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# 36th SITEMSH Kongress
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# Pediatric ACL: Is growing a problem?-or is the problem growing?

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# Is the problem growing?

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## Incidence increasing Contact-/High Energy Sport, higher activity Level

Al Hadity et al: Current concepts of the management of ACL injuries children,JBJS 2013;95-B:1562–9.

## In 20 years (New York) number of operation increased 3x in children

Dodwell ER, Lamont LE, Green DW, et al. 20 Years of pediatric anteriorcruciate ligament reconstruction in New York state. Am J Sports Med 2014;42:675–680.

# Trends in Pediatric and Adolescent Anterior CruciateLigament Injuries in Victoria, Australia 2005–2015

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Shaw et al. Journal of environmental Research and Public Health 2017

Database of hospital admitted ACL injuries in Australia:

2005-2015: rate of ACL injuries **increased by 147.8%**

2005/6: 2.74/100000

2014/15: 6.79/100000

Main age group affected :10-14y

56% sports injuries

# Trends in Pediatric and Adolescent Anterior Cruciate Ligament Injury and Reconstruction

## Werner et al,J Pediatr Orthop 2016;36:447–452

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**TABLE 1.** Pediatric and Adolescent ACL Diagnosis and Reconstruction

| | 2007 | 2008 | 2009 | 2010 | 2011 | Δ′ 2007-2011 (%) | P* |
|---|---|---|---|---|---|---|---|
| 5-9 y old | | | | | | | |
| Diagnosis | 88 | 109 | 105 | 96 | 92 | 4.5 | < 0.0001 |
| Female | 34 | 36 | 41 | 32 | 44 | 29.4 | |
| Male | 54 | 73 | 64 | 64 | 48 | −11.1 | |
| Reconstruction | 16 | 13 | 14 | 18 | 12 | −25.0 | 0.773 |
| 10-14 y old | | | | | | | |
| Diagnosis | 1763 | 1823 | 1894 | 1977 | 2096 | 18.9 | < 0.0001 |
| Female | 829 | 888 | 940 | 998 | 1035 | 24.8 | |
| Male | 934 | 935 | 954 | 979 | 1061 | 13.6 | |
| Reconstruction | 554 | 605 | 595 | 637 | 707 | 27.6 | < 0.0001 |
| Female | 318 | 368 | 359 | 384 | 426 | 34.0 | |
| Male | 236 | 237 | 236 | 254 | 281 | 19.1 | |
| 15-19 y old | | | | | | | |
| Diagnosis | 6450 | 6804 | 6890 | 7039 | 7589 | 17.7 | < 0.0001 |
| Female | 2817 | 2976 | 3743 | 3782 | 3477 | 23.4 | |
| Male | 3632 | 3828 | 3257 | 3477 | 4112 | 13.2 | |
| Reconstruction | 2931 | 3101 | 3167 | 3291 | 3392 | 15.7 | < 0.0001 |
| Female | 1368 | 1449 | 1556 | 1573 | 1628 | 19.0 | |
| Male | 1563 | 1652 | 1611 | 1718 | 1764 | 12.9 | |
| 20-45 y old | | | | | | | |
| Diagnosis | 18,237 | 18,722 | 18,562 | 17,959 | 18,575 | 1.9 | — |
| Female | 6503 | 6683 | 6654 | 6563 | 6779 | 4.2 | — |
| Male | 11,734 | 12,039 | 11,908 | 11,396 | 11,796 | 0.5 | — |
| Reconstruction | 7301 | 7837 | 7561 | 7259 | 7716 | 5.7 | — |
| Female | 2507 | 2636 | 2618 | 2641 | 2719 | 8.5 | — |
| Male | 4794 | 5201 | 4943 | 4618 | 4997 | 4.2 | — |

*Comparing increase in age group to 20- to 45-year-old age group.
ACL indicates anterior cruciate ligament.

