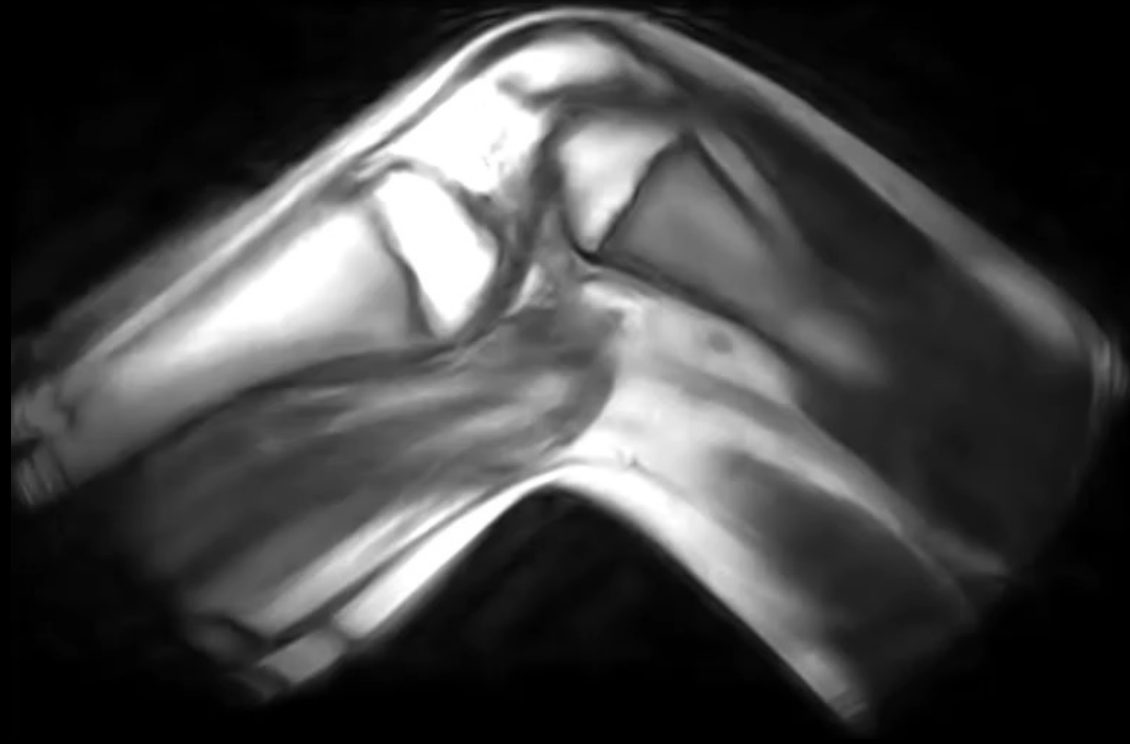
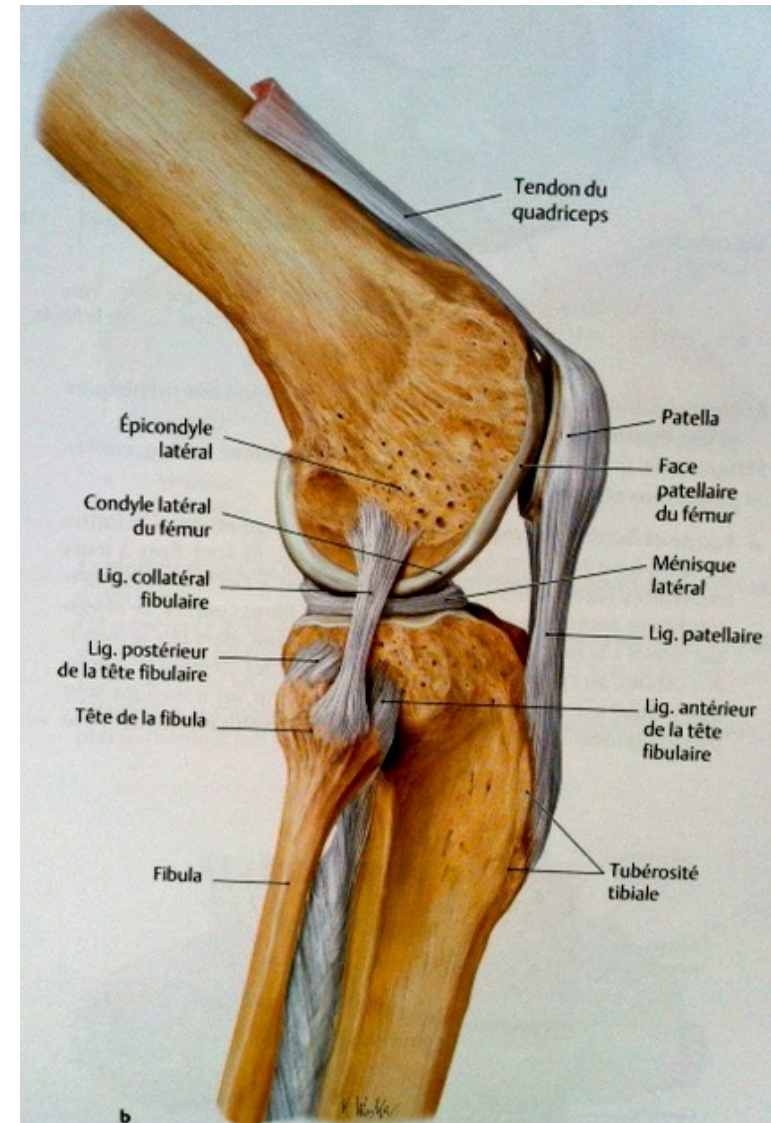
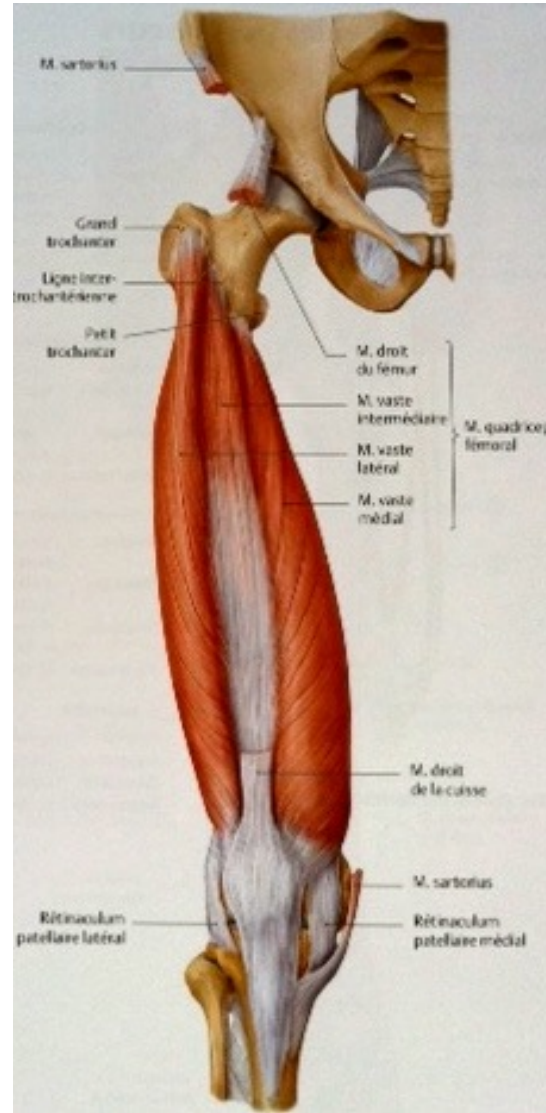
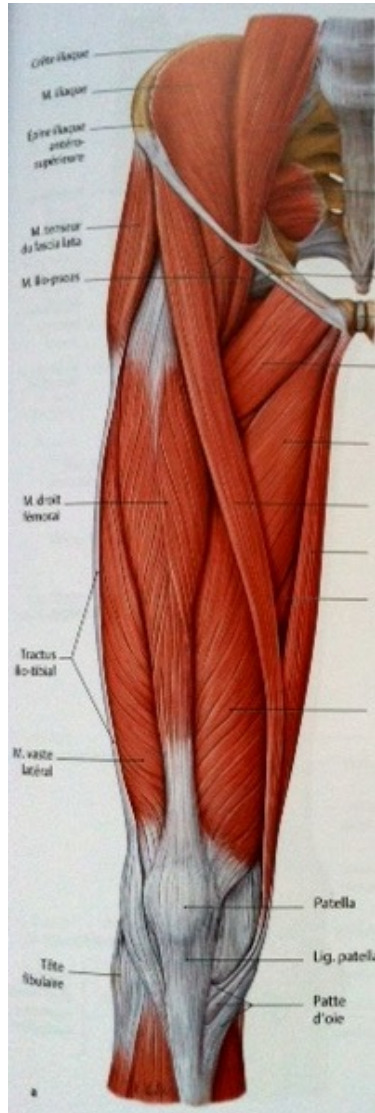


