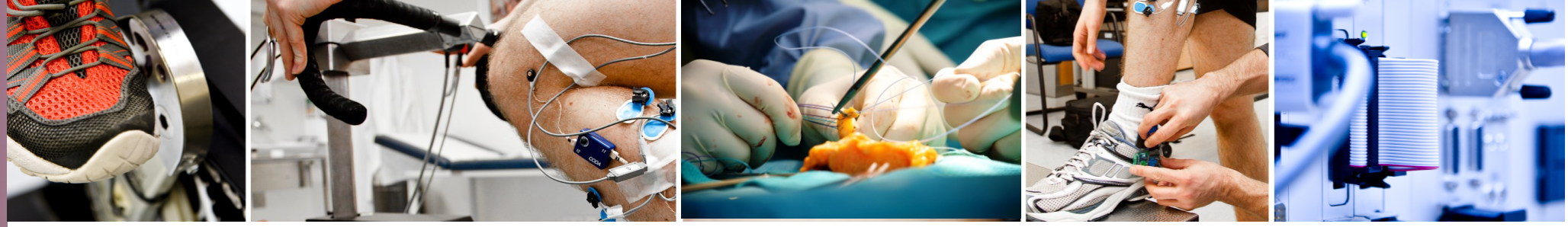


Advanced knee course, Val d'Isère, 01-2016

Spectrum of ACL failures: Overview & algorythm

Romain Seil

Orthopaedic Surgery

CHL Centre Hospitalier de Luxembourg EICH

Centre Hospitalier de Luxembourg

Sports Medicine Research Laboratory

LUXEMBOURG INSTITUTE OF HEALTH RESEARCH DEDICATED TO LIFE

Luxembourg Institute of Health

ACL failures & revisions

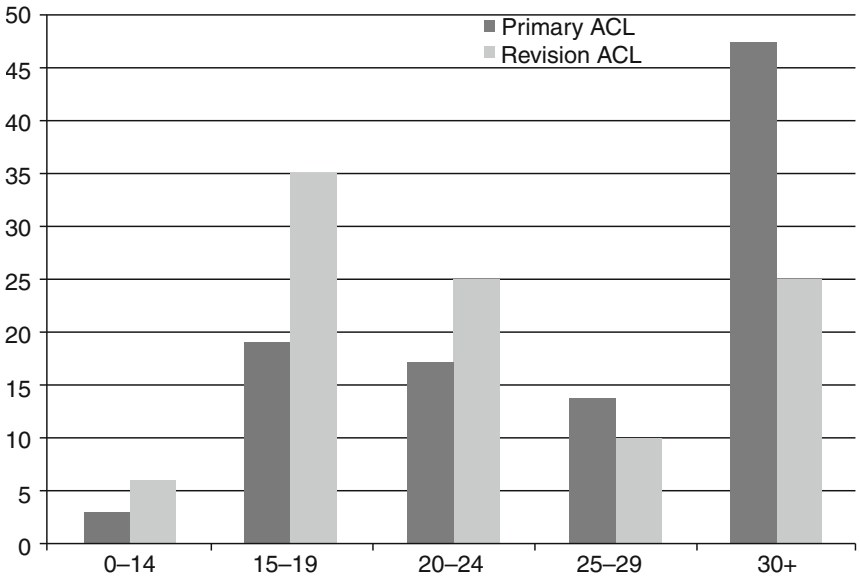
Dramatic event for all parties involved

To manage ACL failures, a surgeon should be a sensitive communicator, an astute clinician, a skilled surgeon familiar with different grafts and fixation techniques as well as being able to instil in his patients realistic expectations.

Neil P. Thomas,
Basingstoke, UK
ESSKA president 2004-2006

ACL failure epidemiology

Age distribution



From: Lind M, Pedersen A: The Danish Anterior Cruciate Ligament Reconstruction Registry:What We Are Doing, How We Do It, and Which Would Be the Best Way to Do It ?

In: V. Sanchis-Alfonso, J.C. Monllau (eds.), *The ACL-Deficient Knee*, © Springer-Verlag London 2013

612 ACL reconstructions:

→ 6% graft ruptures

→ 6% contralateral ACL injuries

→ 3 patients had both

Salmon L, Arthroscopy 2006

ACL failure epidemiology

The Swedish National Anterior Cruciate Ligament Register

A Report on Baseline Variables and Outcomes of Surgery for Almost 18,000 Patients

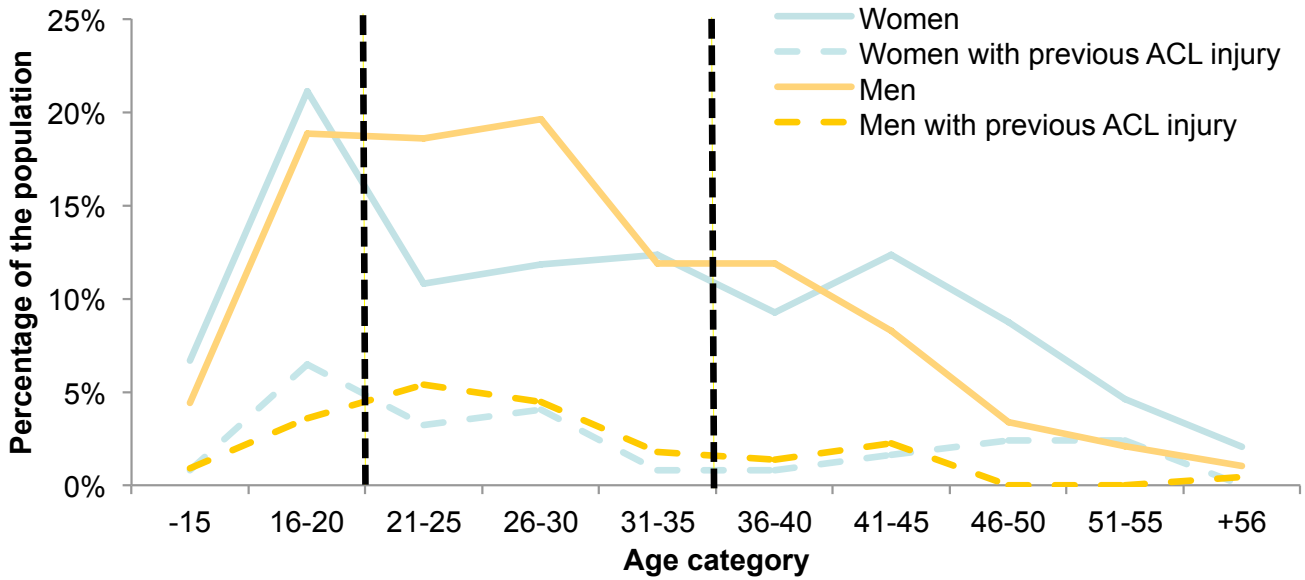
Mattias Ahldén,[*†] MD, Kristian Samuelsson,[†] MD, PhD, Ninni Sernert,[‡] RPT, PhD, Magnus Forssblad,[§‖] MD, PhD, Jón Karlsson,[†] MD, PhD, and Jüri Kartus,[‡¶] MD, PhD
Investigation performed at the Department of Orthopaedics, Sahlgrenska Academy, University of Gothenburg, Sahlgrenska University Hospital/Mölndal, Mölndal, Sweden

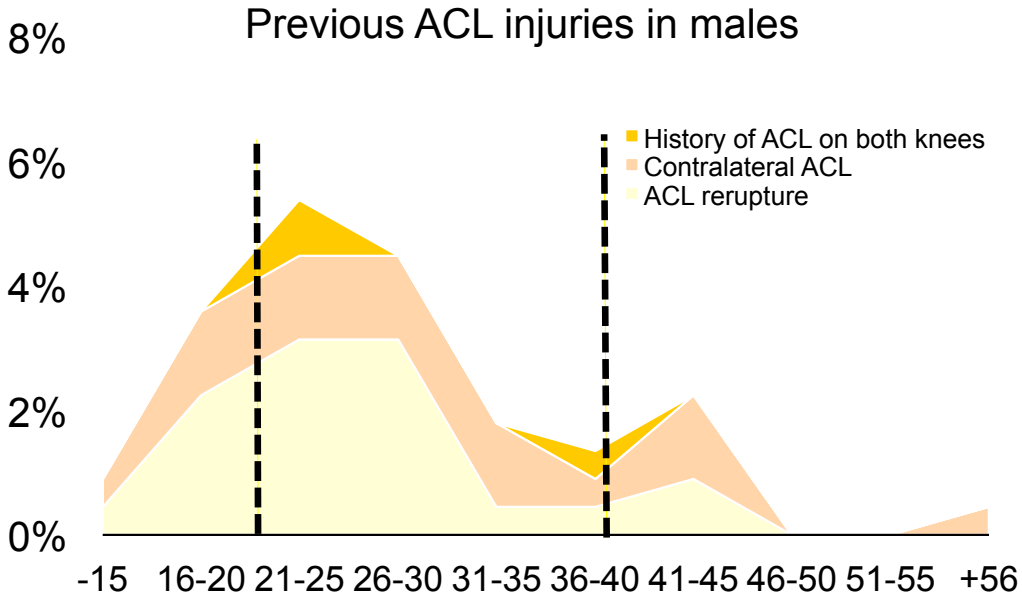
Revision rates:

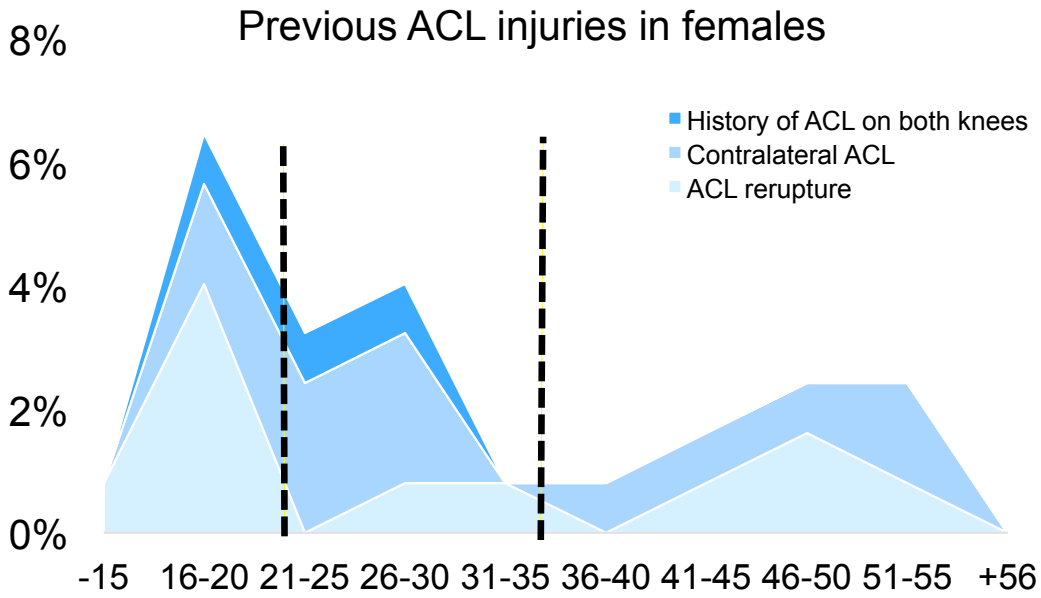
- Overall rate: 9,1 %
- Contralateral: 5%
- Ipsilateral 4,1%
- 15-18 y.old female football players: 22 %

Ahlden M, 2012

ACL failure epidemiology







ACL retear epidemiology

66 ACL revisions:

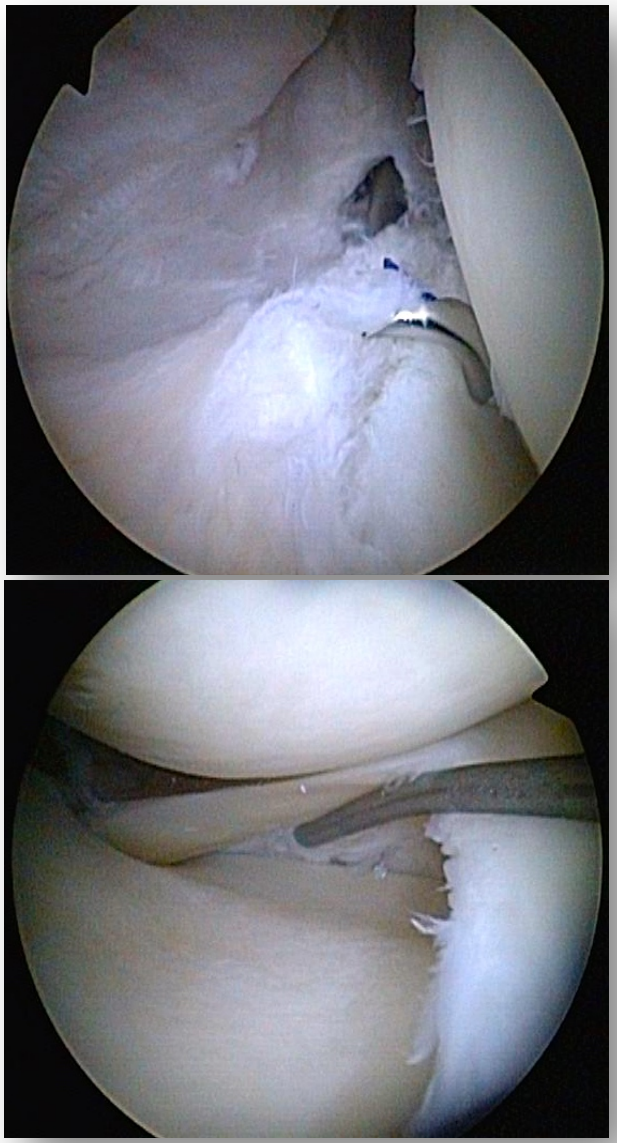
→ mean time ACL-R to ACL-REV 62 mo.

