



International Society For  
Computer Assisted Orthopaedic Surgery



# Dynamic ultrasound imaging in ACL lesions and preoperative decision making

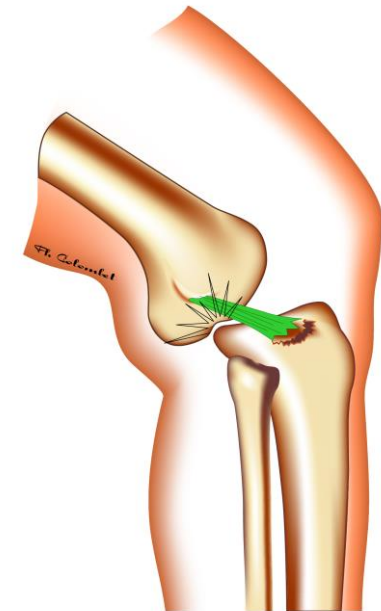
Burt Klos

Stephan Konijnenberg

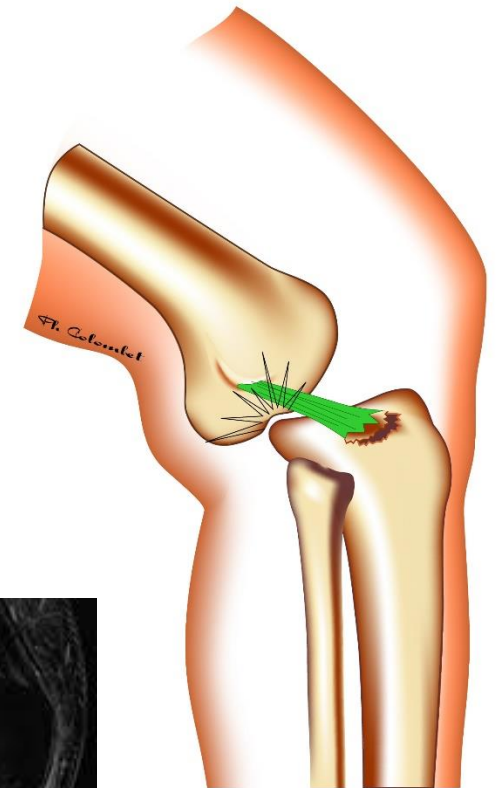
The Netherlands



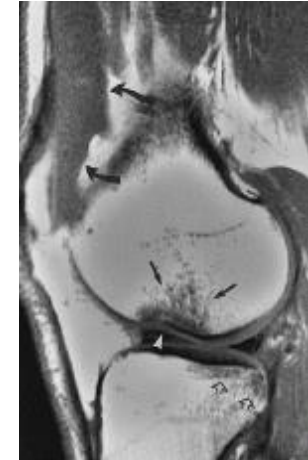
ICONE



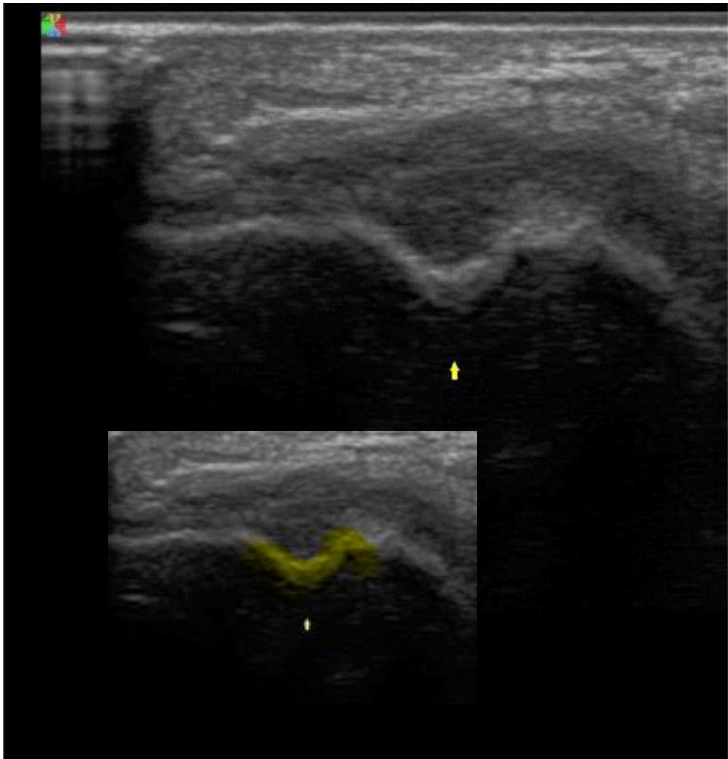