# Knee Extensor System Ruptures

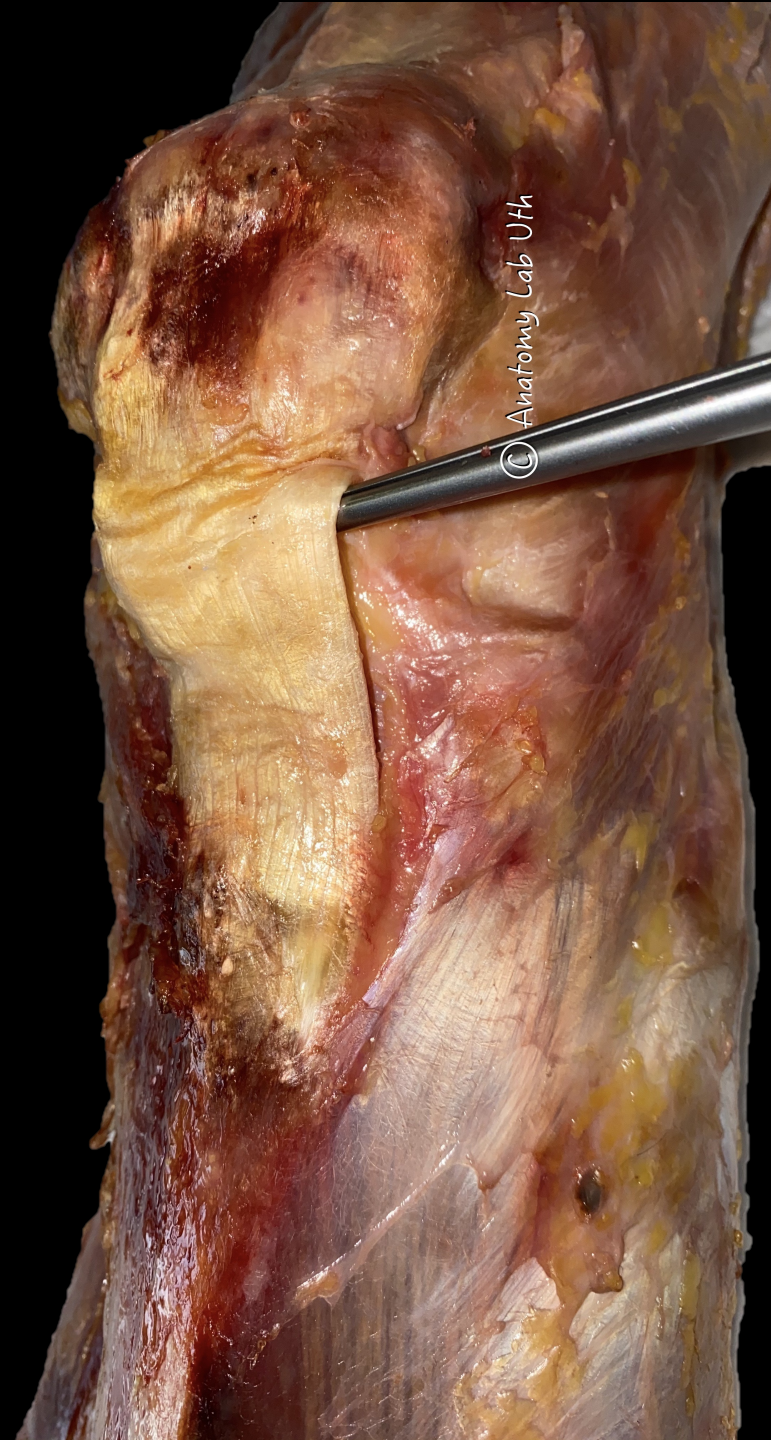
## *Quadriceps & Patellar Tendon*



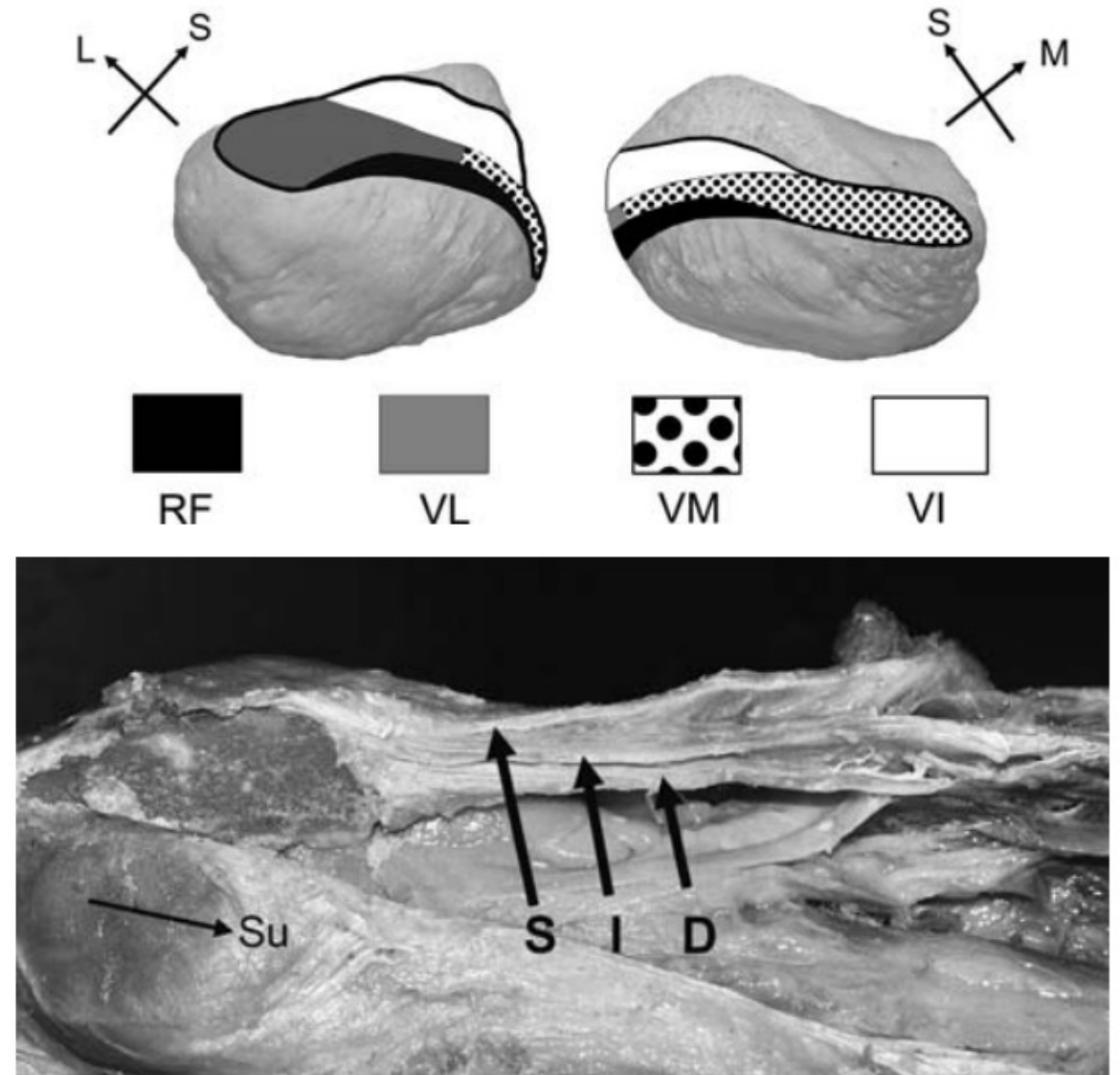
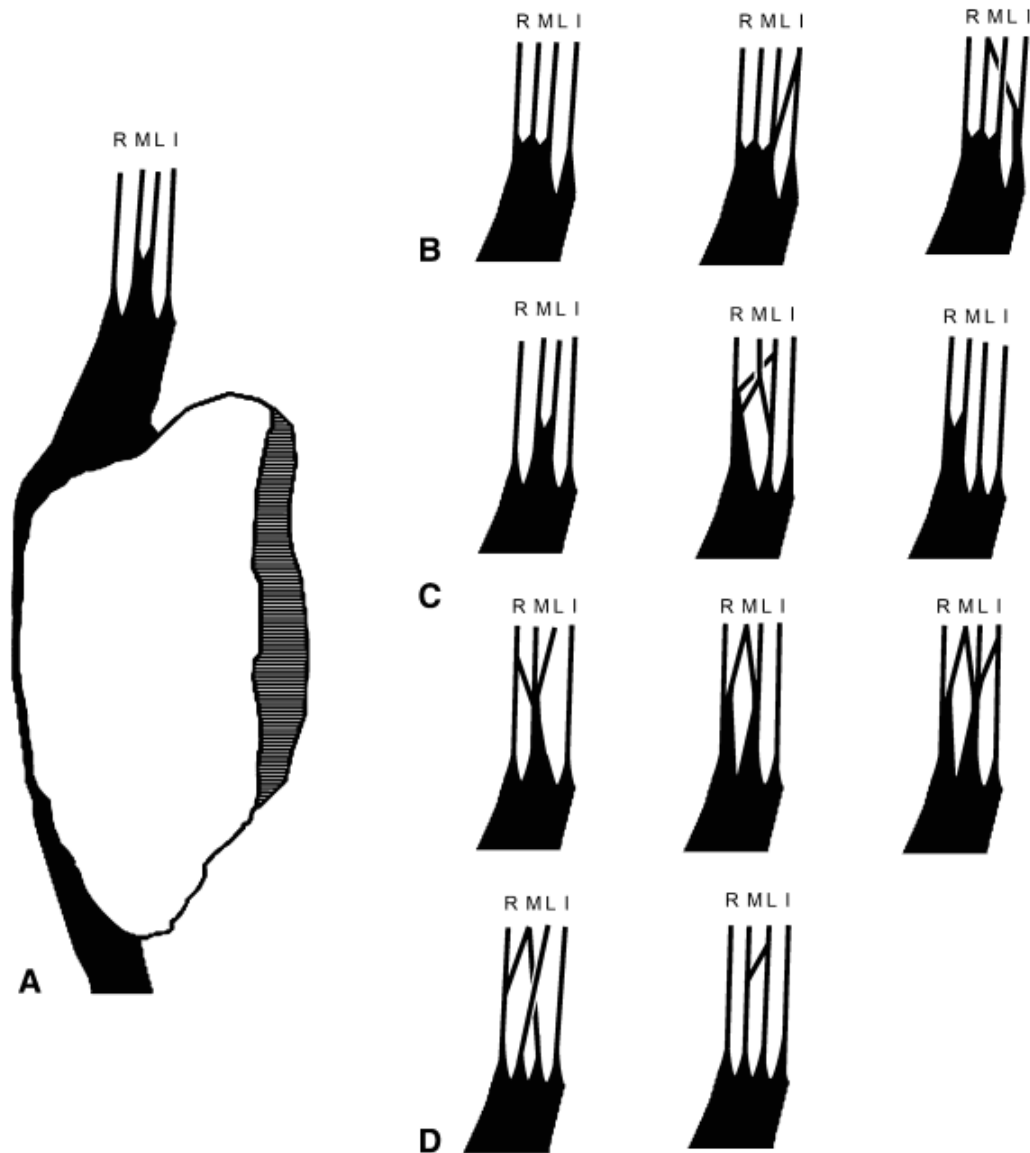
# Anatomy





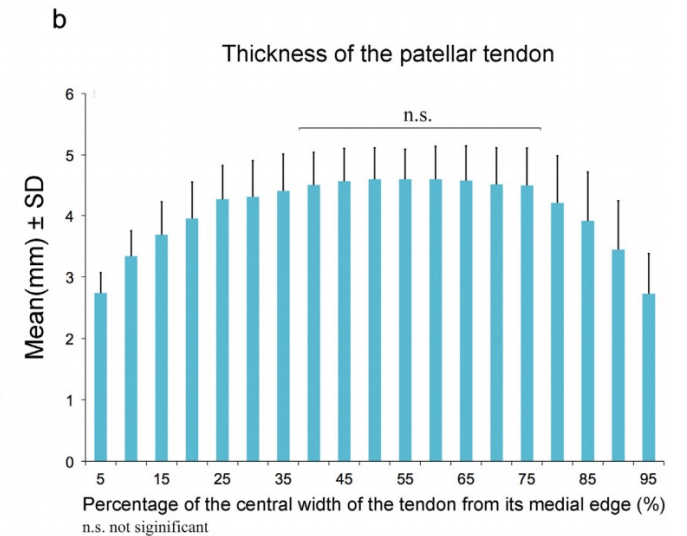
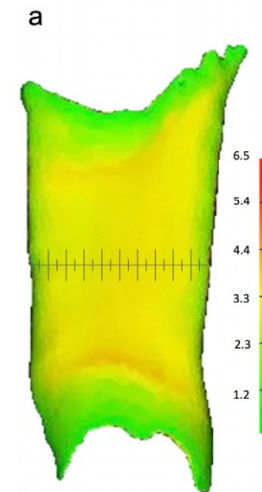
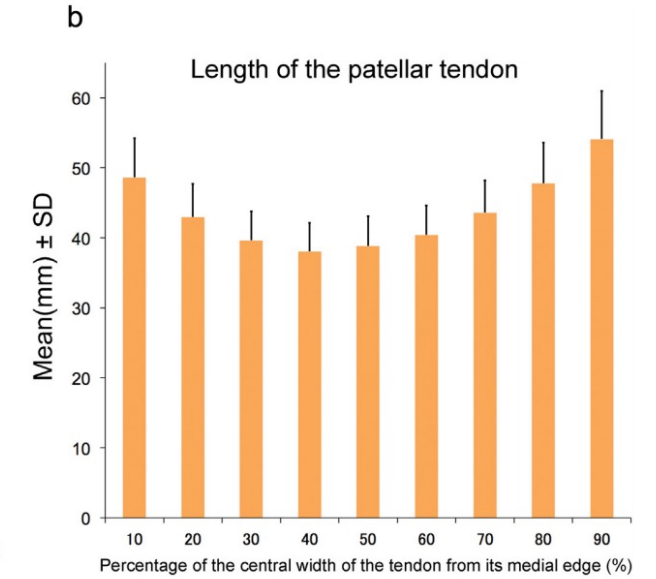
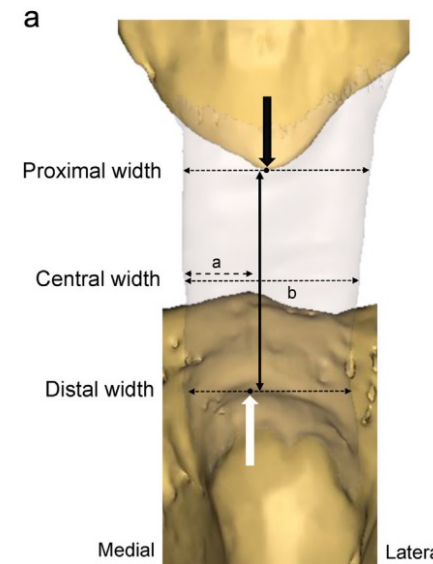
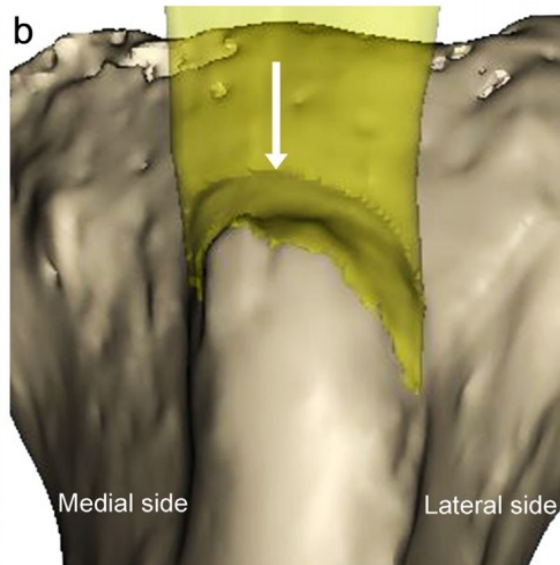
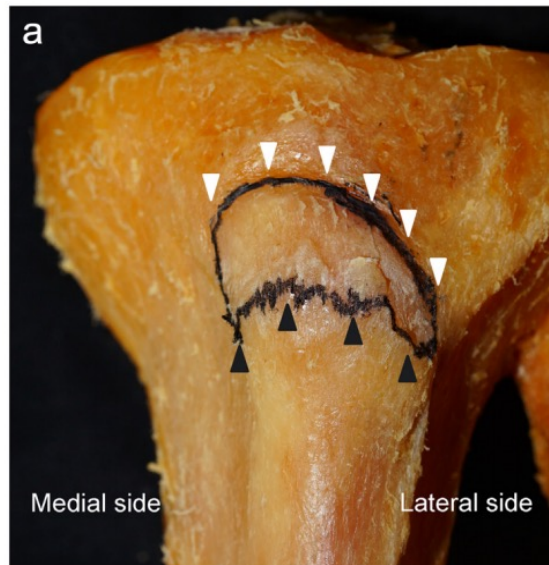
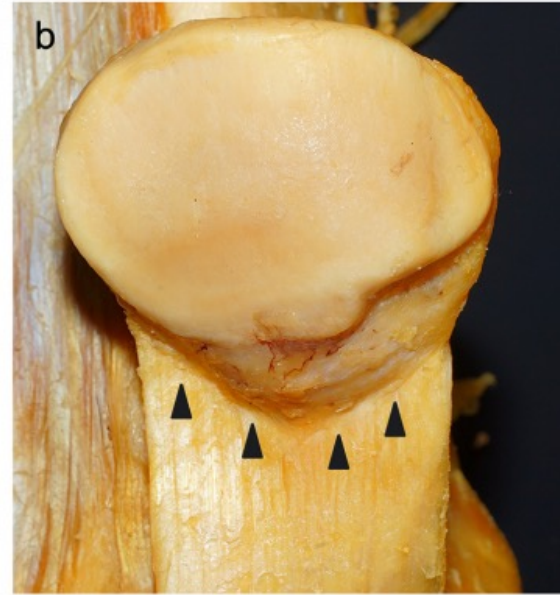
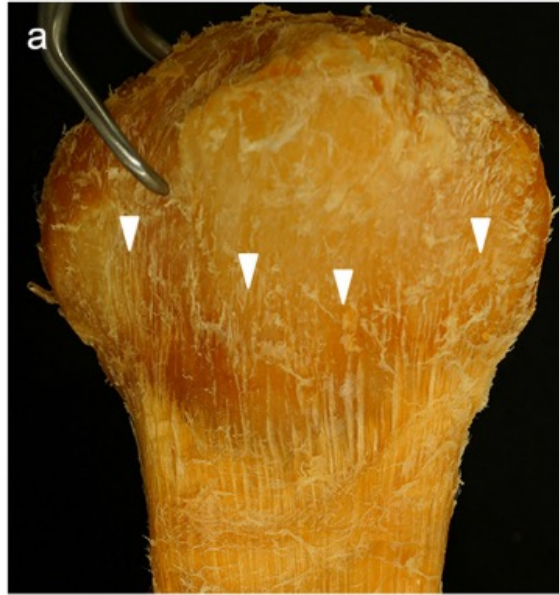