→ 40 % reruptures in first year

→ 126 surgical procedures in same knee (2.52)

Denti M, Am J Sports Med 2008

ACL retear epidemiology



Repair the meniscus !

ACL survival:

→ 95 % if intact menisci

→ 68 % if deficient meniscus

→ 4.9 times higher failure risk with meniscal loss

Robb C, KSSTA 2014

Causes of failure

→ ***Technical errors***

nonanatomic tunnel placement

improper tensioning

failure of fixation

insufficient graft material

→ ***Biological failure***

failed ligamentization

infection

arthrofibrosis

→ ***New trauma***

early (before biological integration)

late (after integration)

failure → trauma or trauma→ failure

→ ***Secondary to associated instability***

multiligament instability

Causes of failure

Retrospective study

n = 186

Anterior femoral tunnel	38%
Traumatic origin	27%
Tibial tunnel malposition	10%
Impingement	11%
Fixation failure	
Ignored laxity	
Hyperlaxity	
Infection	
No obvious cause	18 %

Participating centres: Bordeaux, Brest, Caen, Lyon, Nice, Paris, Versailles, Toulouse

Causes of failure

Prospective study

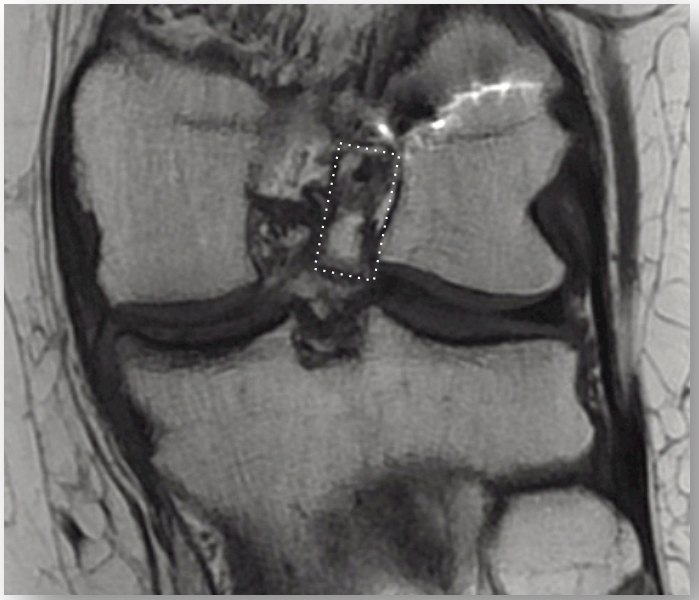
n = 104

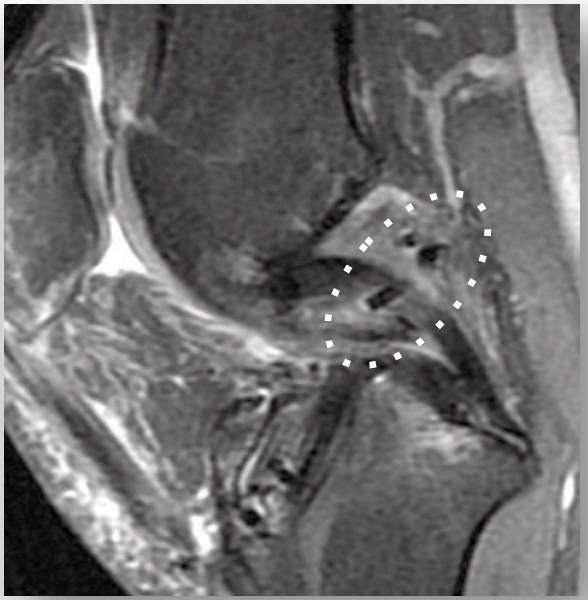
Anterior femoral tunnel	36%
Trauma	35%
Tibial tunnel malposition	15%
Fixation failure	7%
Hyperlaxity	5%
Ignored laxity	5%
No obvious cause	10%

Participating centres: Bordeaux, Brest, Caen, Lyon, Nice, Paris, Versailles, Toulouse

Causes of failure

Failure of fixation





Populations at risk

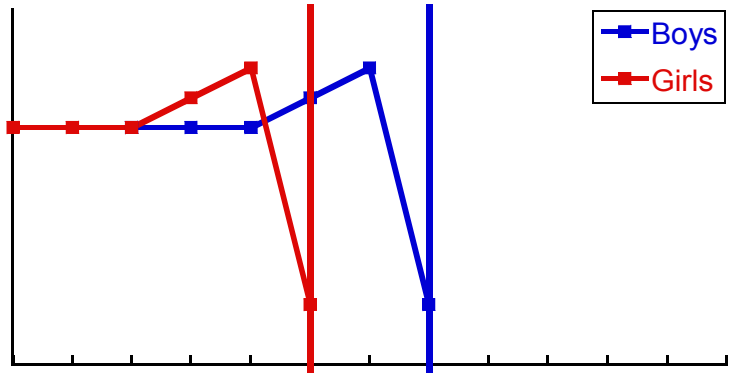
Adolescents

- ♀ ACL tear + reconstruction @ 13;
- Retear and 2nd reconstruction @ 16;
- Re-retear and 3d reconstruction @ 17

- ✧ Knee growth & maturation
- ✧ Lower IKDC scores

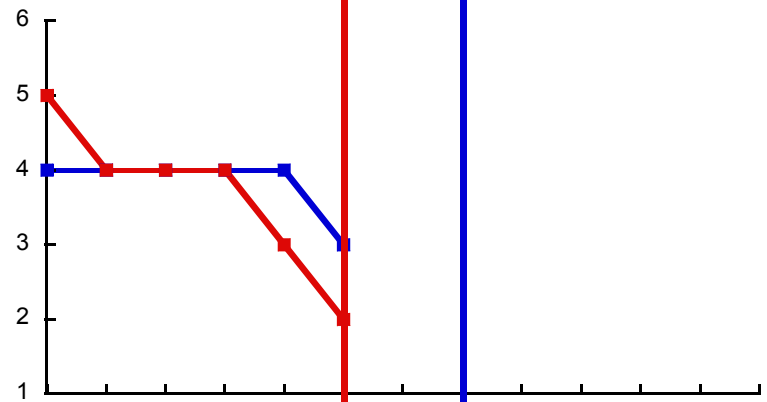
Populations at risk

Growth velocity lower limb



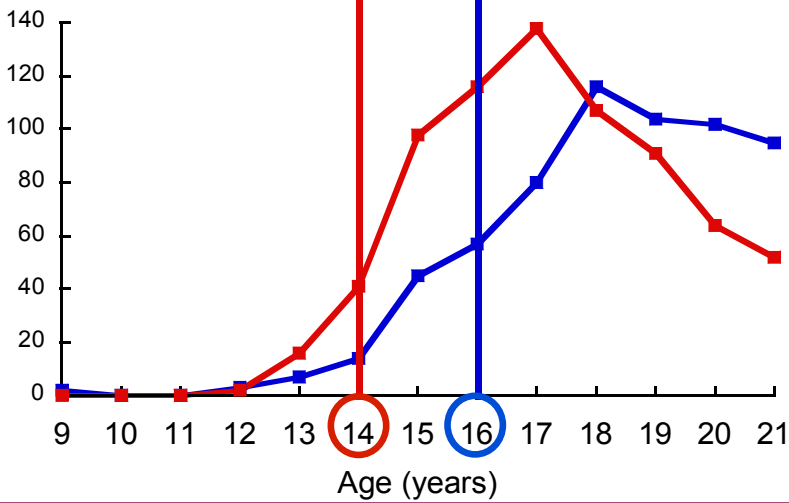
Gicquel P, 2007

AP laxity (mm)



Baxter MP, 1998

ACL reconstructions



Swedish ACL registry 2010

Populations at risk

Females

- ✧ Anatomic factors
- ✧ Hormonal factors
- ✧ Neuromuscular factors

Females: anatomic factors

	Men (n=35)	Women (n=25)	Δ (%)
$TR^{5\ Nm}$ (°)	41.8 ± 8.9	58.8 ± 8.8	40.1

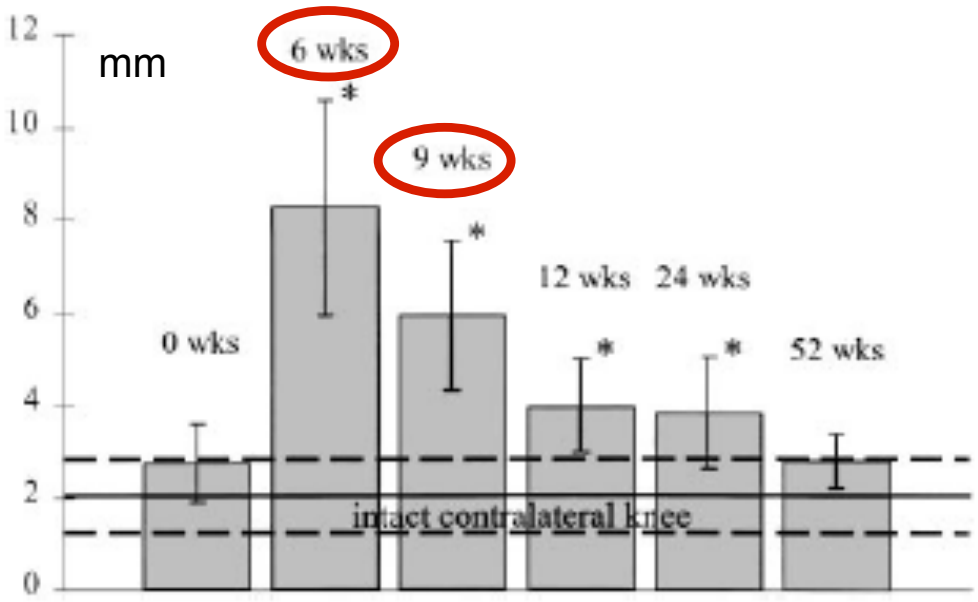
Women have a 40% increased rotational laxity
(Park, JOR 2008; Shultz, JOR 2007; Mouton, KSSTA, 2012)

- Hyperextension
- Valgus
- Smaller ACL, smaller notch
- Increased rotation

Females: neuromuscular factors

- Increased quadriceps contraction & lesser flexor muscle activation than males
- → increased strain on ACL

Fate of the graft ?



Anterior tibial displacement at 50 N

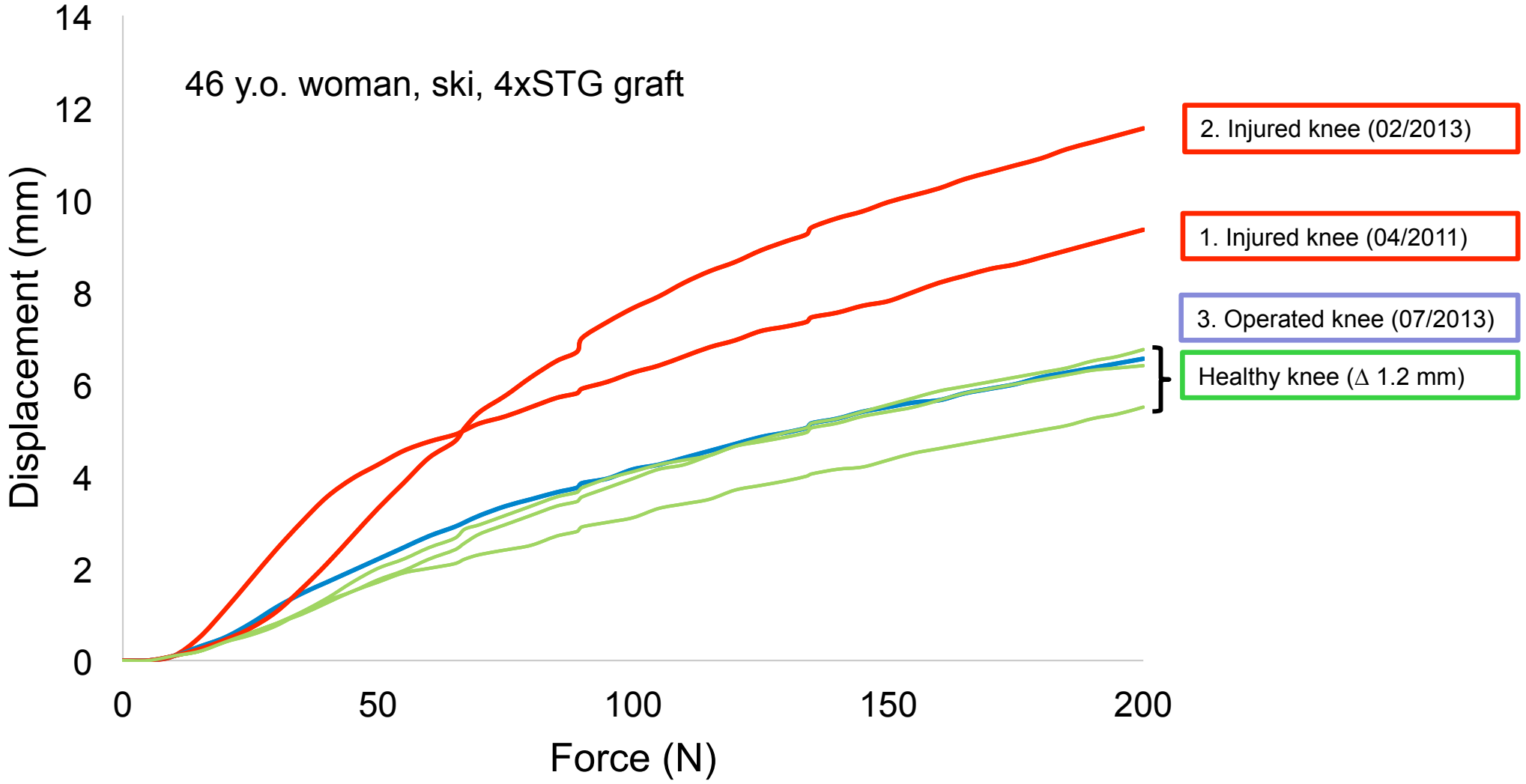
- Ovine model
- Intraarticular model.
- Direct, aperture fixation
- Graft weakness highest at 6 and 9 weeks

After tendon-bone healing it is the intraarticular portion of the graft which is the weakest link in the bone-graft-bone construct.

