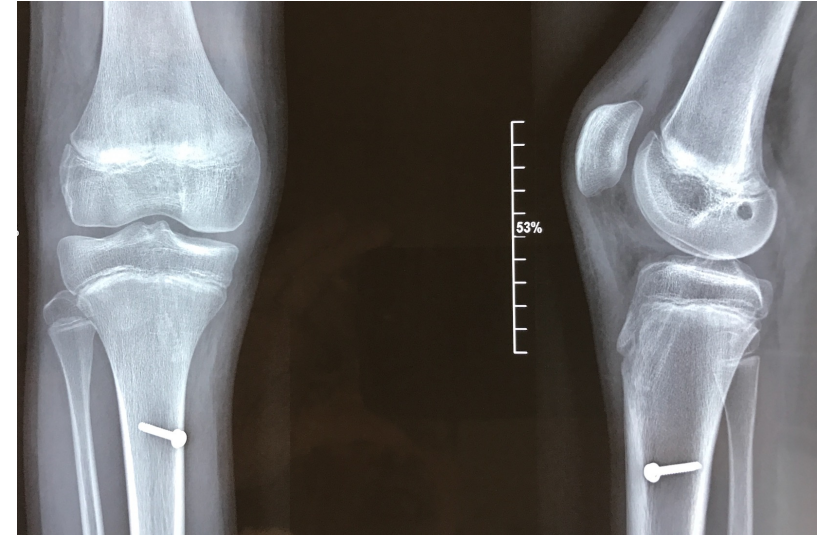
- Distance > 3 mm from the perichondrial ferrule ✓
- Intraoperative X-ray identification of the physes ✓
- Tunnel less than 9 mm ✓
- Vertical tibial tunnel (>60°) ✓
- Fixation distant from the physis ✓

And lateral tenodesis ++



Adult technic (ACL + ALL)  
ST + Gracilis

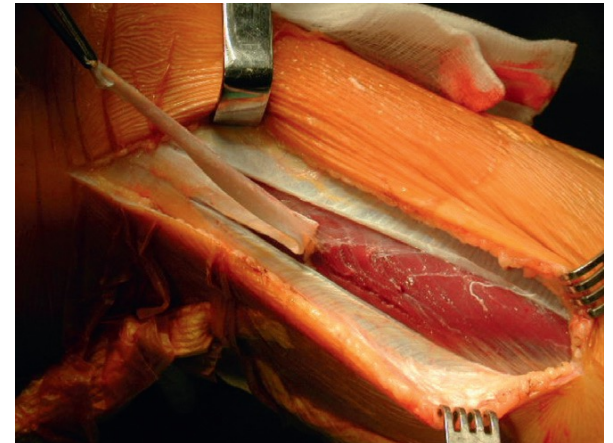
# Practice



Nothing in the femoral tunnel

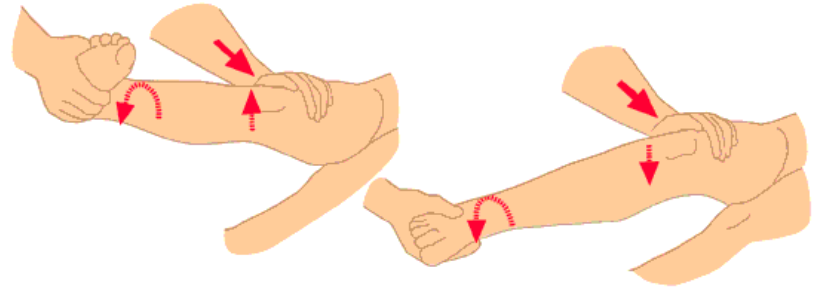
Non absorbable suture with 3,5 cortical screw for the tibia