# Clinical Anatomy





# Clinical Anatomy



# Extensor system rupture

- quadriceps tendon rupture
- transverse fracture of the patella
- patellar tendon rupture

→ inability to actively extend the knee





# How Often?

## Quad Tendon

**1.37 / 100.000 ruptures**

- ✓ x8 risk fold in males
- ✓ x10 risk fold in African-American males
- ✓ x2 risk fold in the non-dominant limb
- ✓ Bilateral in 12% of all cases
- ✓ After 40, usually between 60-70 years old

*Pengas et al. Injury 2016*

## Patellar Tendon

**0.68 / 100.000 ruptures**

- ✓ x9 risk fold in African-American males
- ✓ Between 30 and 40 years old

*Brinkman et al. Injury 2024*

# Risk Factors

- Tendinopathy
- Steroid Injections
- Fluoroquinolones (levofloxacin)
- Diabetes
- Obesity
- Inflammatory Arthritis
- Hyperparathyroidism
- Renal Failure





# Mechanism of Injury

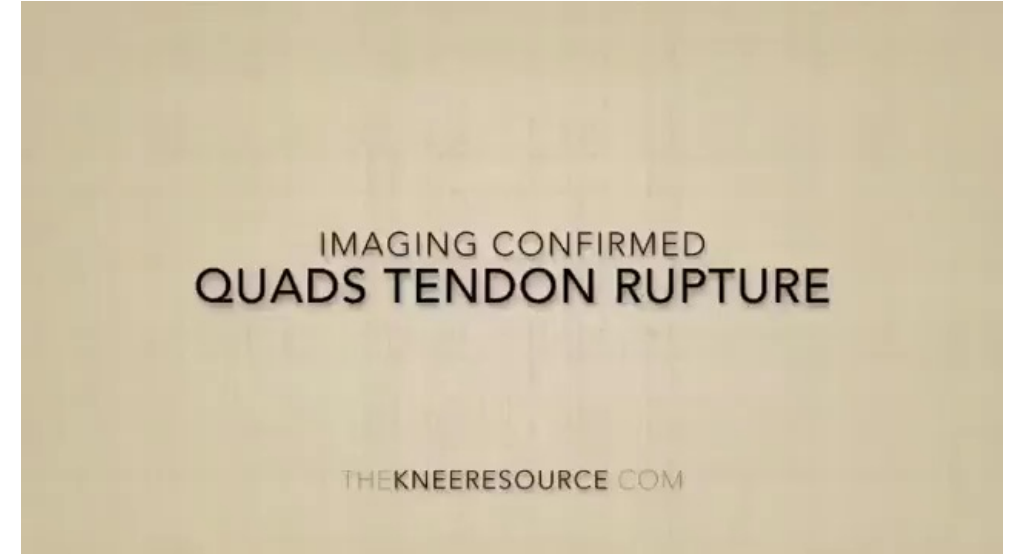
- ✓ **Indirect low-energy trauma** with eccentric contraction of the quadriceps muscle
- ✓ **Indirect high-energy trauma** or part of multi-ligamentous injury of the knee
- ✓ **Direct injury** to the tendon or penetrating trauma
- ✓ **Other:** Iatrogenic injuries, TKA related-injuries



# Clinical Presentation

- ✓ Pain
- ✓ Swelling
- ✓ Inability to walk (knee buckling)
- ✓ Palpable defect
- ✓ Loss of active extension (or weakness if partial rupture)

*Tandogan et al. 2022*



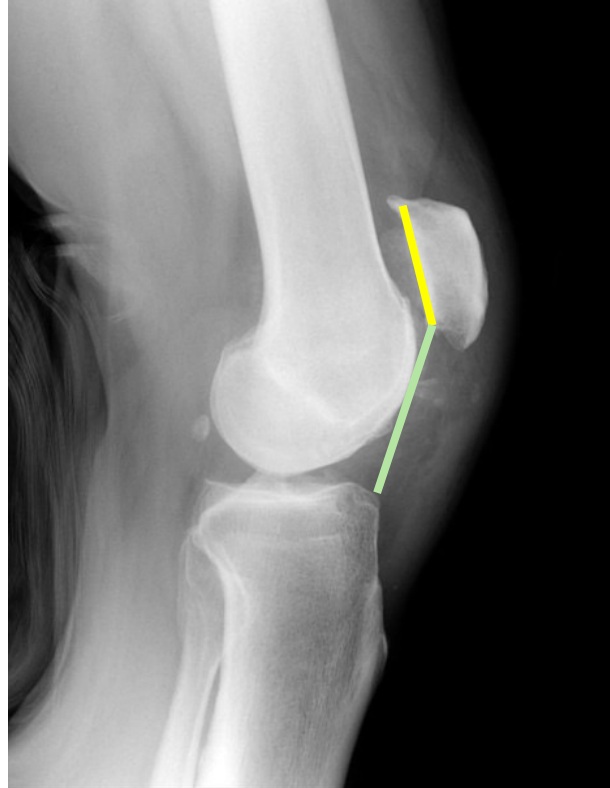


# Imaging – X-rays

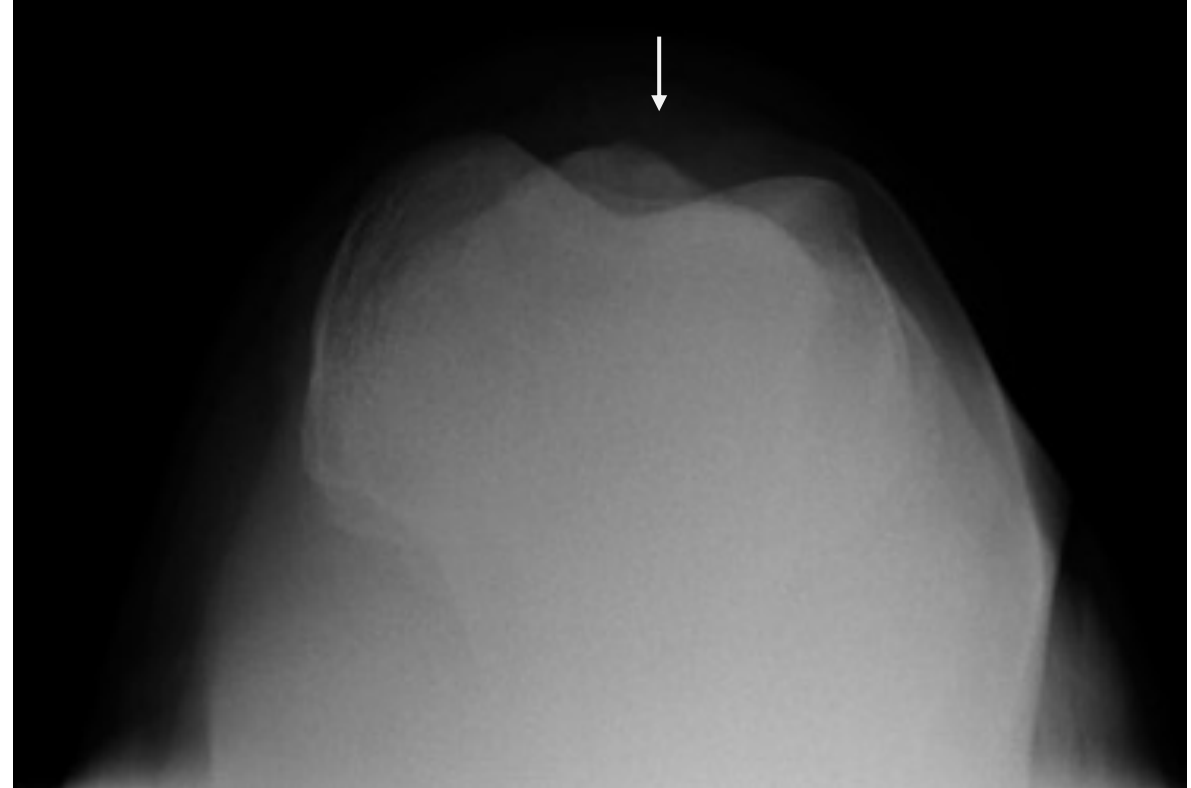
- ✓ Always useful to exclude avulsion injuries or patella fracture.



Patella Baja  
*Quad Rupture*  
*Following Tendinopathy*



Patella Alta  
*Patellar Tendon Rupture*  
*Canton Deschamps ▲*





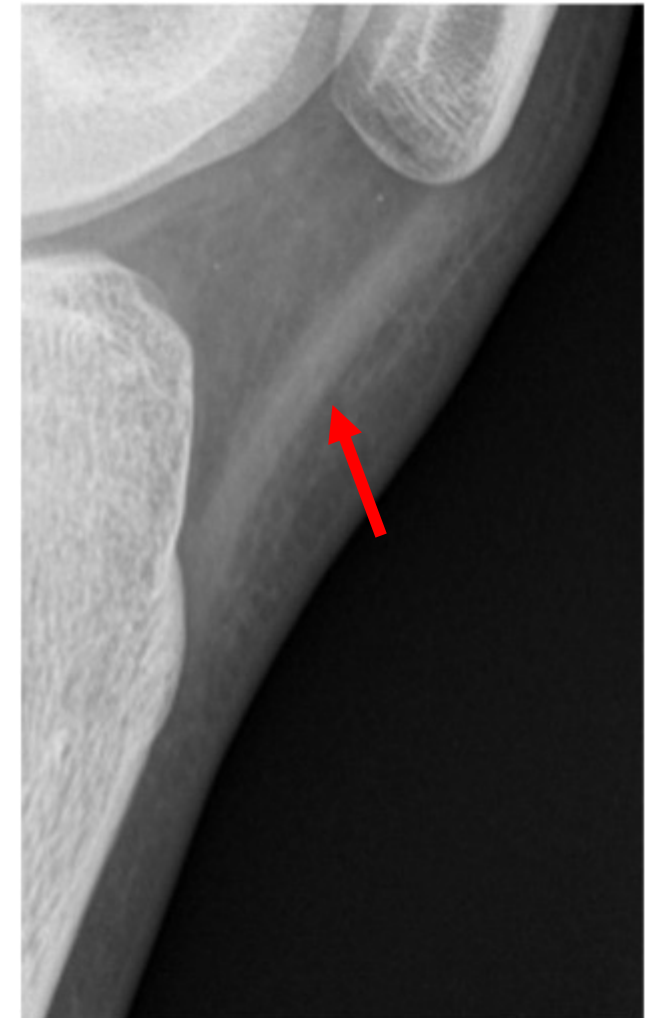
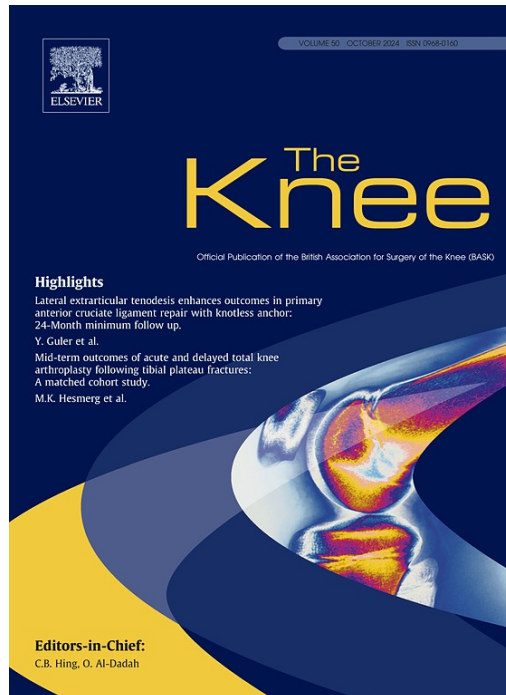
*Empty Merchant Sign*

# Imaging – X-rays

Do not underestimate the value of a simple lateral knee x-ray!

