

Advanced knee course, Val d'Isère, 01-2016

Partial fractures around the knee: bone bruise and fractures.

Prof. Romain Seil, MD, PhD

Orthopaedic
Surgery

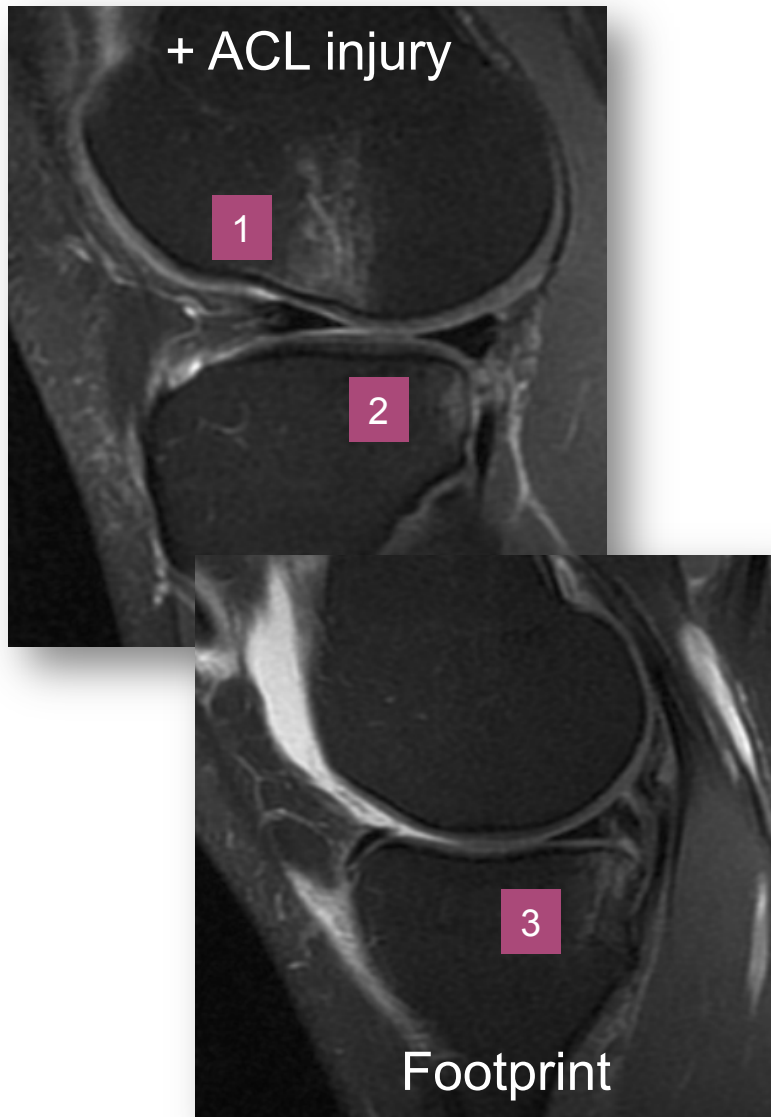


Centre Hospitalier
de Luxembourg

Sports Medicine
Research Laboratory

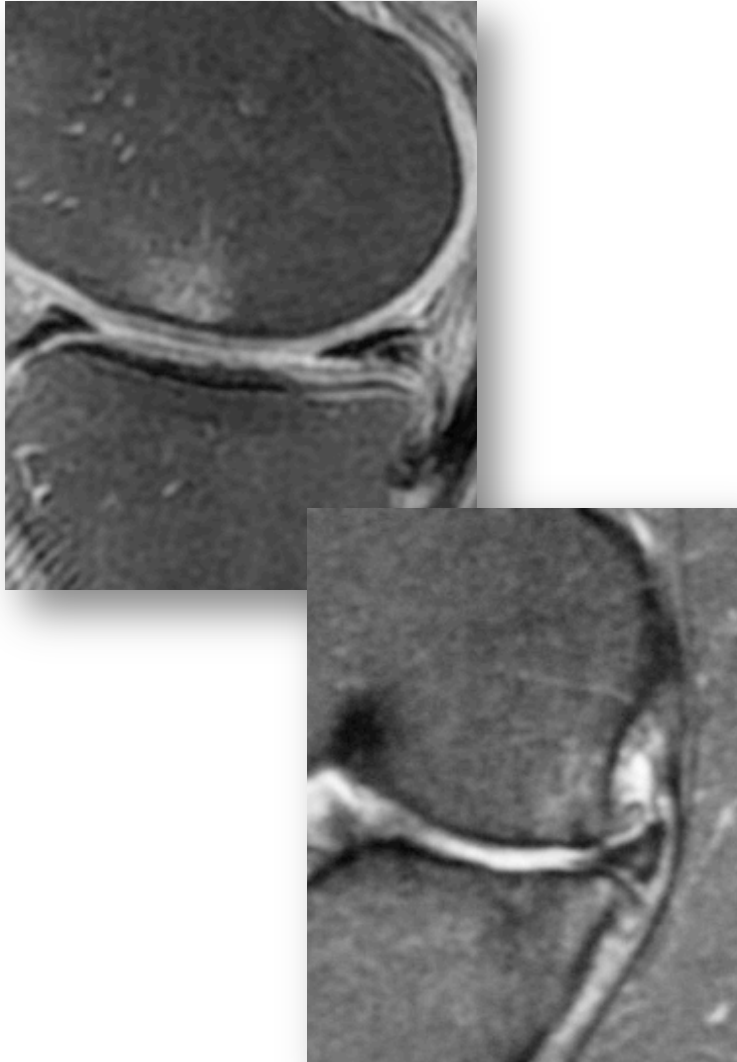


Luxembourg
Institute of Health



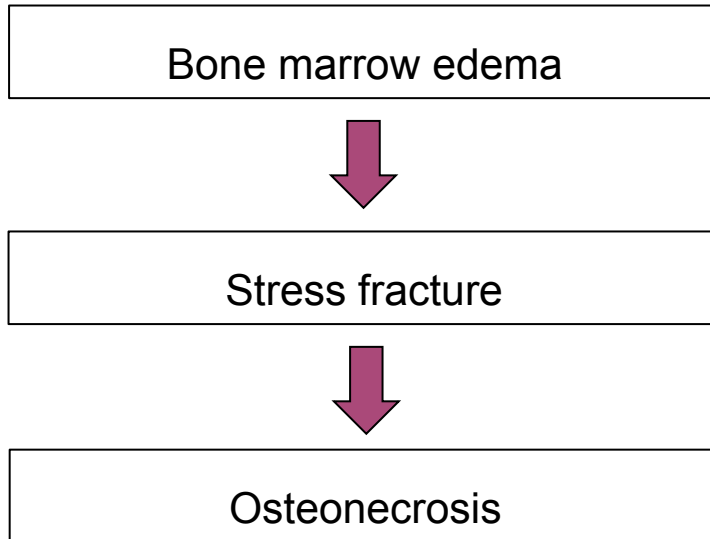
Bone bruise

- ✧ **Alteration of bone marrow signal intensity**
- ✧ \neq bone marrow lesion (bone on bone stress in OA)
- ✧ \neq stress-related bone marrow edema