With resorbables screw in the tibial tunnel if is long enough



# So when to operate?

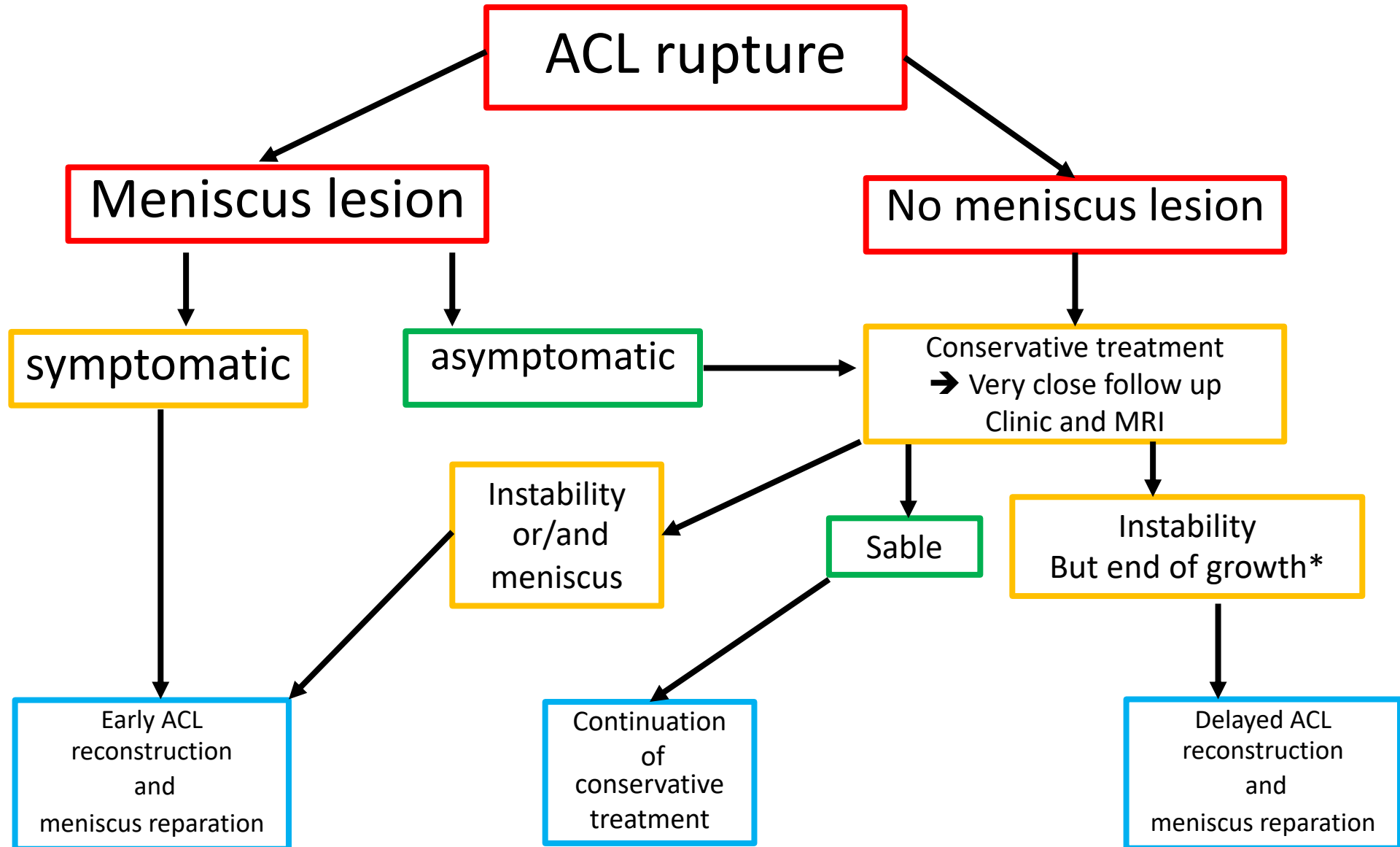
- Poor tolerance
  - Chronic instability
  - “pivot shift”
- Meniscal lesions
  - MRI follow-up
  - Repair+++
- Failure of conservative treatment
- High level contact pivot sport
- After discussions with the child and those around him



**> 50% des patients avec lésions méniscales ont un examen clinique normal**



# Algorithm



# CONCLUSION

- No matter when but choose the adapted technic:  
➔ But remain cautious towards the end of growth