ICD Scores
44.800 children
92000 adults
2007-11

Age group 10-14y
Diagnosis of ACL tear : +18.9%
Reconstruction+27.6%

# Switzerland Hospital admitted ACL injuries 2001-2016 (data from Federal Office of Public Health)

S-Code Trauma
M-Code Chronic disease

**Incidence of ACL diagnosis increased**
**2001:117 patients**
**2016 449 patiens**

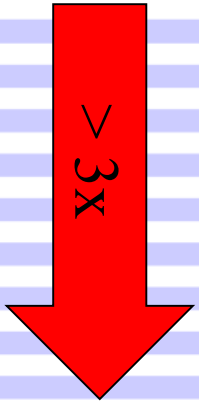
Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Eidgenössisches Departement des Innern EDI
**Bundesamt für Statistik BFS**
Abteilung Gesundheit und Soziales

**Medizinische Statistik der Krankenhäuser**

**Anzahl Fälle (ohne ambulante Fälle) nach Haupt- und Nebendiagnosen von Kinder (0-15-jährige)**

| | Anzahl Fälle | |
|---|---|---|
| Jahr | Diagnose S* | Diagnose M* |
| 2001 | 117 | |
| 2002 | 142 | |
| 2003 | 128 | |
| 2004 | 161 | |
| 2005 | 145 | |
| 2006 | 173 | |
| 2007 | 151 | 17 |
| 2008 | 176 | 27 |
| 2009 | 191 | 93 |
| 2010 | 193 | 116 |
| 2011 | 217 | 114 |
| 2012 | 198 | 126 |
| 2013 | 236 | 128 |
| 2014 | 284 | 136 |
| 2015 | 252 | 122 |
| 2016 | 314 | 135 |



# Risc factors for ACL injuries in children

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**Anatomical:**

- **Joint laxity**
- **Female (during menstruation?!)**
- **Narrow intercondylar notch**
- **Hormones**
- **Neuromuskular function**

Al Hadity et al: Current concepts of the management of anterior cruciate ligament injuries in children,JBJS 2013;95-B:1562–9.

# Reason for increasing incidence of ACL injuries

- **Dramatic rise in competitive athletic activity among skeletally immature patients**
- **Increased single-sport concentration, year-round participation, and less time spent in free play**
- **Increased awareness of the potential for ACL tear in skeletally immature patients and more aggressive diagnosis evaluation with MRI**


Fabricant PD,et al. Reconstruction of the anterior cruciate ligament in the skeletally immature athlete: a review of current concepts: AAOS exhibit selection. J Bone JointSurg Am. 2013;95:e28.

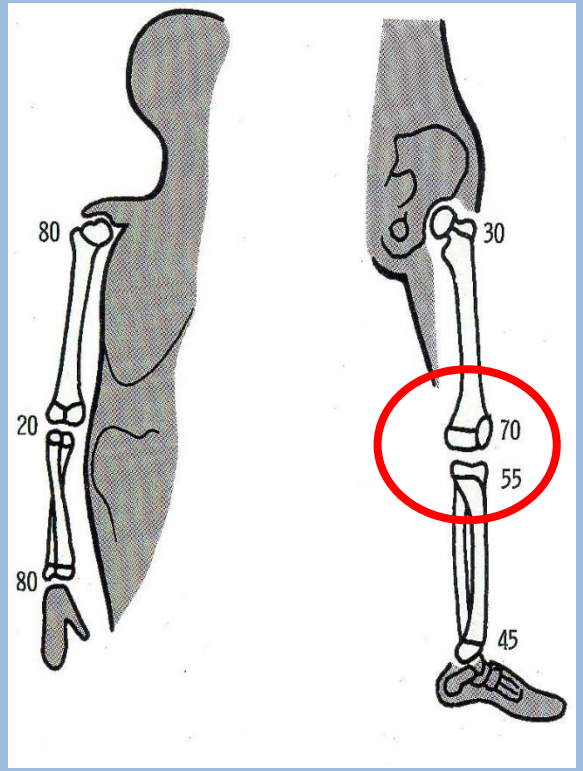
Shea KG et al. Youth sports anterior cruciate ligament and knee injury epidemiology: who is getting injured? In what sports? When? Clin Sports Med. 2011;30:691–706.

Frank JS. Anterior cruciate ligament injuries in theskeletally immature athlete: diagnosis and management. J Am Acad Orthop Surg. 2013;21:78–87.