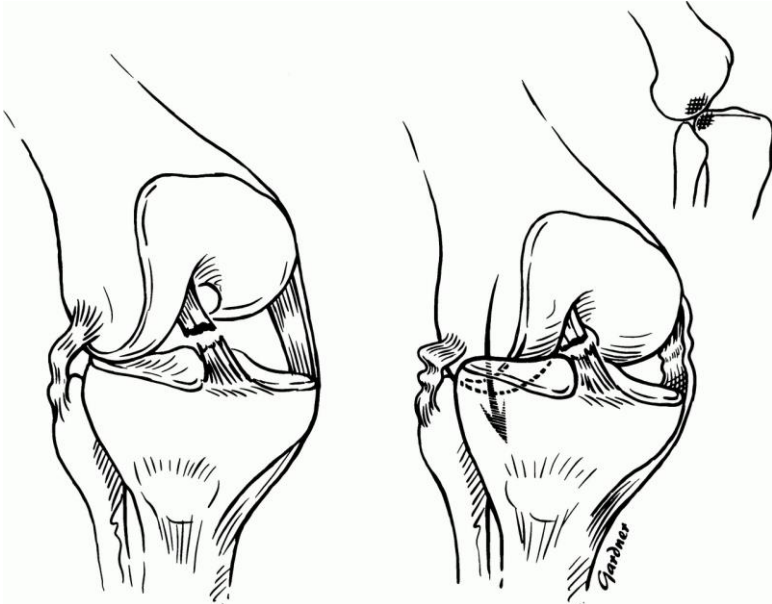
# Primary injury / plain X ray information



# Segond and Impression fractures



# Impaction lateral FC



In flexion

- Anterior meniscus
- ACL
- Bone lesions

Prone

- Posterior meniscus
- PCL



# HR Dynamic Ultrasound

- Meniscus video

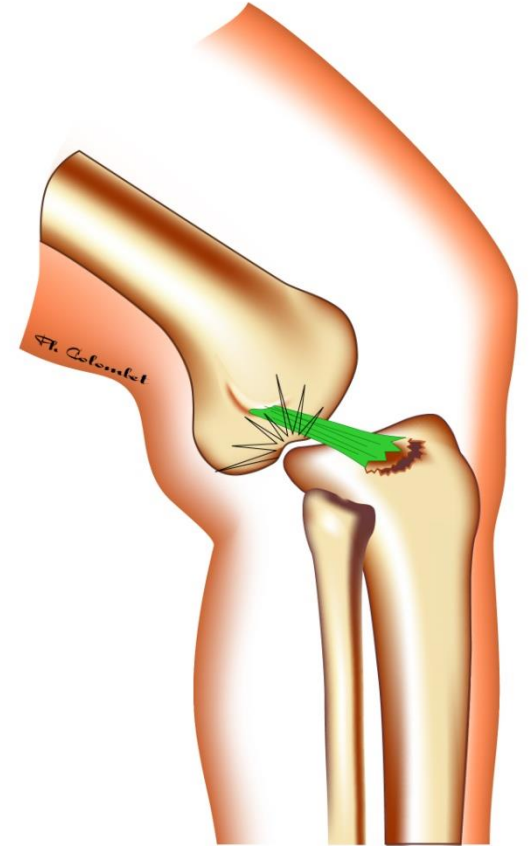
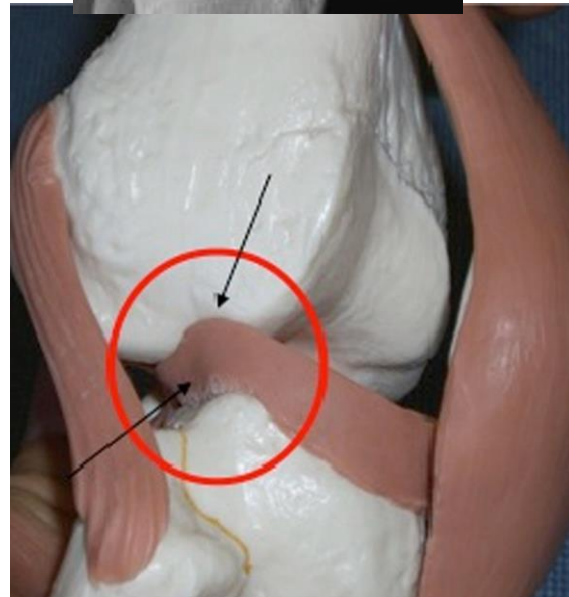
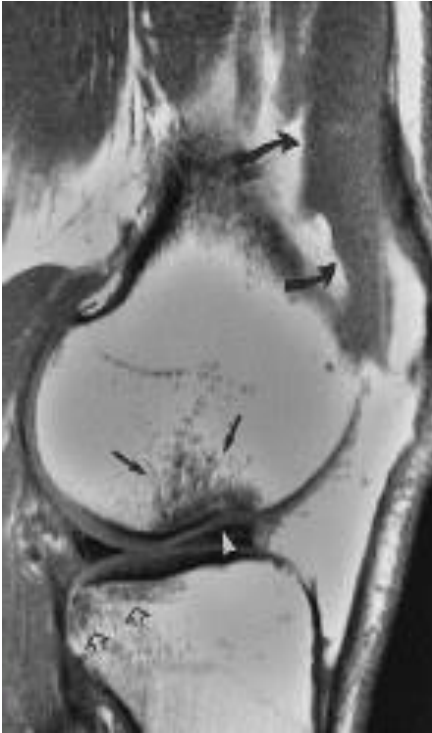