Weiler A, Arthroscopy, 2002

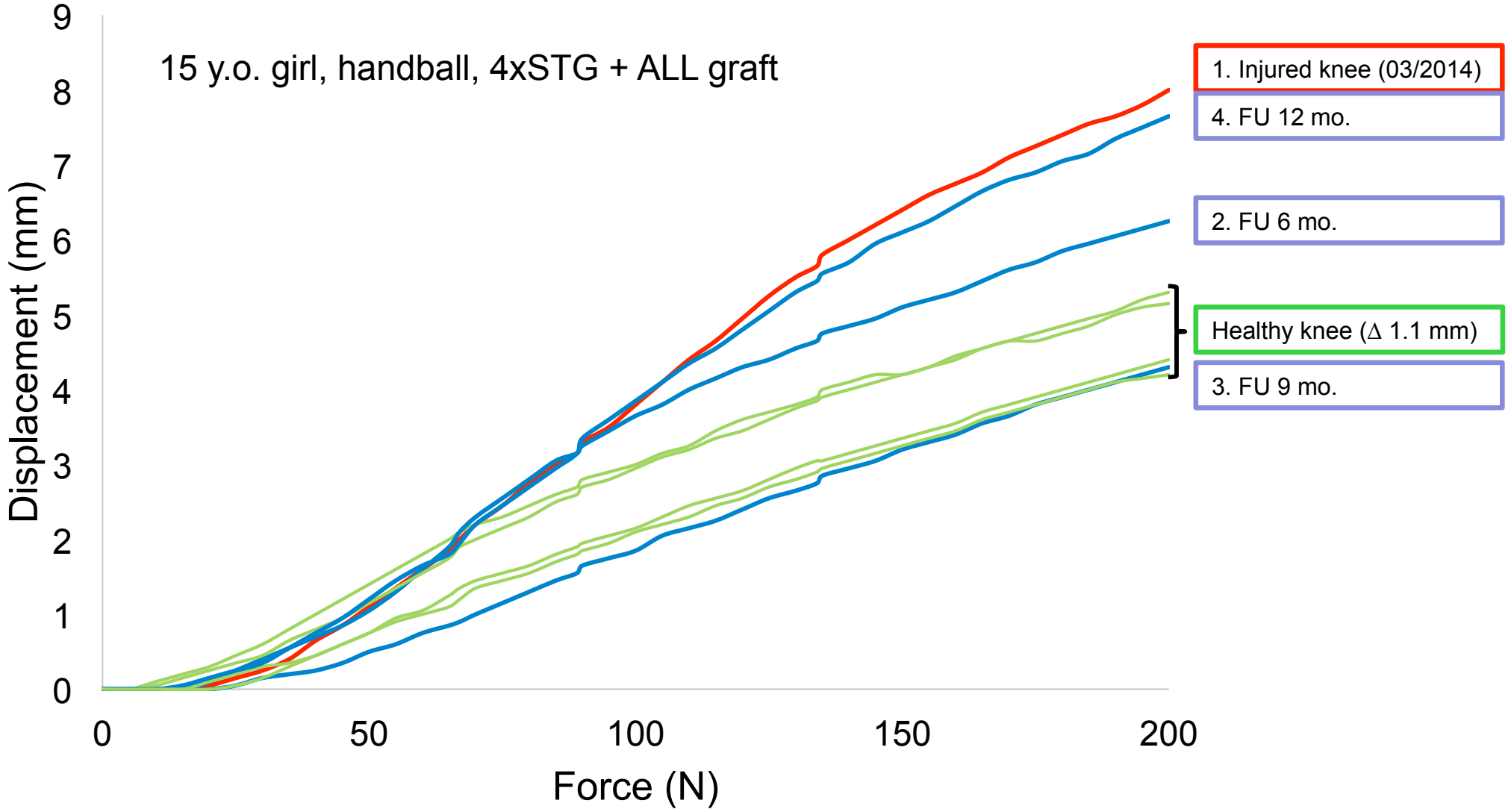
Longitudinal follow-up

Low failure risk case



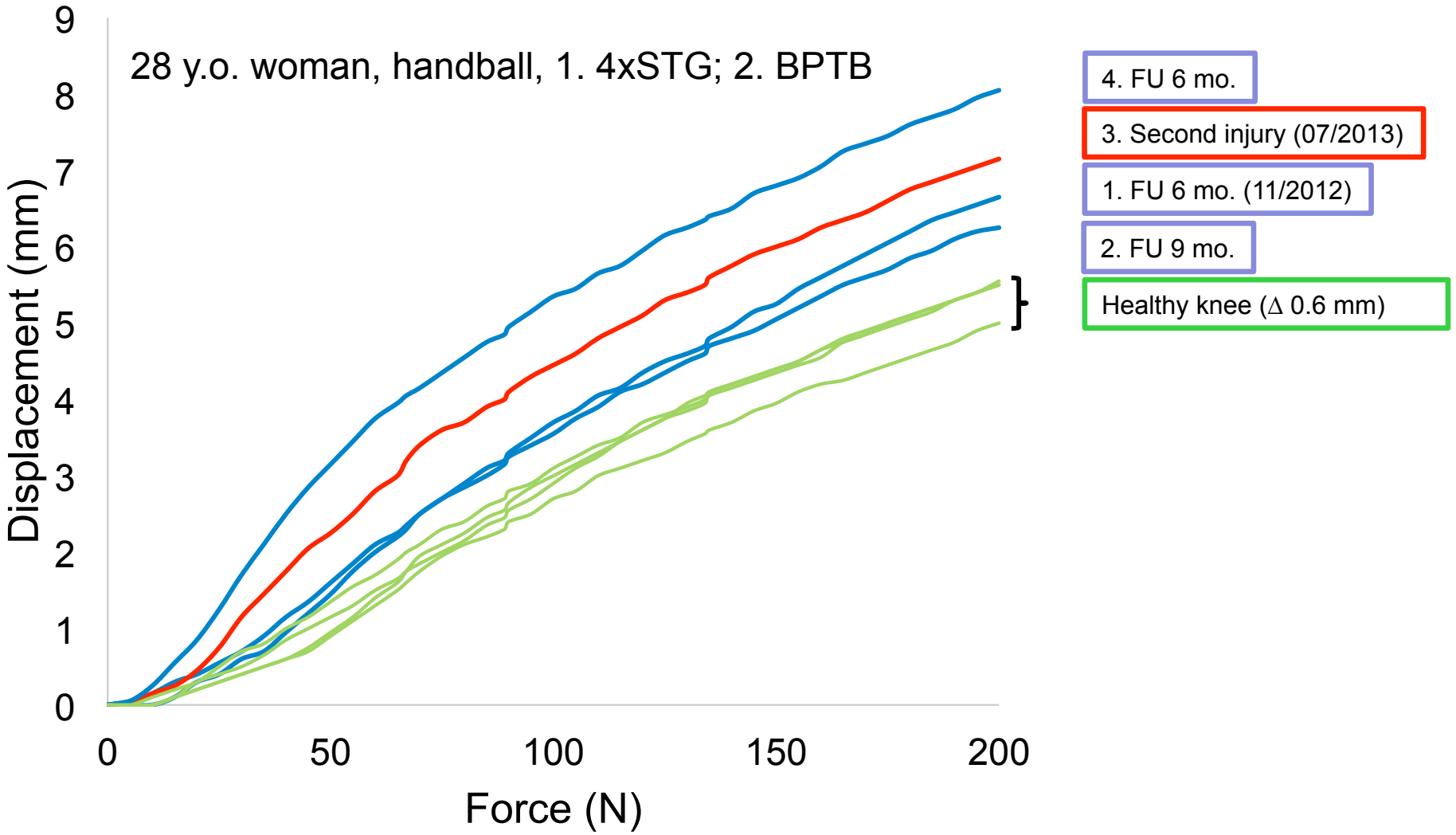
Longitudinal follow-up

High failure risk case



Longitudinal follow-up

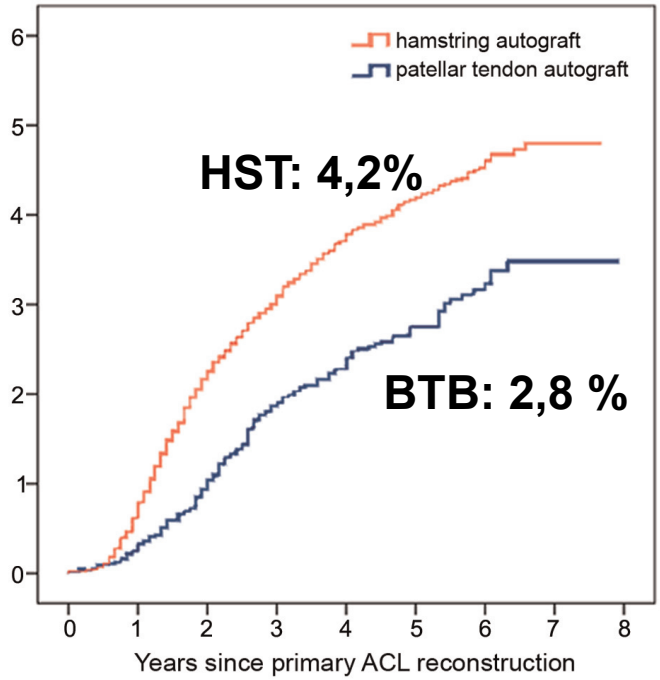
High failure risk case



Lower Risk of Revision With Patellar Tendon Autografts Compared With Hamstring Autografts

A Registry Study Based on 45,998 Primary ACL Reconstructions in Scandinavia

Tone Gifstad,[*†‡] MD, PhD, Olav A. Foss,[†‡] MD, PhD, Lars Engebretsen,[§] MD, PhD, Martin Lind,[‖] MD, PhD, Magnus Forssblad,[¶] MD, PhD, Grethe Albrektsen,[‡] PhD, and Jon Olav Drogset,[†‡] MD, PhD
Investigation performed at Trondheim University Hospital, Trondheim, Norway



Gifstad T, AJSM 2014

Results

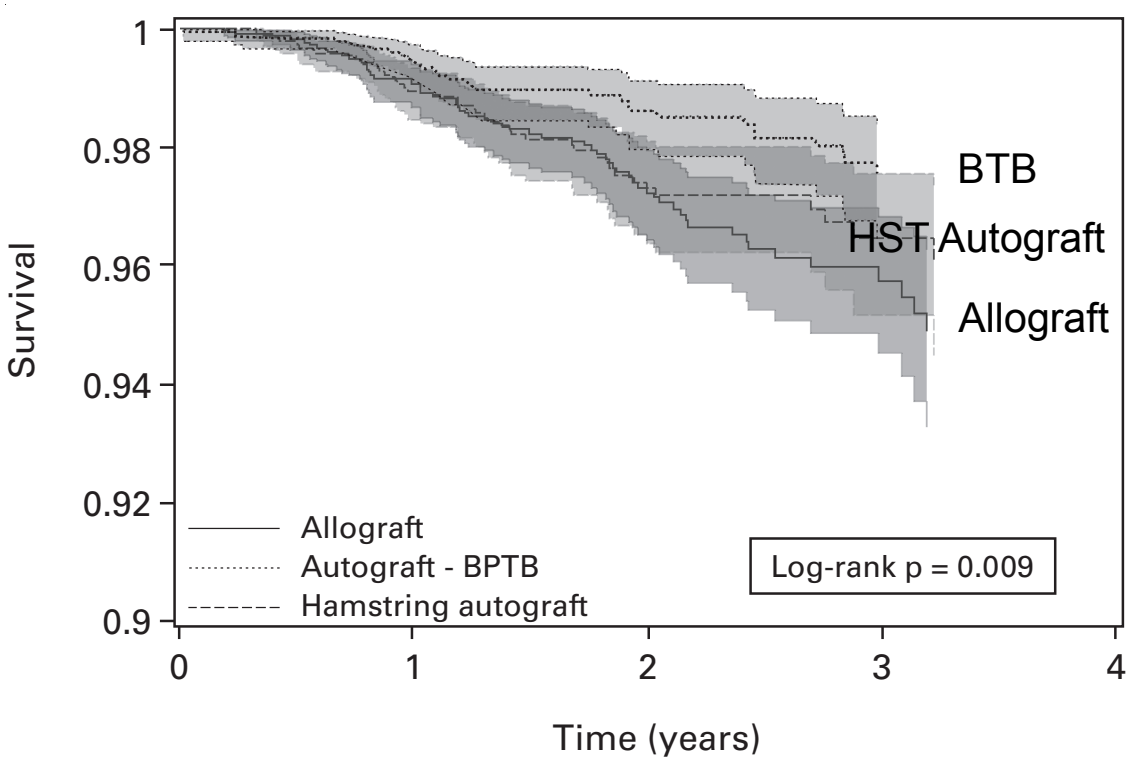
■ KNEE

Reconstruction of the anterior cruciate ligament

ASSOCIATION OF GRAFT CHOICE WITH INCREASED RISK OF EARLY REVISION

G. B. Maletis,
M. C. S. Inacio,
J. L. Desmond,
T. T. Funahashi

From Kaiser Permanente, San Diego, California, United States



Maletis G, BJJ 2013

Risk factors

Summary

↑ risk

- → Age (young)
- → Gender (female)
- → Laxity (recurvatum knee)
- → Graft type (hamstring tendon autograft, allograft)
- → Sports type (football)
- → Meniscus deficiency

↓ risk

- → Metal IF screw + hamstring tibia
- → Extraarticular procedure (ALL) (?)

