Knee
Postoperative Imaging

1st Educational SSSR Meeting on Postoperative Imaging»

Saturday, Nov 1st, 2014

Session:
Knee Arthroscopy - Surgery of Menisci & Cruciate Ligaments
1 - 2.20 pm

Gustav Andreisek , MD, MBA
Head MSK and MR Imaging
Department of Radiology
University Hospital Zurich

UniversityHospital Zurich

University of Zurich[UZH]

Declaration of Financial Interests

Speaker Name: Gustav Andreisek

I have the following financial interest or relationship(s) to disclose with regard to the subject matter of this presentation:

- Gustav Andreisek was co-worker of a study which resulted in US patent (USPTO Number 12/947,256); received grants from Swiss National Science Foundation (SNCF), Holcim, and Siemens; is currently Co-PI or Sub-PI in several third party funded clinical trials at the University of Zurich (Sponsors include: Millennium Pharmaceuticals, Eli Lilly, GlaxoSmithKline, Cytheris SA, Roche, BioChemics, Novartis, Bristol-Meyers Squibb, TopoTarget, and Merck Sharp & Dohme) and where money is paid to the department Gustav Andreisek works for. The department also receives grants from Bayer and Guerbet and has ongoing research collaborations with Siemens.
- Gustav Andreisek has given workshops and talks at a congress which was sponsored by Mepha Pharma AG, Switzerland, and received a speaker fee. He also gives talks at Lunch symposia and CME courses, which are organized and sponsored by Guerbet, and receives speakers fees. Gustav Andreisek served as a consultant for Otsuka Pharmaceutical Europe Ltd at a one-day meeting in London, and received a consultant fee and reimbursement of travel costs. Gustav Andreisek was invited by GE, Philips and Siemens for official company receptions at international radiological congresses (RSNA).

Learning Objectives

After this talk you will…

- know what sequenze to use
- look different on post-operative knee MRI
- understand how menisci & cruciate ligaments should look like

Content

- Imaging protocol
- Meniscus
- Cruciate ligaments

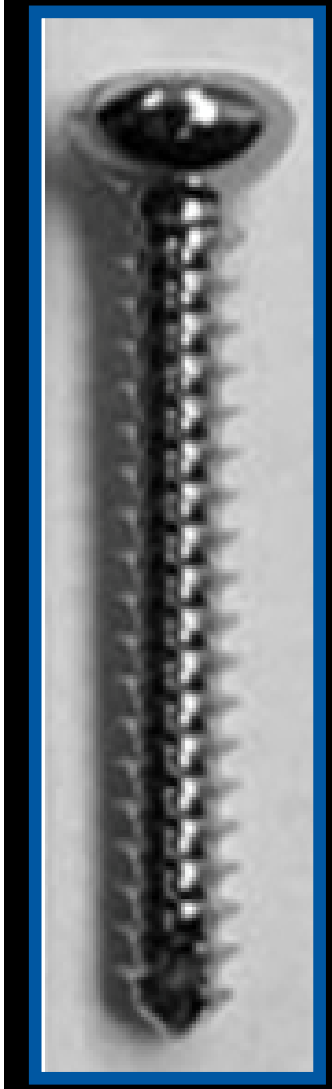
Our Knee MR Imaging Protocol

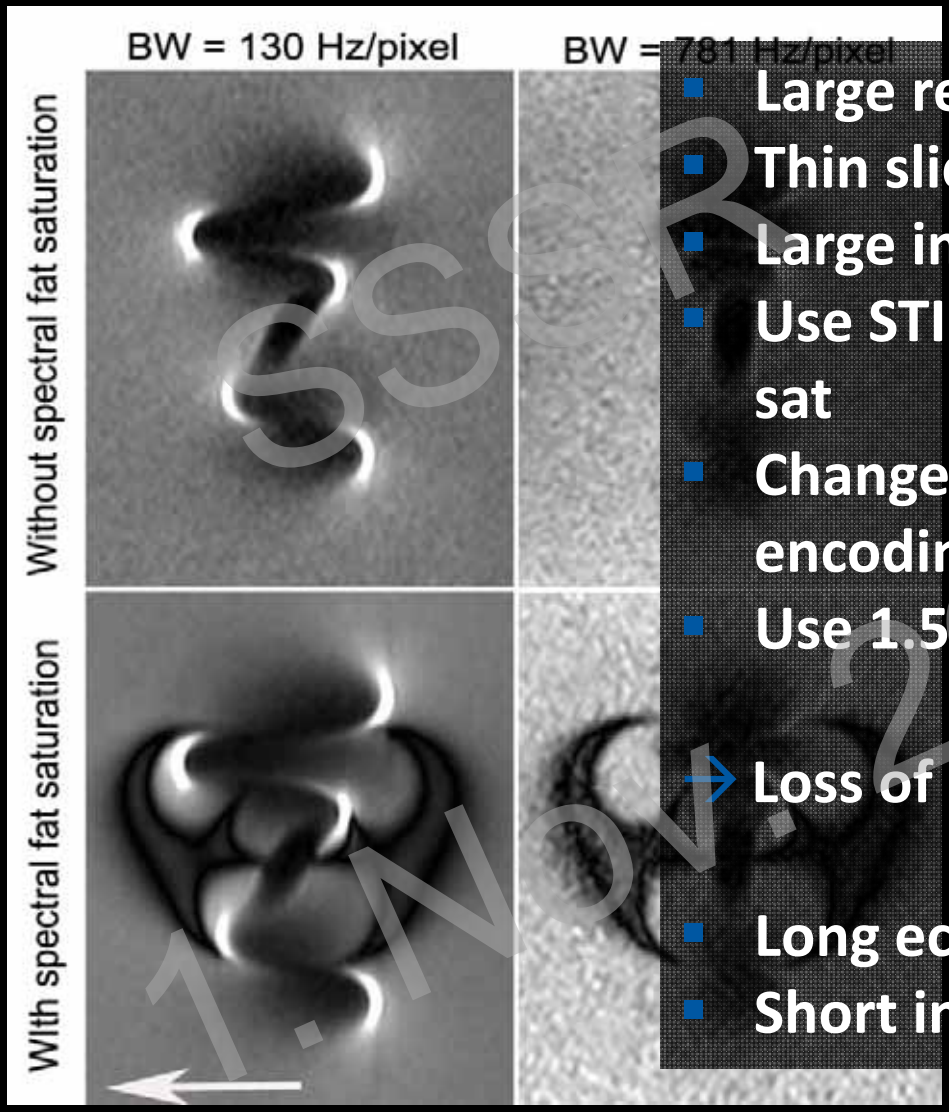
- Standard Protocol
  - Sagittal T2 weighted fat sat, TR/TE 4020 / 74 ms, 384x294
  - Sagittal intermediate weighted, 2300 / 14 ms, 384x256
  - Coronal intermediate weighted, 4320 / 48 ms, 512x256
  - Axial T2 weighted fat sat, 2600 / 42 ms, 384x256
  - High-resolution 3D CUBE (reformatted in all three planes)

- Additional Sequences
  - G
  - Us

Easy way to adjust for metall:
- **increased bandwidth**
- **change frequency encoding direction**

Typical things to do against metal artifacts





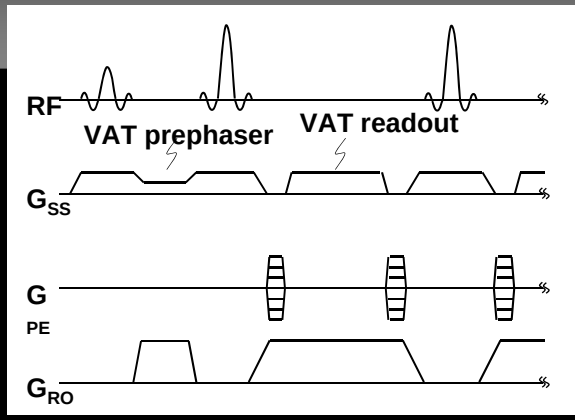
- Large readout bandwith
- Thin slice thickness
- Large image matrix
- Use STIR rather than fat sat
- Change frequency encoding direction
- Use 1.5 rather than 3.0T

→ Loss of SNR

- Long echo train
- Short inter-echo interval

Courtesy Prof VM Runge

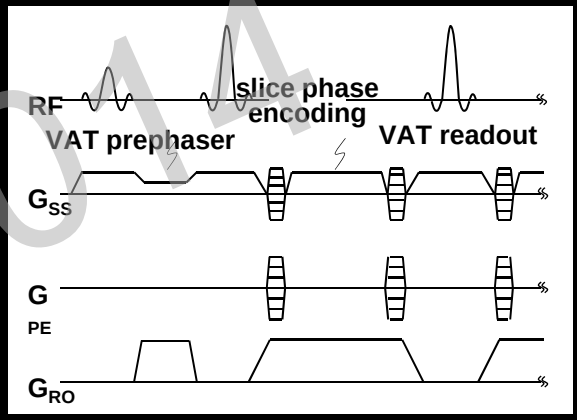
New sequences for artifact reduction



VAT: View Angle Tilting

- Corrects for in-plane distortion
- Suffers from through-plane distortion
- High bandwidth to compensate blurring

SEMAC: Slice Encoding for Metal Artifact Correction



- Selective excitation-based
- Corrects for through-plane distortion
- Prolonged scan time and high SAR

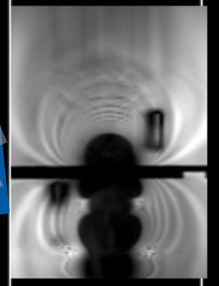
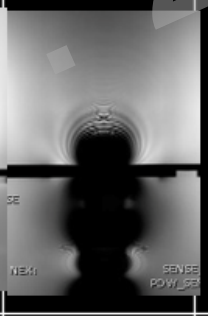
MAVRIC: MultiAcquisition Variable-Resonance Image Combination

- Non-selective excitation-based
- Limited clinical use

MAVRIC-SL (combines MAVRIC-SEMAC)

Ongoing Research – Philips Platform

Test scan V6 (Stainless Steel)

	PDw	PDw	PDw	PDw	PDw	PDw
Clear/Syn.	Clear	Clear	Clear	Synergy	Synergy	Synergy
Sense (y/n)	y	y	n	n	y	y
TE	66	27	66	66	66	27
Cor/sag	Cor	Cor	Cor	Cor		Cor
MACRIC						
SEMAC						
Time (min)	13	13	25	25	13	13

For Metall:

- **Siemens, GE, Philips**
- **Best parameters not yet defined**

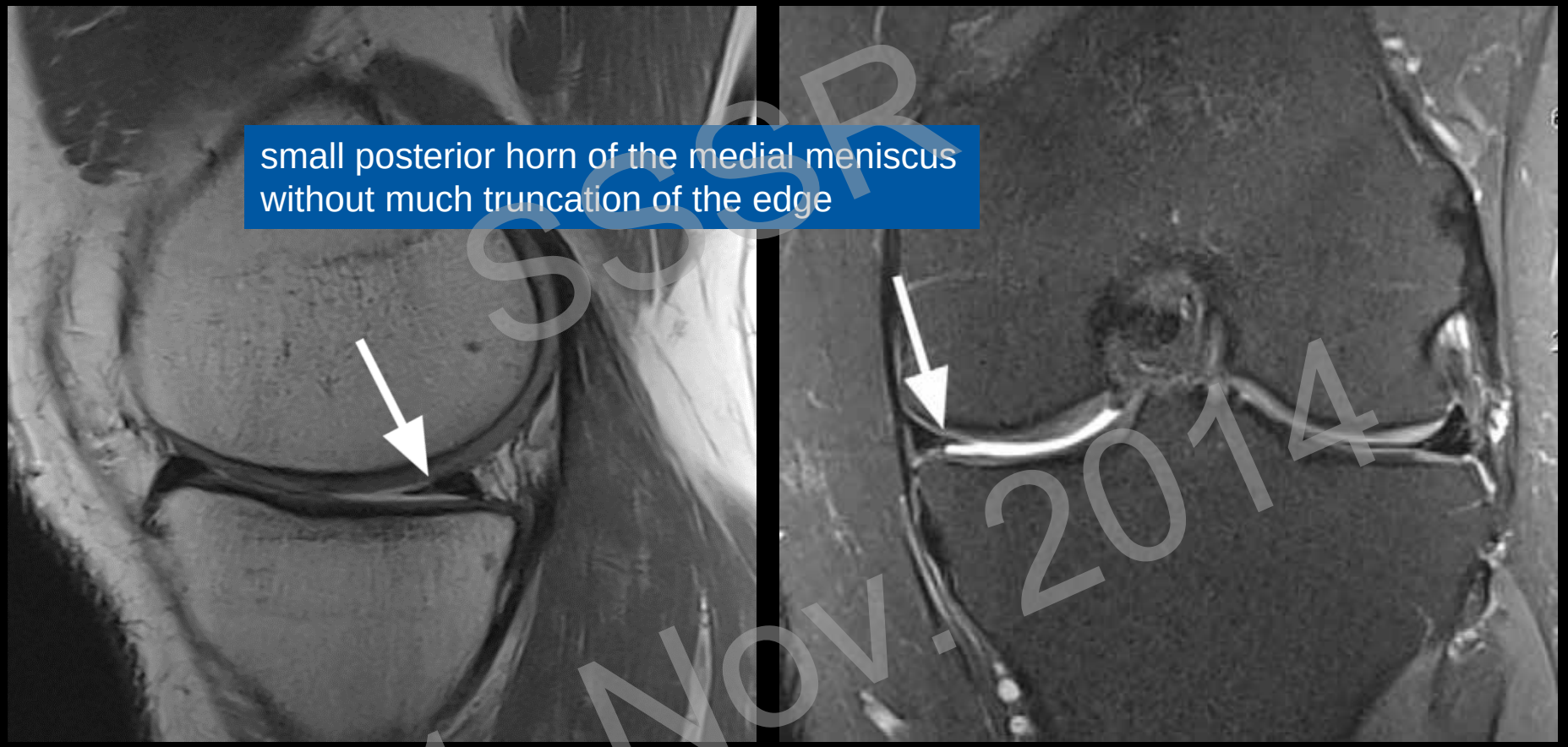
UniversityHospital Zurich

Courtesy N. Farshad

Content

- Imaging protocol
- Meniscus
- Cruciate ligaments

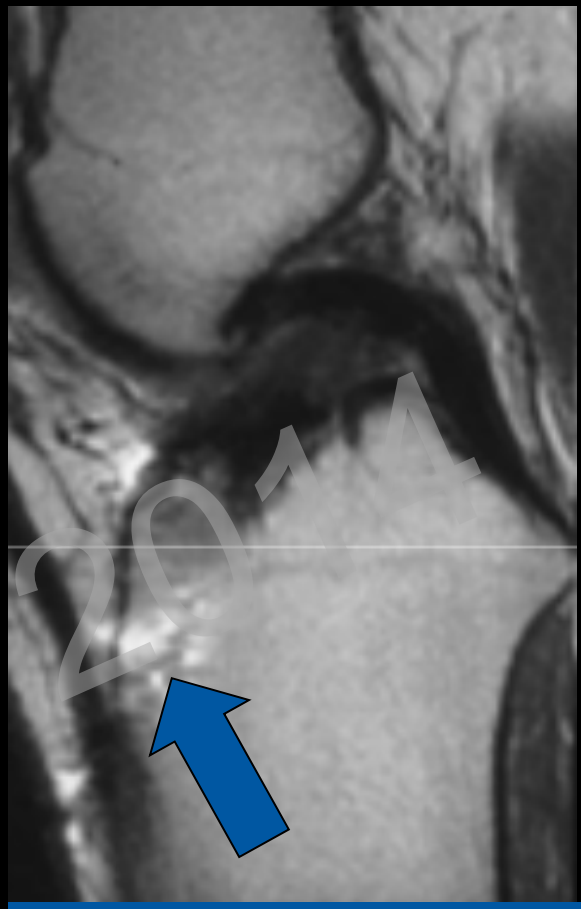
45 year old male 5 years after partial meniscectomy



First question ?

- Has there been surgery ?

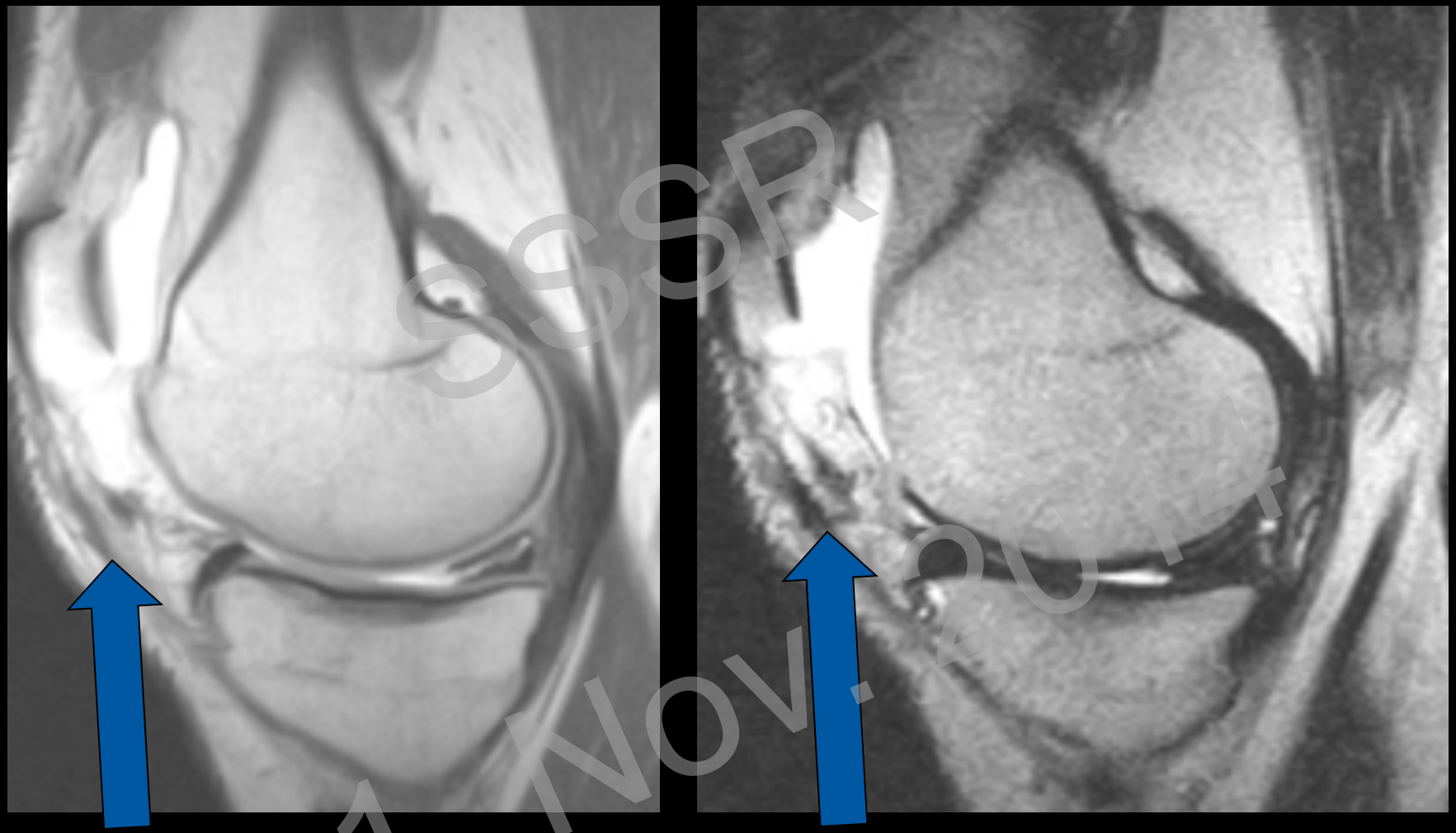
Represents footprint of the arthroscopic cannula



Susceptibility artifact from metallic hardware or microscopic metallic fragments

Courtesy B. Morrison

Scope Scar



Each side of patellar tendon: rounded low signal

UniversityHospital Zurich

Courtesy B. Morrison

Meniscus Lesions

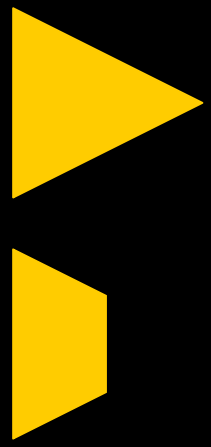
Size matters !

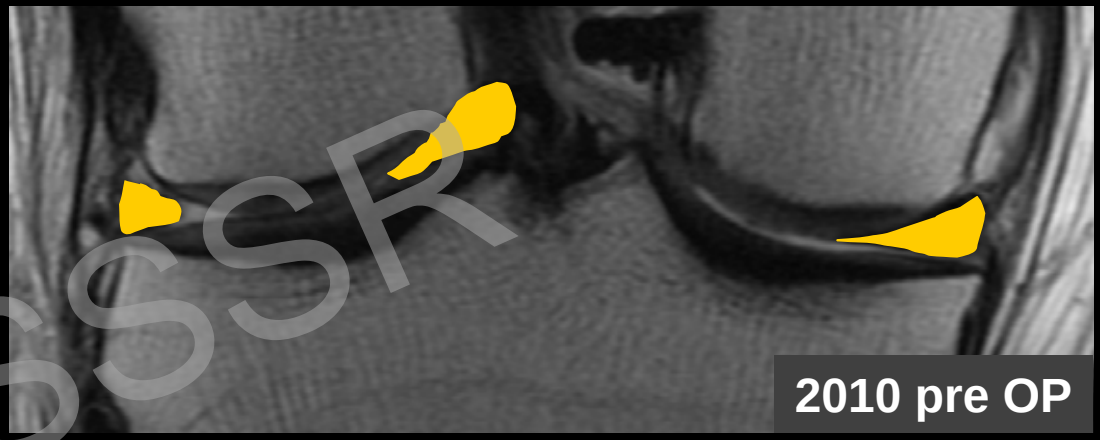
AH PH

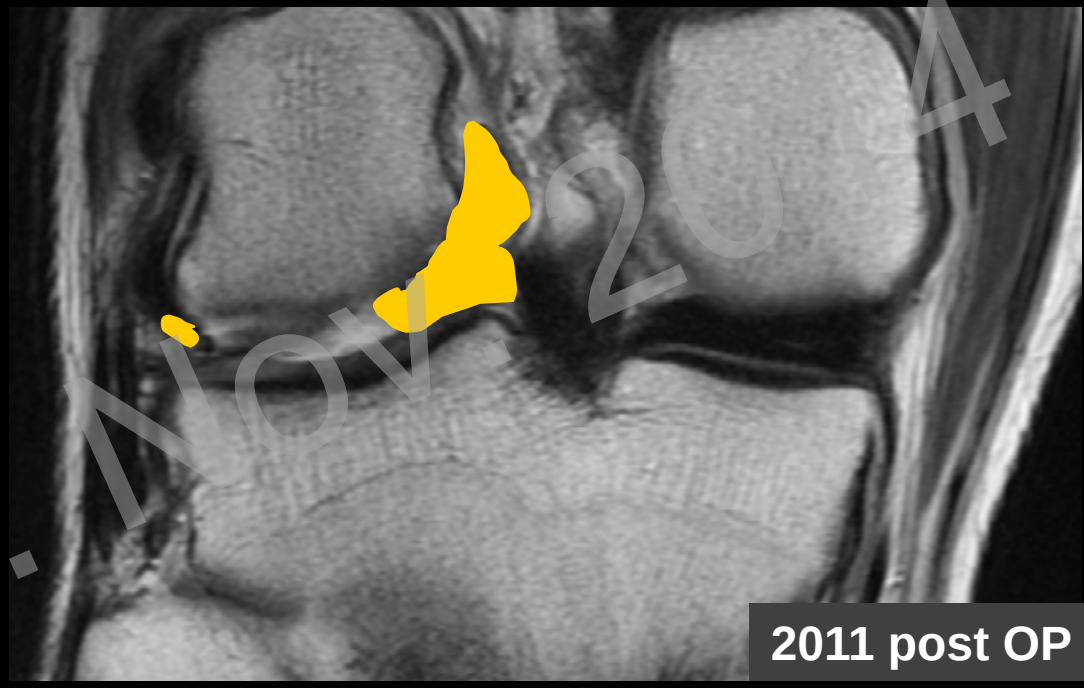
UniversityHospital Zurich

Shape Matters

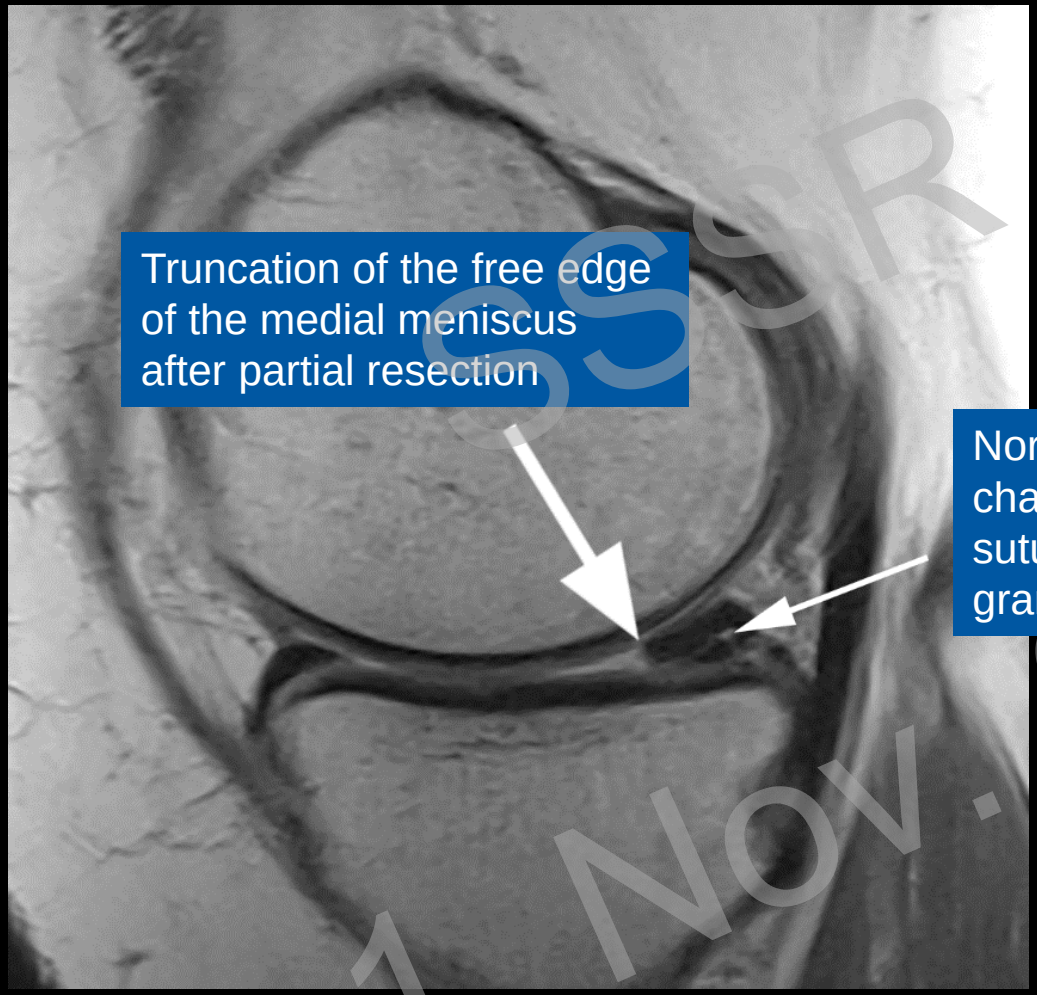
35 ys old male snowboarder with re – bucket handle tear