MRI	Echografie
Expensive	Cheap
Extensive information	Focused information
Static	Dynamic
No intervention	Intervention possible (injection)
Availability / waiting time	Depending local situation / less waiting
Patient no interaction Claustrobic ( 5 % )	Patient friendly Interactive .
Patient passive role	Interactive role patient



# Combined lesions.



# Misunderstanding Knee Imaging

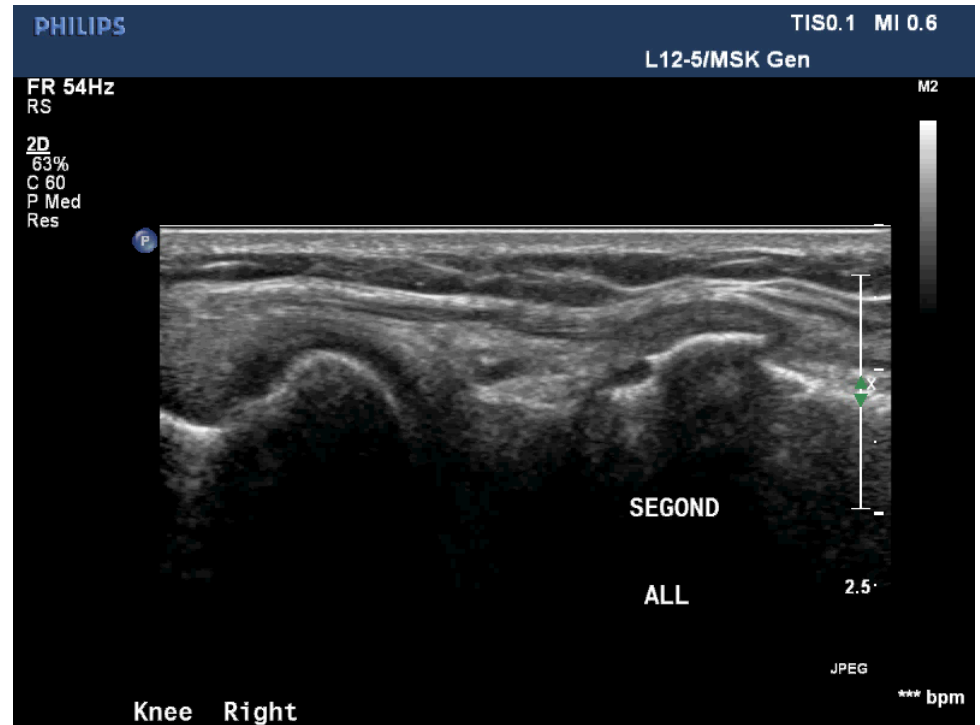
- Ultrasound can not detect meniscus / ACL lesions
- Ultrasound has a steep learning curve
- Most intra articular lesions can be detected with MRI



# Misunderstanding Segond lesion:

- Segond avulsion is only a minor small fragment (on X ray )
- Segond fracture is not attached to strong ligament complex ( not just small ALL )
- Segond fracture is rare ( hard to find )
- Segond fracture itself needs no treatment .
- Segond fracture cannot be fixed ( with a implant )

# Segond fracture



# Knee instability



# Laxity check



TEST 90° - DRAWER  
REFERENCE POSITION

A 3D computer-generated model of a knee joint, showing the femur (thigh bone) and tibia (shin bone) in a light blue color. Two yellow dots are visible on the tibia, representing tracking markers. The model is set against a dark blue background.