Bone bruise

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- ✧ **≠ bone marrow lesion (bone on bone stress in OA)**
- ✧ **≠ stress-related bone marrow edema**

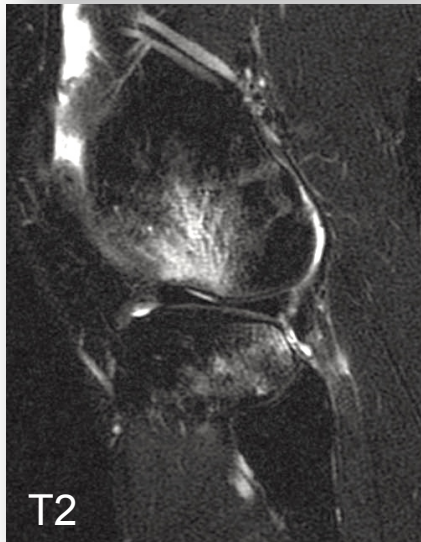


Bone bruise

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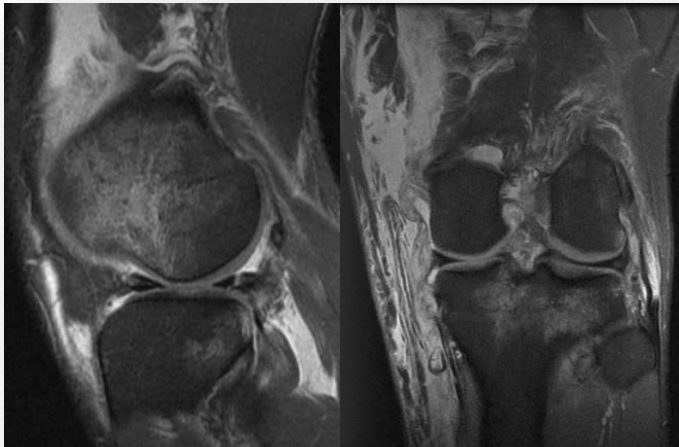
Bone bruise

- ✧ First description in 1989 *Mink JH, Deutsch AL, Radiology 1989*
- ✧ 37-100% of all ACL tears *Lee K, Radiology 1999*
- ✧ Inferior sensitivity in pediatric population
Lee K, Radiology 1999; Snearly WN, Radiology 1996
- ✧ Resolves over time: first 6 weeks after injury most important
Graf BK, AJSM 1993



MRI sequences

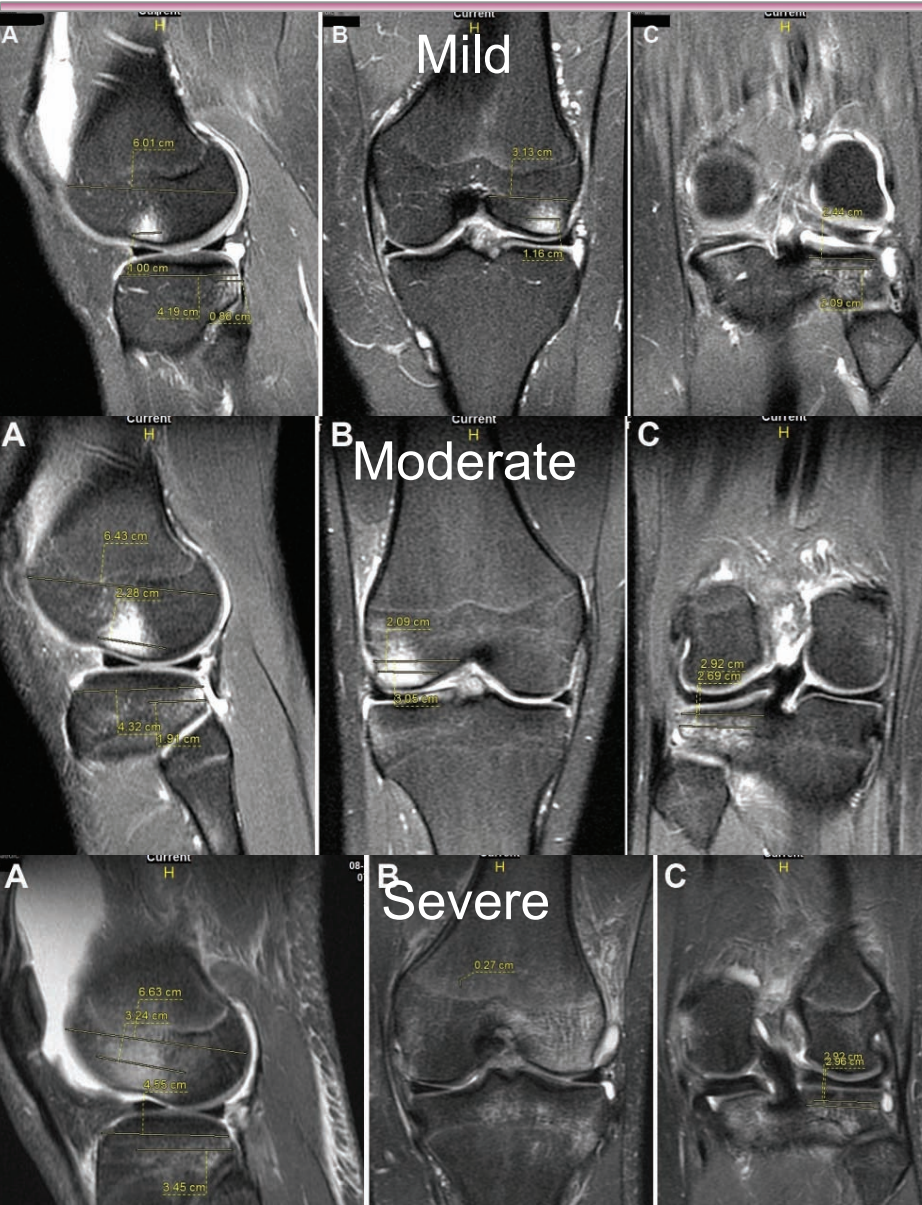
- ✧ Lower signal intensity in T1-weighted sequences
- ✧ Higher signal intensity in T2-weighted sequences
- ✧ Fat suppression
- ✧ Short tau inversion recovery (STIR) sequences



*Soft tissues and i.a. effusion
predominant !*

- ✧ Direct impact loading \pm shear stress
- ✧ Bone contusion: hemorrhage & edema \rightarrow \uparrow water concentration
- ✧ Alterations of loadbearing properties of subchondral bone \rightarrow cartilage changes (Faber KJ, AJSM 1999)
- ✧ Cartilage contusion \rightarrow chondrocyte damage;
 \uparrow cartilage oligomeric protein (COMP) (Fang C, JOR, 2001; Koelling S, Arthritis Res Ther 2006; Johnson DL, Radiology 1989)

proton density fat-saturated magnetic resonance image (MRI)



LFC bone bruising volume:

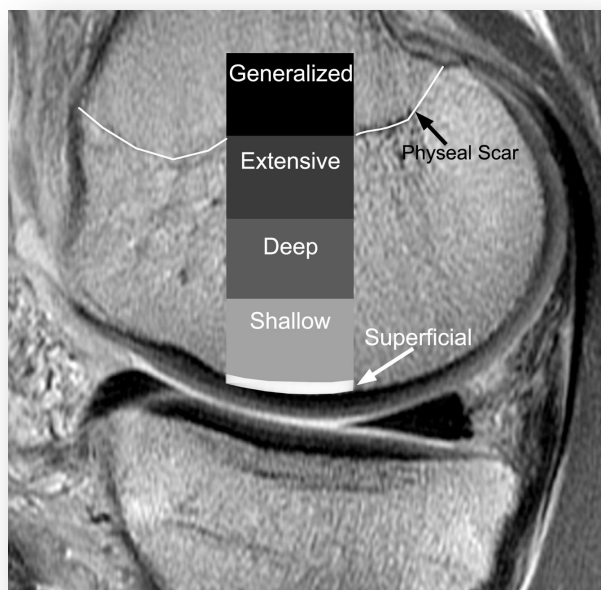
- none/minimal <4%
- mild 4%-9.75%
- moderate 9.8%-17%
- severe $\geq 18\%$

LTP bone bruising volume:

- none/minimal <8%
- mild 8%-16%
- Moderate 17%- 38%
- severe $\geq 39\%$

Bisson L, AJSM 2013

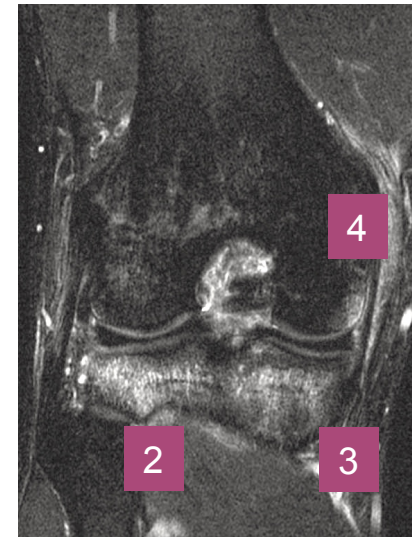
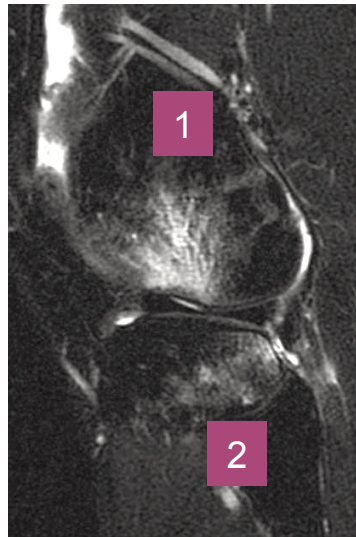
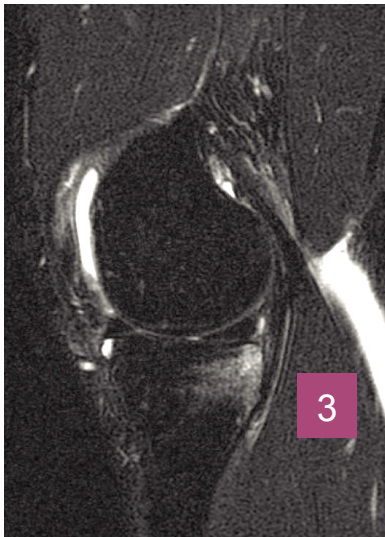
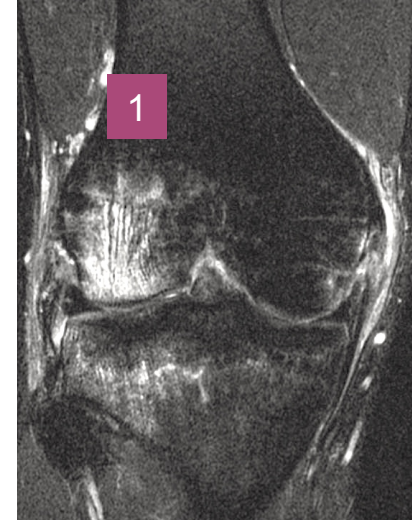
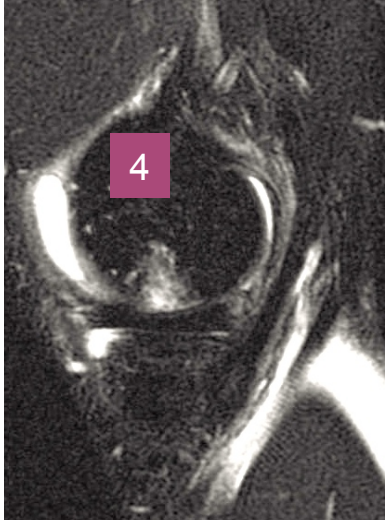
Brittberg & Winalski classifications

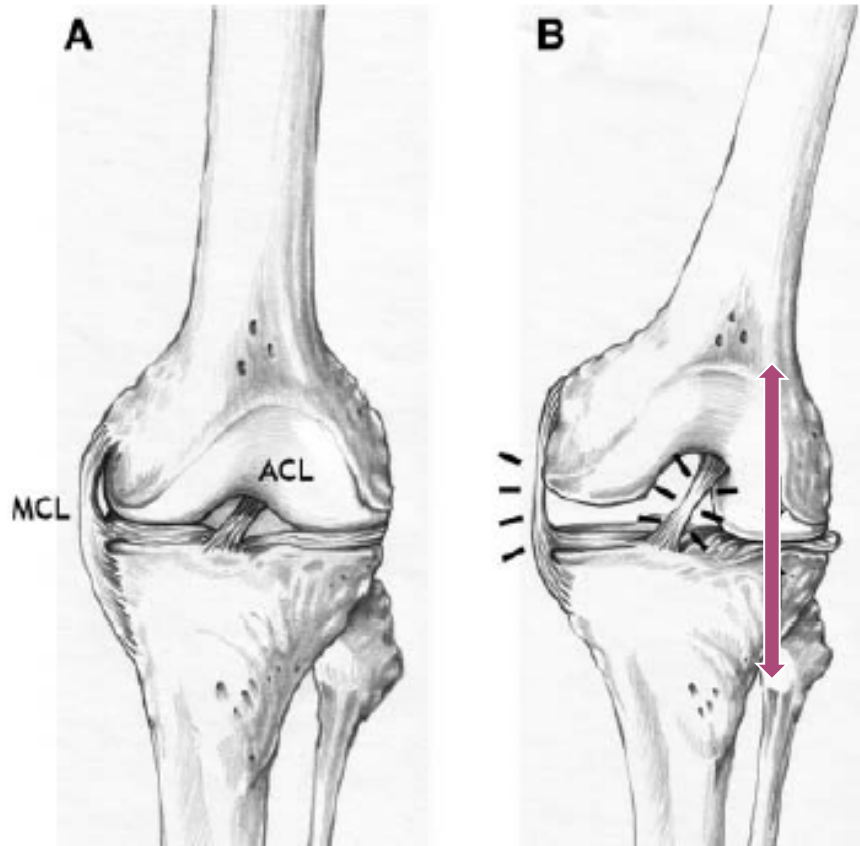


Depth	
Superficial	Just beneath subchondral bone
Shallow	Extends up to 1/3d of the distance from articular surface to physeal scar
Deep	Extends from 1/3d-2/3ds of the distance to physeal scar
Extensive	Extends from 2/3ds of the distance to the physeal scar but not beyond
Generalized	Extends beyond the physeal scar