## Focal intratendinous radiolucency: A new radiographic method for diagnosing patellar tendon ruptures

Jonathan P. Ng <sup>a</sup>  , Derek T. Cawley <sup>a</sup>, Suzanne M. Beecher <sup>a</sup>, Matthew J. Lee <sup>a</sup>, Diane Bergin <sup>b</sup>,  
Fintan J. Shannon <sup>a</sup>

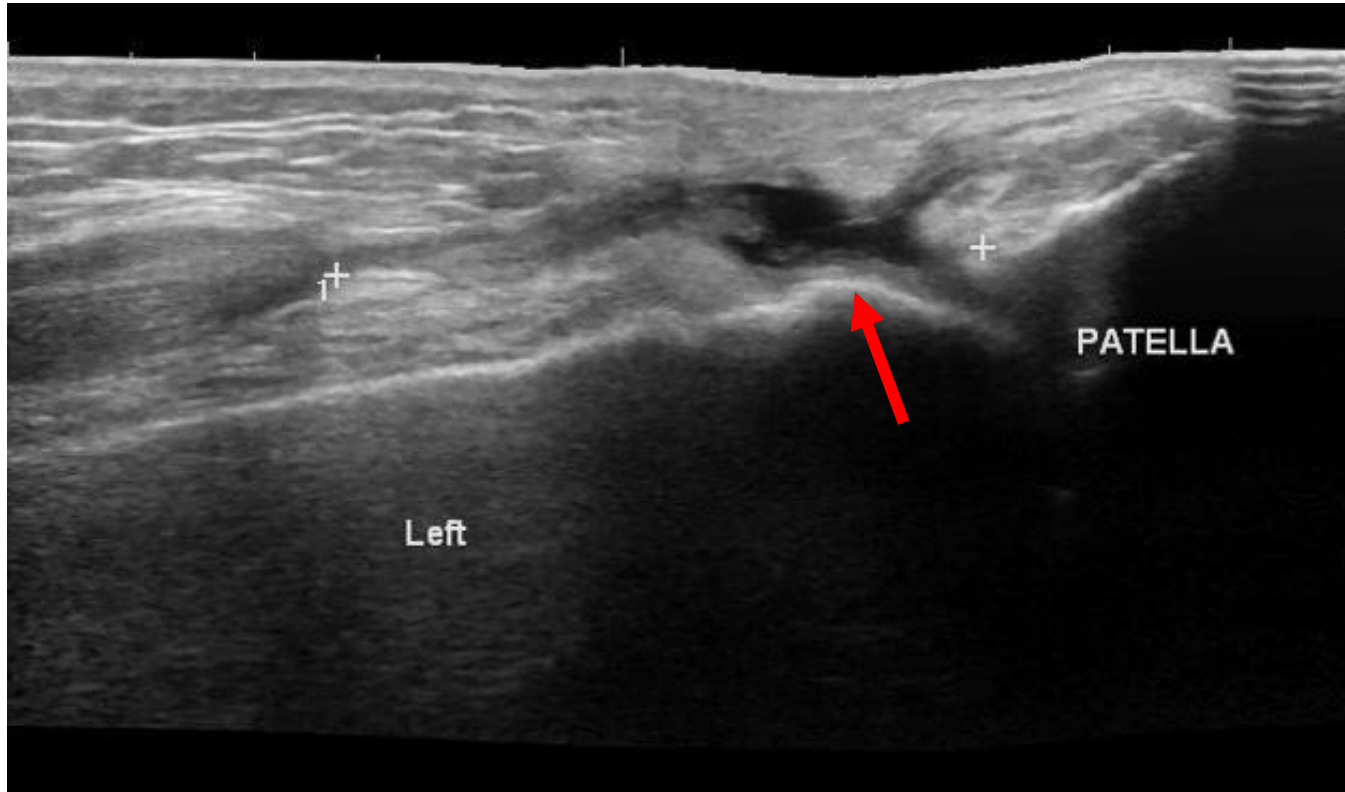




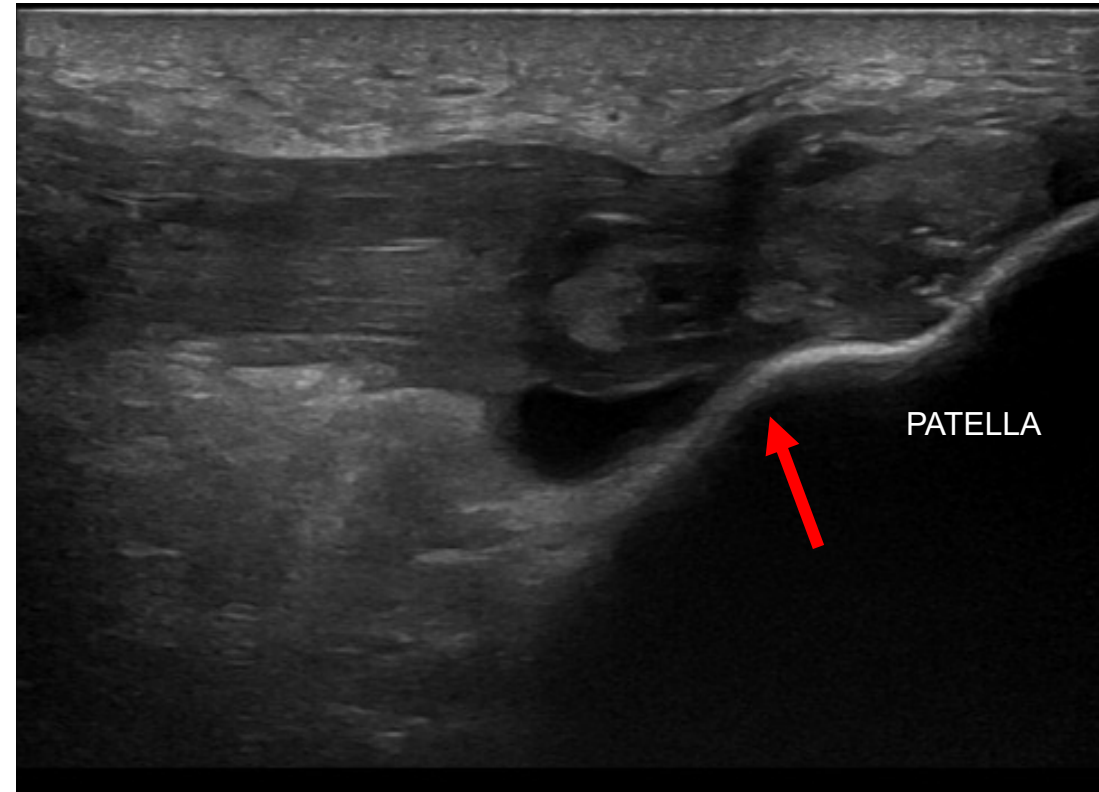
# Imaging - Ultrasound

- ✓ Useful, especially in the emergency department
- ✓ Sensivity and specificity lower than MRI – False positives up to 33%

*Carr et al. 2000, LaRocco et al. 2012*



Quad Tendon Rupture

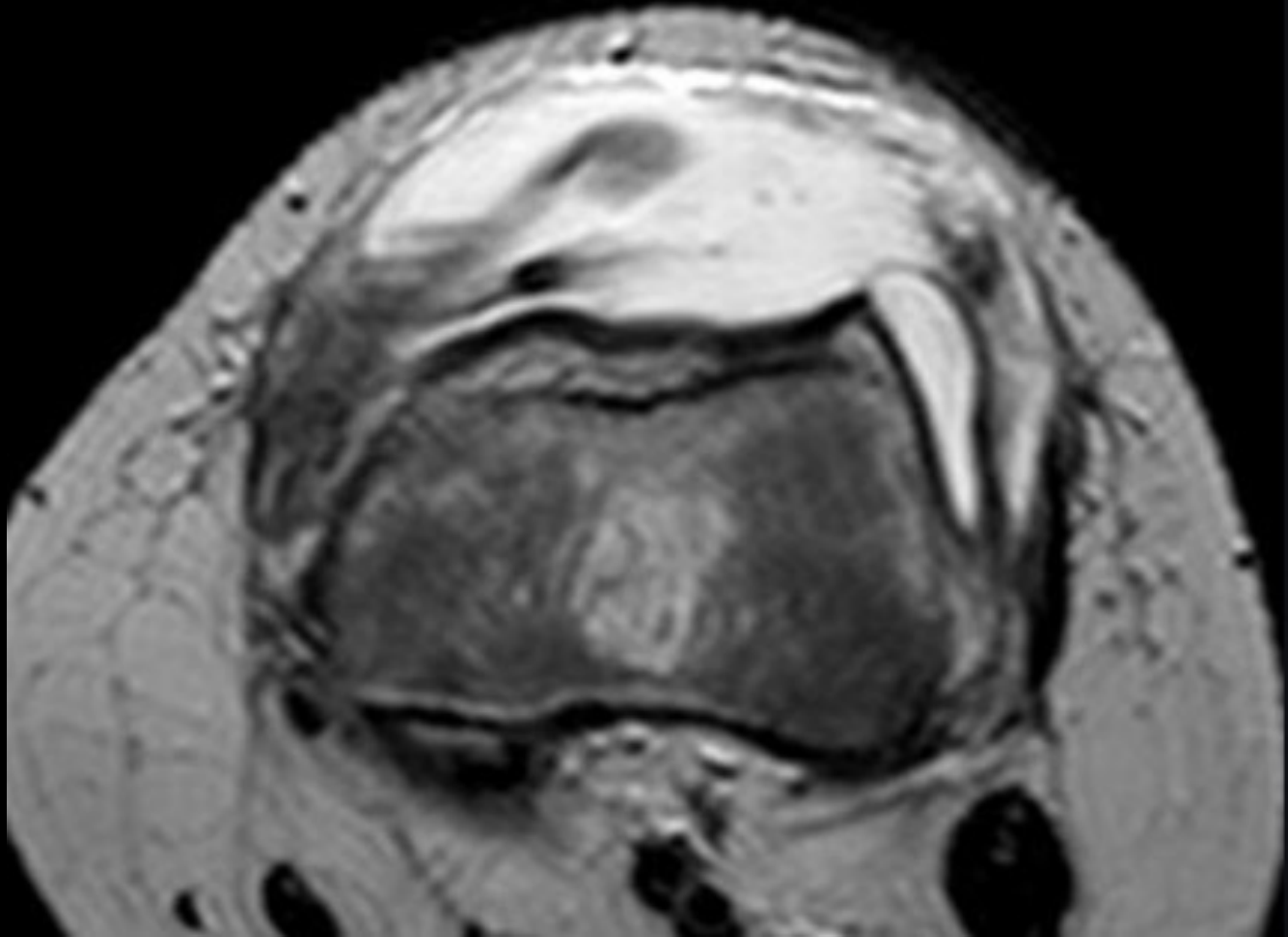


Patellar Tendon Rupture

# Imaging – MRI : quad tendon rupture

- ✓ 98% - 100% sensitivity & specificity
- ✓ The imaging modality of choice

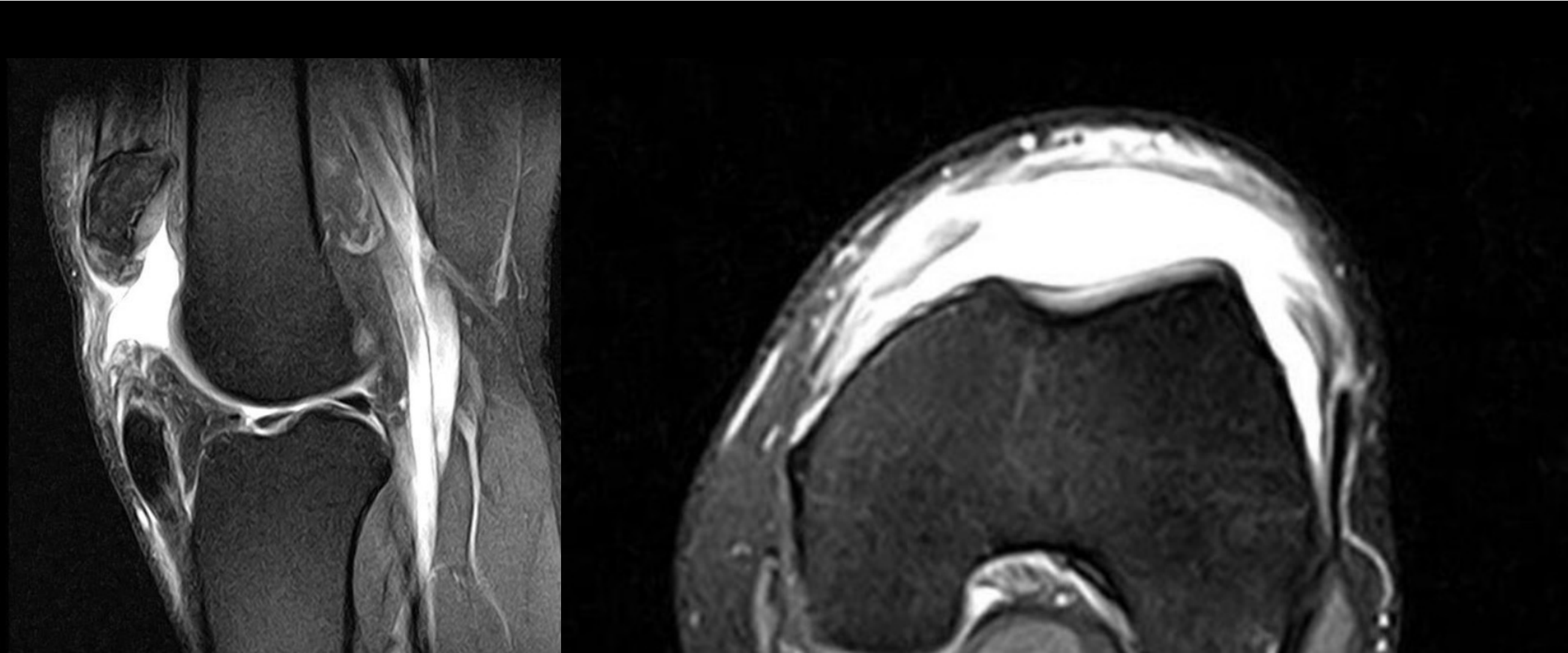
*Tandogan et al. 2022, LaRocco et al. 2012*