Kim SJ, CORR 2010
Maletis GM, BJJ 2013
Andernord D, AJSM 2014
Robb C, KSSTA 2014
Sonnery-Cottet B, AJSM 2015

ACL revisions

→ Indications:

- → Functional instability (rotation)
- → Pain
- → Pain & instability
- → Limited ROM
- → Infections

Revision surgery depends on primary surgery

Preoperative planning

Preoperative planning

Mandatory to get the full picture !

Don’t get fooled by first impression !

Revision strategy

Preoperative planning

Clinical examination

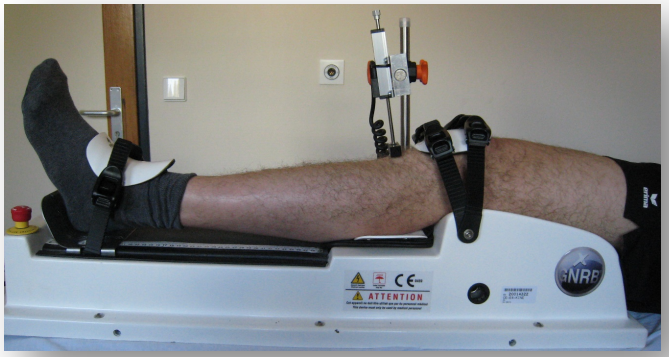
- ROM
- Frontal plane
- Sagittal plane
- Rotational

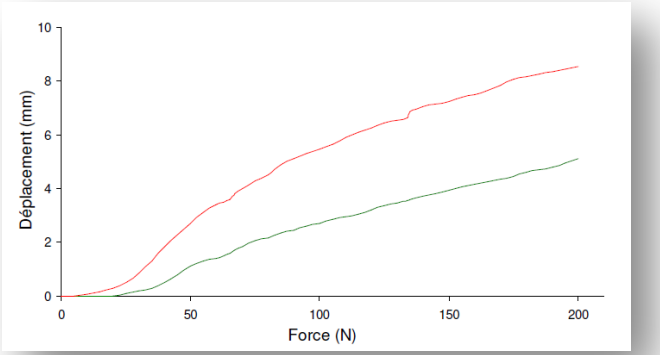
Preoperative planning

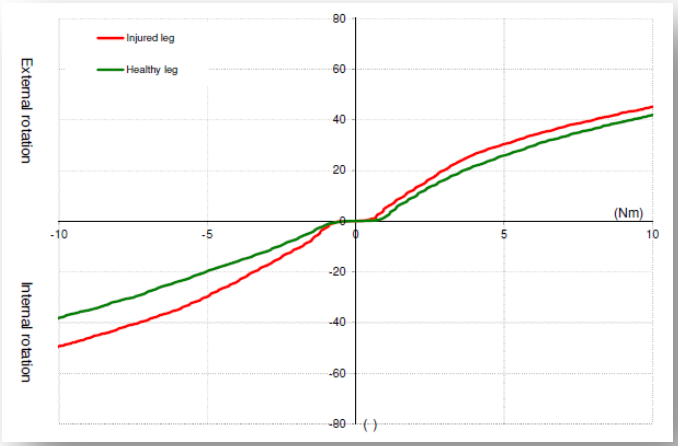
Clinical examination: gait

Preoperative planning

Clinical examination: instrumented laxity measurements

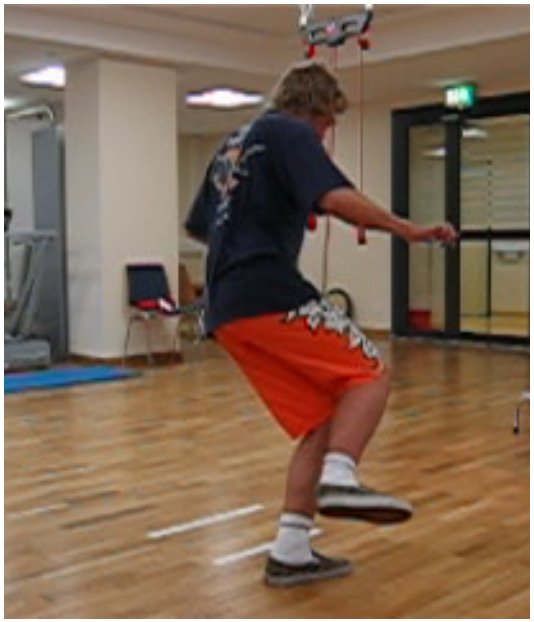






Preoperative planning

Clinical examination: functional evaluation



- ✧ neuromuscular control
- ✧ force (isokinetics) (LSI)
- ✧ Hop tests (LSI)
- ✧ Scores (IKDC, KOOS)

Preoperative planning

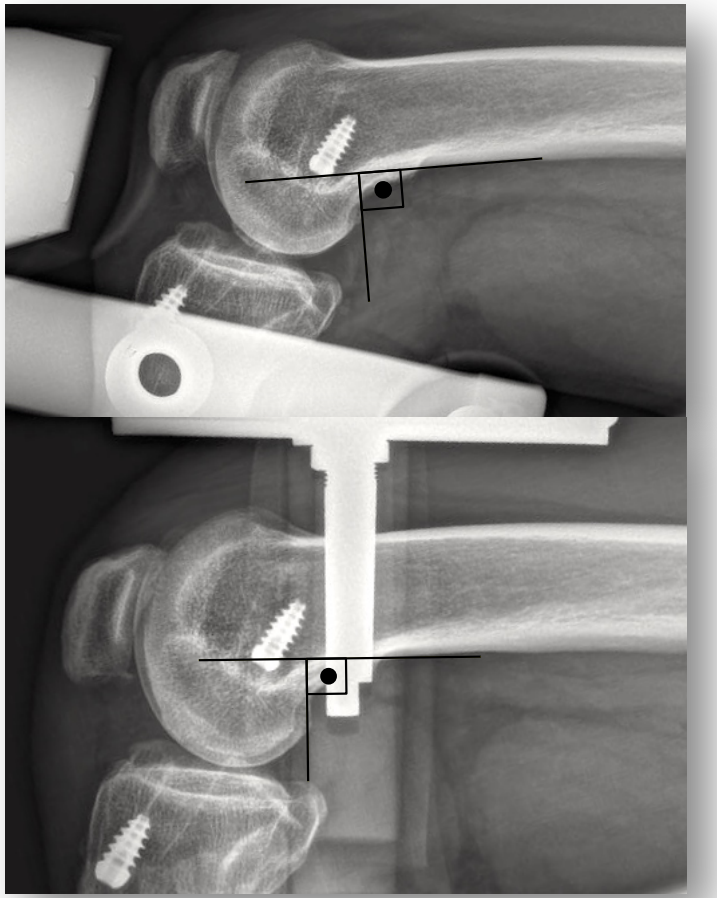
Imaging: standard radiographs

- AP, lateral, skyline, schuss
- Long leg standing radiograph

- Graft type
- Hardware
- Tunnel placement & widening
- Patellar height
- Bone quality
- OA & alignment

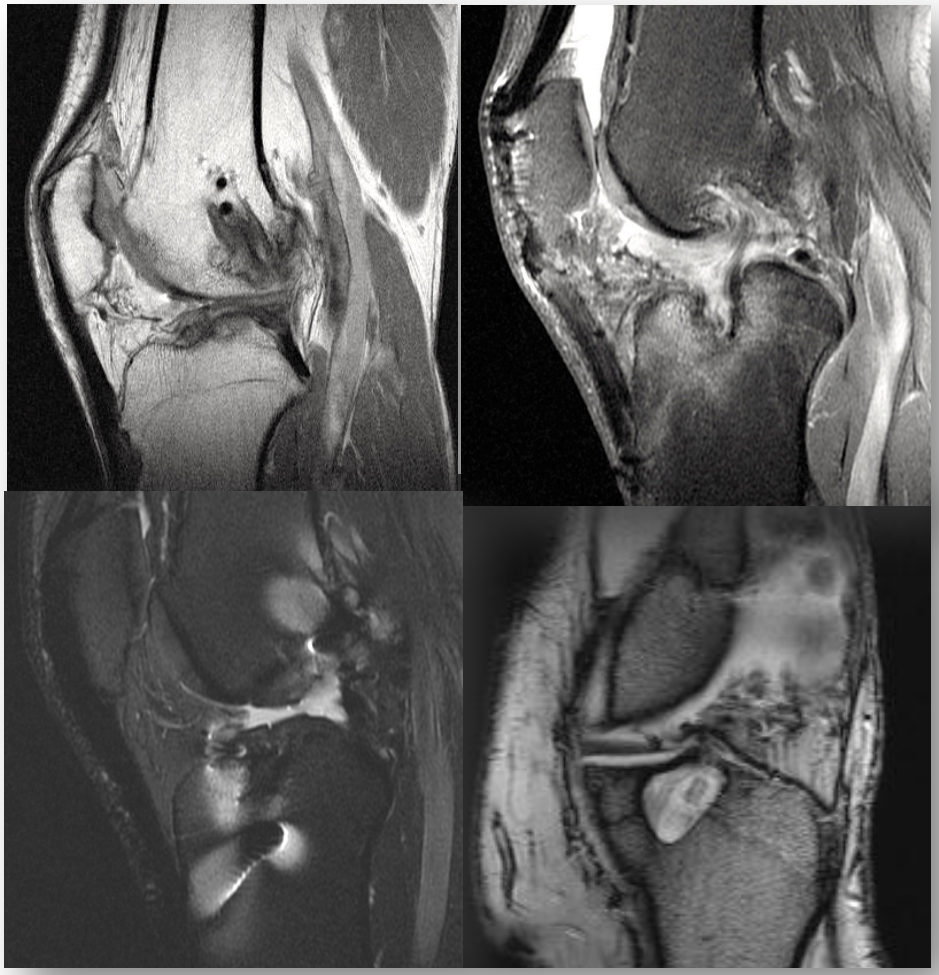
Preoperative planning

Imaging: stress radiographs



Preoperative planning

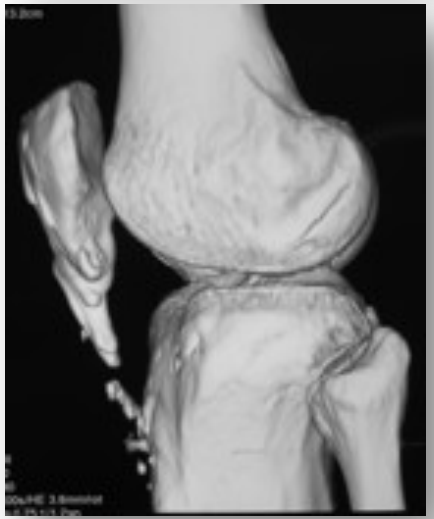
Imaging: MRI



- Graft type & integrity
- Fixation devices
- Tunnel placement & widening
- Bone marrow edema
- Cartilage
- Meniscus

Preoperative planning

Imaging: CT scan

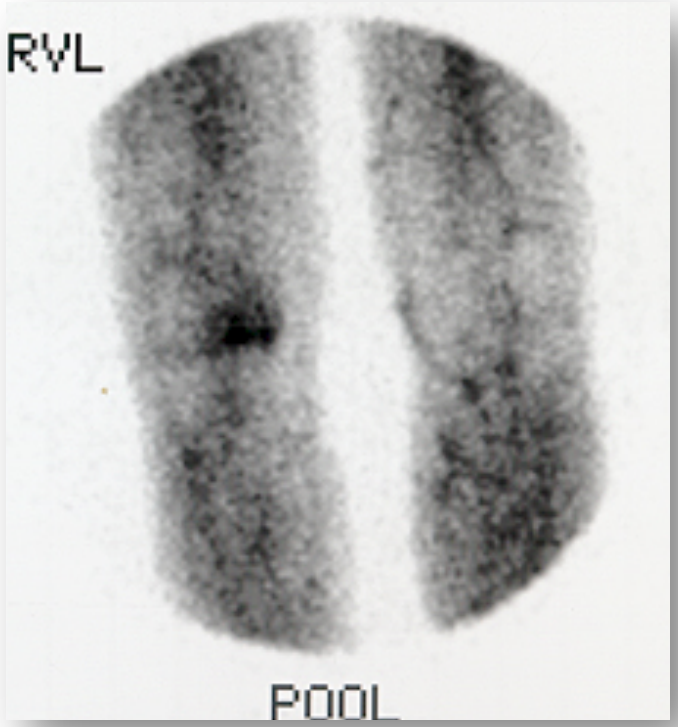


- Bone defects
- Ossifications
- Cartilage (arthro CT)

Courtesy of Prof. G. Camillieri, Rome, Italy

Preoperative planning

Imaging: bone scan (scintigraphy) / SPECT CT

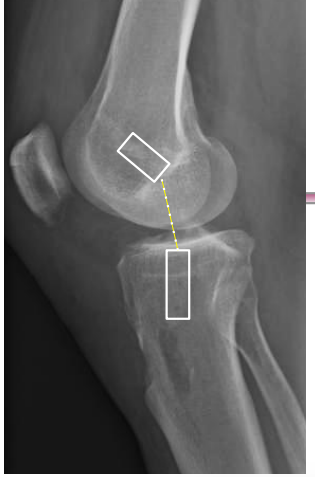


- Compartment overload
- OA
- Infection
- CRPS

Preoperative planning

1 vs. 2-stage revision ?