# Is growing a problem?!

**High impact of distal femur and proximal tibia physis` on leg length**

**Proportion of growth :**
**Distal femoral physis 70%**
**Proximal tibia physis 55%**

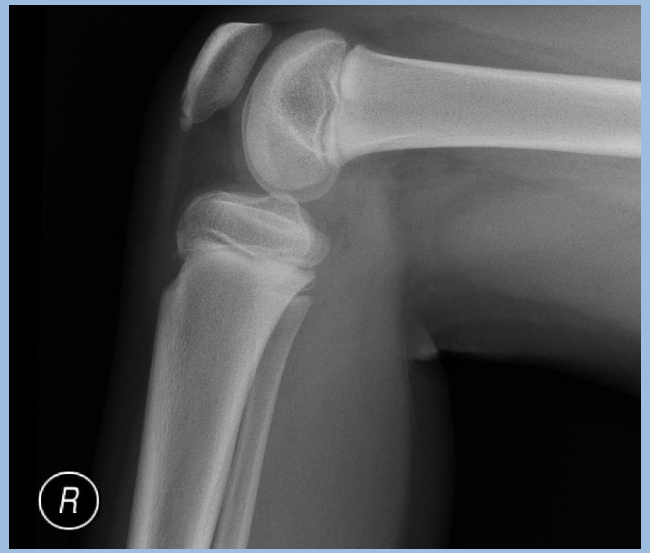


# Failed ACL surgery


**15 y, boy**
**4 y after ACL-reconstruction**
**Bone tendon bone!!!!**

# Case example

- girl, 7.5 y sports injury 1 month ago
- knee painful, unstable knee

# MRI

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## Acl tear,menisceal injury medial posterior horn

# Treatment recommendation???

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2002


**The natural history and treatment of rupture of the anterior cruciate ligament in children and adolescents**

A PROSPECTIVE REVIEW

P. M. Aichroth, D. V. Patel, P. Zorrilla

*From the Wellington Hospital and the Chelsea and Westminster Hospitals, London, England*

23 patients with conservative treatment
14 menisceal tears

“At the final review, many of these patients were at the end of their second decade. **Radiological signs of degenerative changes were seen in ten.** All showed a substantial Fairbank sign on the femoral condyle, three narrowing of the joint space, and four major osteophytes.”

# Concomitant menisceal injuries :

| | |
|---|---|
| 43,2% | Dumont et al Am Sports Magazine 2012, (370 Patienten) |
| 44% | Hui et al Am J. Sports Med 2012 (Tanner 1-2) |
| 50% | Kocher et al JBJS 2007 (Tanner Stad 3), |
| 38,5% | Nikolau et al, Knee Surg Sports Traumat Arthro,2011, |
| 31,7% | Mosknes et al Am Journ of Sports Med 2013 |

**Prevalence of new meniceal injuries after conservative treatment of ACL tears**

**19,5% Mosknes et al**

# Correlation of Meniscal and Articular Cartilage Injuries in Children and Adolescents With Timing of Anterior Cruciate Ligament Reconstruction

**2015 American Journal of Sports Medicine**

Allen F. Anderson,*† MD, and Christian N. Anderson,† MD
*Investigation performed at Tennessee Orthopaedic Alliance, Nashville, Tennessee, USA*

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## Level of Evidence III

**112 /130 patients had menisceal tear (86%)**

**Risk factor for menisceal tears: young age,instability of the knee, female,return to sports before ACL reconstruction**

**Cartilage damage in 13%**

**Risk factor cartilage alteration: delay of OR >3 month instability,sports actvity**

# Operative Versus conservative treatment

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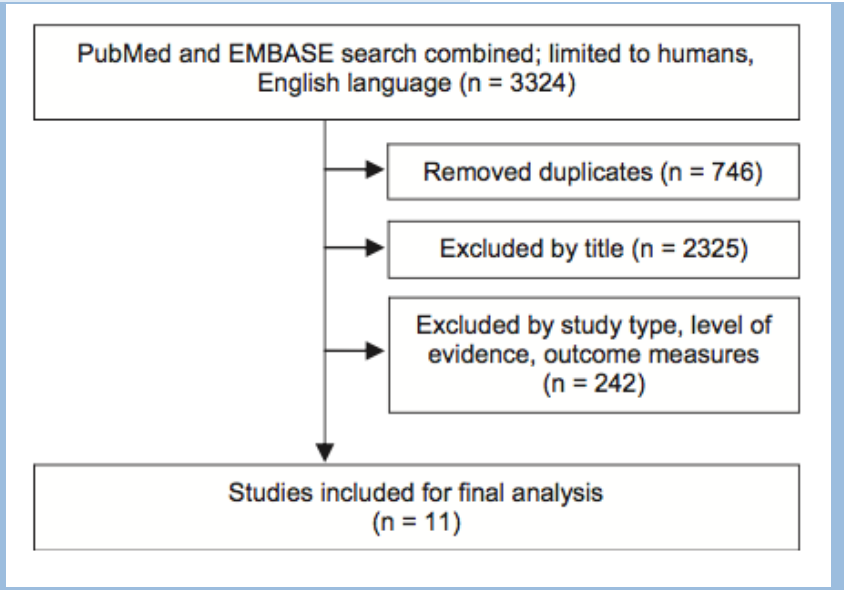
## Ramski et al