# Imaging – MRI : patellar tendon rupture

✓ Invaluable for preoperative planning

*Magnussen et al. 2014*





# Quadriceps Tendon Repair – Our technique



ARTICLES THÉMATIQUES : MÉDECINE DU SPORT

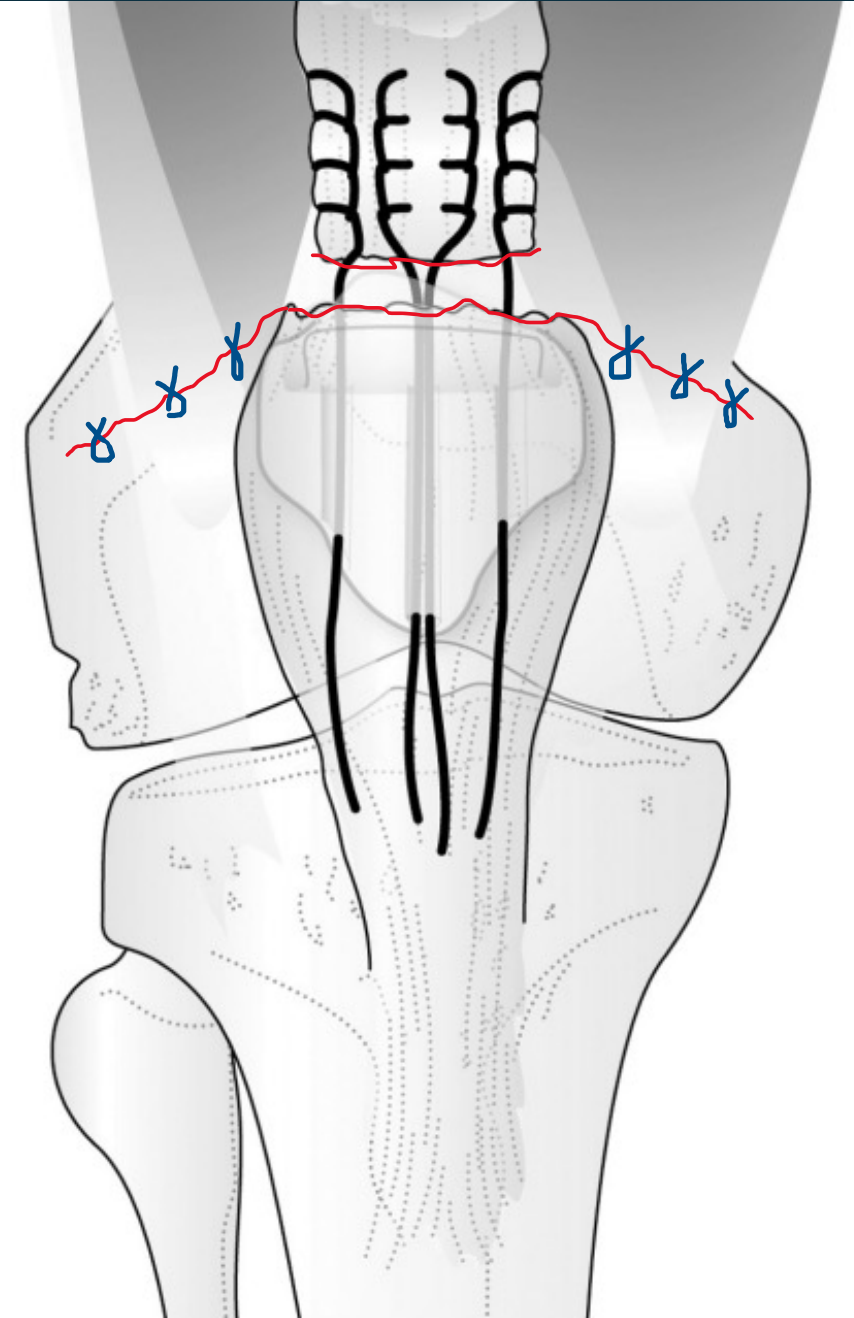
10 août 2011

## Ruptures de l'appareil extenseur du genou

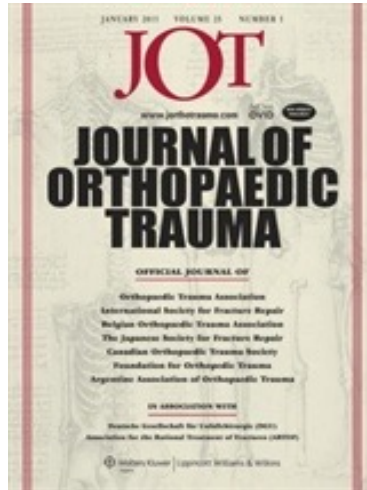
Victoria B. Duthon, Daniel Fritschy

DOI: 10.53738/REVMED.2011.7.304.1544

- ✓ Skin incision and hematoma evacuation
- ✓ Tendon debridement
- ✓ Krackow sutures
- ✓ Bone tunnels in the patella
- ✓ Repair the torn retinacula



# Quadriceps Tendon Repair – Other options

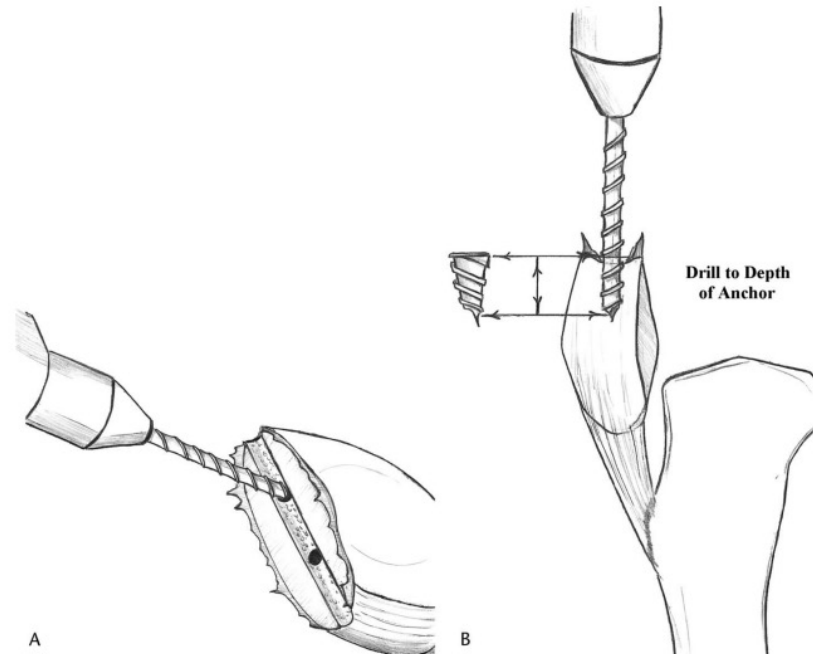
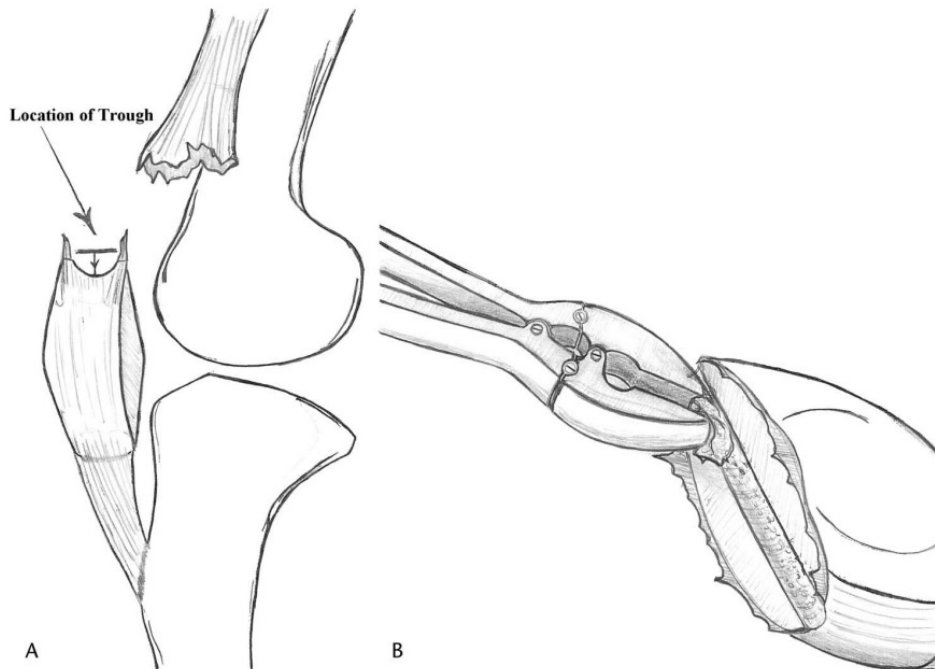
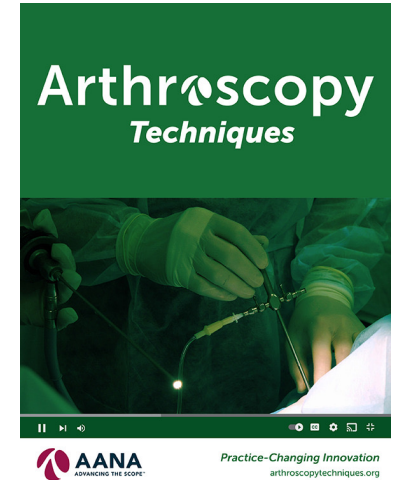


## The Use of Suture Anchors to Repair the Ruptured Quadriceps Tendon

*Brandon D. Bushnell, MD,\* George B. Whitener, BA,† James H. Rubright, BS,†  
R. Alexander Creighton, MD,‡ Kevin J. Logel, MD,§ and Mark L. Wood, MD§*

## Quadriceps Tendon Repair Using Knotless Anchors and Suture Tape

Michael H. Amini, M.D.



# Any Difference between Osseous Tunnels and Anchors?

JOURNAL OF  
ORTHOPAEDIC SCIENCE  
Official Journal of The Japanese Orthopaedic Association

Original Article

## Transosseous tunnels versus suture anchors for the repair of acute quadriceps and patellar tendon ruptures: A systematic review and meta-analysis of biomechanical studies

John F. Dankert <sup>1</sup>  , Devan D. Mehta <sup>1</sup>, Lindsey H. Remark, Philipp Leucht

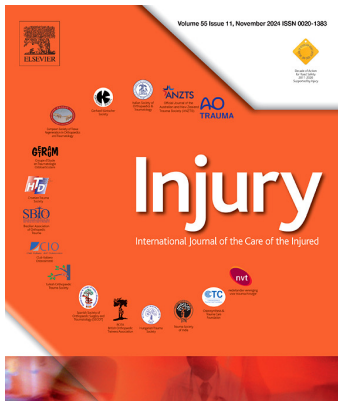
### Arthroscopy, Sports Medicine, and Rehabilitation



## Similar Outcomes Are Found Between Quadriceps Tendon Repair With Transosseous Tunnels and Suture Anchors: A Systematic Review and Meta-Analysis



Carlo Coladonato, M.S., Andres R. Perez, B.A., John Hayden Sonnier, M.D., Austin M. Looney, M.D., Bela P. Delvadia, B.S., David O. Okhuereigbe, M.S., Pankhuri Walia, B.S., Fotios P. Tjounmakaris, M.D., and Kevin B. Freedman, M.D.



## Outcomes following quadriceps tendon repair using transosseous tunnels versus suture anchors: A systematic review

Anuj V. Mehta <sup>a,\*</sup>, Christopher Wilson <sup>a</sup>, Tonya S. King <sup>a</sup>, Robert A. Gallo <sup>a,b</sup>

- ✓ Ultimate load to failure similar
- ✓ No significant differences in function
- ✓ Suture anchors may be associated with more complications.