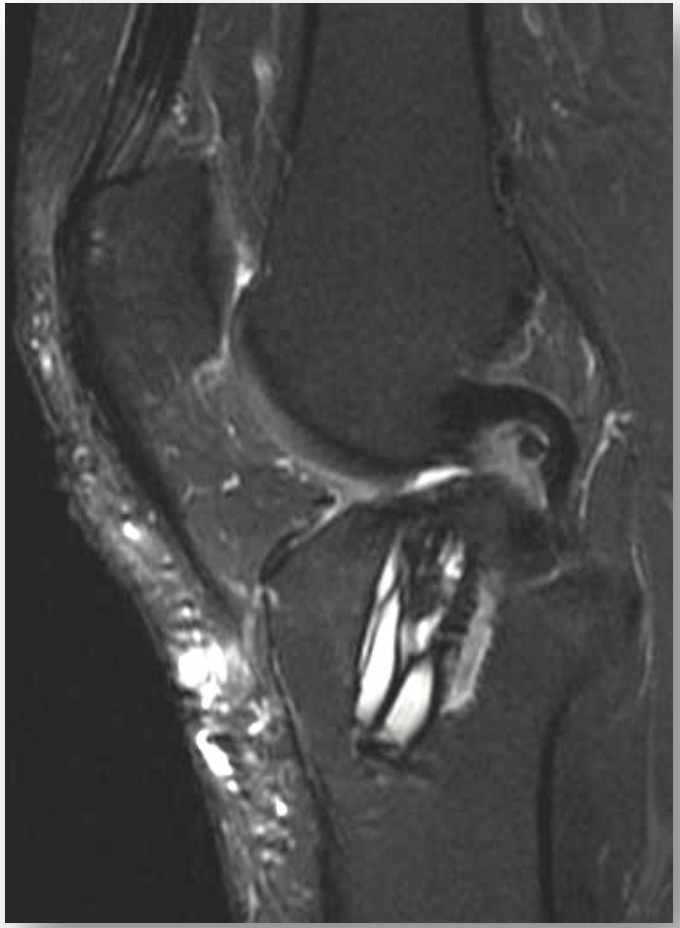
- > 90% 1-stage revision surgery
- 2-stage if:
  - Tunnel enlargement
  - Bone loss
  - Artificial ligament
  - Technical problems
  - Limited ROM

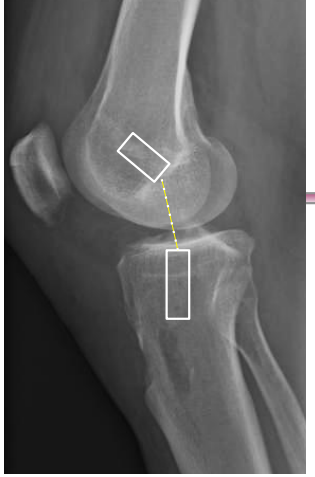


Revision strategy

Preoperative planning

2-stage revision





Revision strategy

Preoperative planning

2-stage revision

Surgical technique

→ Graft selection

→ Skin incision

→ Hardware removal

→ Notchplasty

→ Tunnel placement

→ Graft fixation

Strategy

Thumbrule surgical strategy

- Plan hardware removal
- Tunnel management before graft harvesting

Revision ACL-reconstruction:

1. Confirmation of diagnosis
2. Hardware removal
3. Repair of associated injuries
4. *Tunnel management*
5. *Graft harvesting*
6. Graft fixation

Graft type

Thumbrule graft sequence

Hamstrings

⇩

Patellar tendon

⇩

Quadriceps

→ BPTB

→ ST/G

→ Quadriceps

→ Allograft

→ Contralateral grafts

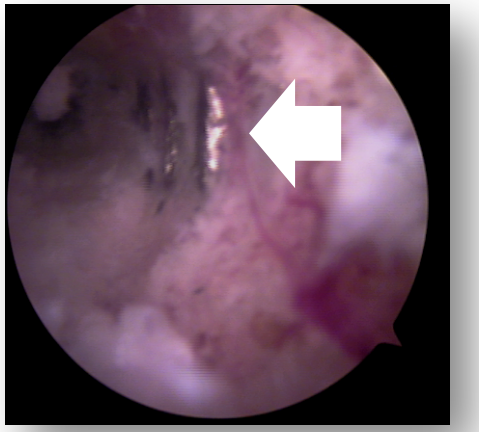
Strategy: hardware removal

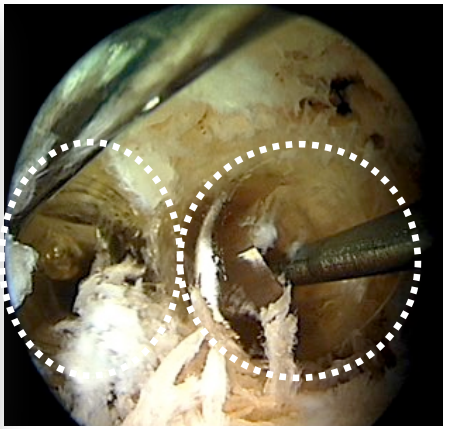
✧ Specific instruments (screwdrivers)

✧ Sometimes removal not required

→ no interference

→ better tunnel stability





Beware metal debris

Strategy: tunnel management

If previously correct → use the same !

Correct

Wrong

Tibia: Stäubli HU, Rauschning W, KSSTA 1994
Femur: Bernard M, Hertel P, Am J Knee Surg 1997

Strategy: tunnel management

If previously uncorrect → the worse the tunnel placement, the easier the revision

Check bone quality (bone bridges)

If too wide → bigger bone block

→ bone grafting

→ 2-step

→ change technique

(hardware, 2 incision, over the top)

Strategy: tunnel management

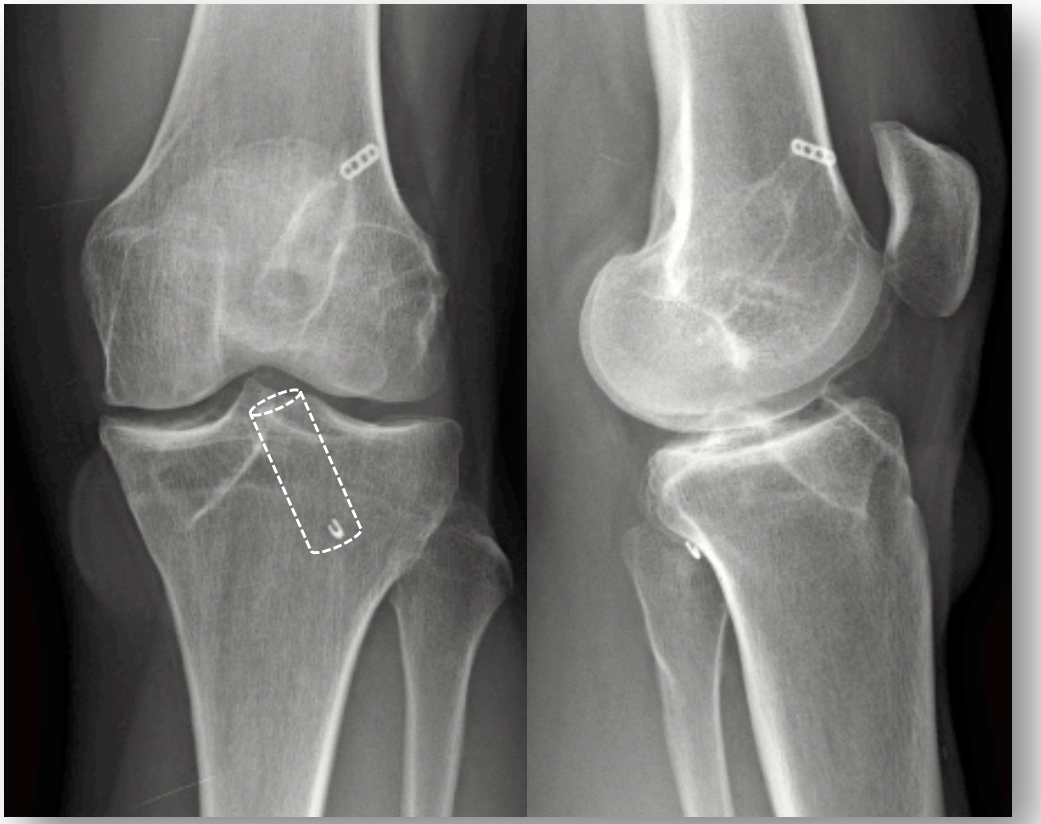
Evaluate bone healing capacity & tunnel stability

Strategy: tunnel management

Tibia: too posterior → new anterior or bone grafting

Strategy: tunnel management

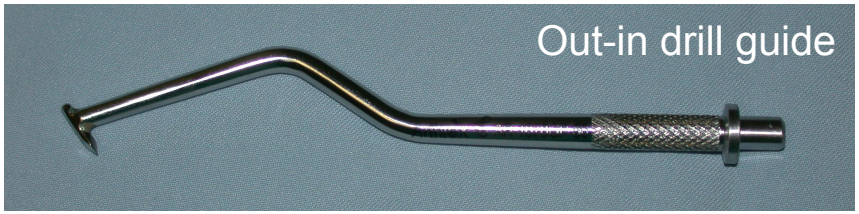
Tibia: too medial → consider lateral



Van der Bracht H, Arthroscopy 2012; Acta Orthop Belg 2012

Strategy: tunnel management

Femur: too posterior → out-in tunnel or extracortical

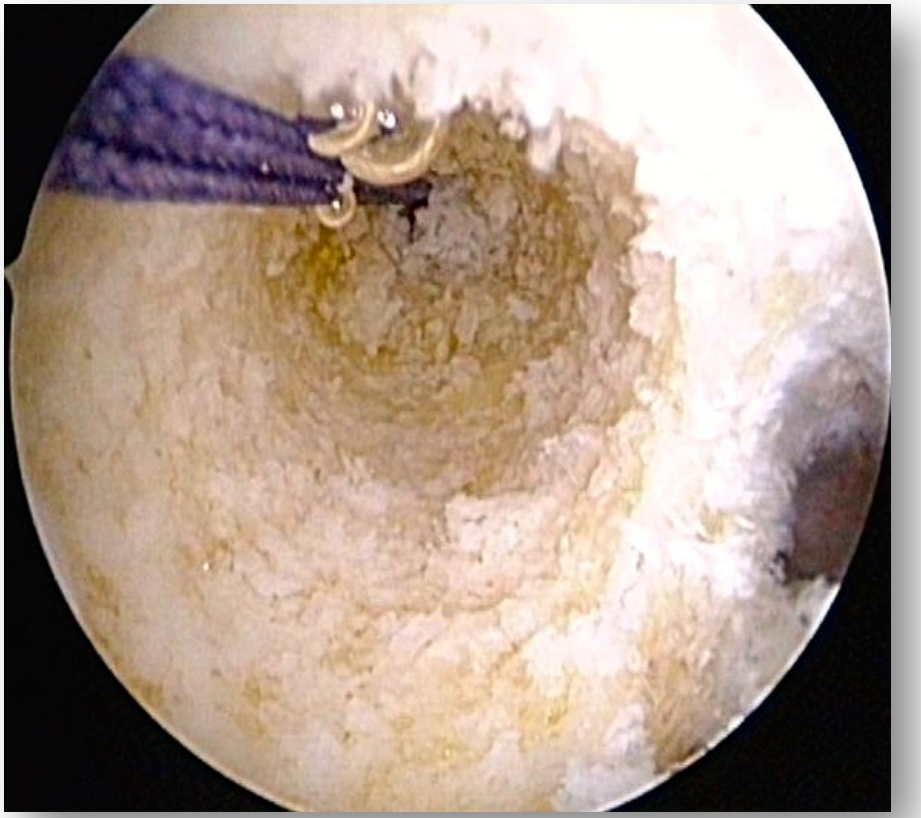


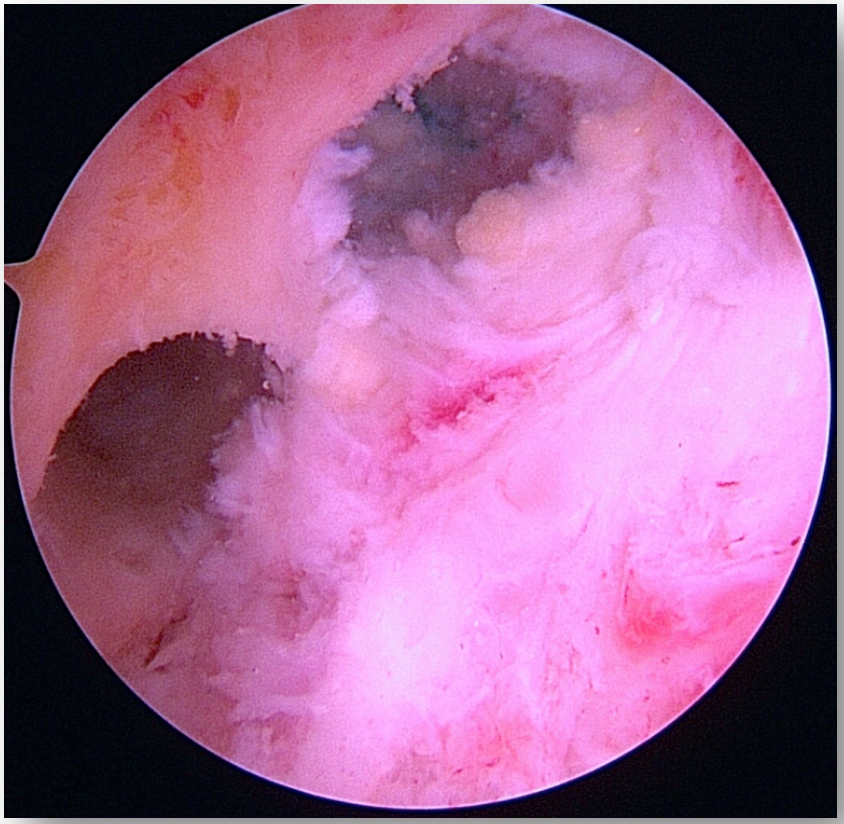
- Fractures of posterior wall (posterior blow out)