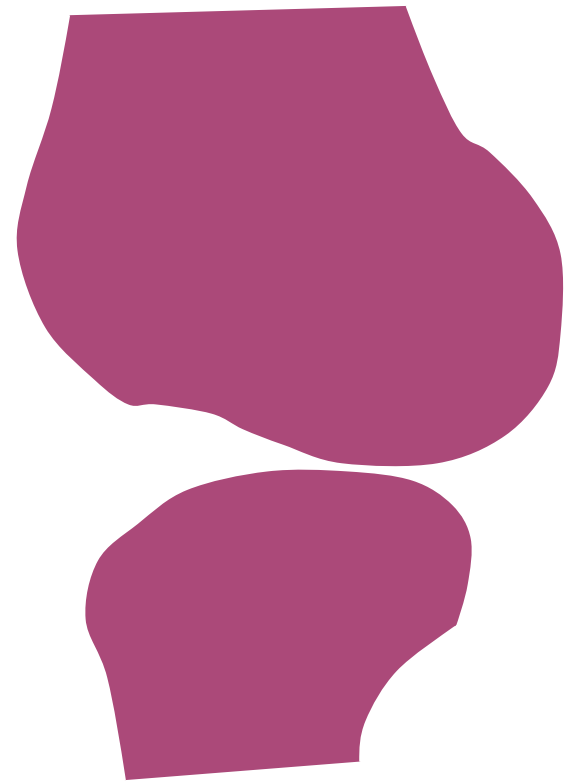
Intensity	
Mild	Signal intensity less than muscle
Moderate	Signal intensity equal to muscle
Severe	Signal intensity brighter than muscle

Brittberg & Winalski , JBJS 2003



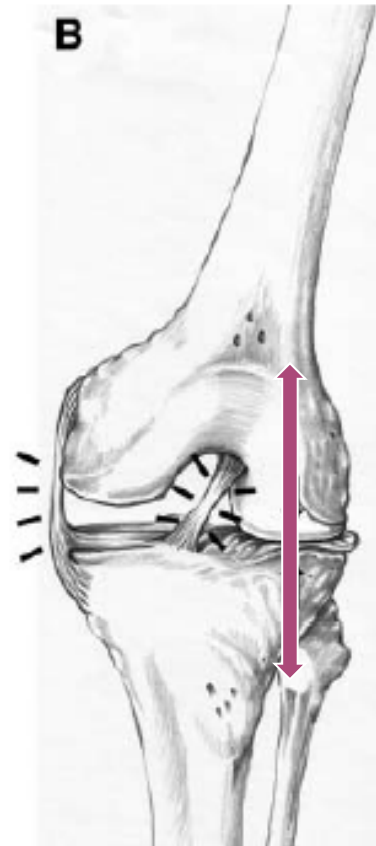
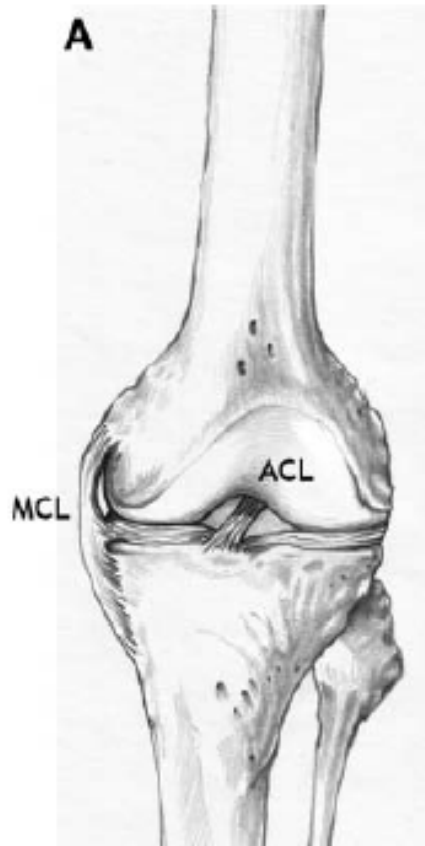