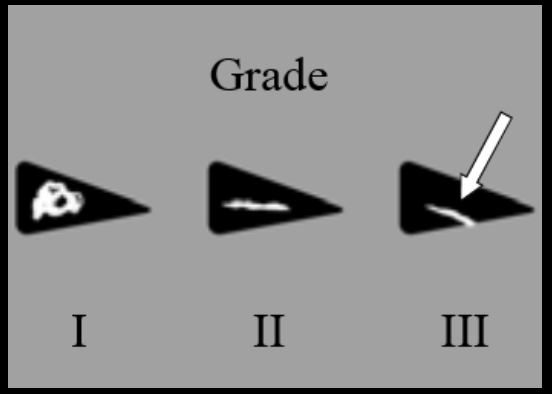






25 year old male 3 months after partial meniscectomy



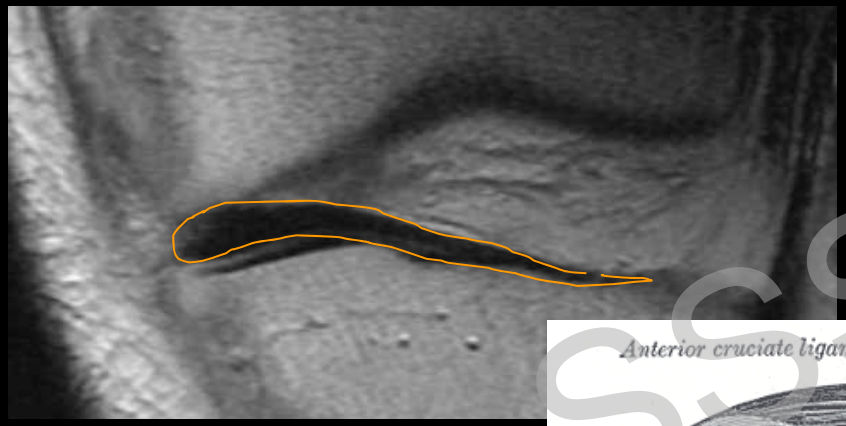


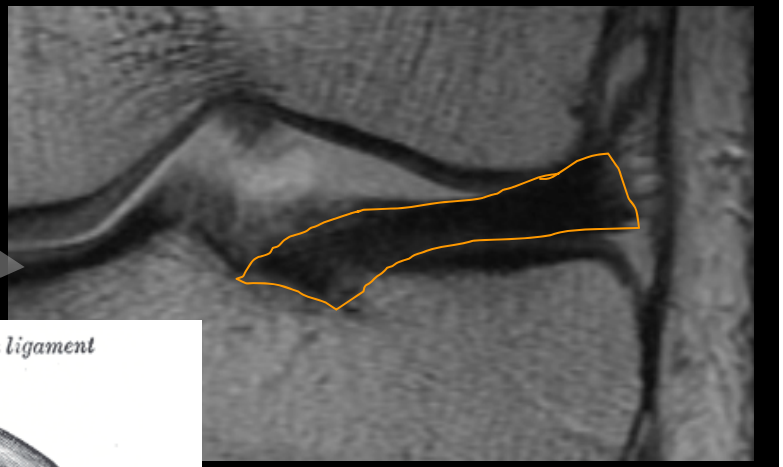
Grade III signal in post-op meniscus

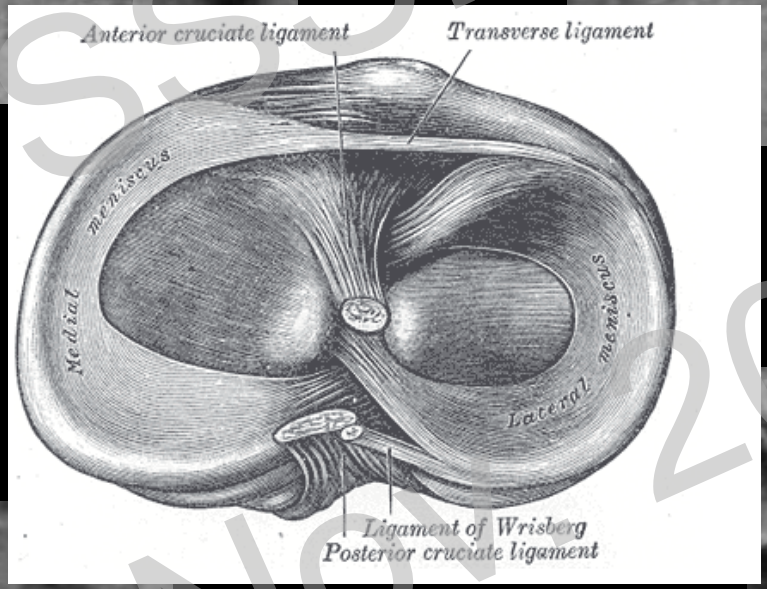
- Stable intrasubstance signal
- Granulation tissue
- Persistent tear/ retear