ACL  
Surgeries

P T F  
1 2 C

DR24 - Drawn

R

PRE-OP. LAXITIES

- DRAWER**
- ROTATION 90°
- LACHMAN
- ROTATION 30°
- VAR-VALG. STABILITY
- PIVOT-SHIFT
- PRE-OP. SUMMARY

FLEXION: 89°      ROTATION: 15° INT

Place the leg in the reference position for the drawer test (90°), without any drawer.

PRAXIM



# Rotation



**TEST 90° - ROTATION ACQUISITION**

Lateral (mm)

Ant 0 4

Post 4

Ext 13

13

3

Ant 2

Post 0 2

Medial (mm)

Axial rotation (°)

5 POSITIONS (MIN 10 - MAX 500)  
FLEXION: 82° ROTATION: 10° EXT

ACL Surgeries

P 1 T 2 F C

PRE-OP. LAXITIES

DRAWER

**ROTATION 90°**

LACHMAN

ROTATION 30°

VAR.-VALG. STABILITY

PIVOT-SHIFT

PRE-OP. SUMMARY

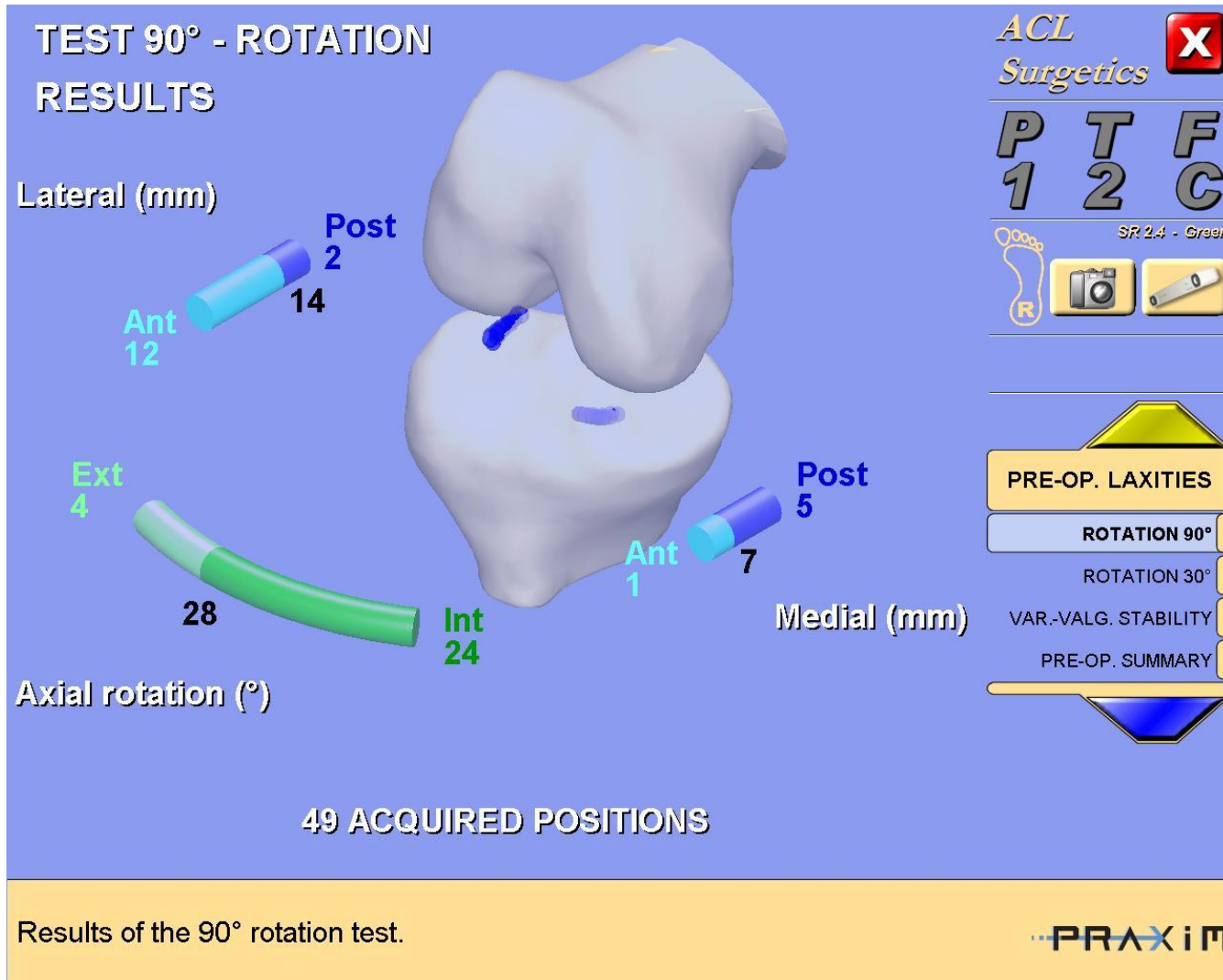
PRAXIM