# Patellar Tendon Repair – Our technique



ARTICLES THÉMATIQUES : MÉDECINE DU SPORT

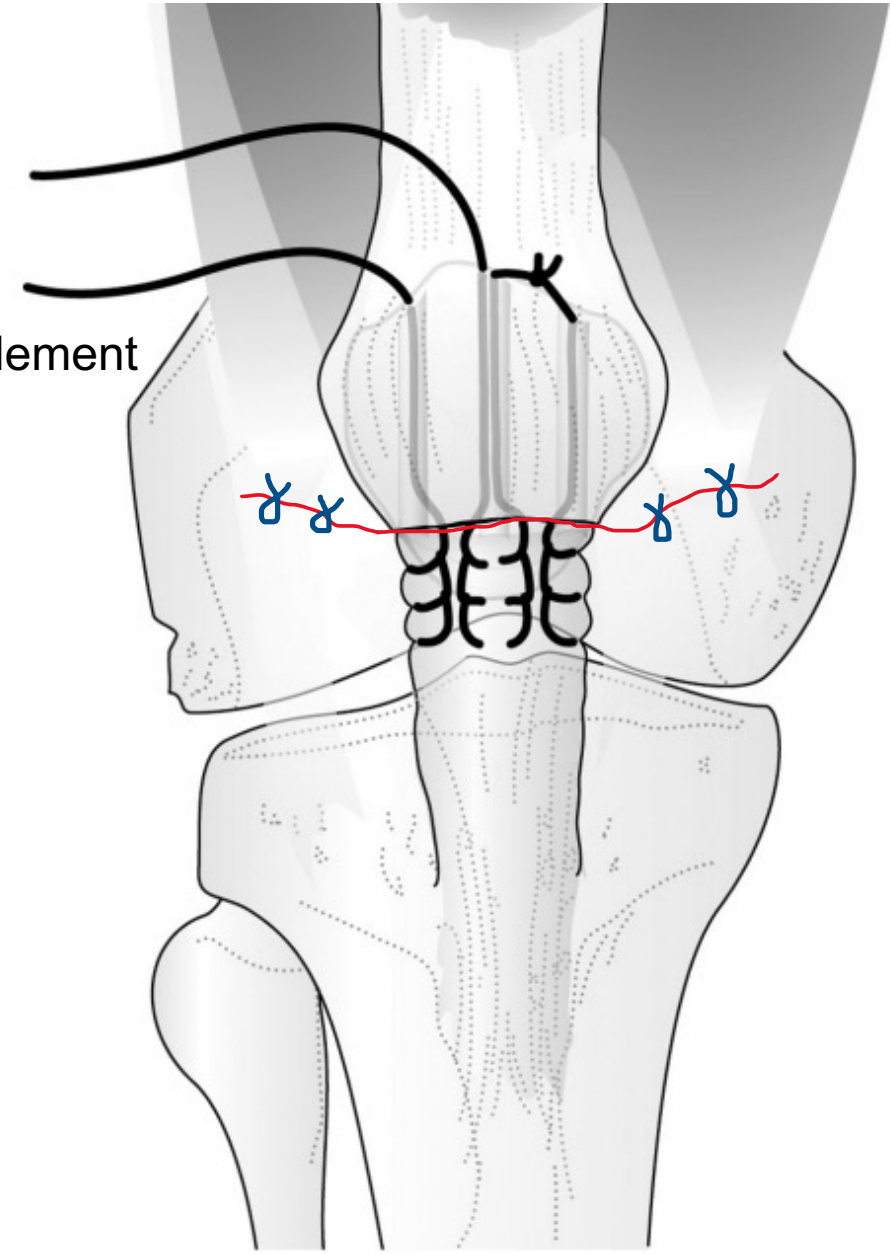
10 août 2011

## Ruptures de l'appareil extenseur du genou

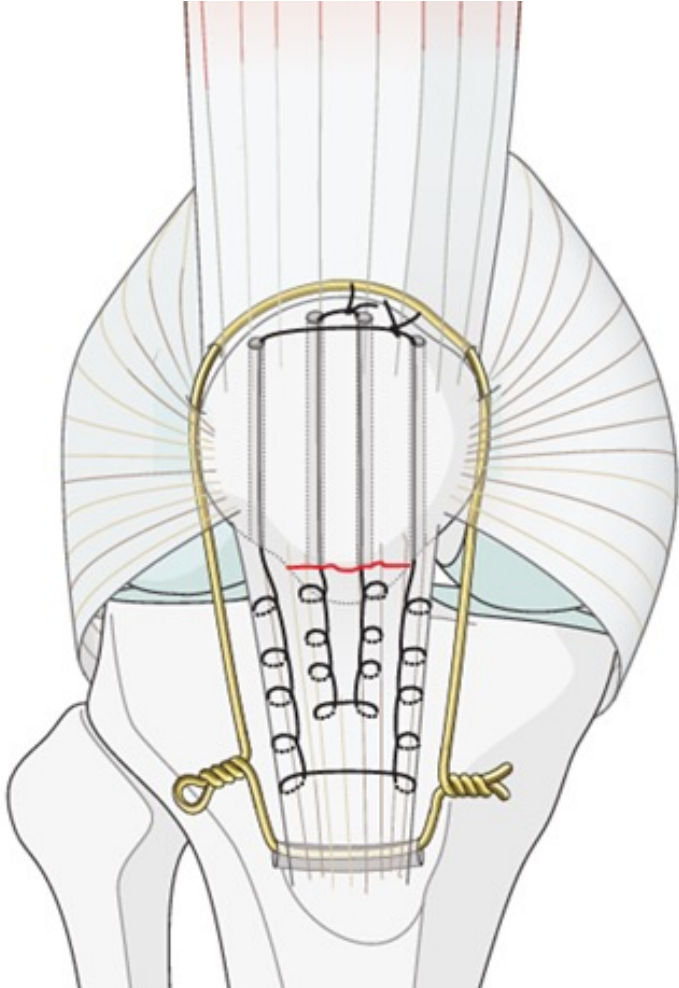
Victoria B. Duthon, Daniel Fritschy

DOI: 10.53738/REVMED.2011.7.304.1544

- ✓ Skin incision, hematoma evacuation, tendon debridement
- ✓ Krackow sutures
- ✓ Bone tunnels in the patella
- ✓ Repair the torn retinacula
- ✓ **Restore patella height**  
tensioning at 90° knee flexion  
use fluoroscopy and compare to controlateral knee
- ✓ Cerclage can be used to protect the repair



# Protective cerclage with wire

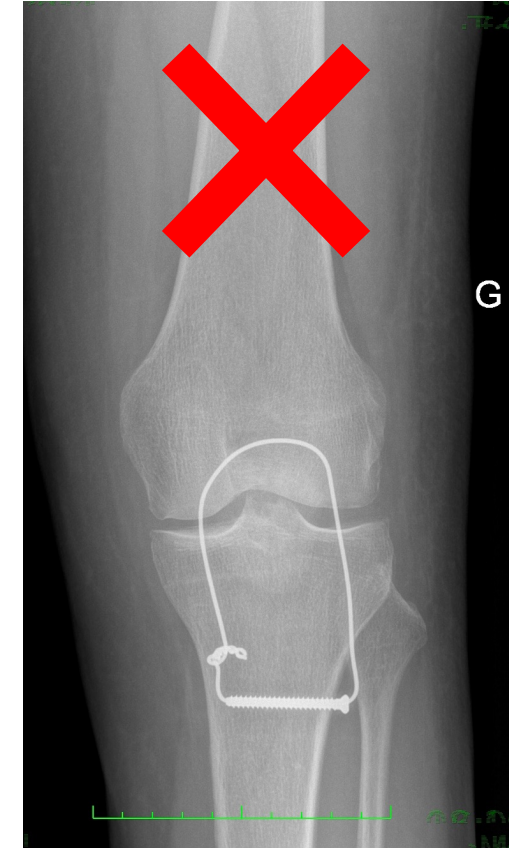
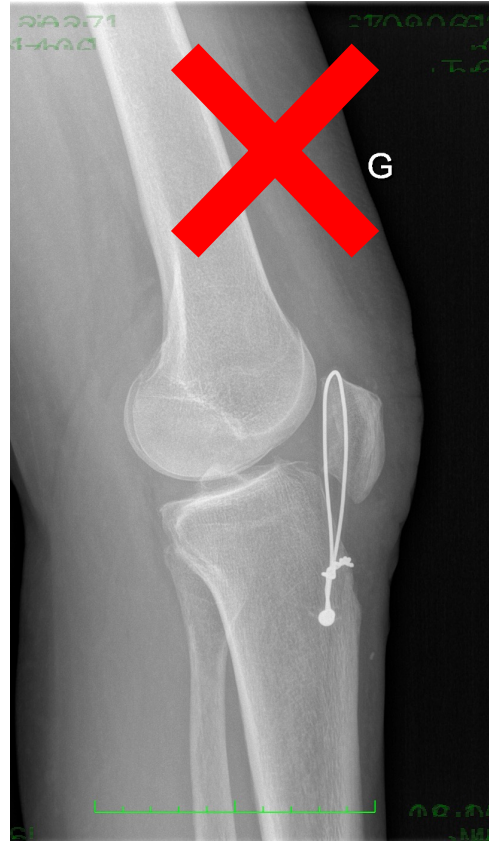


a protective cerclage wire can be passed around the upper pole of the patella and through a transverse drill hole at the tibial tubercle.

This wire frequently breaks later, and it is best to remove it once healing is assured at 3-4 months.

AO

# Respect the patellar height !!



iatrogenic patella baja

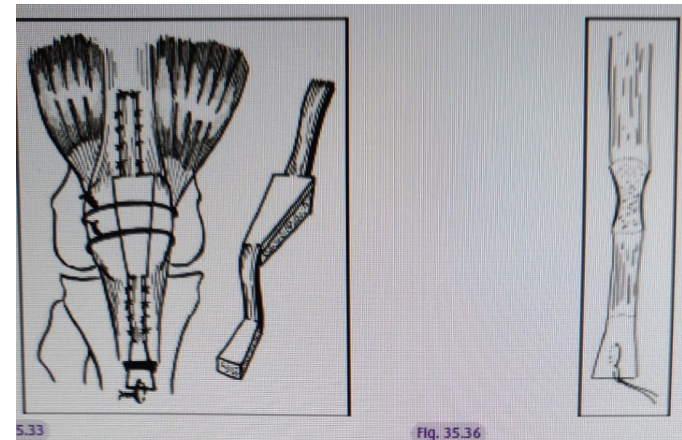
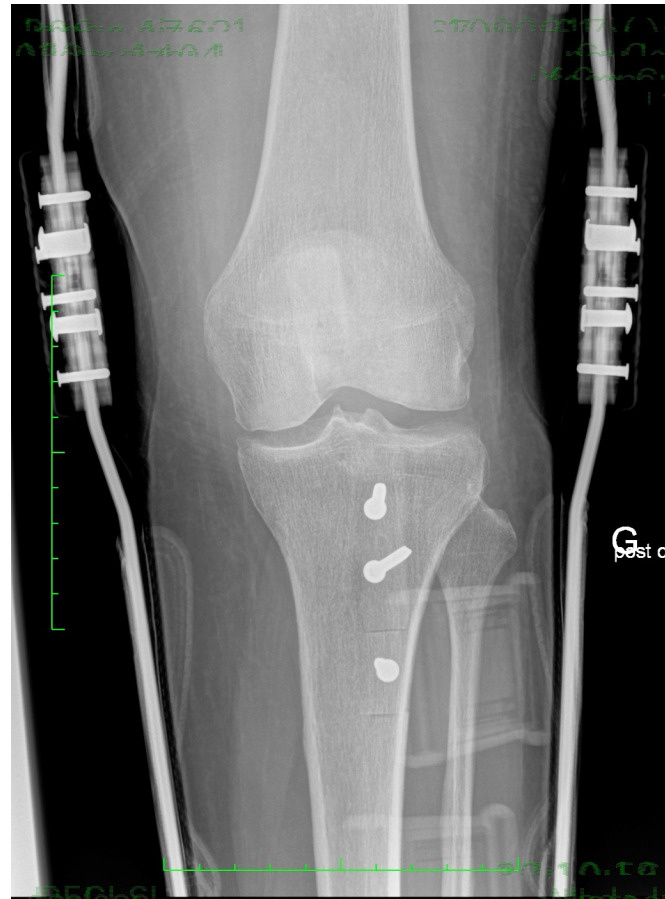
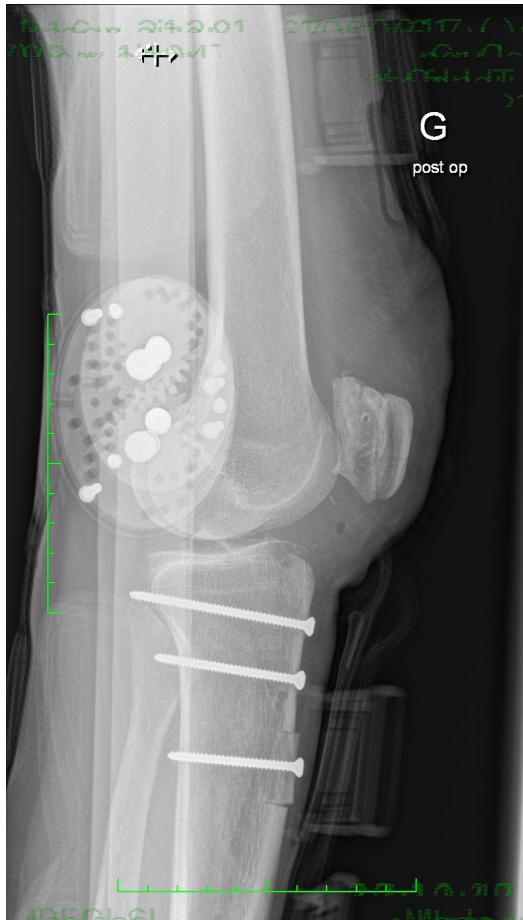


# Extreme patella baja





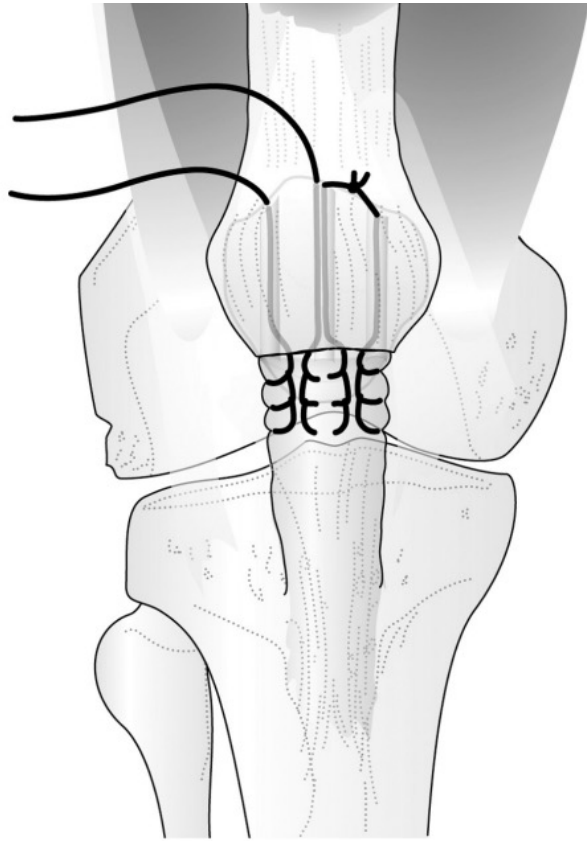
# Reconstruction with extensor mechanism allograft