  (1,2 % Almazan A, Arthroscopy 2006)

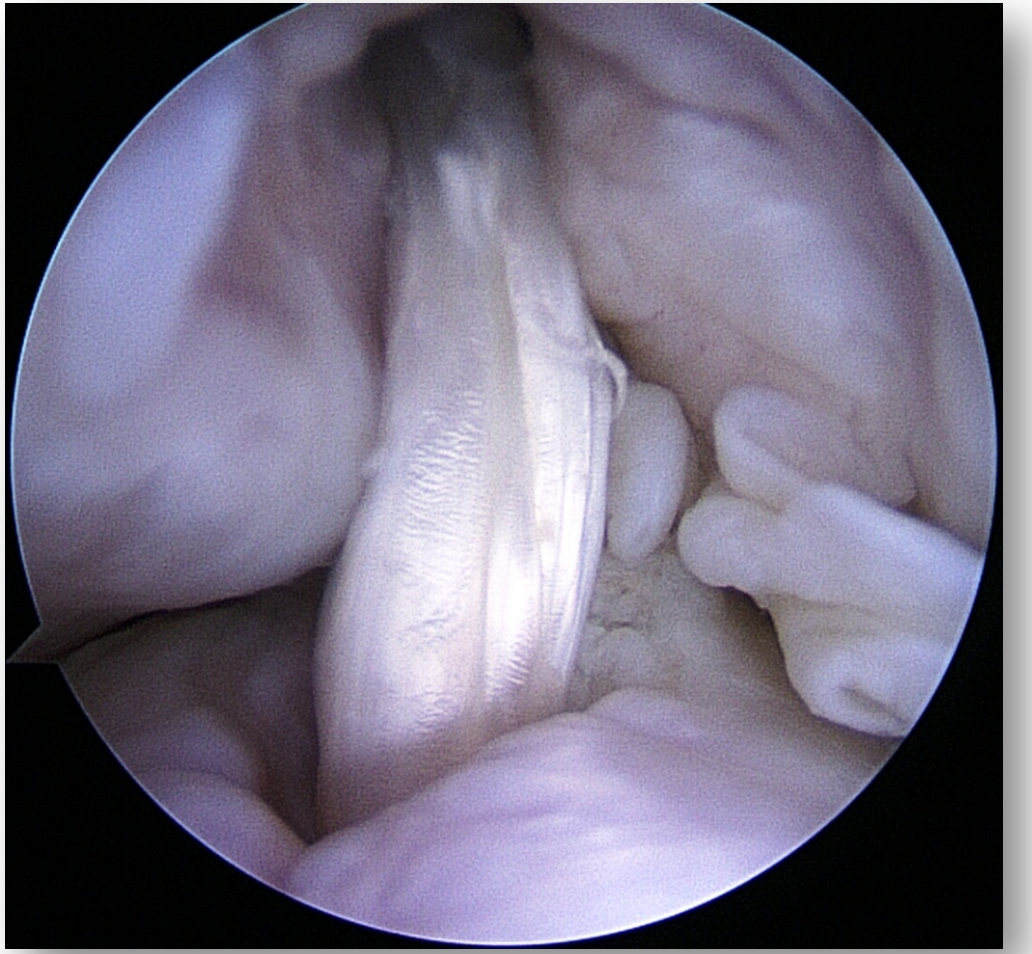
- Alternatives: Out-in drill guide
  Extracortical fixation techniques

Strategy: tunnel management





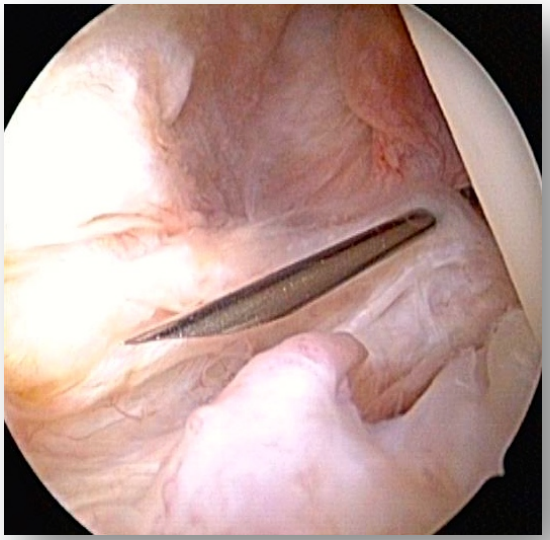
Strategy: notchplasty

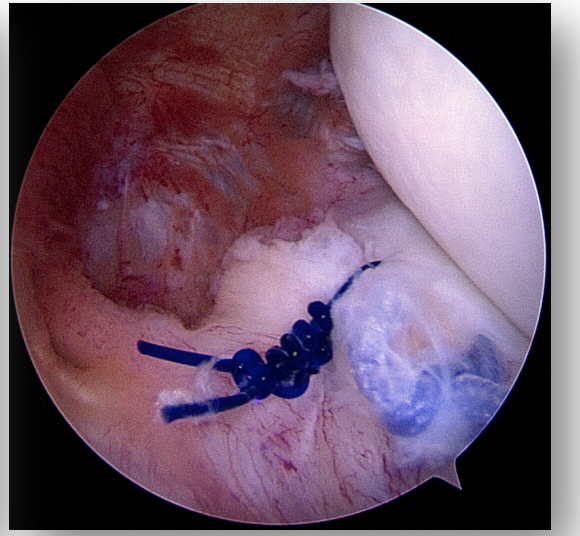


Strategy: graft fixation

- ✧ Usually similar to primary procedures
- ✧ Several solutions available (IF screws, extracortical fixations with buttons, lag screws, …)

Strategy: associated procedures



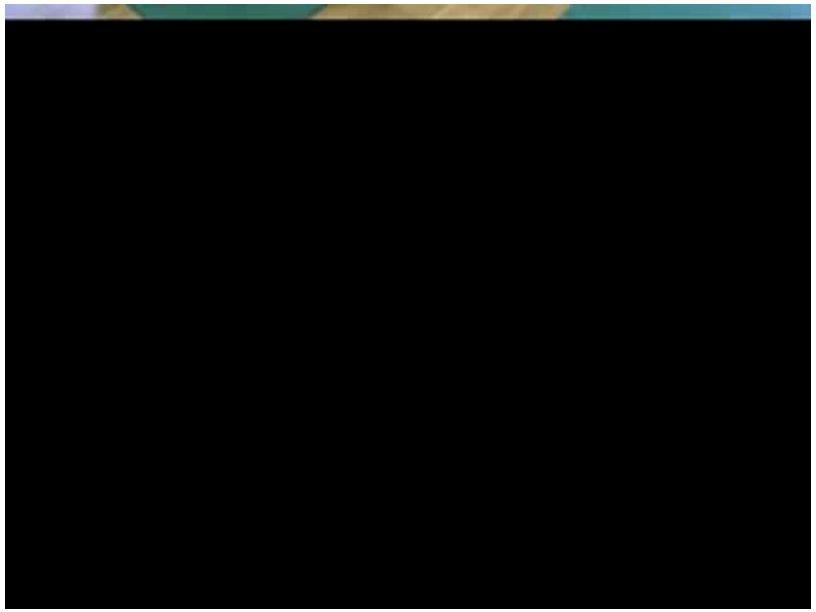


- Meniscus
- EAP
- Cartilage
- Osteotomy
- Other ligaments

SLROMS

Société Luxembourgeoise de Recherche en Orthopédie et en Médecine du Sport a.s.b.l.

1st Return-to-Sports Group Luxembourg



1-stage revision

- Free ROM
- Full weightbearing as tolerated (except massive bone graft)
- Brace only if associated meniscal repair
- Jogging at 3 months
- Sports at 6-9 months

Outcome

3 categories

60 % ✧ Similar to primary ACL-R
(correct anatomic position, good quality bone, limited associated injuries)

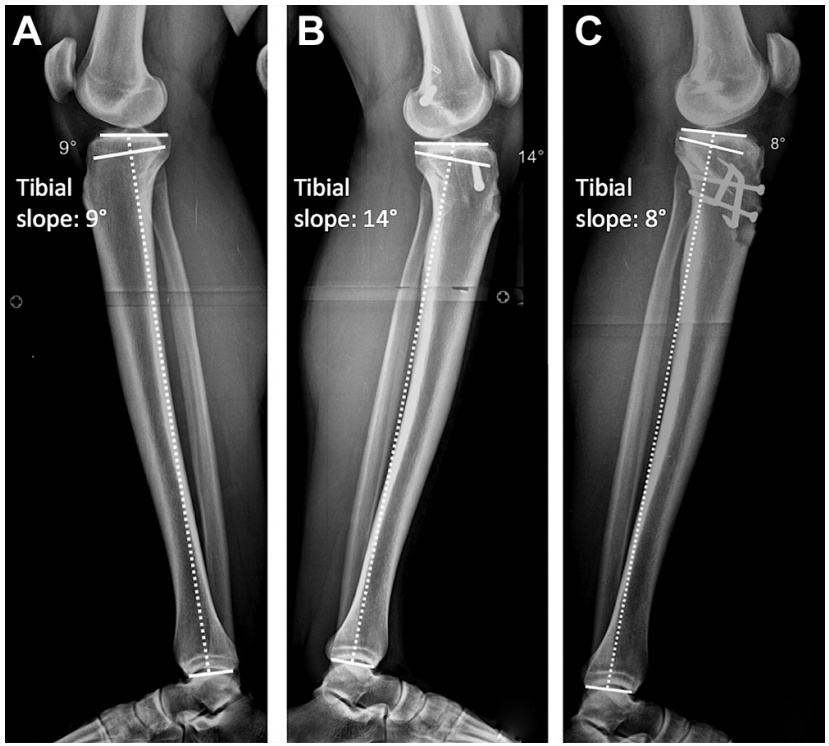
30 % ✧ More limited but still encouraging
(complex multiligament instabilities, major cartilage lesions, limited quality bone stock, long standing symptoms of instability and pain)

10 % ✧ Salvage procedure, limited-goal surgery
(associated osteotomies or meniscus transplantations may be required)

Feucht MJ, KSSTA 2014
Shelbourne KD, AJSM 2014
Sonnery-Cottet B, AJSM 2014

Proximal Tibial Anterior Closing Wedge Osteotomy in Repeat Revision of Anterior Cruciate Ligament Reconstruction

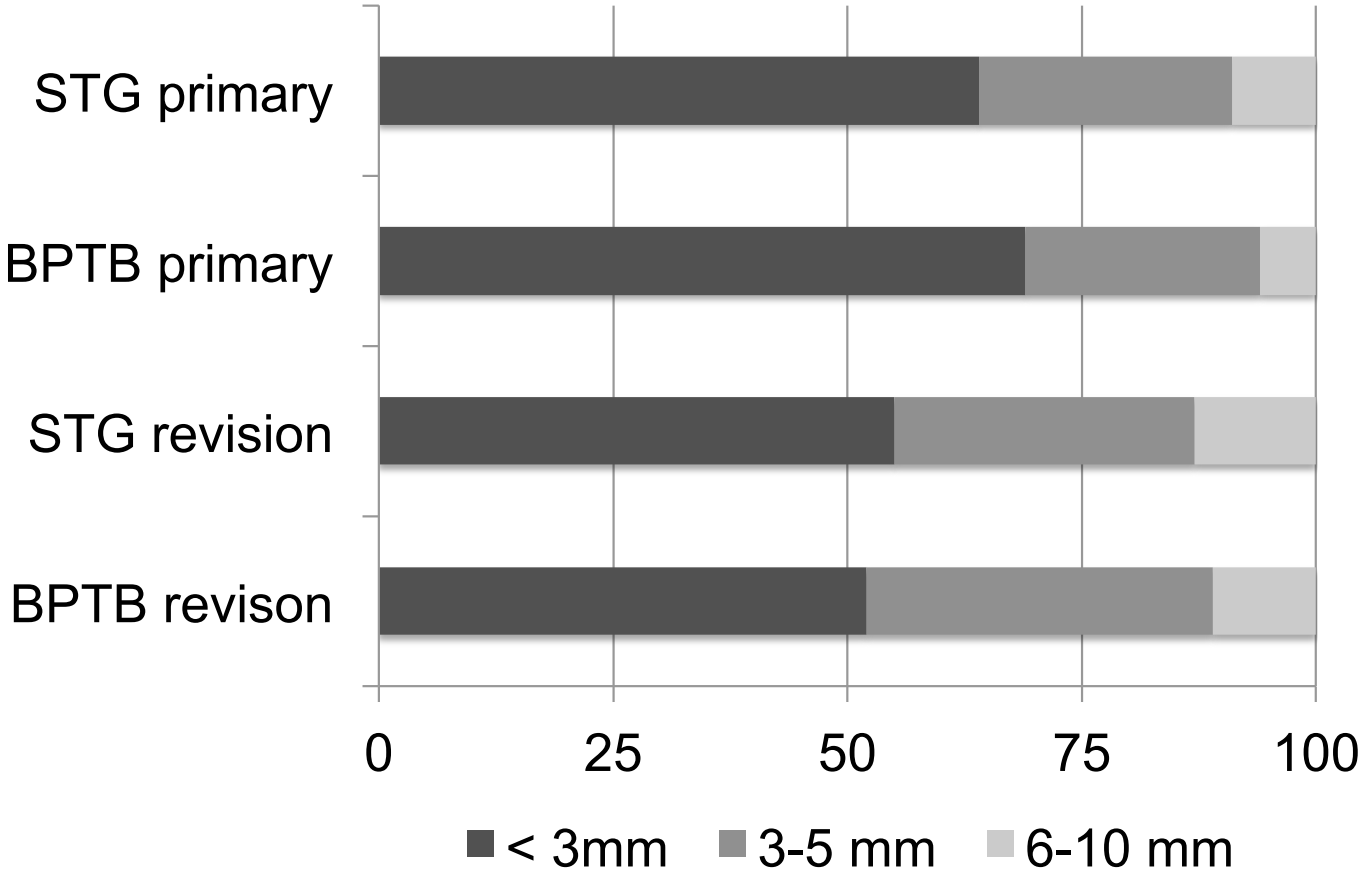
Bertrand Sonnery-Cottet,*† MD, Stefan Mogos,† MD, Mathieu Thaunat,† MD, Pooler Archbold,‡ MD, Jean-Marie Fayard,† MD, Benjamin Freychet,† MD, Julien Clechet,† MD, and Pierre Chambat,† MD
Investigation performed at the Centre Orthopédique Santy and Hôpital Privé Jean Mermoz, Lyon, France