Perform the rotation test at 90°.  
BLUE pedal to stop the acquisition.

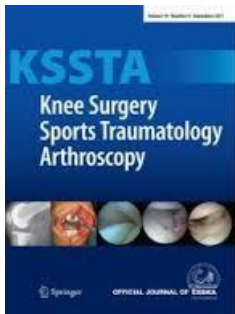


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# ALL instability







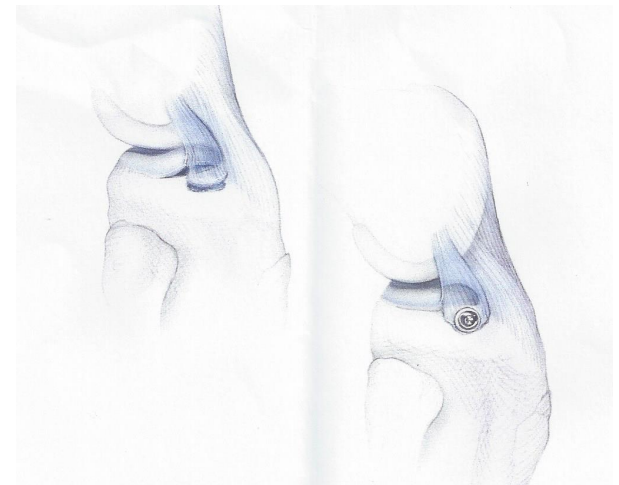
# KSSTA April 2017

- High prevalence of ALL complex Segond avulsion using ultrasound imaging .
- Klos / Scholtes / Konijnenberg
- Ultrasound should be considered in case of impaction fracture to check for Segond avulsion.



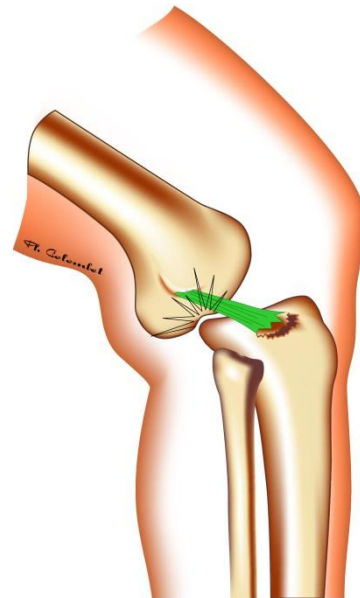
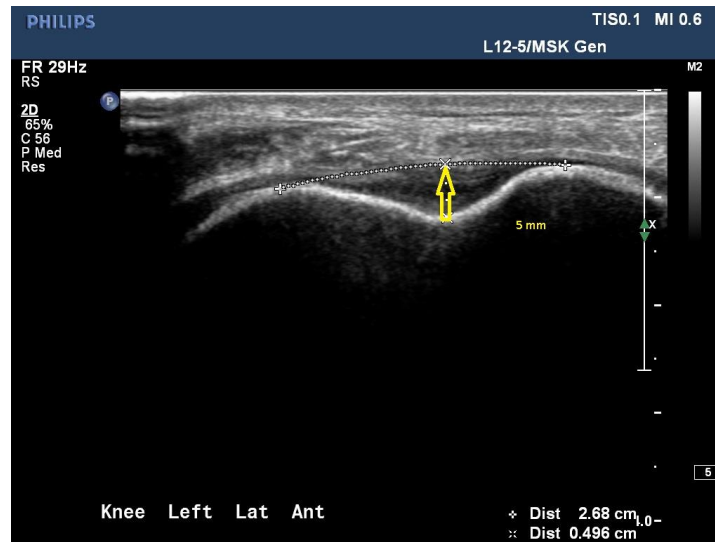
# Imaging Segond avulsion

- Incidence in MRI 3 % Resnick USA
- Incidence in X ray CORR Hess D 9 %
- Incidence ultrasound 29 % (ICONE)
- Higher velocity trauma ?
- Refixation / Feagin :