Forceful valgus

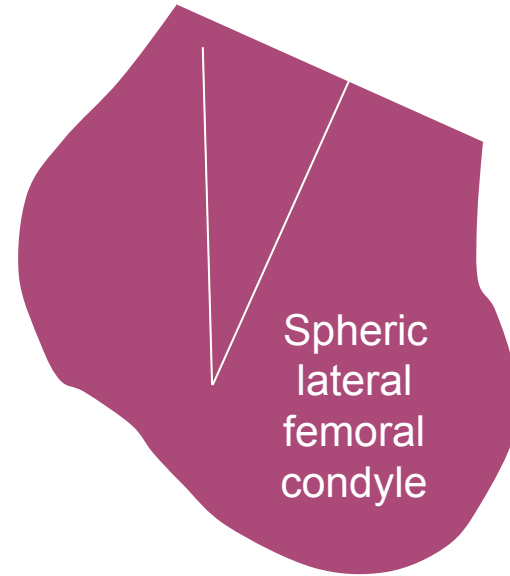


Koga H, Am J Sports Med 2010

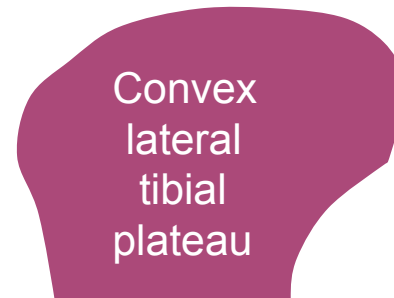
Correlation with injury mechanism



Forceful valgus



Spheric
lateral
femoral
condyle

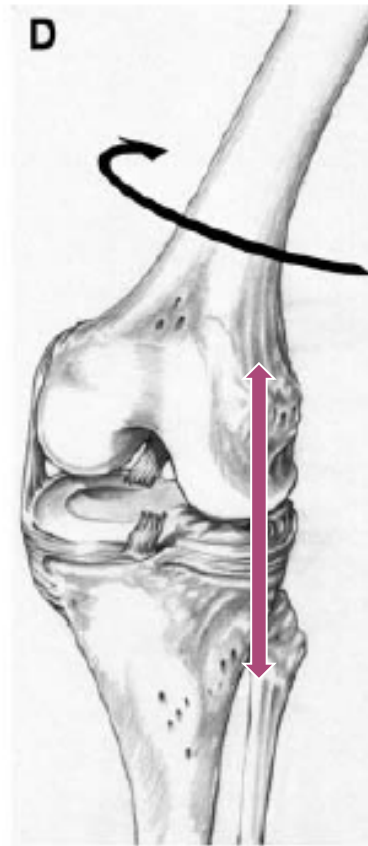


Convex
lateral
tibial
plateau

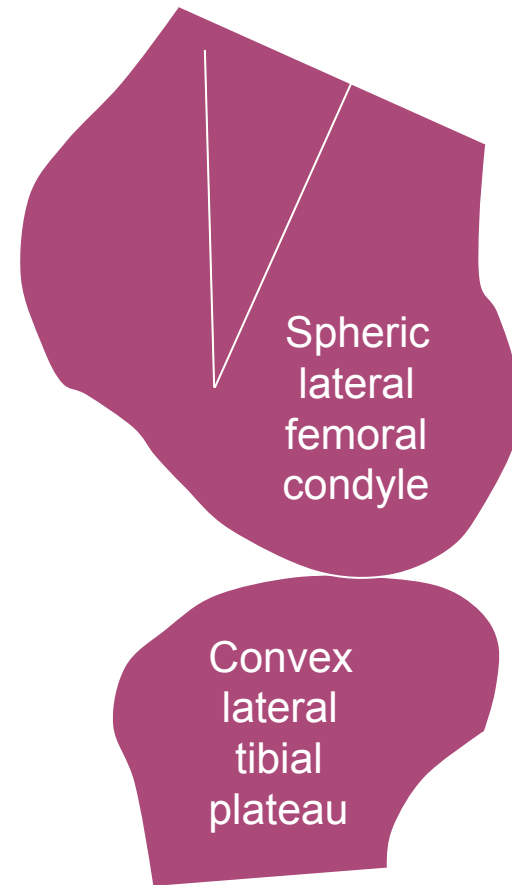
Koga H, Am J Sports Med 2010



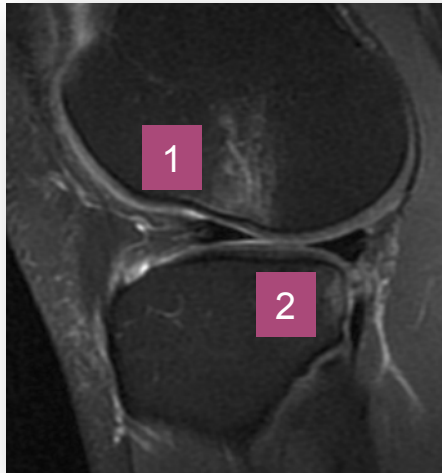
Quadriceps pull
IR tibia → ACL#



Reflex reposition
IR femur

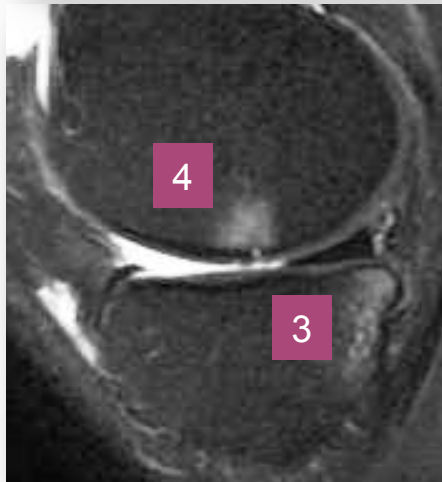


Koga H, Am J Sports Med 2010



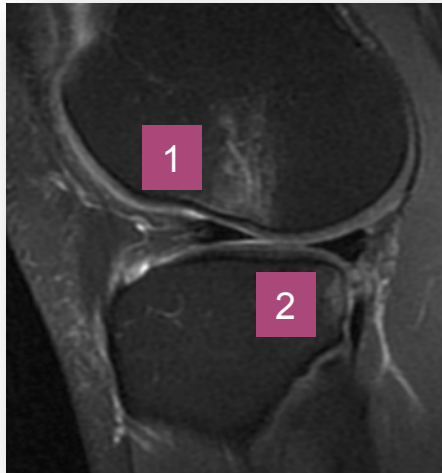
✧ Lateral compartment:

- 1 - weight bearing portion of LFC (94%) → lateral notch sign
- 2 - posterolateral tibial plateau (91%) → kissing impaction fracture



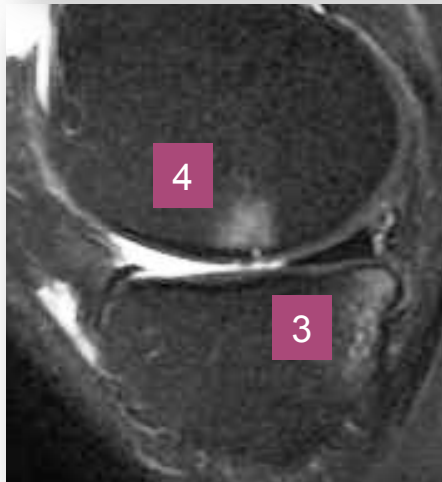
✧ Medial compartment:

- 3 - posteromedial tibial plateau → contre-coup injury with tibial reduction
- 4 - medial femoral condyle