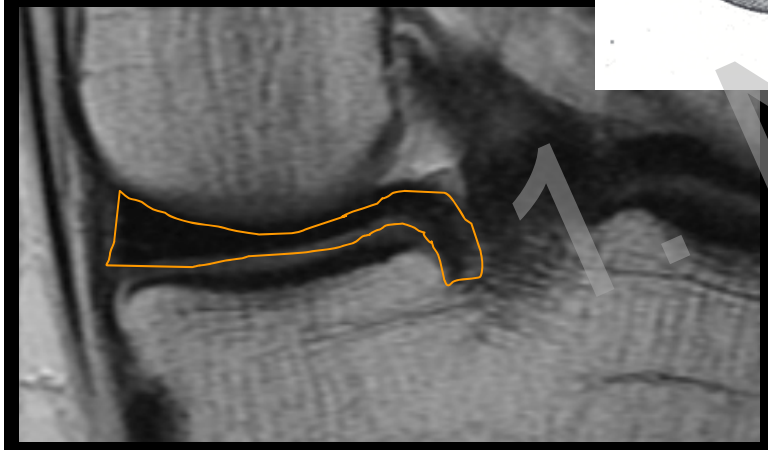
Courtesy B. Morrison

Meniscal Roots – Often Forgotten

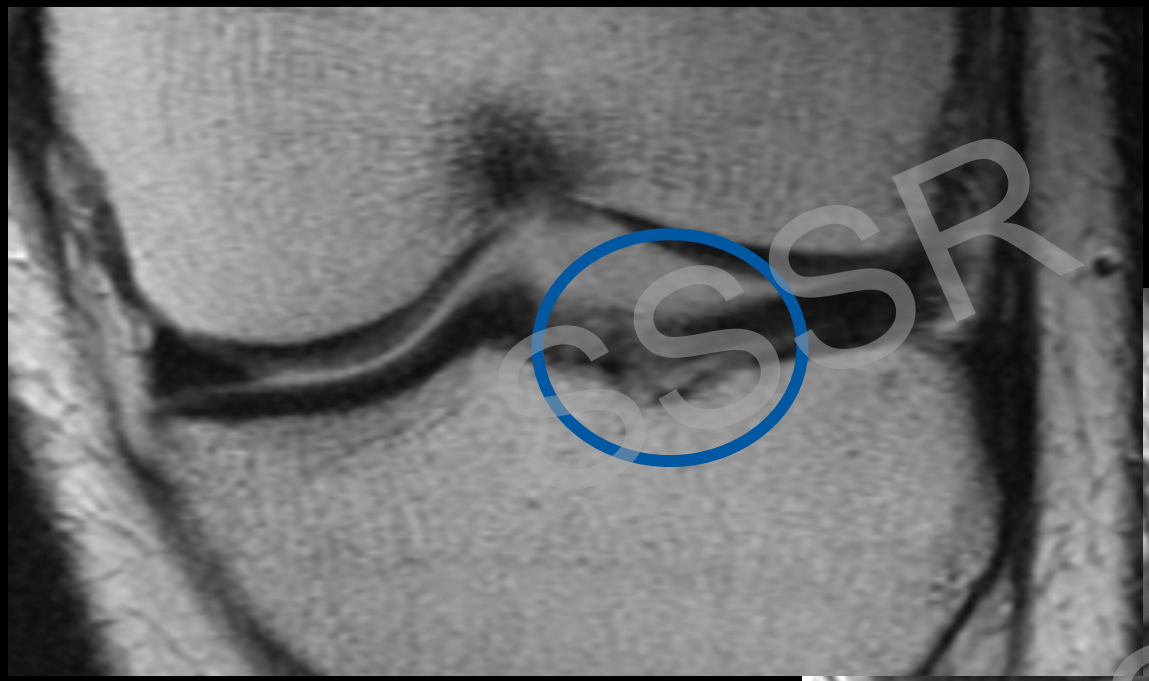






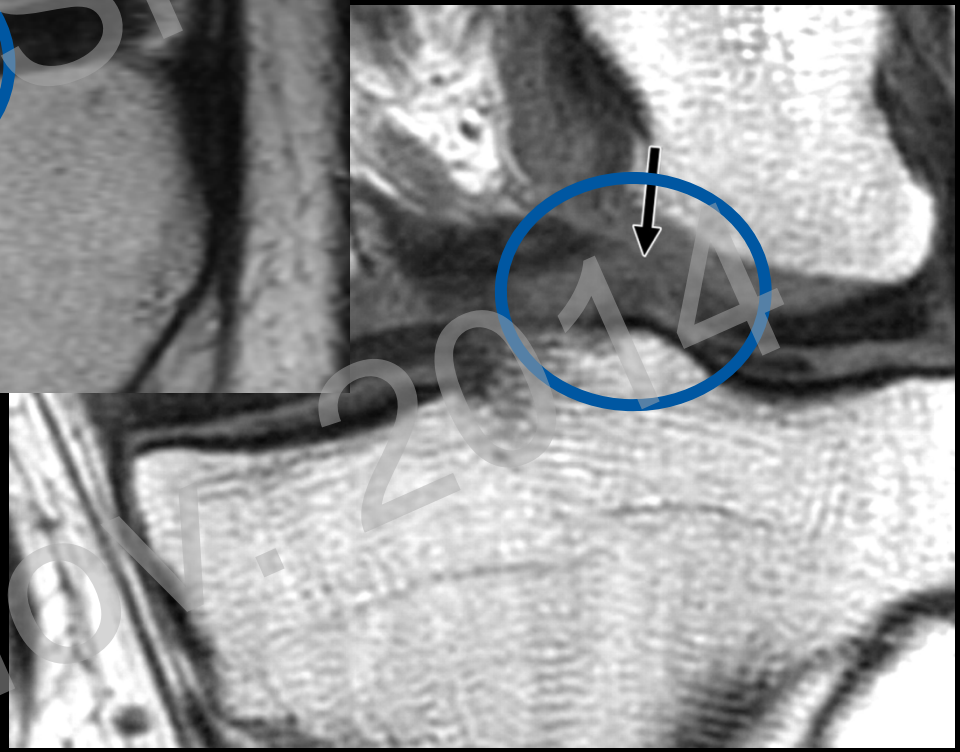


Examples for Meniscal Root Tears

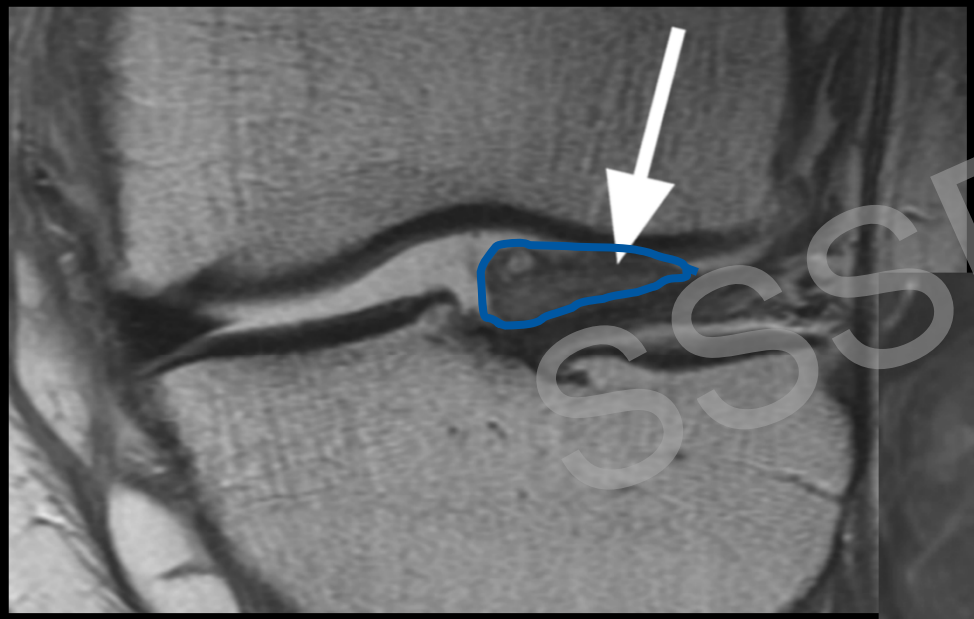


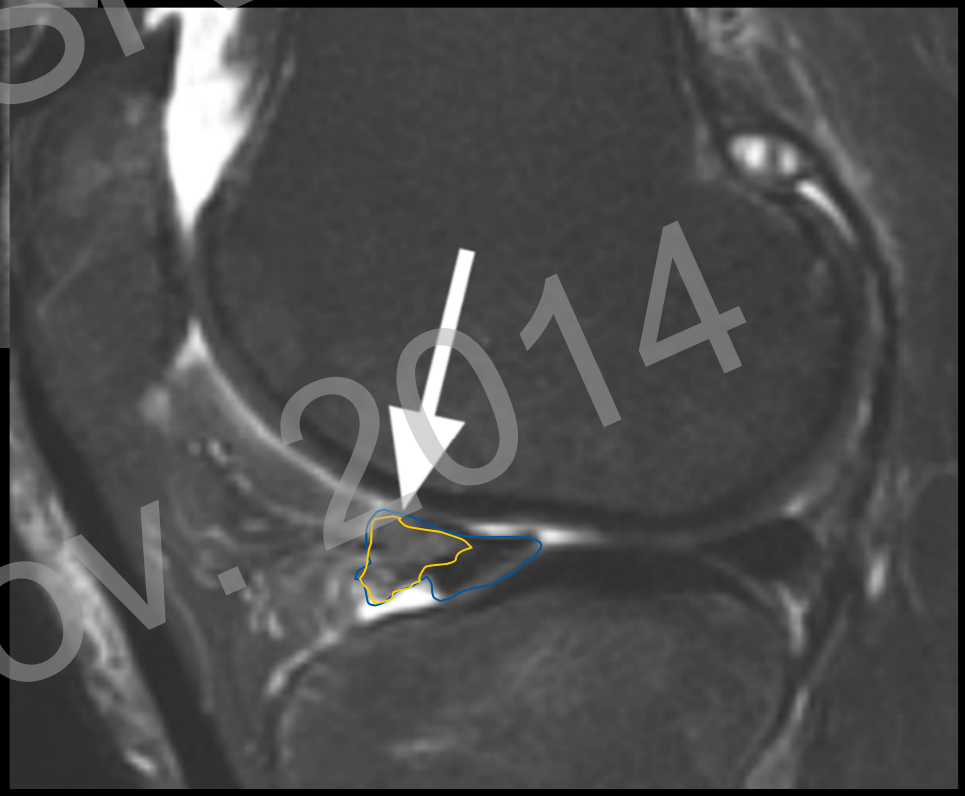
43 ys old male swimmer

De Smet et al. *AJR* 2009; 192:480-486



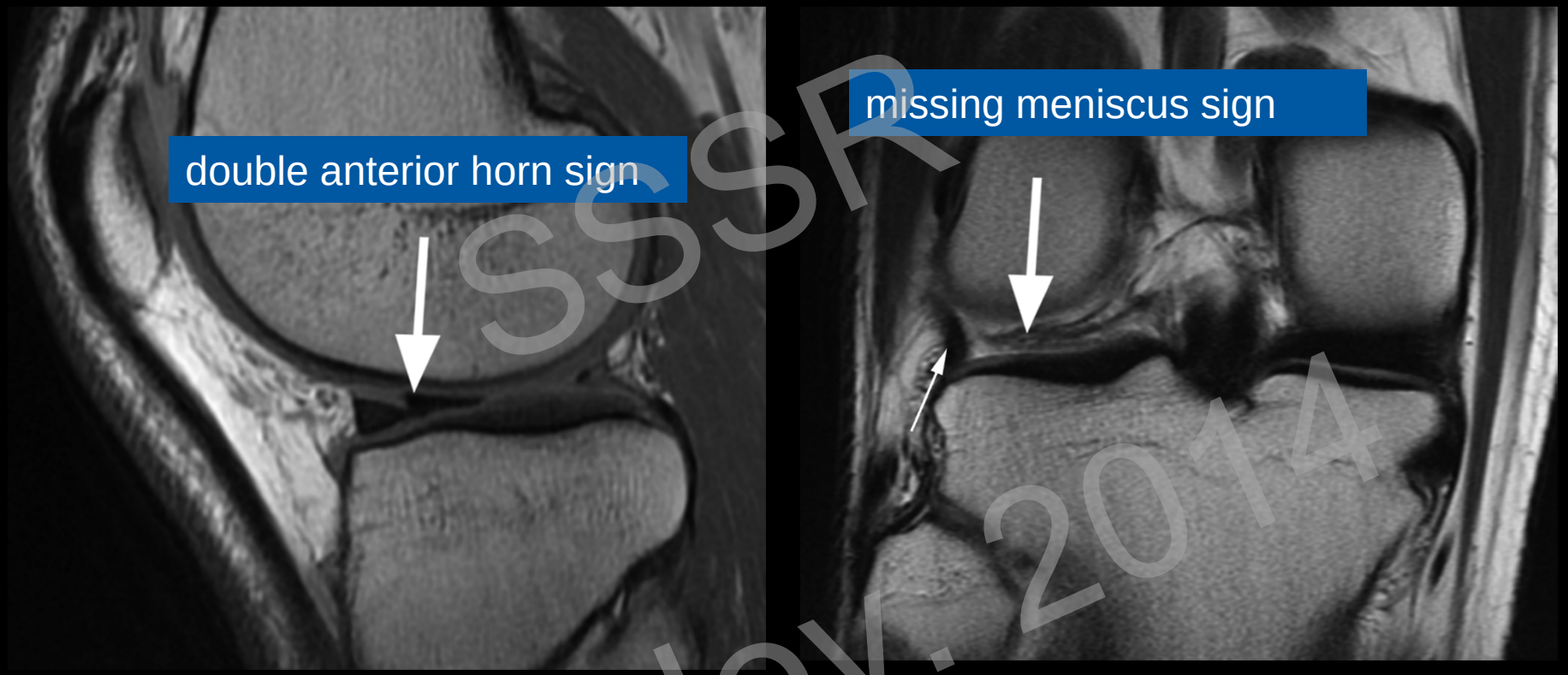
Complication after partial menisectomy





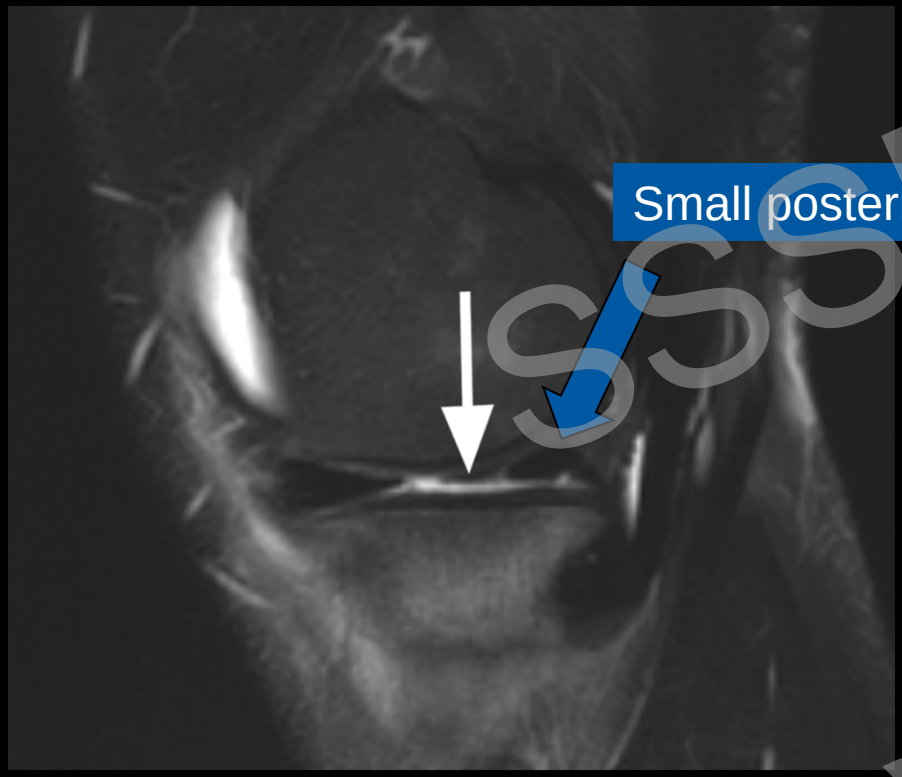
58 year old male 8 month after surgery with (para-) meniscal cysts

Complication after partial menisectomy

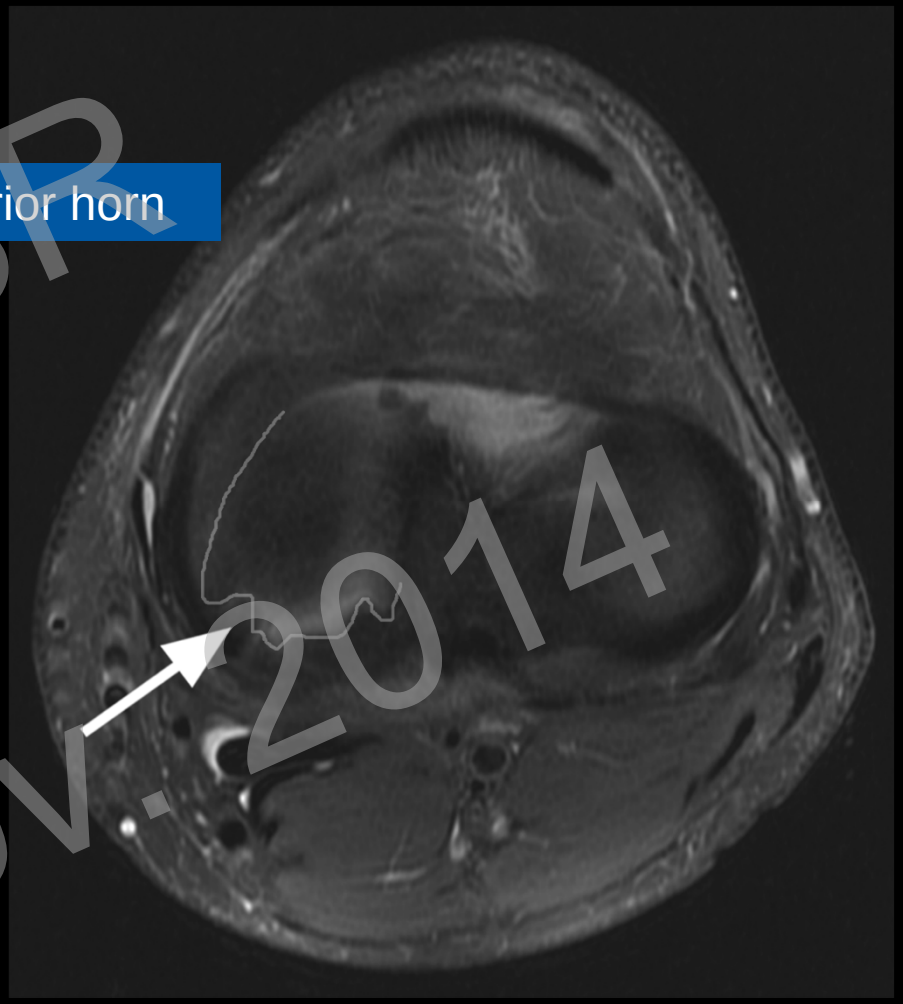


Flap re-tear (flipped meniscus) of the lateral meniscus in a 26 year old male

Complication after partial menisectomy

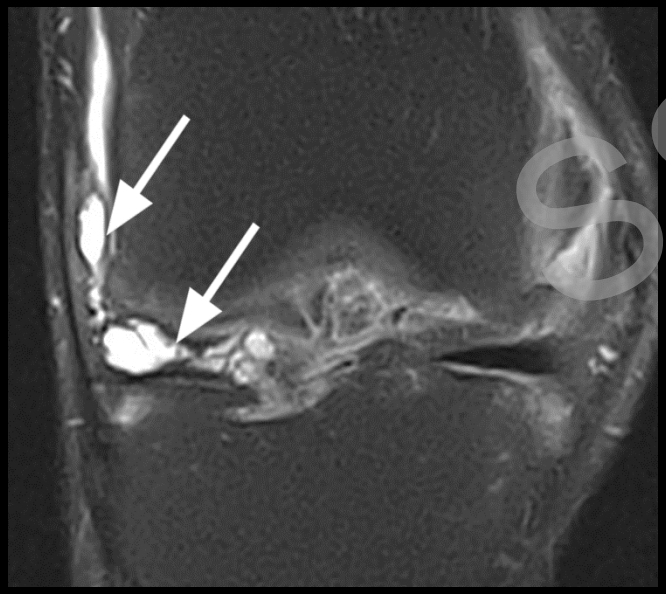


Small posterior horn

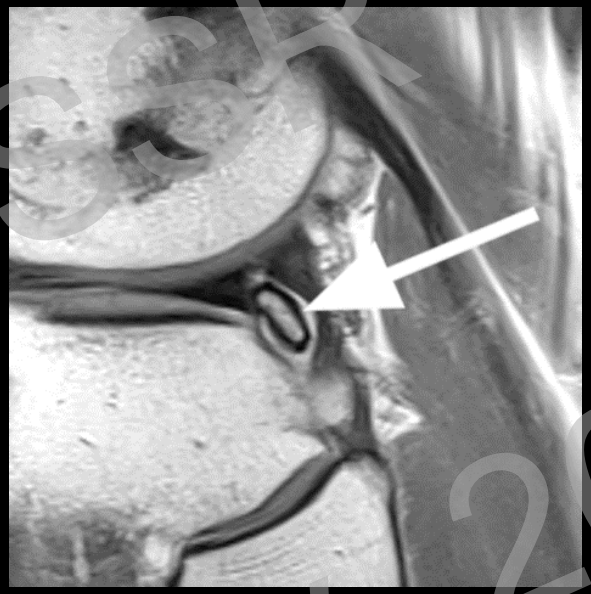


Flap re-tear of the lateral meniscus in a 32 year old male

Some more post-op abnormalities



Meniscal cysts development



Pers. osseus fragment

Advanced OA

Take Home Points - Meniscus

- Has there been surgery ?
- Size matters
- Look for the edges
- Identify retears
- Look for rout injuries
- Recognize typical complications