The American Journal of Sports Medicine
Vol. 42, No. 11 2014




Pub Med und Med Line 11 studies:
6 compare OR versus conservative (217 patients, 219 knee)
5 early intervention vs late intervention (353 patients, 354 knee)

# Results

Instability:

13% ACL Reconstruktion

75% conservative

} P<0.05

New menisceal tear:

Risk after  OR 4%

Risk after conservative treatment 67%

} P<0.05

# Results

Back to sports:

92% operation group

0% conservative treatment group

**Significant probability for instability or new menisceal tear with conservative treatment!!!!!!!!**

# Treatment recommendation

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**Stable knee no concomitant injury (e.g. Menicus) :**

Conservative treatment possible with stringent rehabilitation protocol

**Unstable knee w/o concomitant injuryies:** surgery recommended

**Ardern et al, British Journal of Sports Medicine 2018, 0,1-17**

2018 International Olympic Committee consensus statement on prevention, diagnosis and management of paediatric anterior cruciate ligament (ACL) injuries

Clare L Ardern,[1,2] Guri Ranum Ekås,[3,4,5] Hege Grindem,[6] Håvard Moksnes,[4] Allen F Anderson,[7] Franck Chotel,[8] Moises Cohen,[9] Magnus Forssblad,[10] Theodore J Ganley,[11] Julian A Feller,[12,13] Jón Karlsson,[14] Minider S Kocher,[15,16] Robert F LaPrade,[17,18] Michael McNamee,[19] Bert Mandelbaum,[20] Lyle Micheli,[15,16,21] Nicholas Mohtadi,[22] Bruce Reider,[23] Justin Roe,[24] Romain Seil,[25,26] Rainer Siebold,[27,28] Holly J Silvers-Granelli,[29] Torbjørn Soligard,[30,31] Erik Witvrouw,[32] Lars Engebretsen[3,4,5,30]

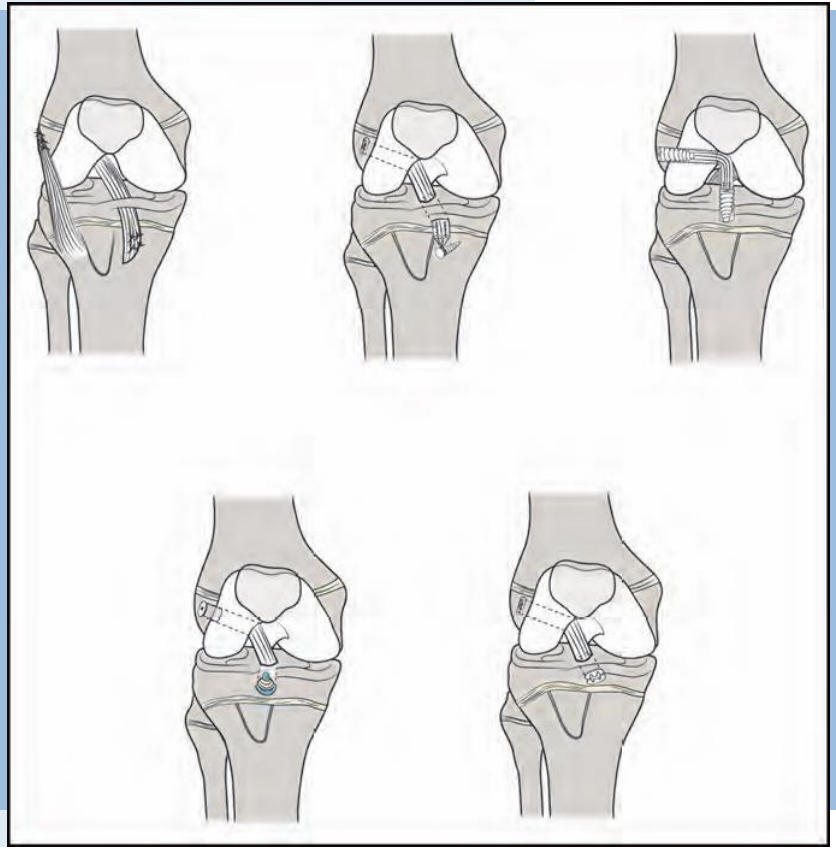
# Technique of ACL Reconstruction in Children