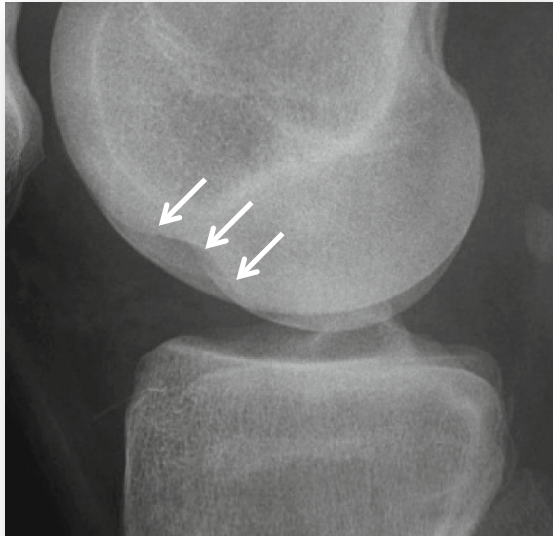
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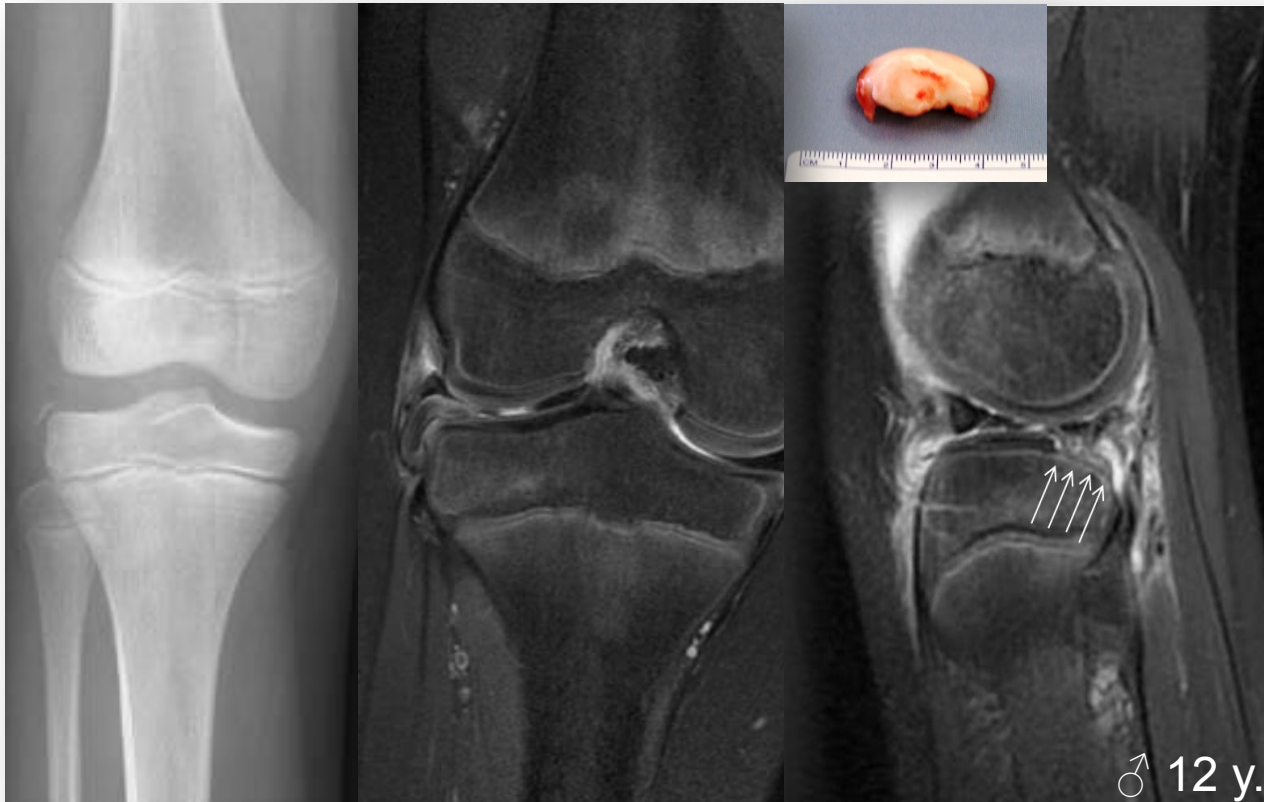
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- ✧ Depression of > 2 mm in depth of condylotrochlear sulcus
- ✧ 26% of ACL injured patients
- ✧ 40 % association with lateral meniscus tear
- ✧ High risk pivoting sports

- ✧ Frightens the patient
- ✧ Rarely problematic



Kaplan PA, Radiology 1992

ACL + meniscosynovial lesion

- « Meniscosynovial »
- « Meniscocapsular »
- « Ramp » lesion
- systematic posterior arthroscopy:
 - Intercondylar approach
 - knee @ 90° of flexion
 - 30° (70°) arthroscope