Content

- Imaging protocol
- Meniscus
- Cruciate ligaments

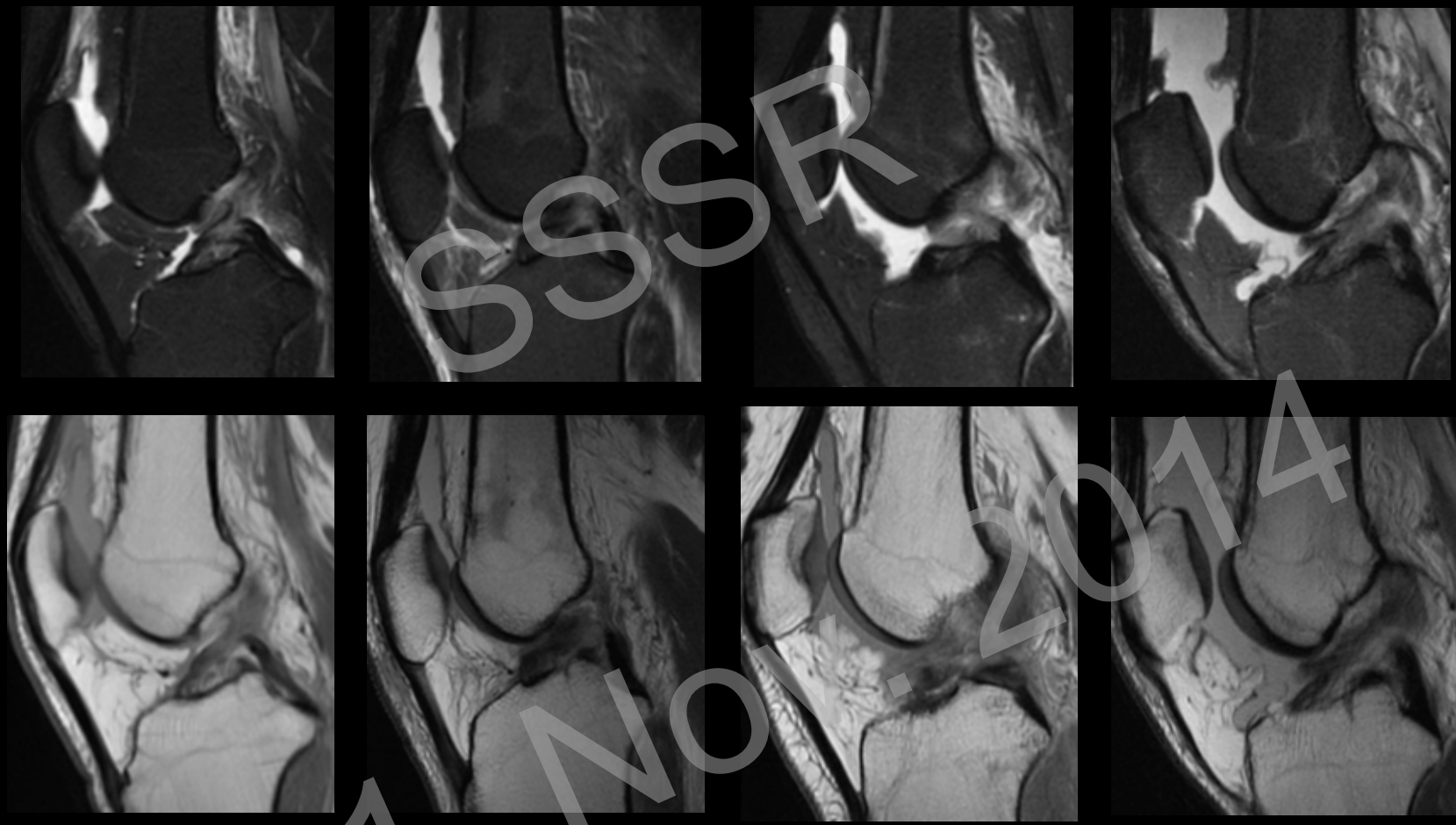
Question to the Audience …

Who is skiing ?

- **Yes**
- **No**

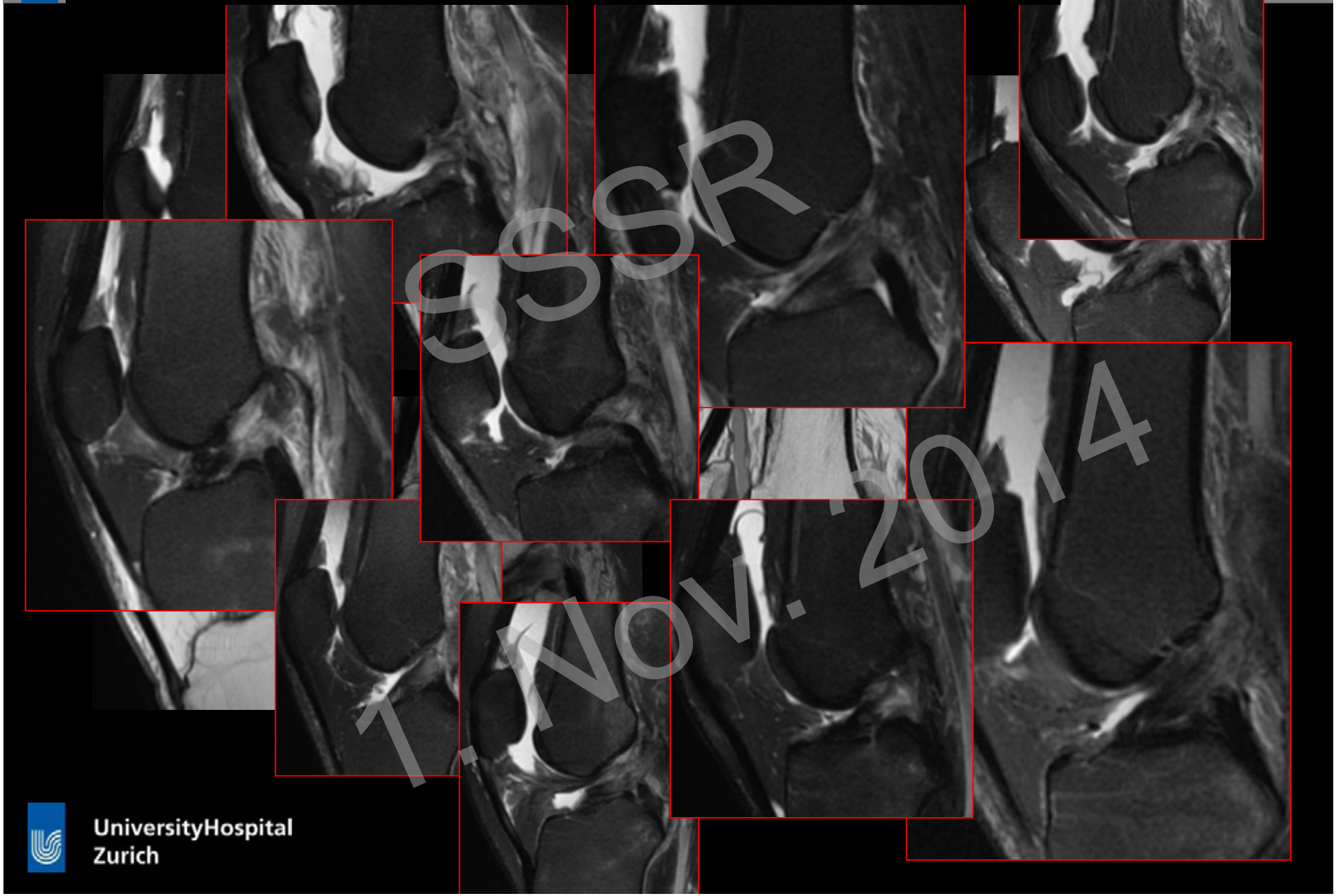
World Cup Champion Didier Cuche

Complete ACL Tears



Four cases from a typical Monday morning at USZ

… and this is from the Tuesday-Friday…



UniversityHospital
Zurich

Who still wants to go skiing next winter ?

- Yes
- No

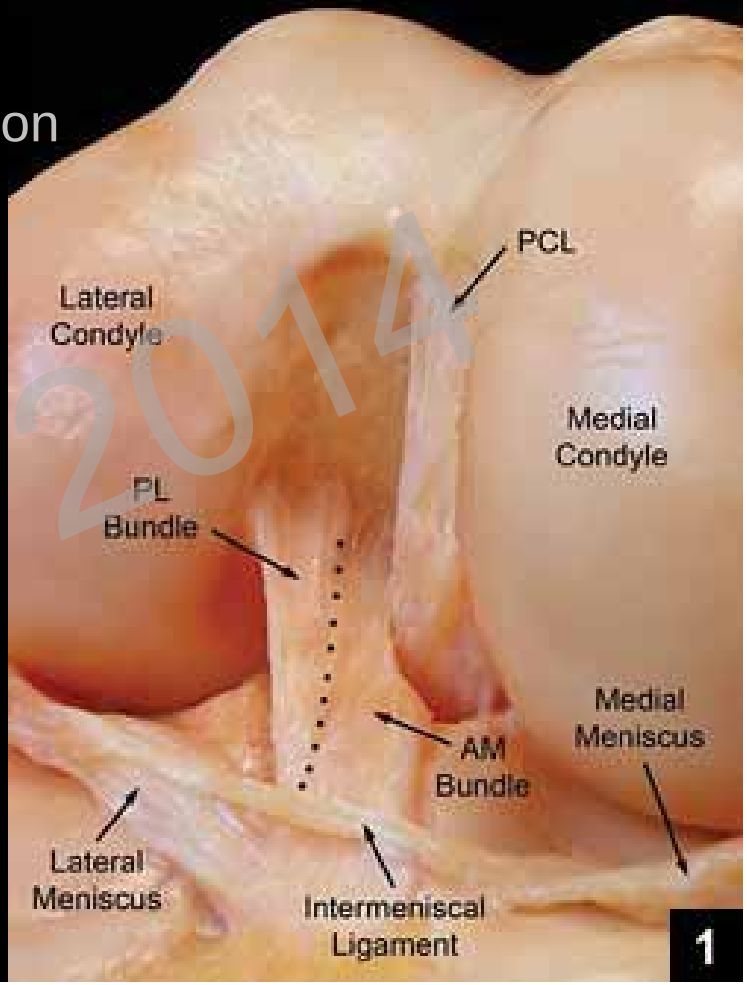
1st Learning Objective

Change to snow shoe walking

Montebello, Québec

Anterior Cruciate Ligament (ACL)

- Anatomy
  - Runs from medial facet of lateral chondylus anteriorly to intercondylar eminence
  - Anteromedial bundle is tight in flexion
  - Posterolateral bundle is tight in extension
  - Intraartikular, extrasynovial
- Normal MR appearance
  - Striated or fascicular pattern
  - Fatty interposition
- **N°1 causes for tears**
  - Sport injuries (e.g. soccer, skiing)



Fu FH et al. Orthopedics 2011;34(4):281.