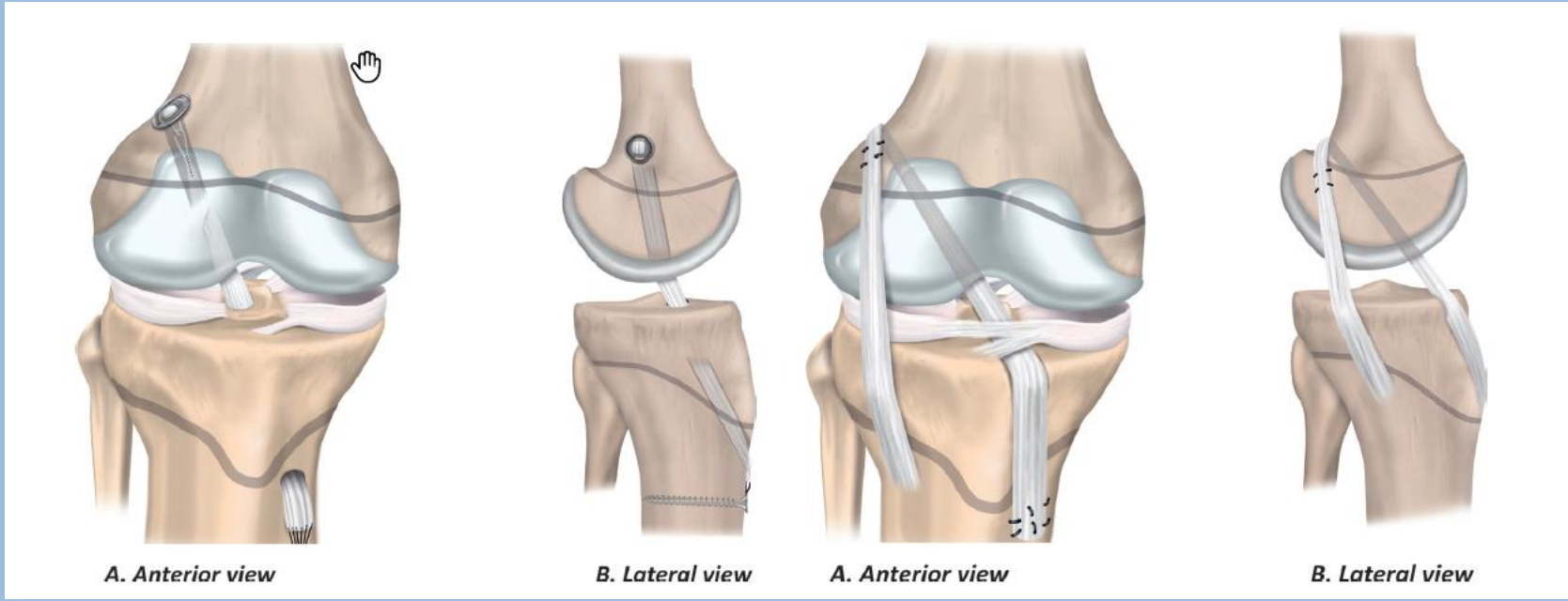
Frosch et al, Journal of Arthroscopic and related surg, 2010
Fabricant et al AAOS 2013
Kaeding et al , Journal of Arthroscopic and related surg, 2010
Ziebarth et al, European Journal of Pediatric surgery 2014