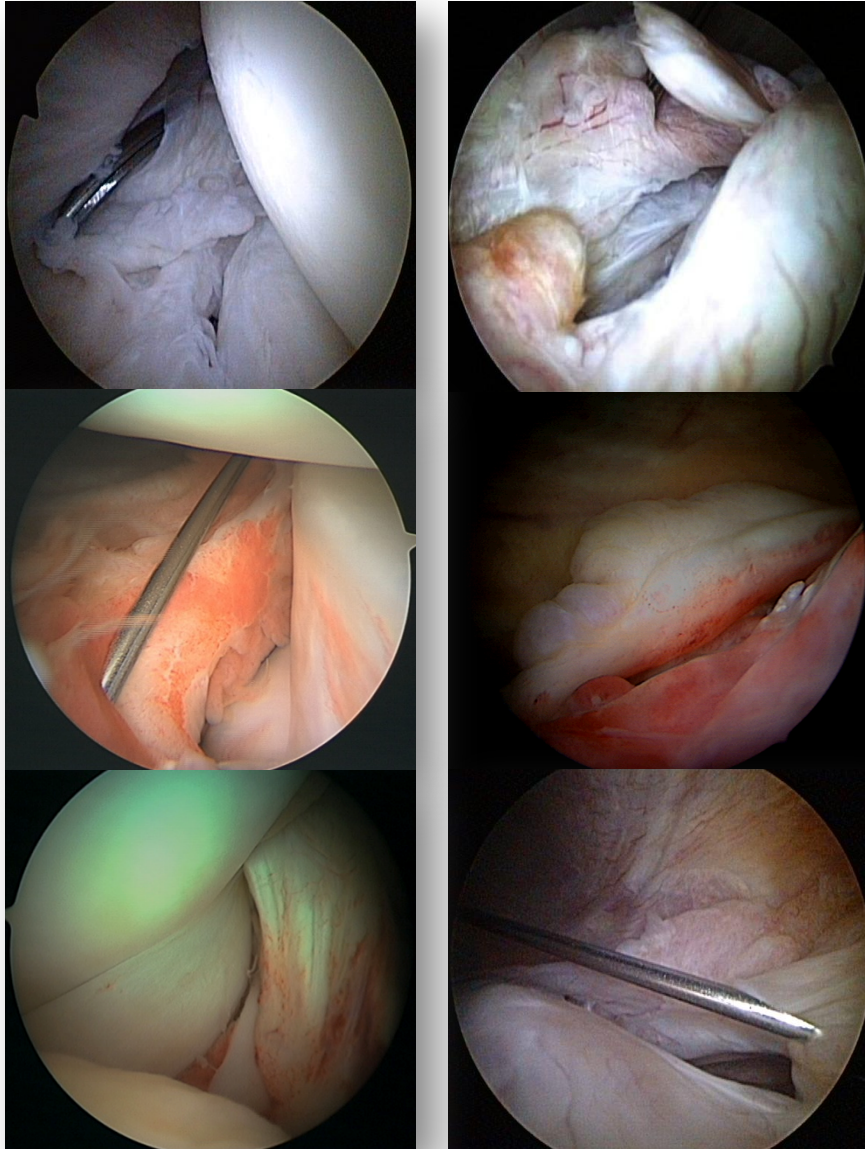
Hamberg P, JBJS 1983

Seil R, OTSR 2009

Bollen SR, JBJS-B, 2010

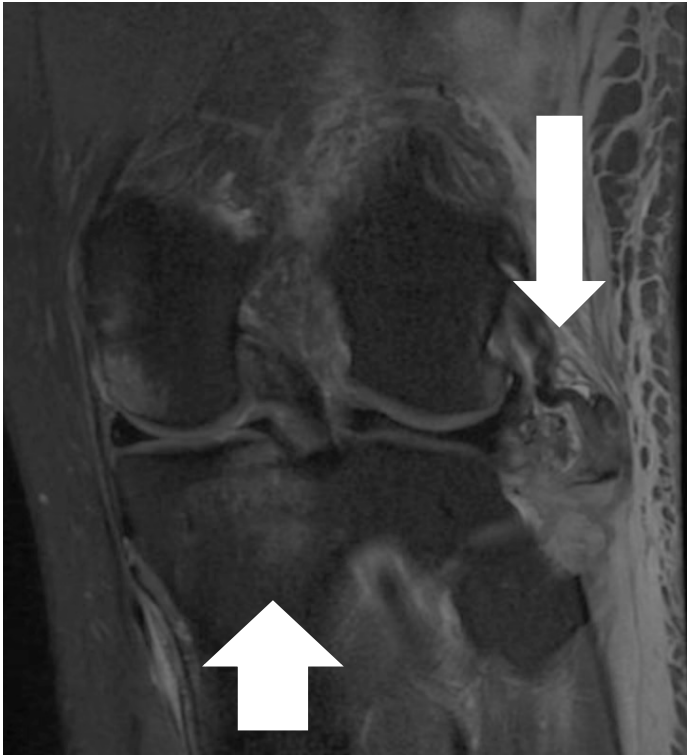
Liu X, AJSM 2011

Sonnery-Cottet, AJSM 2014



Location of Bone Bruises and Other Osseous Injuries Associated With Acute Grade III Isolated and Combined Posterolateral Knee Injuries

Andrew G. Geeslin,* BS, and Robert F. LaPrade,†‡ MD, PhD
Investigation performed at the University of Minnesota, Department of Orthopaedic Surgery, Minneapolis, Minnesota