- 5 patients, min. 2 ACLs; all tibial slope > 12°
- IKDC (subj.): 40 → 80
- Laxity: 10,4 → 2,8

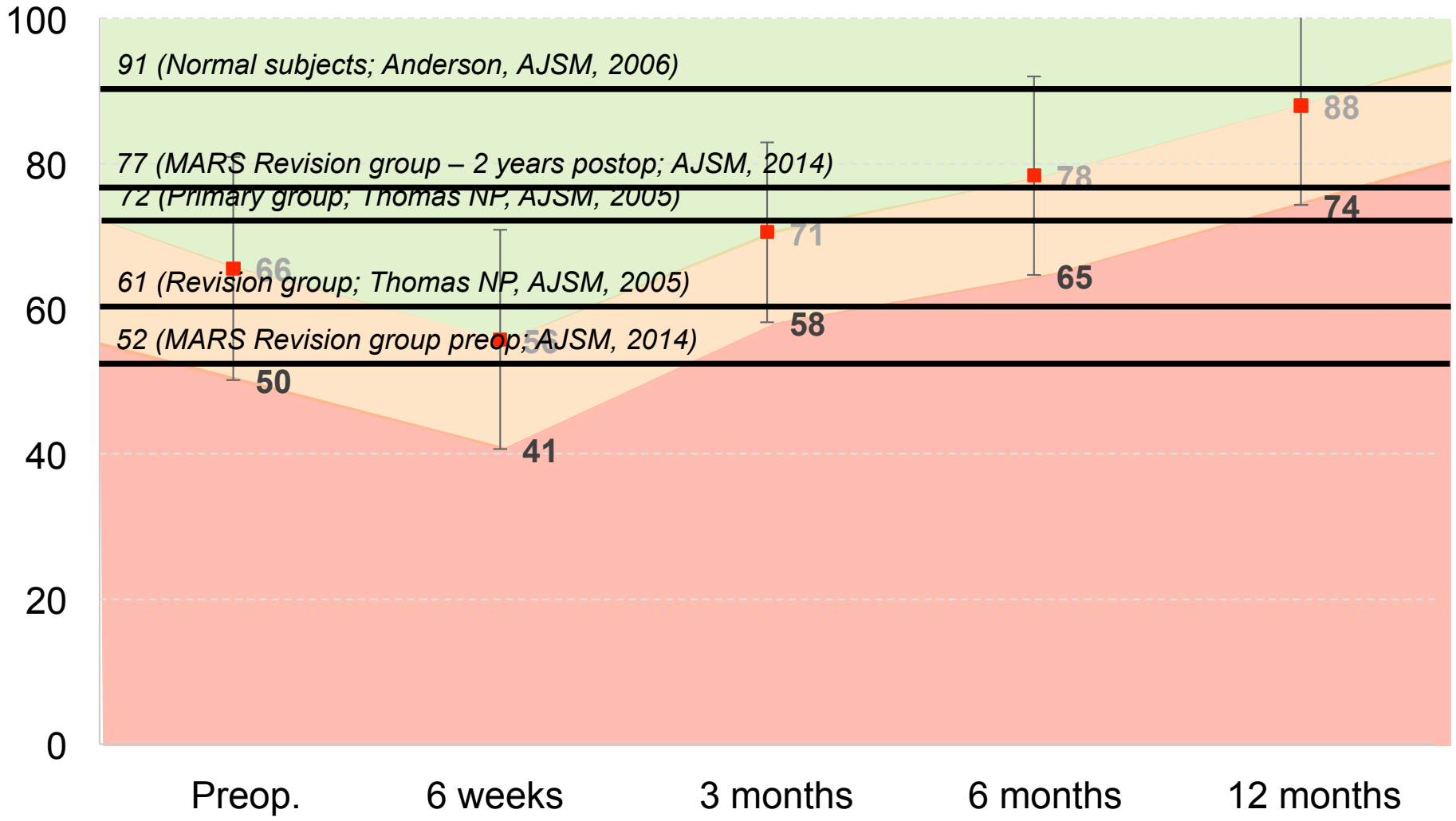
Sonnery-Cottet B, AJSM 2014

Laxity



Denti M, AJSM 2008
Denti M, KSSTA 2006

Function: IKDC



Primary ACL-R group Luxembourg, unpublished data

ACL revisions

- Can be challenging
- Understand symptoms & failure causes
- Preoperative planning
- Always consider plan B (2-stage procedure)
- Normal knee function can be expected in majority of cases
- Prognosis depends on associated lesions
- Some cases with salvage procedure

European Society of Sports Traumatology, Knee Surgery & Arthroscopy

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INTER CONGRESS
inspires. effects!

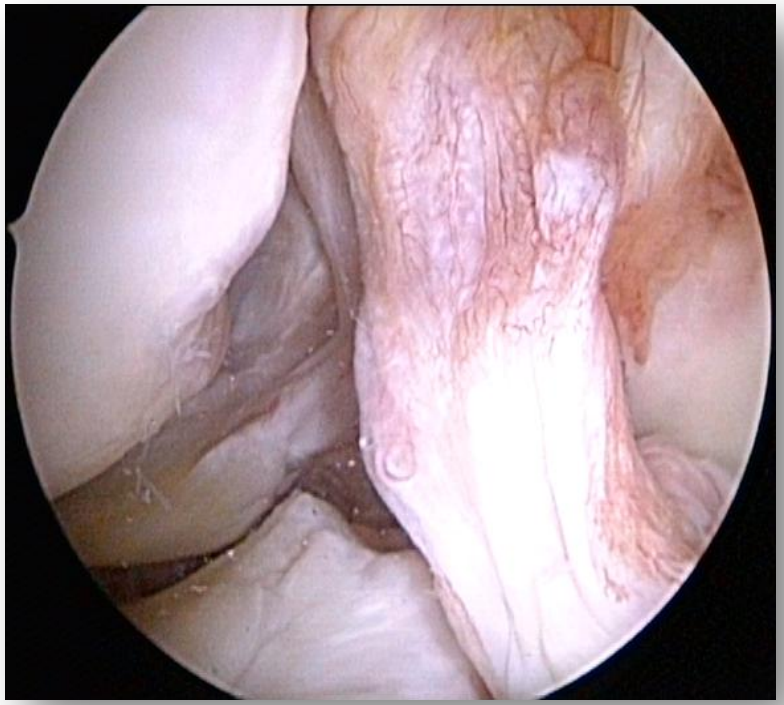
Strategy: hardware removal

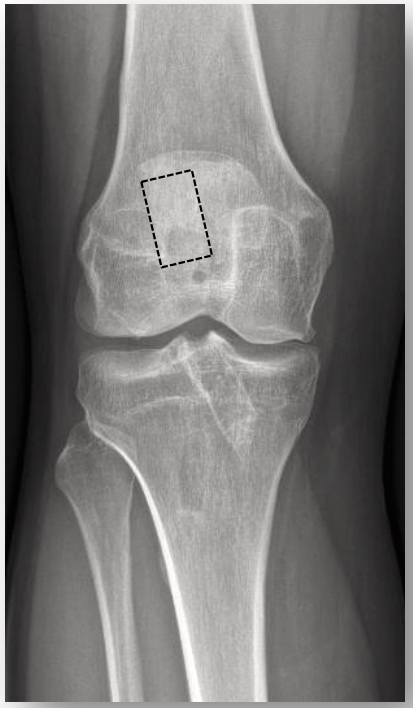
Revision surgery should be considered during the development phase of primary ACL-R techniques