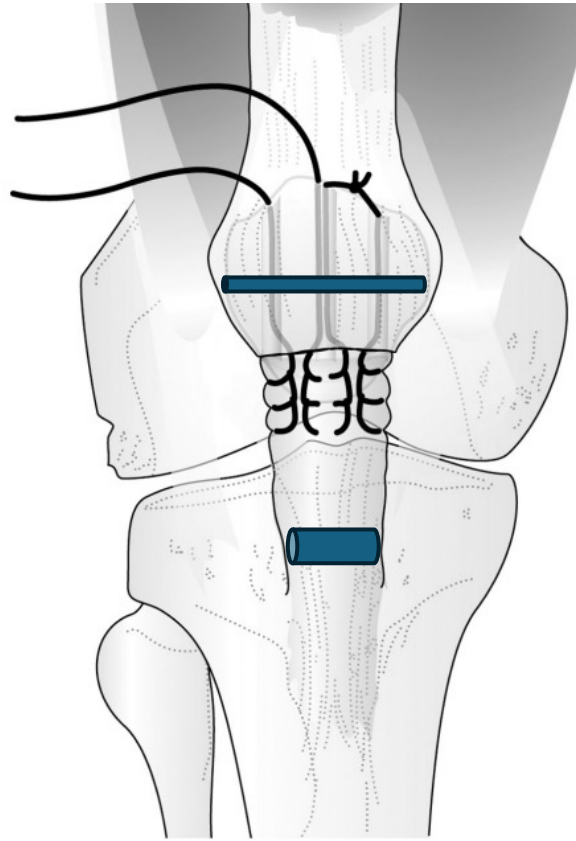
Prof. Ph.Neyret



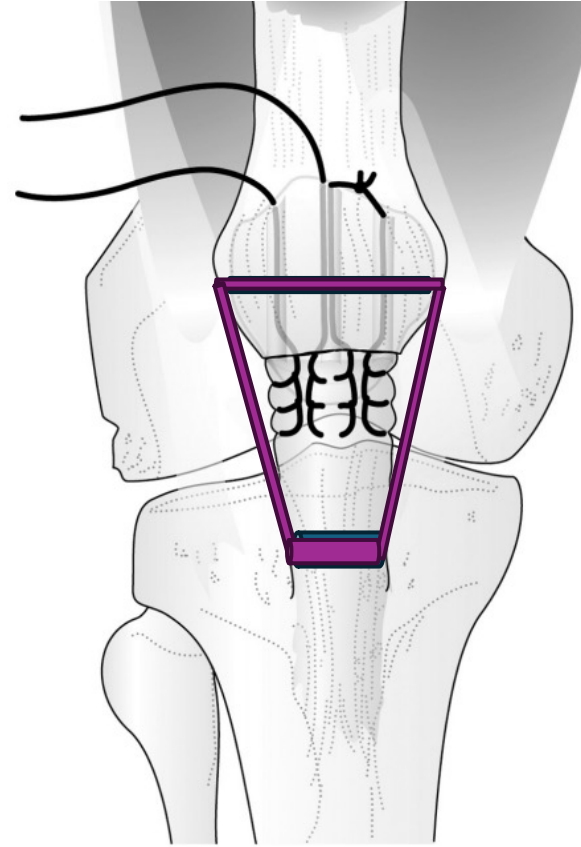
# Protective cerclage with semi-tendinosous



trans-patellar  
reinsertion



trans-patellar tunnel  
+  
tunnel underneath ATT



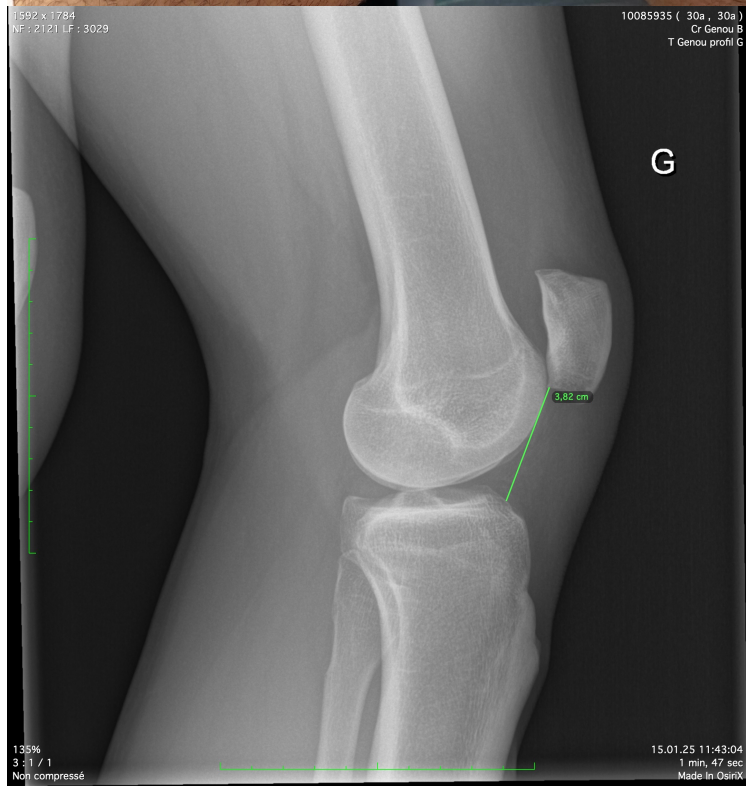
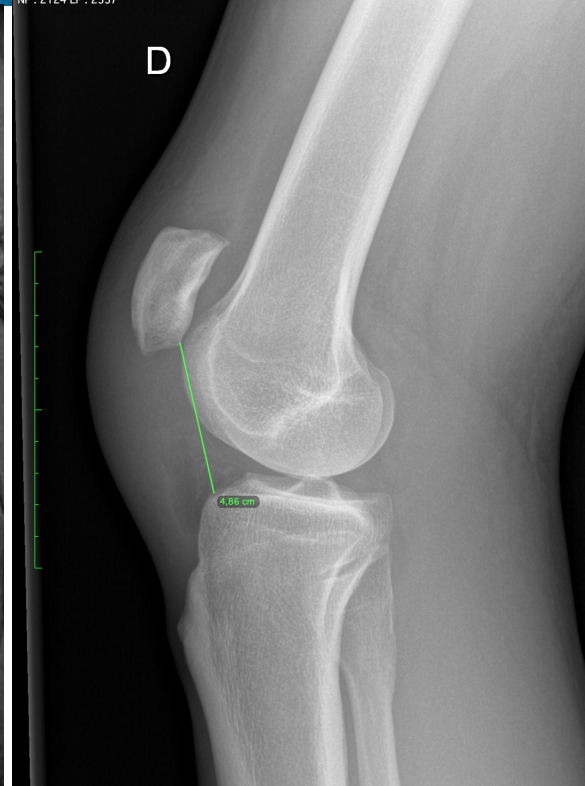
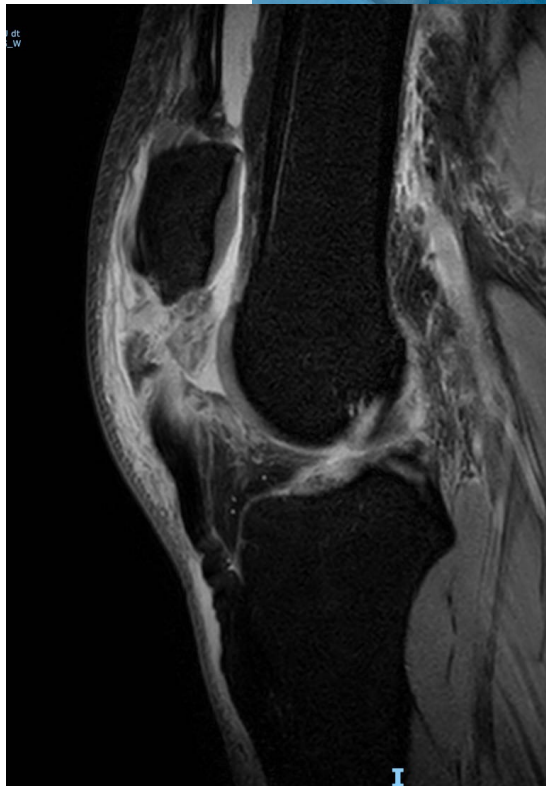
protective cerclage with semi-tendinosous autograft  
interference screw in the tibial tunnel

figure of 8



Example  
31yo male

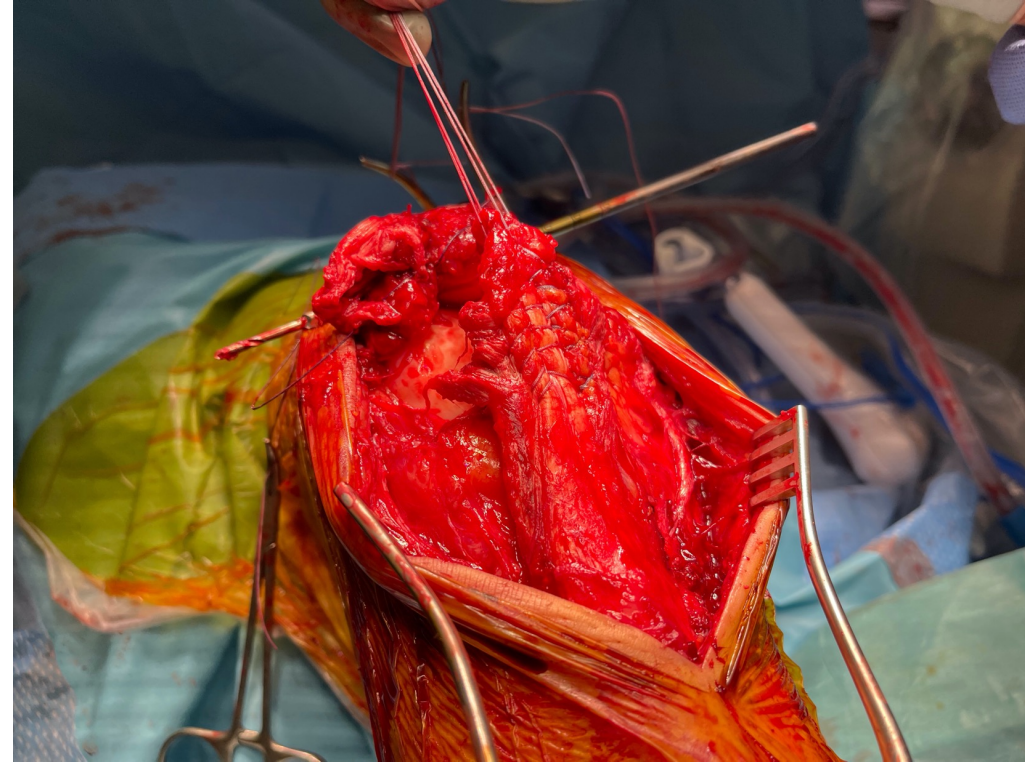
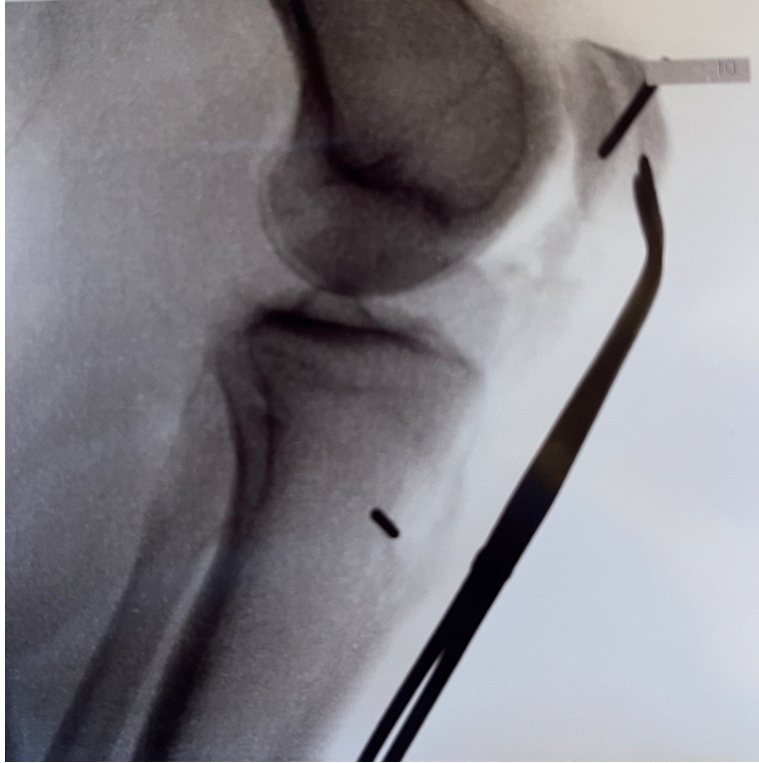