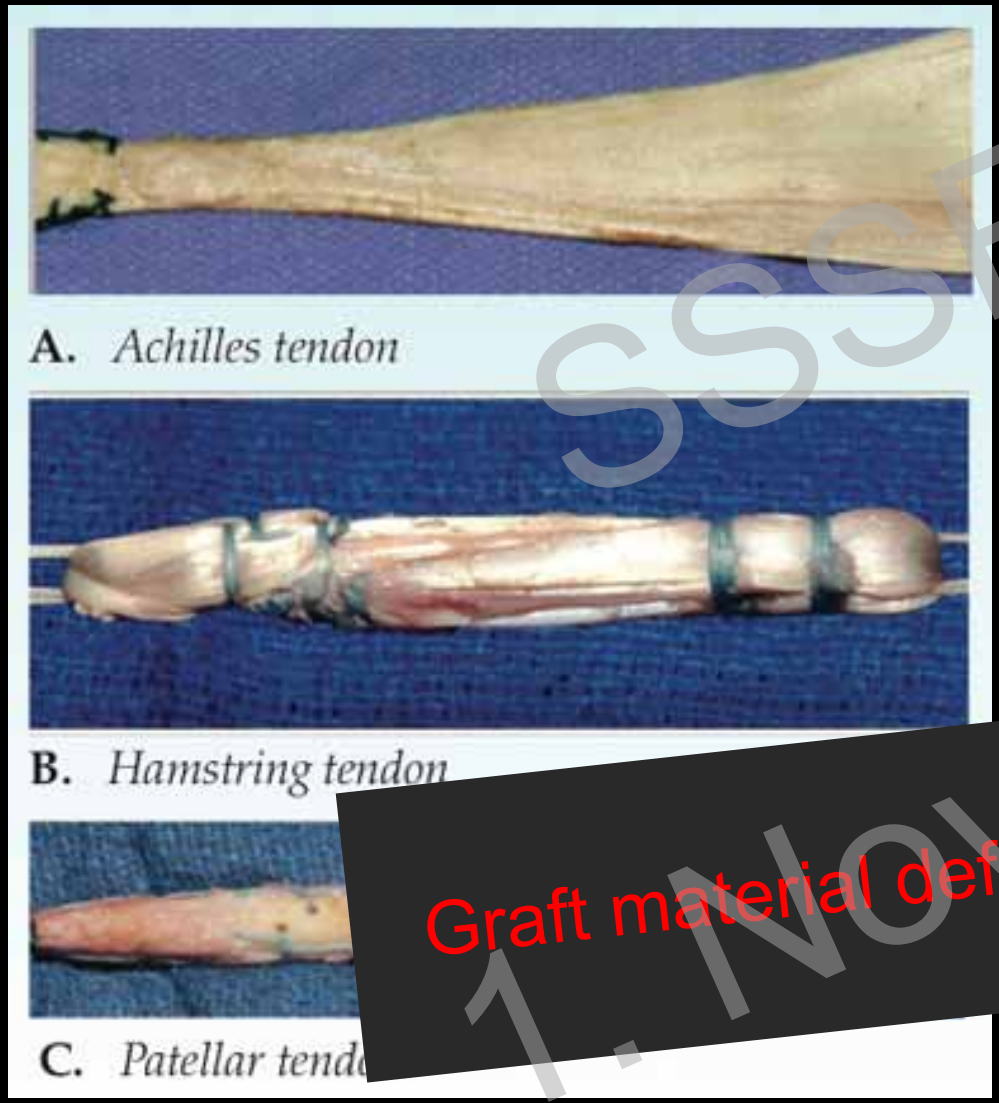
ACL graft

Single bundle repair

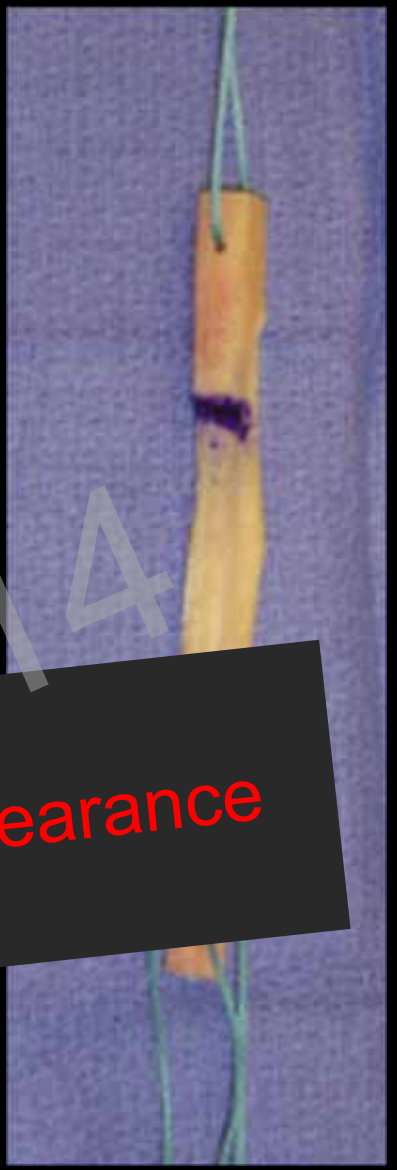
Double bundle repair

UniversityHospital
Zurich

Normal graft appearance



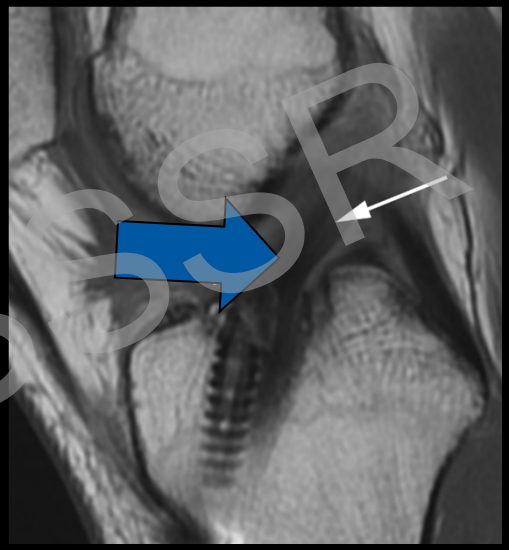
Bone
tendon
bone
grafts

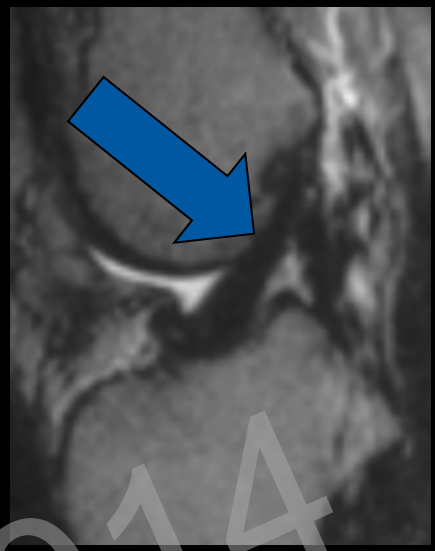


Graft material defines MRI appearance

http://www.mayoclinic.org/

Normal «aging» of BTB grafts





Low on T1
Low on T2

Remodelling
Mild increased on T1 and T2

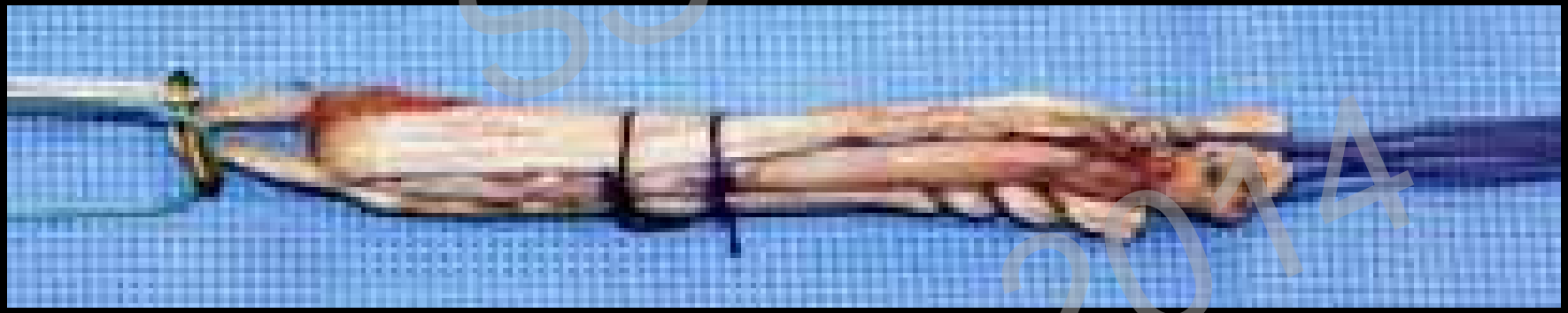
Normalize
to native ACL

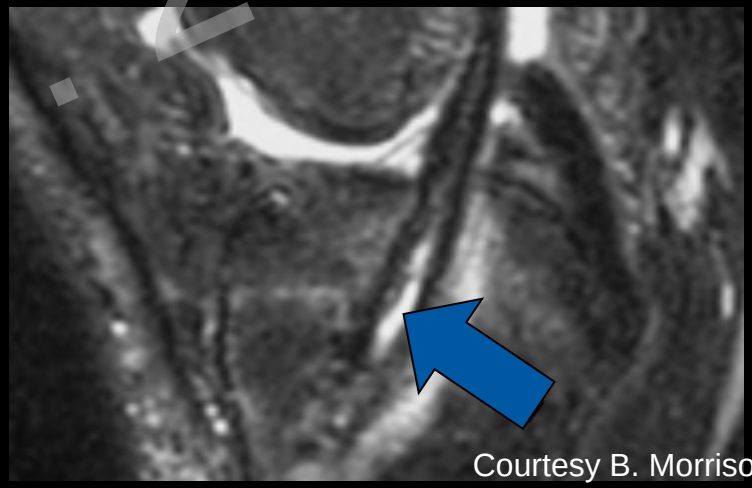
Surgery — 1st month — 12-18 months — old

UniversityHospital Zurich

BTB versus Hamstrings grafts

- Hamstring grafts progress through the same stages
- Fluid between the fascicles on T2 weighed images can be normal with hamstring grafts but should not appear on BTB grafts.





Courtesy B. Morrison

Tunnel misplacement – too anteriorly …

Too anteriorly positioned tibial tunnel in a 46-year-old male patient with ACL reconstruction

chronic impingement and secondary degenerative graft changes with increased signal intensity

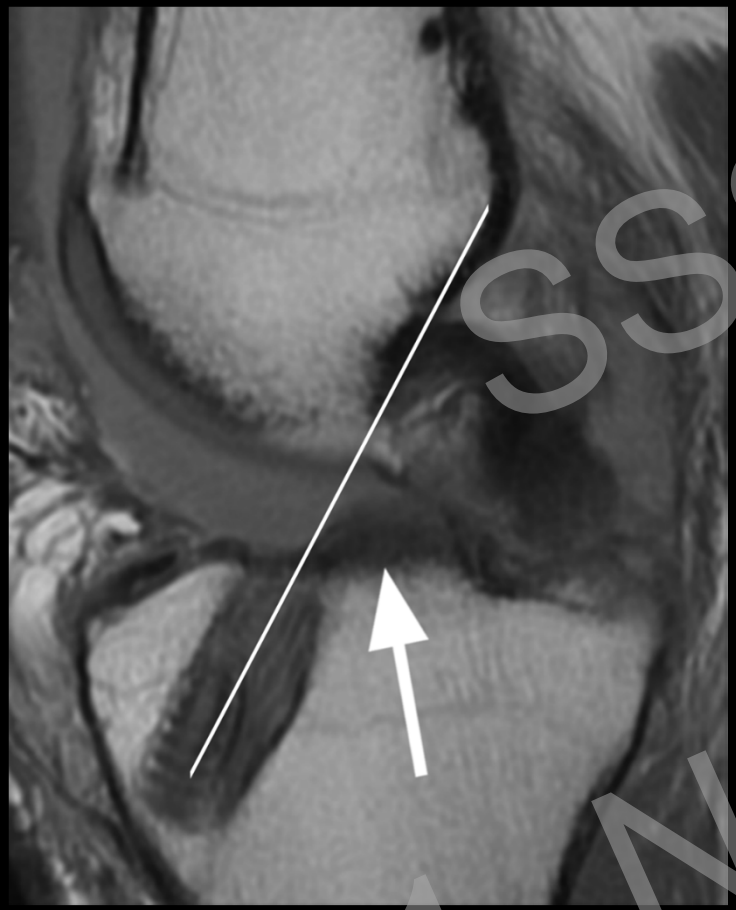
UniversityHospital Zurich

…too posteriorly

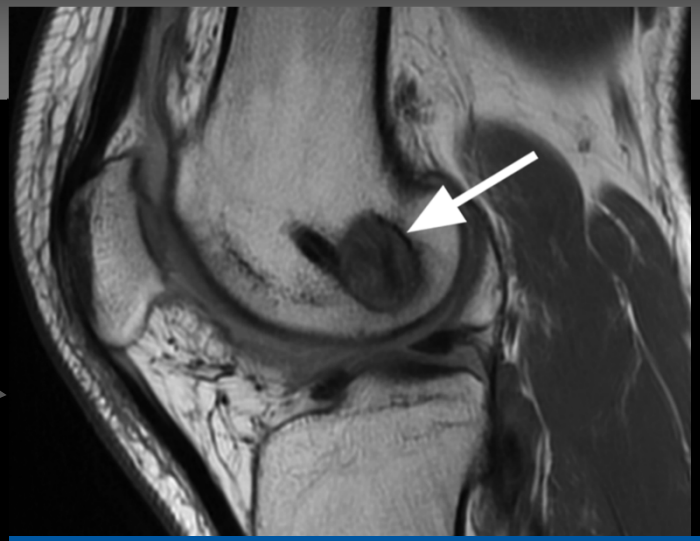
Too posteriorly positioned tibial tunnel in a 20-year-old female patientwith ACL reconstruction

tibial tunnel opening posterior to the midpoint of the proximal tibia as well as secondary graft laxity