# Ultrasound imaging

- 88 patients with ACL #
- 25 Segond lesions (29 %)
- 40 Impaction # lateral FC (46%)



# US patho anatomy ALL complex



251196WI 34261320140225



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# Preoperative marker of Segond avulsion / ultrasound



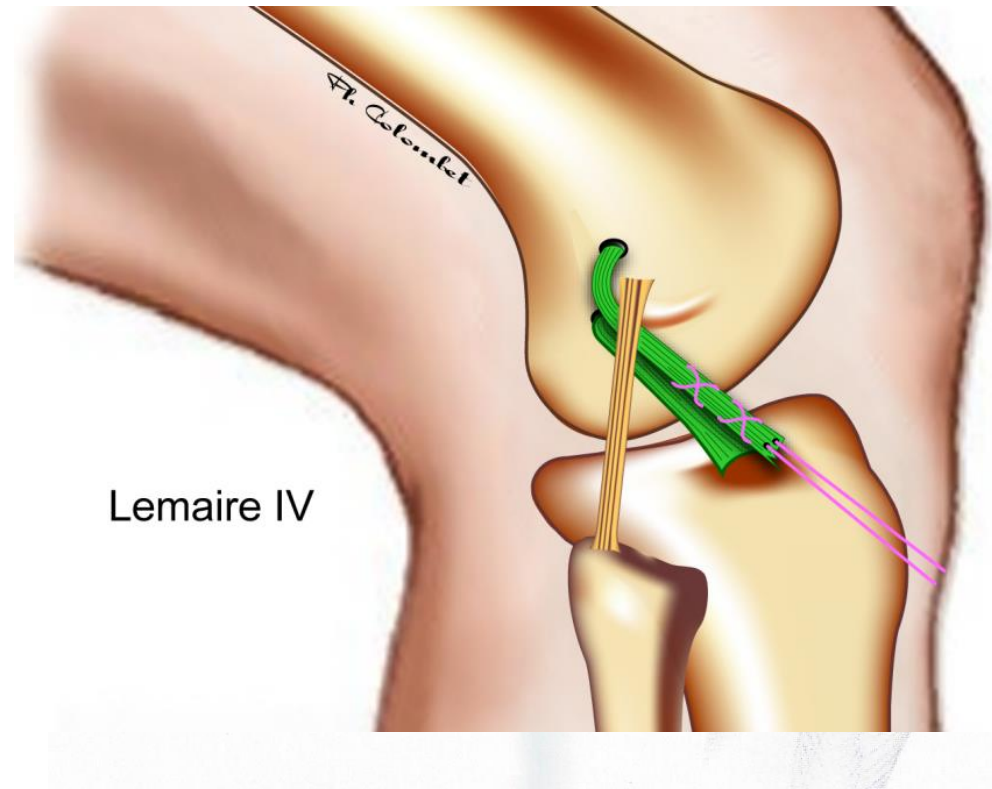
# Peroperative imaging lift off lateral meniscus



# Case Report : Refixing ALL / second # Checking the pivot on the table is pulling the staple off / prove of importance in stability ?



# Refixing Segond or reconstruction AL tenodesis?



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# Discussion ALL lesions location

- Ferretti I : surgical dissection in ACLR :
- Arthroscopy 2016 ALL 54/60 lesions
- Distal lesions 19/60 (32 %)
- Cavaignac F
- Arthroscopy 2017 : Ultrasound Segond avulsion 15/ 30 (50 %) / MRI 4/30 (13 %)

# Discussion Anatomy

- Segond avulsion > anatomy and MRI > ITB and AL capsule avulsion Campos Resnick Radiology 2001
- Segond avulsion > 36 Segond # MRI ALL complex avulsion Skaikh Fu AJSM 2017
- Segond avulsion > Case report Segond # Ultrasound Combined ITB and AL capsule attachment Albers Fu KSSTA April 2017

# Conclusion

- Segond avulsion is not rare (30 + %)
- Improving diagnosis and treatment
  - Improved Imaging Ultrasound (vs MRI)
  - Segond avulsion is attached to ITB / ALL complex
  - Surgical treatment or neglect /reconstruction ?
  - Fixation method ?



# Conclusion

- We have new possibilities
  - Imaging Ultrasound vs MRI
  - Improved Surgical treatment with improved diagnosis
  - Reconstruction vs Refixation
  - Some questions can be addressed by intraoperative navigation (CAOS)