**General growth disturbance after ACL reconstruction 1.8% (Range 0-3,9%)**

**More likely with intraepiphyseal technique!!**



# Transphyseal /Physeal sparing technique




From Ardern et al, British Journal of Sports Medicine 2018, 0,1-17

# Bernese treatment

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## ACL Reconstruction with Hamstrings (Semitendinosus) Transepiphyseal (anatomical)

>**Tibial fixation: Interference screw vs. Cortical screw (Poller) depending on the age of patient**

→ **Transplant across the physis**

>**Femoral Fixation Cortical screw or Endobutton**

Mid-term results of transphyseal anterior cruciate ligament reconstruction in children and adolescents The Knee 2013

Sandro Kohl [a], Chantal Stutz [a], Sebastian Decker [a], Kai Ziebarth [b], Theddy Slongo [b], Sufian S. Ahmad [a], Hendrik Kohlhof [a], Stefan Eggli [c], Matthias Zumstein [a], Dimitrios S. Evangelopoulos [a,*]

# Prerequisite for success

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**Sufficient Instruments:**

**Optic: 30° angle**

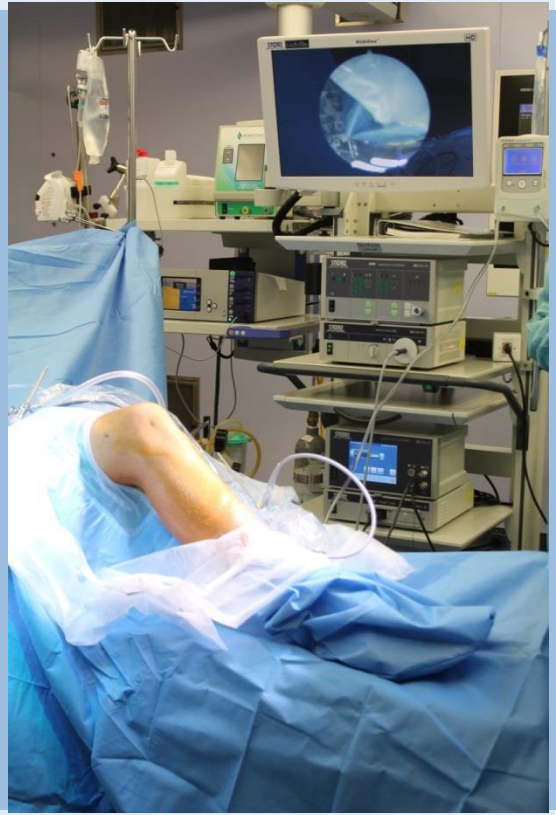
**4.0 mm oder 2.4 mm size of camera**

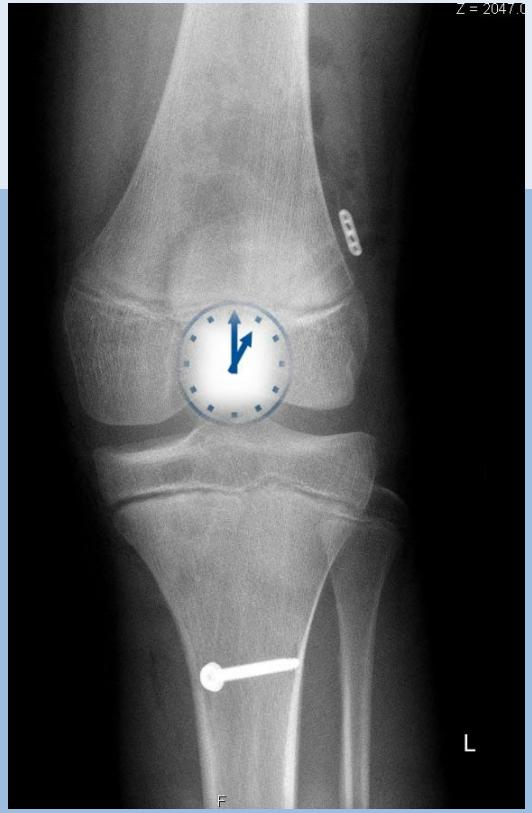
**Small shaver if necessary**

**Interference/ Cortical-screw**

**Arthrostress holding device**

# Portals/Set up

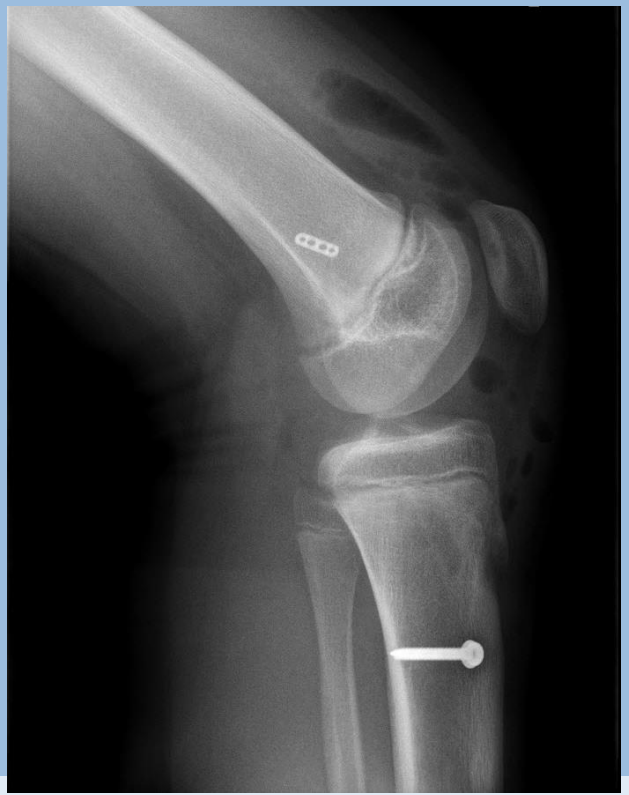





**Size of bony canal: 6-9mm (6-8%/physel width)**
**( Seil et al Arthroscopy 2008,Shea et al , Arthroscopy 2009)**
**Position of canal:**
**11-11:30 right Knee ;12:30-13:00 left Knee**
**Transplant ; M. Semitendinosus,**
**Double/triple/quadrouple**

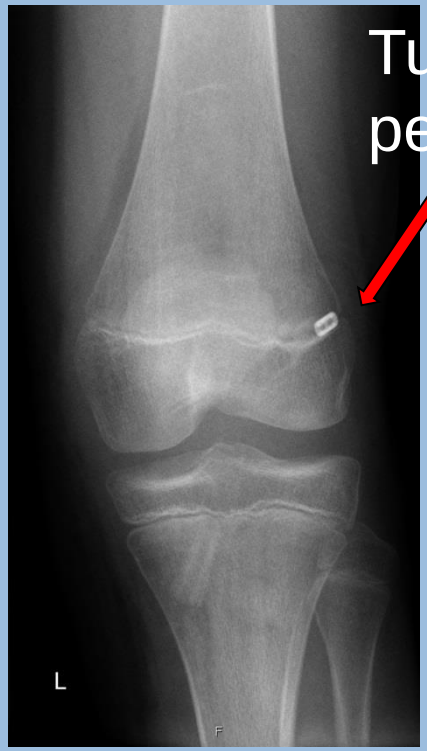