Impingement and widening

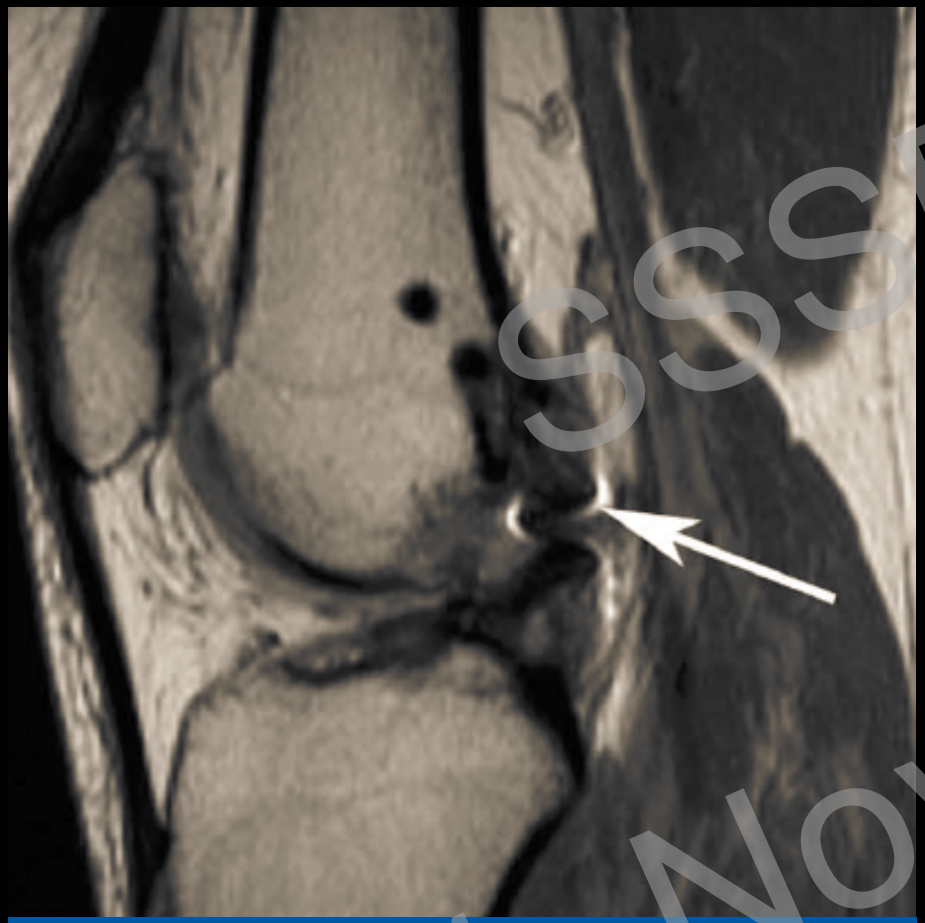


Graft Rupture (impingment)

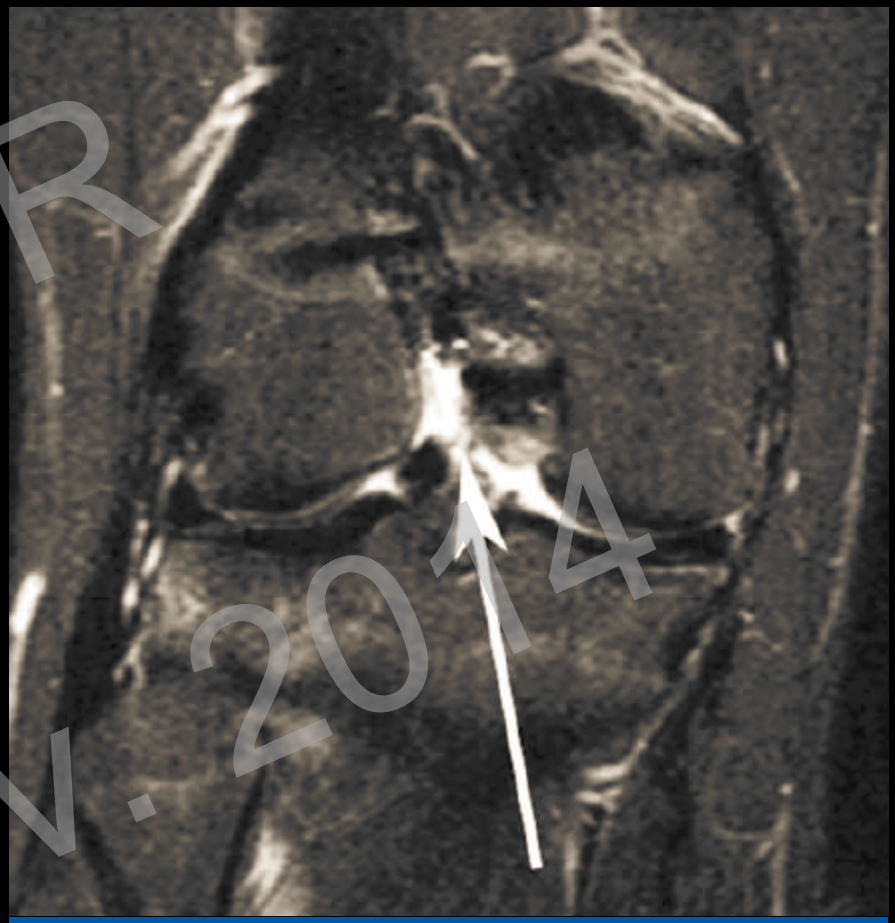


Femoral tunnel widening with too posteriorly and too distally placed graft

Screw loss with graft rupture



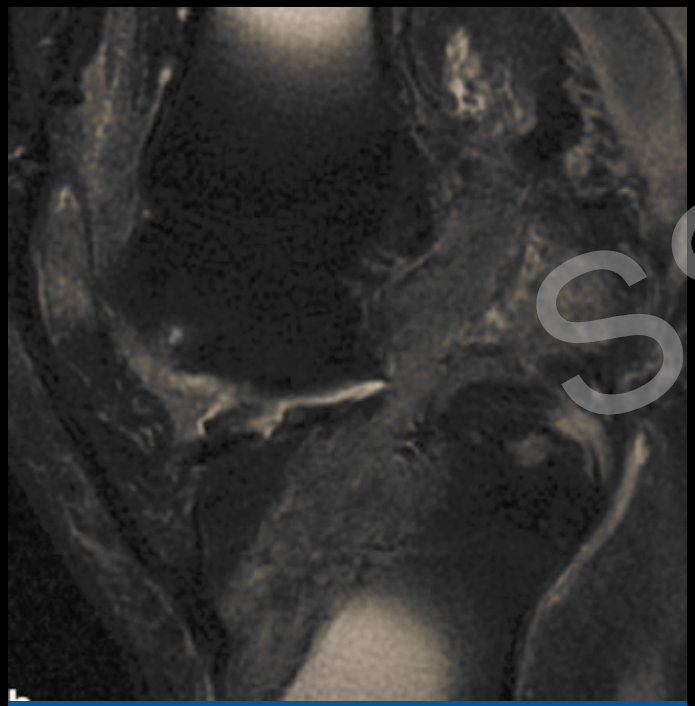
Screw loss



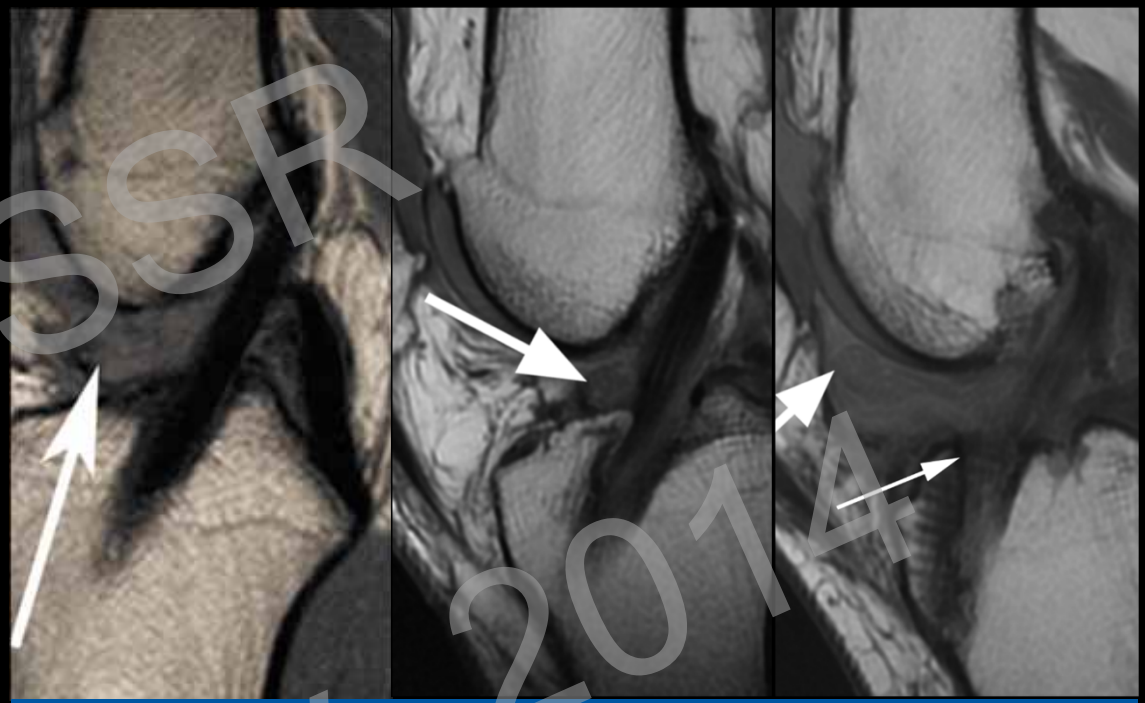
Graft rupture

UniversityHospital
Zurich

Small particle disease and arthrofibrosis



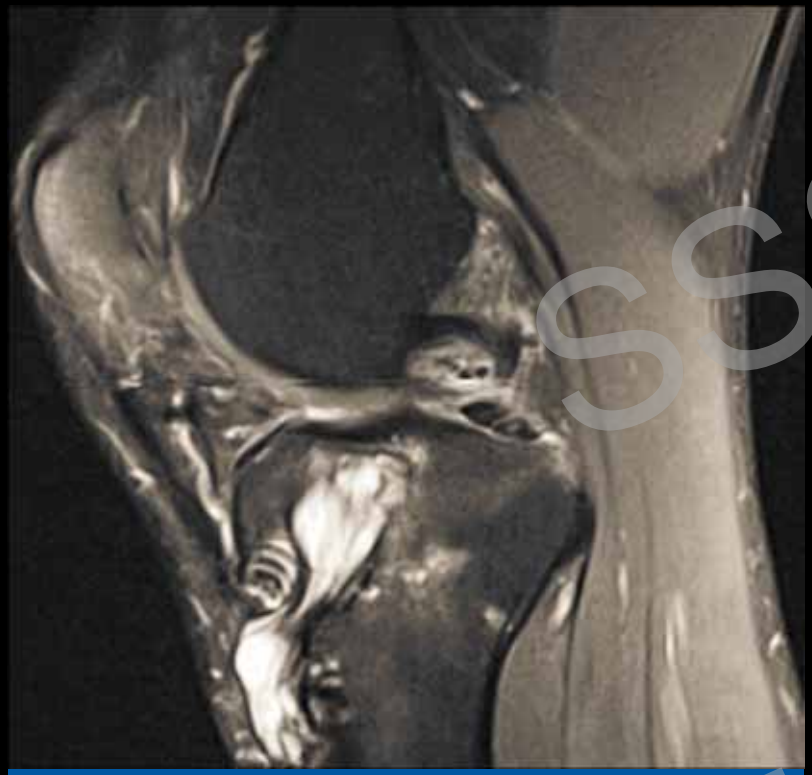
Small particle disease from synthetic graft material



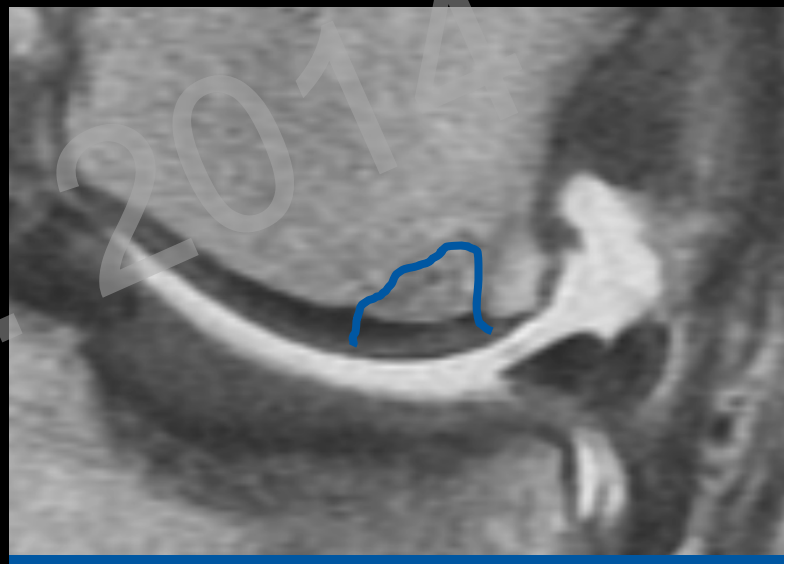
Cyclops lesion due to arthrofibrosis

(3 cases)