If BB of PM tibial plateau
→ Consider ACL + PLC injury

Geeslin AG & LaPrade R, AJSM 2010

Hyperextension



Hyperextension injury

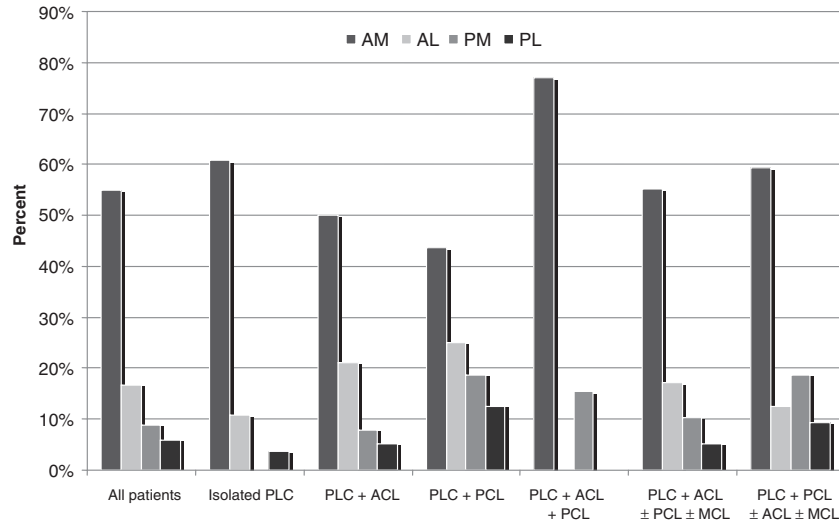


Anterior BB



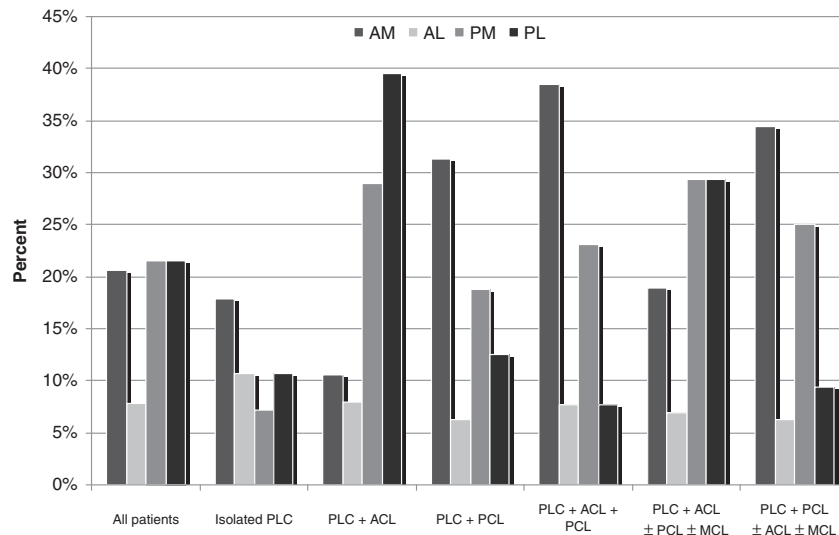
Check PCL / PLC

A) Femoral Bone Bruise Incidence and Location



55% BB on posteromedial FC

B) Tibial Bone Bruise Incidence and Location



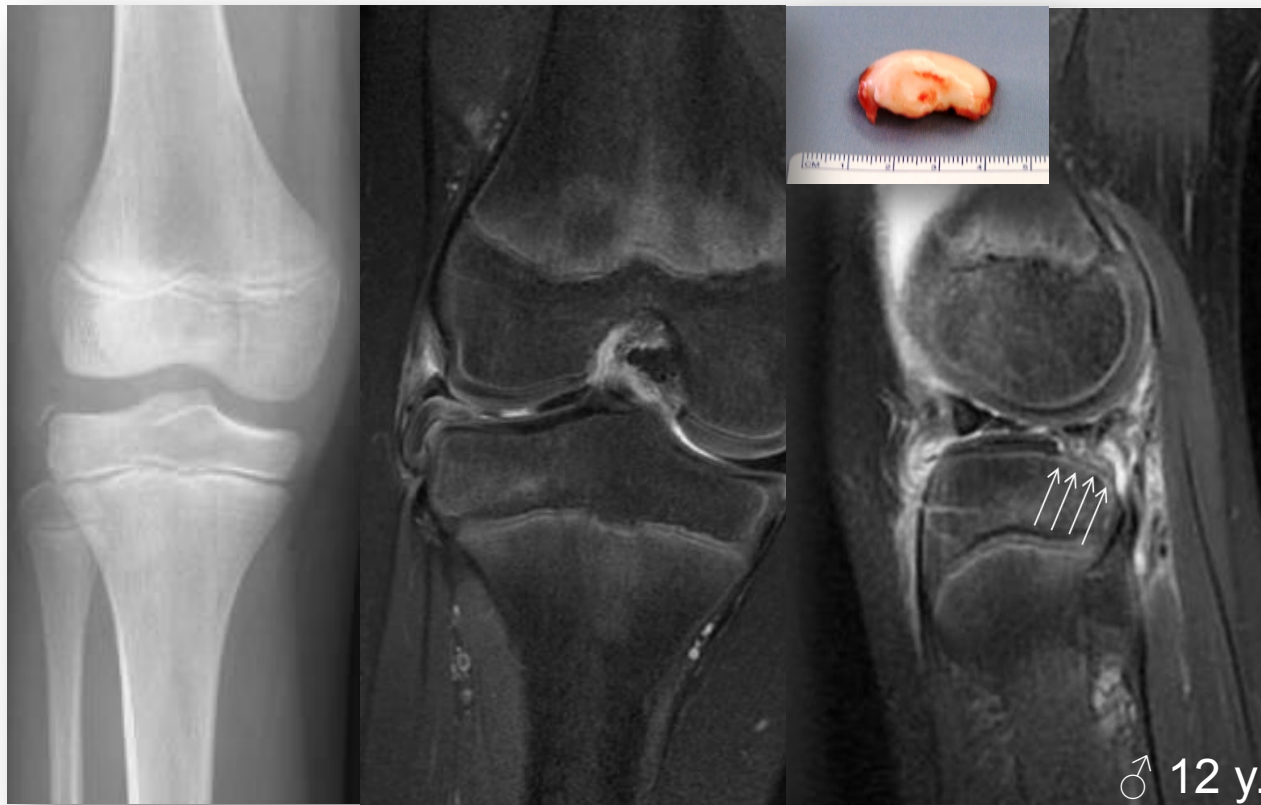
Geeslin AG & LaPrade R, AJSM 2010

- ✧ More important if **noncontact** vs. contact ACL injury
- ✧ More common and severe in **young men**
- ✧ Lateral: associated with lateral **meniscus tears**
- ✧ Medial meniscus tears associated with increased severity of lateral tibial plateau bruise
- ✧ **Not associated with symptoms/pain** at the time of index anterior cruciate ligament reconstruction

*Dunn WR, AJSM 2010; Bisson L, AJSM 2013
Viskontas DG, AJSM 2008*

- ✧ Lack of evidence
- ✧ Poorly understood
- ✧ Variable healing patterns
- ✧ Short-, mid-, long-term consequences

Short-term consequences



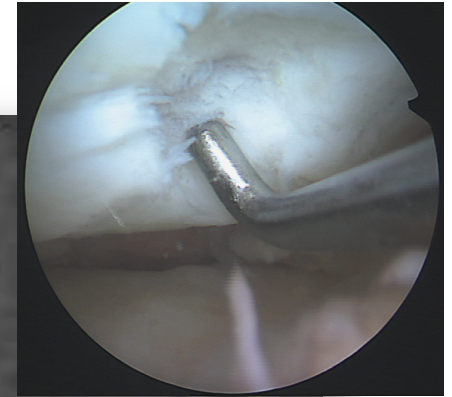
Mid-term consequences



12-2011

♂ 27 years,
isolated ACL tear

Mid-term consequences

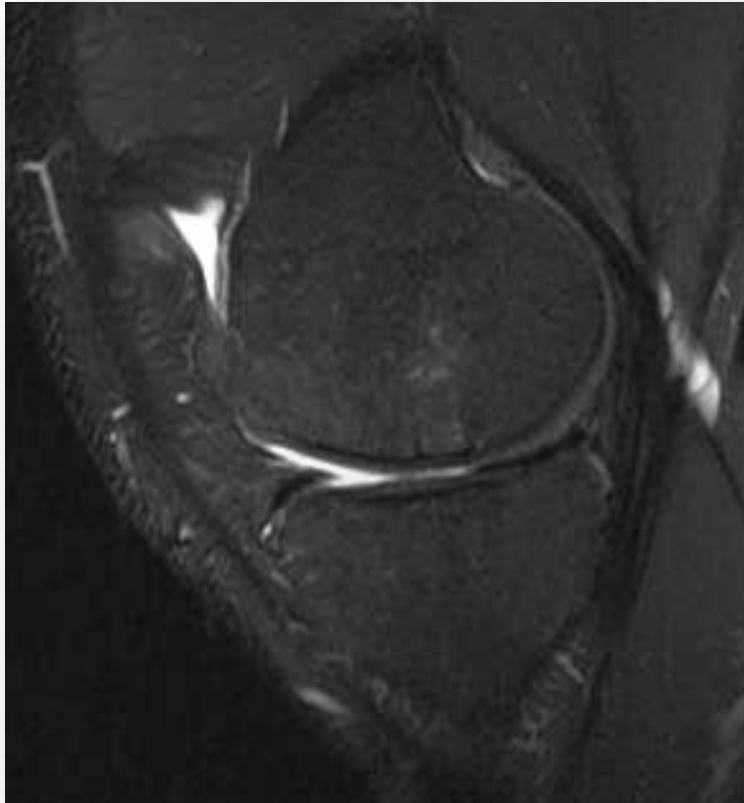


05-2012

4 months post ACL-R

♂ 27 years,
isolated ACL tear

Mid-term consequences

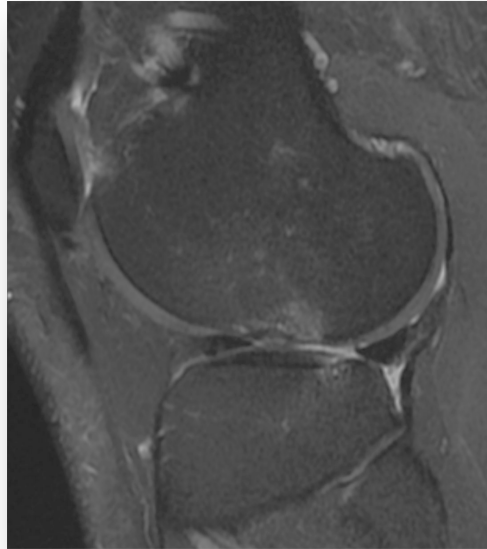


09-2012

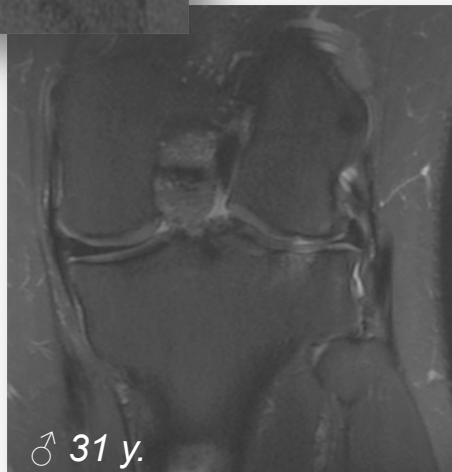
3 months post OATS

♂ 27 years,
isolated ACL tear

Long-term consequences



ACL tear @ 21



♂ 31 y.

Majority of lesions resolve

Rosen MA, Arthroscopy 1991

Bretlau T, KSSTA 2002

Costa-Paz M, Arthroscopy 2001

Hanypsiak BT, AJSM 2008



66 % persistent changes after 1 & 6 years

- Cartilage thinning
- Subcortical sclerosis
- Osteochondral defects
- Cortical impaction

Vellet AD, Radiology 1991

Faber KJ, AJSM 1999

Ligament injury & associated bone bruise:

- BB related to injury mechanism
- Extent of BB reflects injury severity
- LATERAL SIDE: THINK ACL
- MEDIAL SIDE: THINK POSTEROLATERAL CORNER
- Rarely direct clinical consequences

Ligament injury & associated bone bruise:

- Little research, many questions remain
- Unknown effect on:
 - long term knee function
 - outcomes after ACL/ligament injury
 - posttraumatic OA



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4-7 May 2016

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