No overtensioning of transplant
Transplant position across physis

# 10y boy,ACL Reconstruction by Semitendinosus Tendon. tibial fixation with Cortikal screw, femoral fixation Endobutton

# 12 y boy,Fixation of Transplant with Cortical screw


# 11 y girl
# femoral fixation with Endobutton, tibial Interference screw (Milagro)




Tunnel to close to the perichondral ring


**Dangerous localisation of femoral tunnel!!!!!**

# Conclusion

**Incidence of ACL injuries in the pediatric population is increasing:**

- **Dramatic rise in competitive athletic activity among skeletally immature patients**
- **High impact sports at an early age**
- **Increased awareness of the potential for ACL tear in skeletally immature patients and more aggressive diagnosis evaluation with MRI**

# Conclusion

- ACL surgery is recommended in unstable knees or in case of concomitant meniscal/cartilage injury
- ACL Reconstruction is possible at any age
- Transphyseal technique (most anatomical) preferred
- Low complication rates if anatomy of the growing child is respected

**Prospective randomized (multicenter)studies are lacking to analyse ACL surgery in the pediatric population regarding indications and complications!!!**

# Conclusion

**Precise information of parents and children is mandatory**

**If child has a stable knee or parents refuse the recommendation to operation, conservative treatment with stringent rehabilitation is introduced**

# Thank you very much