Ganglion cysts and OCD



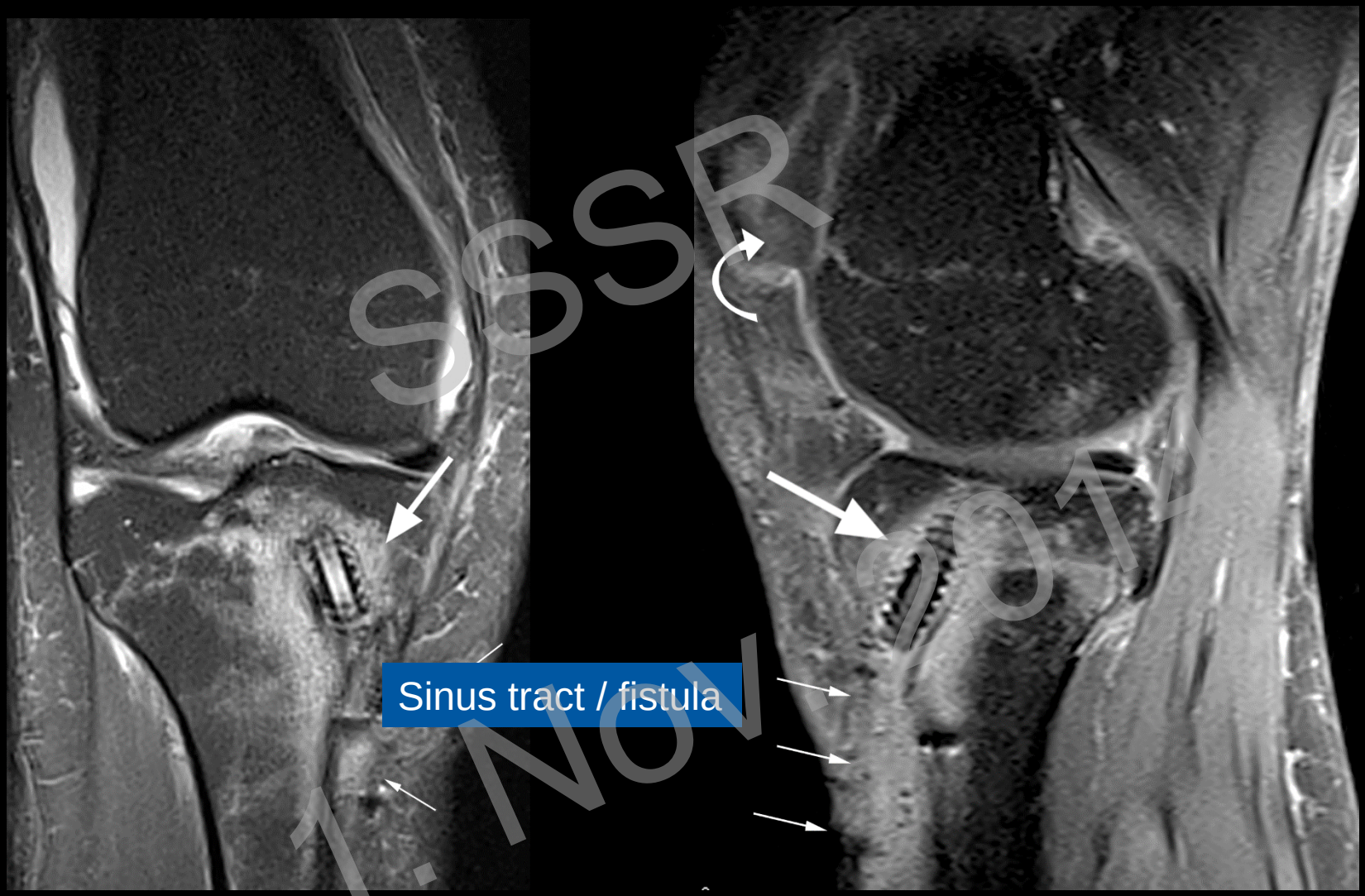
Ganglion cyst formation with tunnel widening



41 ys old male, 5 month after surgery

UniversityHospital Zurich

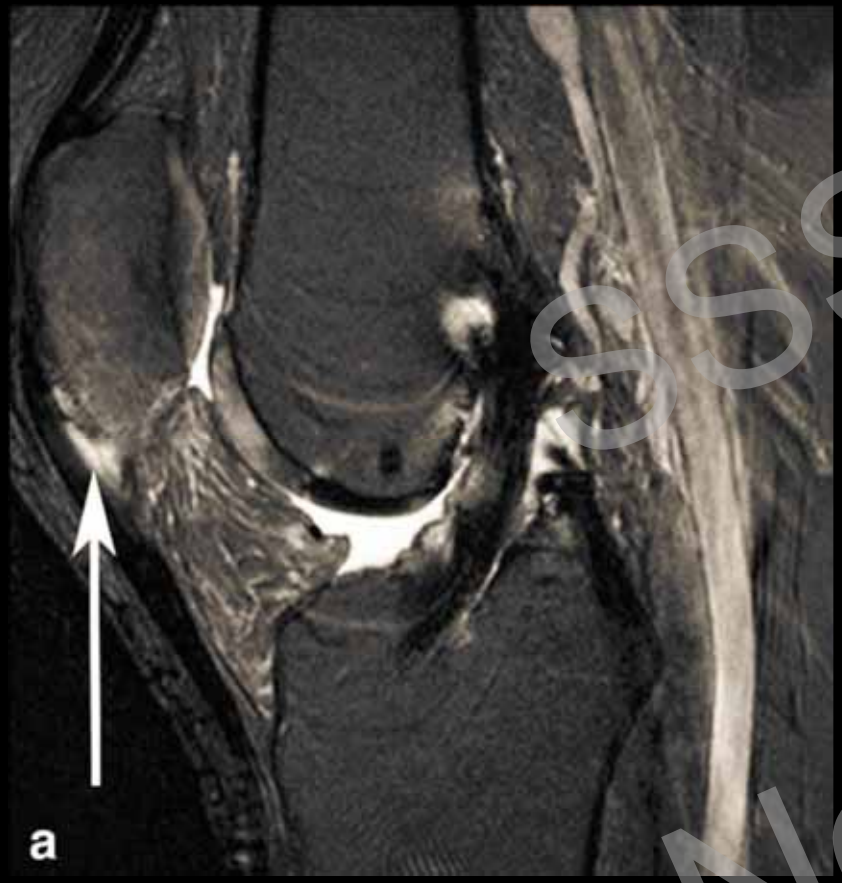
Septic arthritis

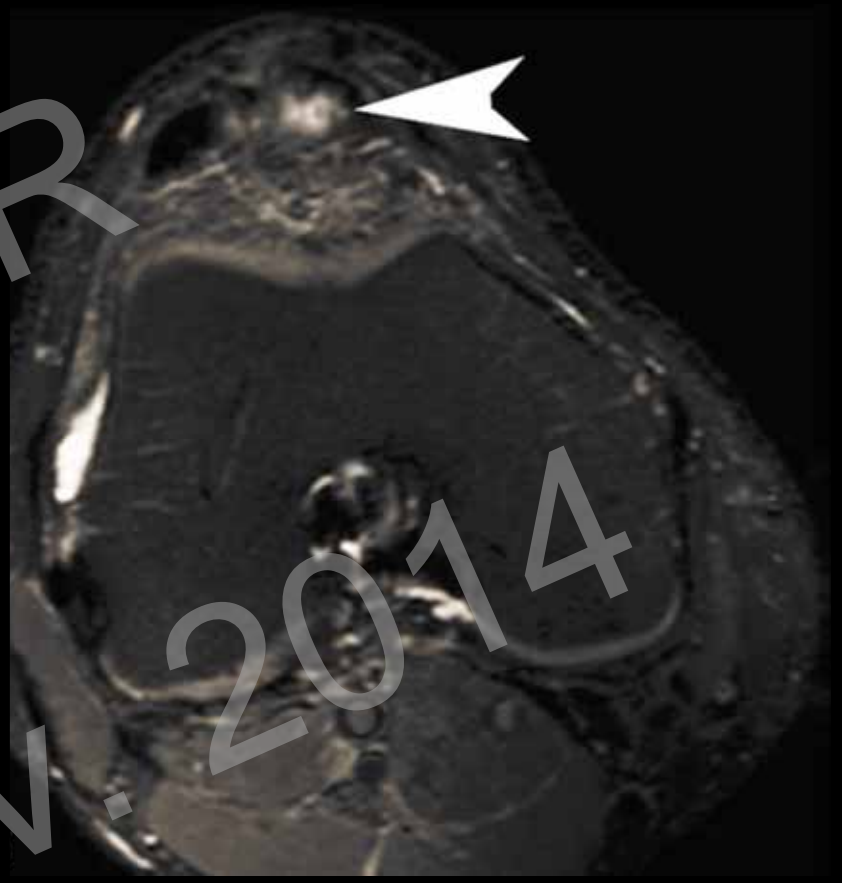


Septic arthritis in a 32 year old female 4 months after ACL reconstruction

UniversityHospital Zurich

Donor site related problems





Chronic patellar pain syndrome in 20-year-old male after BTB graft

UniversityHospital
Zurich

PCL grafts

- Less often than ACL
- Often bony avulsion
- Basic ACL features and problems apply as well

Take Home Points – Cruciate ligaments

- The material defines the appearance
- Grafts «age»

- Complications refer to
  - Technical issues of surgery
  - Donor site
  - Re-trauma

Thank you.

Related Literature from the Speaker:

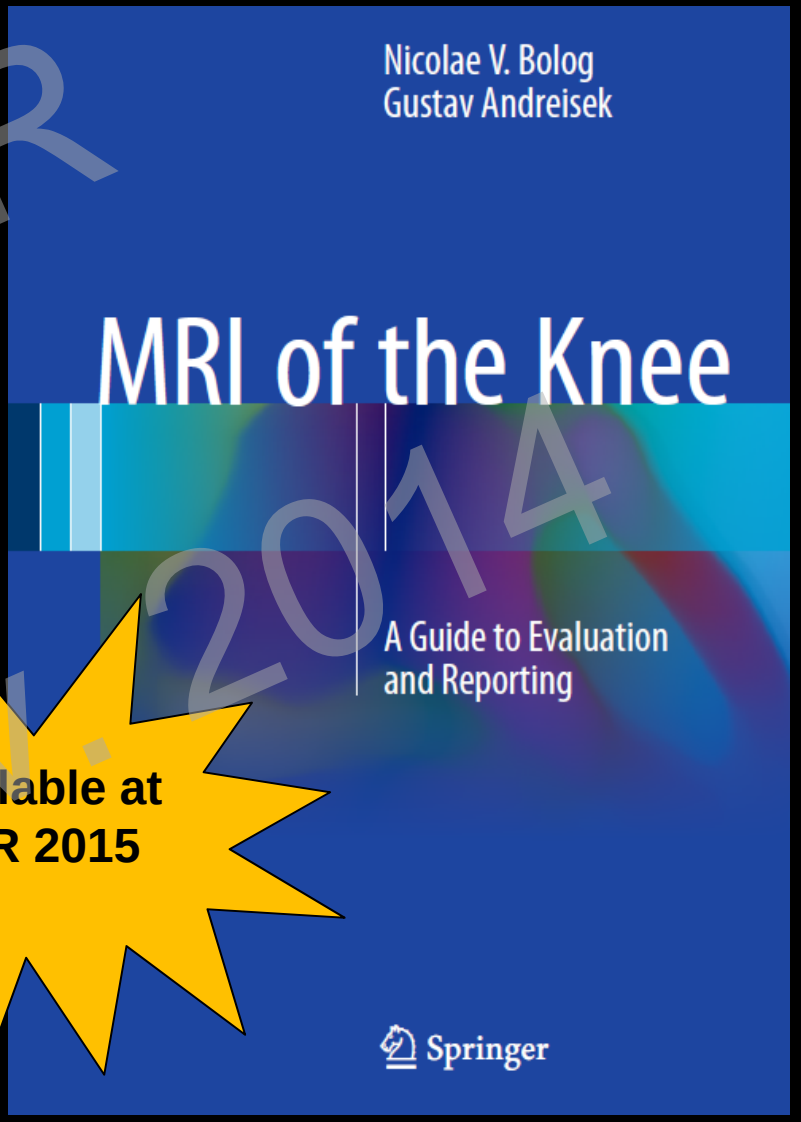
JOURNAL OF MAGNETIC RESONANCE IMAGING 34:1007–1021 (2011)

Review

MR Imaging of the Postoperative Knee

CME

Ralph Gnannt, MD,[1] Avneesh Chhabra, MD,[2] John S. Theodoropoulos, MD,[3] Juerg Hodler, MD, MBA,[1] and Gustav Andreisek, MD[1*]



Available at ECR 2015

UniversityHospital Zurich