Strategy: tunnel management

Tibia: too anterior → new posterior

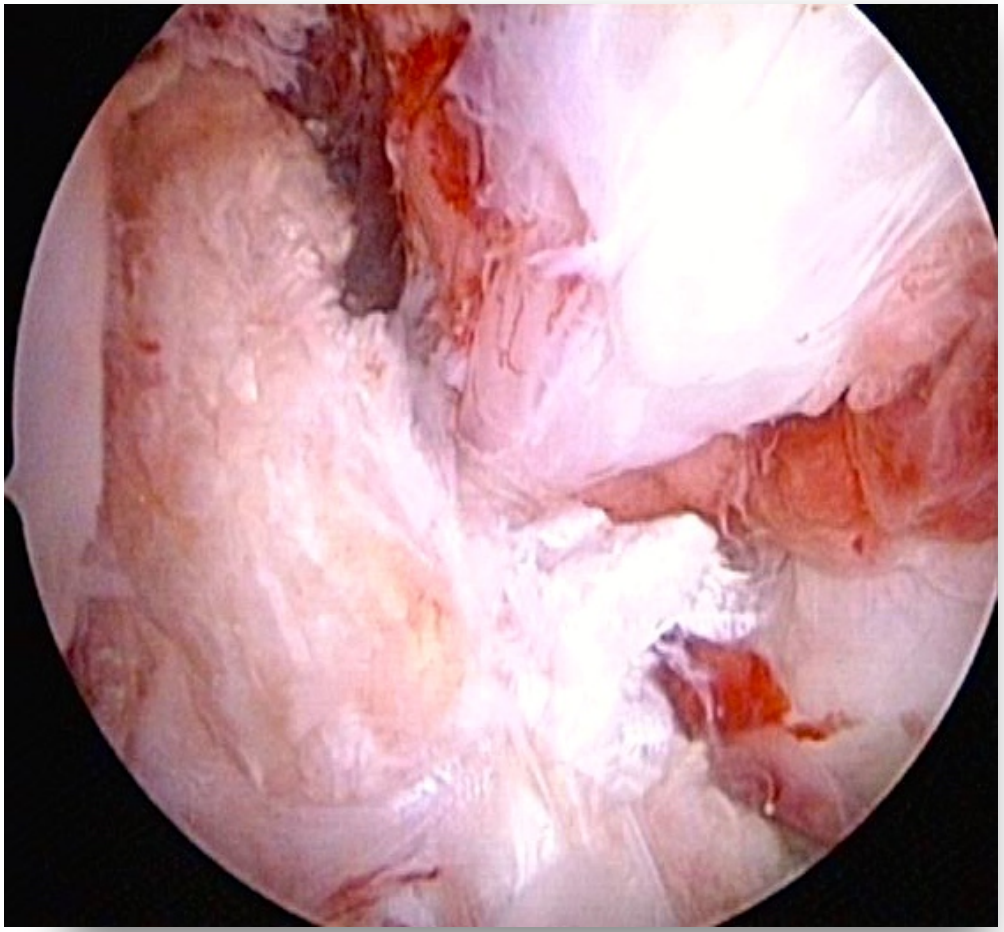
ACL-retear
34 y. old man





Rotational instability

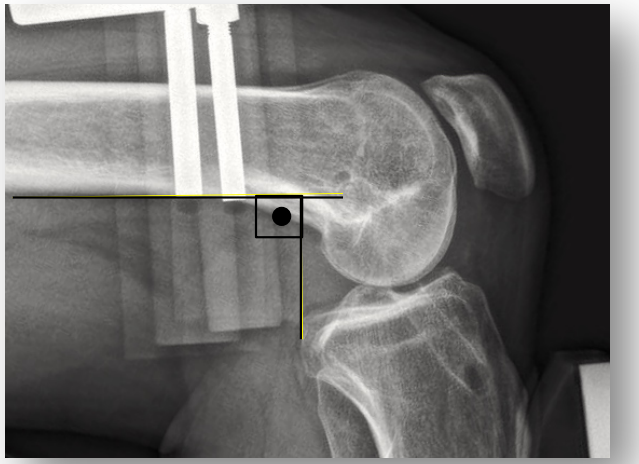
ACL-retear
34 y. old man



Quadriceps tendon graft

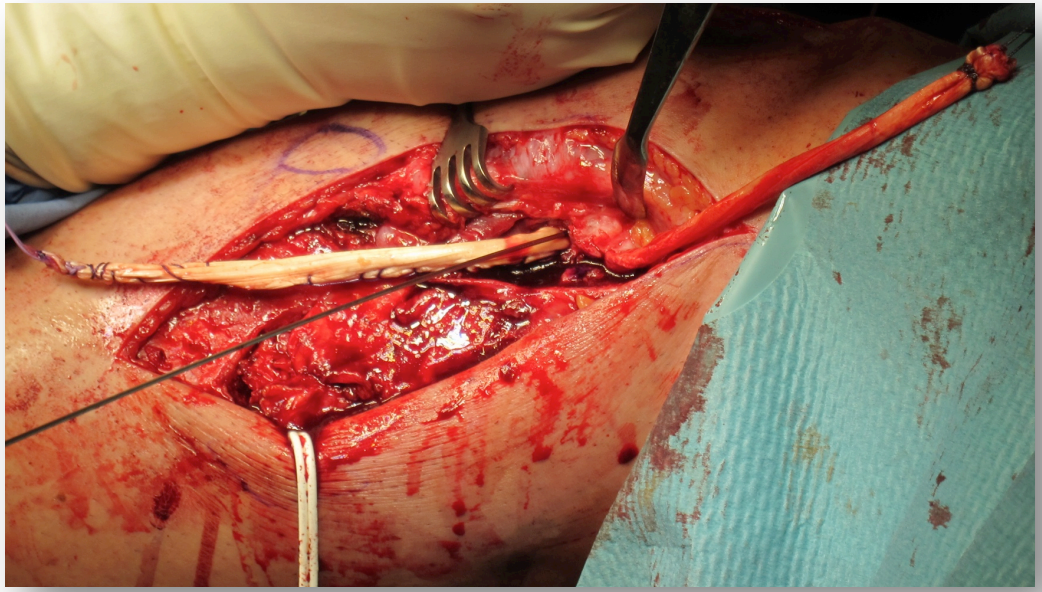
ACL-retear + PCL/PLC-injury

Some cases



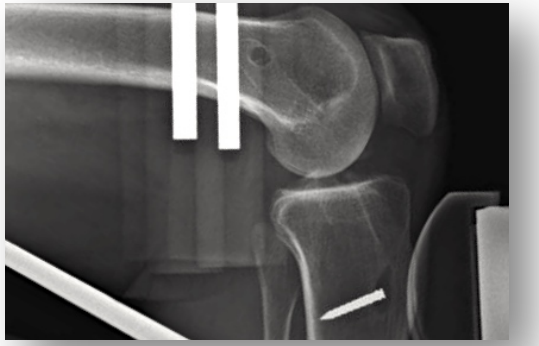
Some cases

ACL revision, PCL, LCL, posterolateral



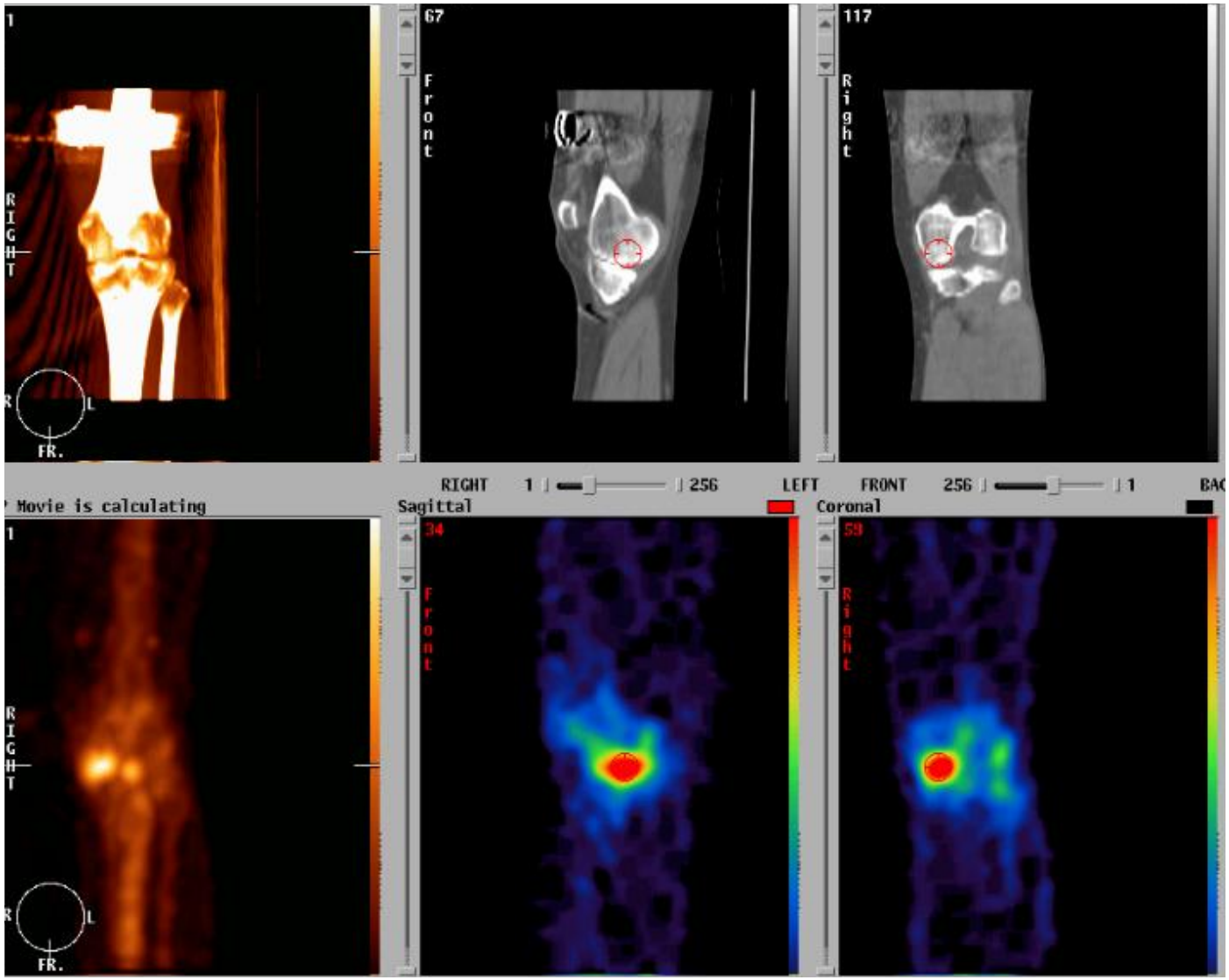
Some cases

♀, 42 y., painful instability; ACL retear

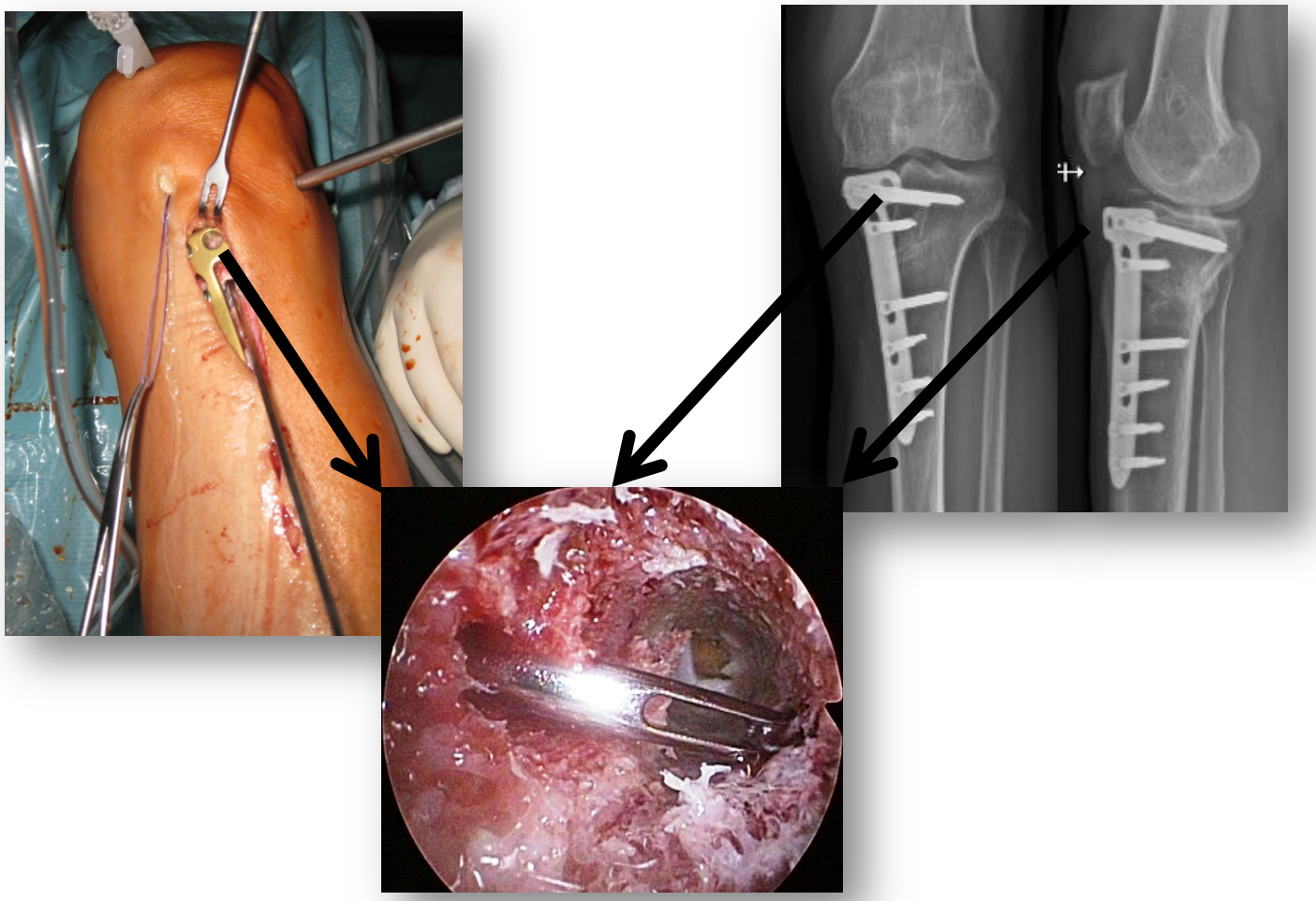


Some cases

ACL-retear +
medial compartment overload



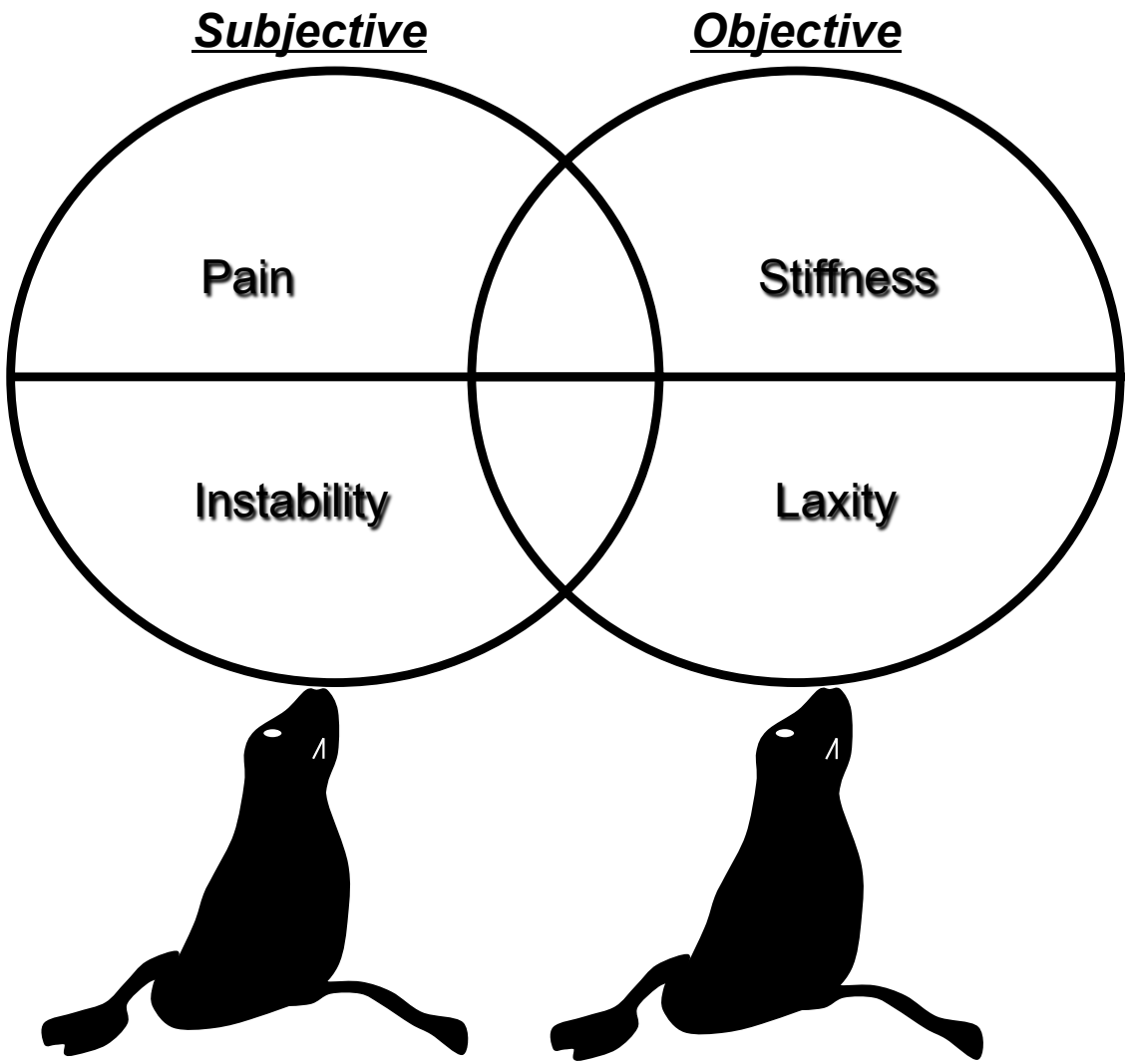
Valgus HTO (no slope change)+ R-ACL



Strategy: tunnel management

Femur: too anterior / vertical → new posterior / horizontal

ACL revisions



Harner CD, 1996