patellar tunnel 3.5  
tibial tunnel 6

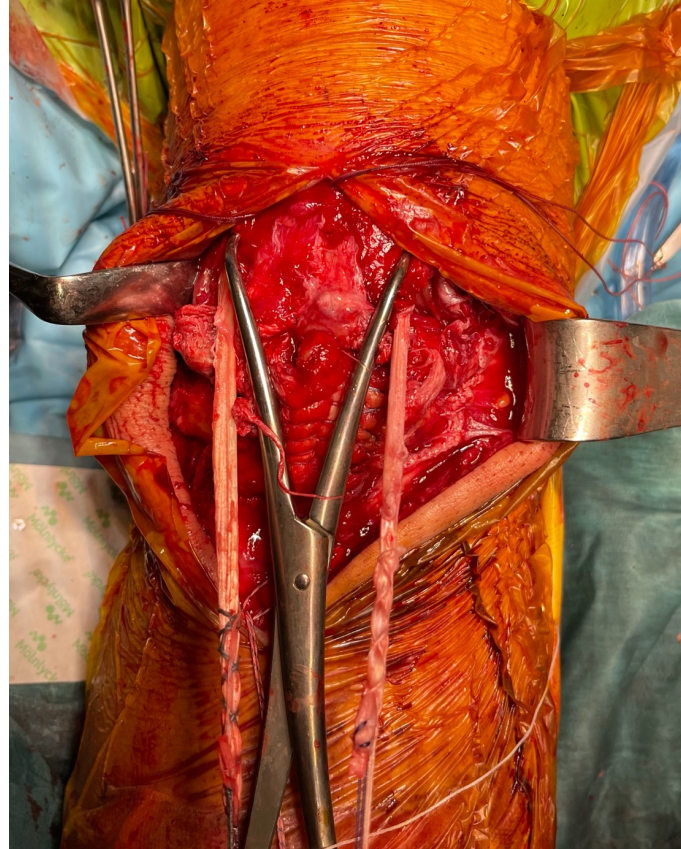


tendon Krackow sutures  
vertical tunnels in the patella





choose the patellar height under fluoroscopy  
compare to the contralateral knee

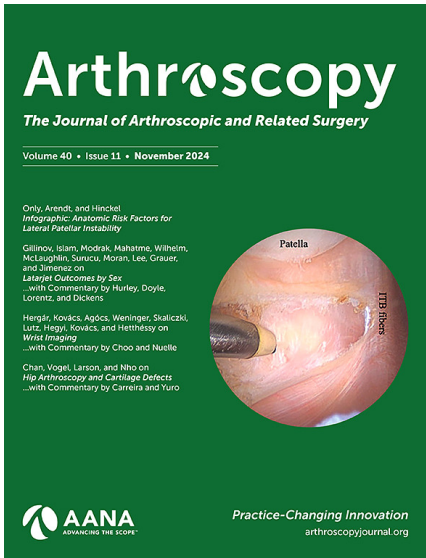


fix the semi-T graft in the tibial tunnel first  
then tight the sutures running through the patellar



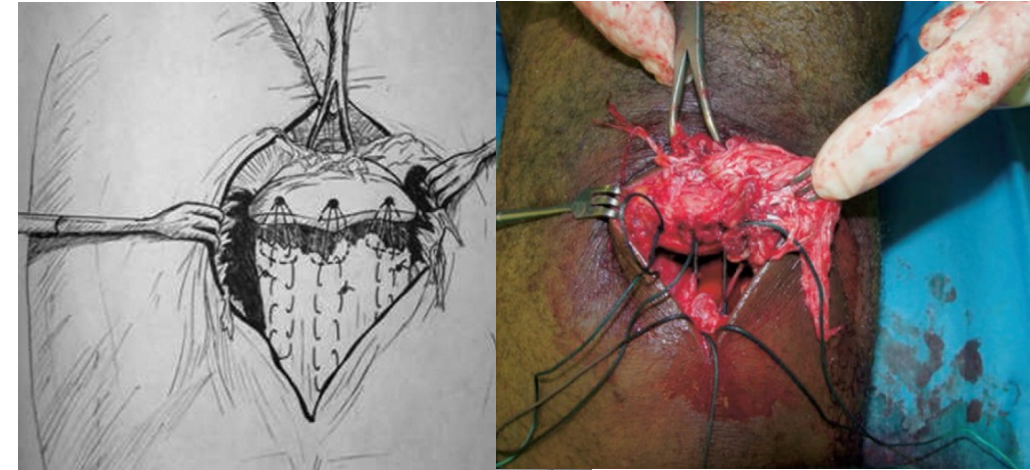


# Patellar Tendon Repair – Other options




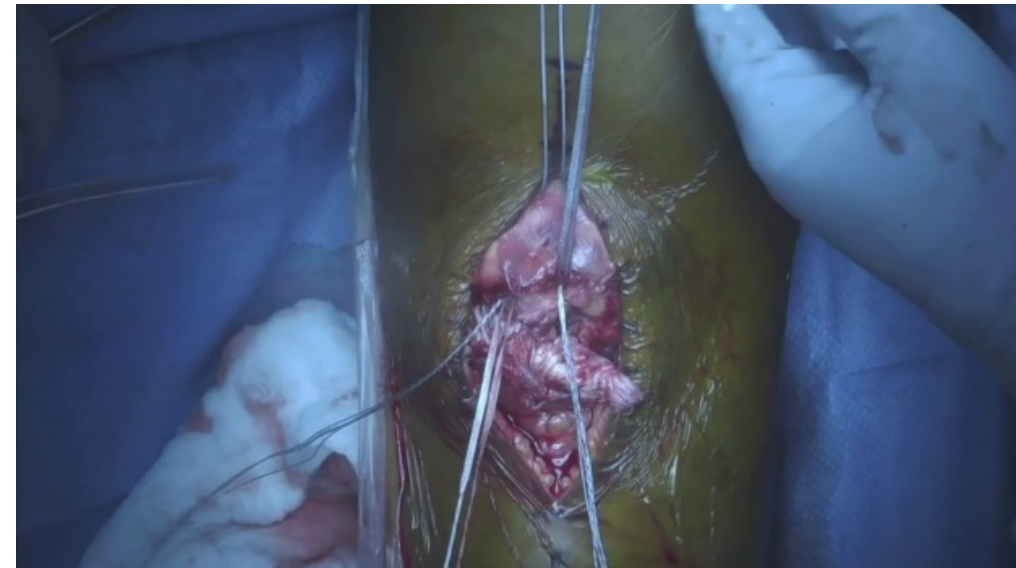
## Repair of Patellar Tendon Rupture With Suture Anchors

David Capiola, M.D., and Louis Re, M.D.



## Hybrid Knot and Knotless Suture Anchor Repair for Patellar Tendon Rupture

Ekene U. Ezeokoli, BS <sup>†,‡,\*</sup>, Daniel Sutton, MD<sup>‡</sup>, and Theodore B. Shybut, MD<sup>‡</sup>





# Any Difference between Osseous Tunnels and Anchors?

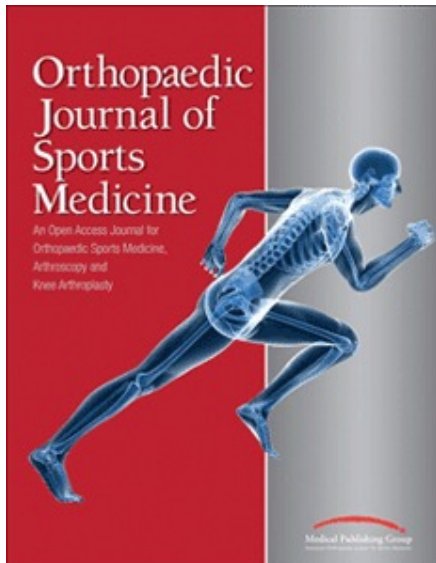


JOURNAL OF  
**ORTHOPAEDIC SCIENCE**  
Official Journal of The Japanese Orthopaedic Association

Original Article

## Transosseous tunnels versus suture anchors for the repair of acute quadriceps and patellar tendon ruptures: A systematic review and meta-analysis of biomechanical studies

John F. Dankert<sup>1</sup>  , Devan D. Mehta<sup>1</sup>, Lindsey H. Remark, Philipp Leucht



## Failure Rates of Suture Anchor Fixation Versus Transosseous Tunnel Technique for Patellar Tendon Repair

### A Systematic Review and Meta-analysis of Biomechanical Studies

Casey Imbergamo,<sup>\*,†</sup> MD, Sean Sequeira,<sup>†</sup> MD, Joseph Bano,<sup>‡</sup> MS, William R. Rate IV,<sup>‡</sup> MS, and Heath Gould,<sup>†</sup> MD

- ✓ Ultimate load to failure similar
- ✓ No significant differences in function



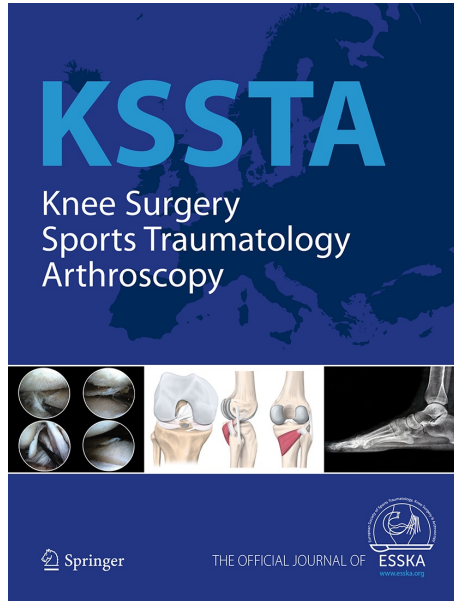
# Goals of Rehabilitation



- ✓ Limit pain and inflammation
- ✓ Regain full-extension control
- ✓ Regain ROM
- ✓ Strengthening
- ✓ Return to Sports



# Rehabilitation



Knee Surg Sports Traumatol Arthrosc (2012) 20:2275–2278  
DOI 10.1007/s00167-012-1887-8

KNEE

## Postoperative functional rehabilitation after repair of quadriceps tendon ruptures: a comparison of two different protocols

Ronny Langenhan · Matthias Baumann ·  
Pedro Ricart · David Hak · Axel Probst ·  
Andreas Badke · Per Trobisch



- ✓ N = 66 patients
- ✓ **Group 1:** Light touch and limited flexion    vs    **Group 2:** Full weight bearing and functional rehab
- ✓ No difference in IKDC
- ✓ No difference in re-ruptures
- ✓ Group 2 returned to work earlier

# Expected Outcomes : re-rupture rate

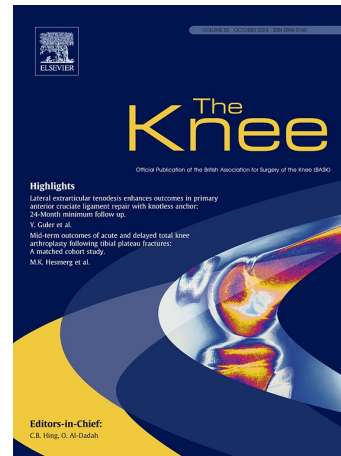


Review



## Clinical outcomes after repair of quadriceps tendon rupture: A systematic review

Vincenzo Ciriello <sup>a</sup>, Suribabu Gudipati <sup>a</sup>, Theodoros Tosounidis <sup>a</sup>, P.N. Soucacos <sup>b</sup>,  
Peter V. Giannoudis <sup>a</sup>  

- ✓ Type of surgical repair did not influence the clinical results. The overall rate of re-rupture was 2%.



## Reconstruction techniques and clinical results of patellar tendon ruptures: Evidence today

Jack H. Gilmore <sup>a</sup> · Zoë J. Clayton-Smith <sup>a</sup> · Marc Aguilar <sup>a</sup> · Spiros G. Pneumáticos <sup>c</sup> · Peter V. Giannoudis <sup>a,b</sup>  

Affiliations & Notes  Article Info 

- ✓ A primary repair method augmented with cerclage wire or non-absorbable sutures reported the

best clinical results, with a 2% re-rupture rate.

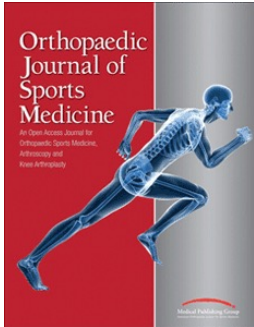


# Expected Outcomes : return to sport

## Outcomes After Repair of Quadriceps Tendon Rupture in Patients Aged 40 Years and Younger

Somnath Rao,\* MD, Emma E. Johnson,\* BA, Taylor D'Amore,\* MD, Stanley Szeto,\* BS, Peters Otlans,\* MD, and Steven B. Cohen,\*<sup>†</sup> MD

*Investigation performed at Rothman Orthopaedic Institute, Philadelphia, Pennsylvania, USA*




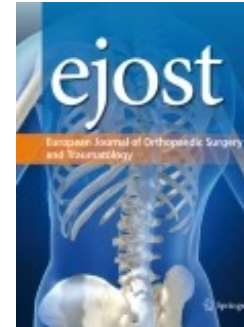
- ✓ Mean IKDC 74
- ✓ Mean Lysholm 85
- ✓ 42% returned to same sport level
- ✓ Return to play at a mean time of 9 months
- ✓ 8-10% long-term pain and stiffness

### ORIGINAL ARTICLE



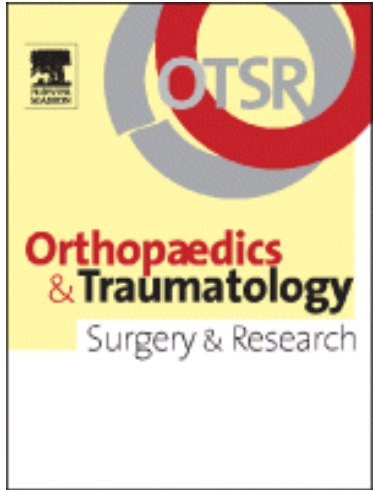
## Clinical and biomechanical outcomes following patellar tendon repair with suture tape augmentation

Maximilian Hinz<sup>1</sup>  · Stephanie Geyer<sup>1</sup> · Felix Winden<sup>1</sup> · Alexander Braunsperger<sup>2</sup> · Florian Kreuzpointner<sup>2</sup> · Markus Irger<sup>1</sup> · Andreas B. Imhoff<sup>1</sup> · Julian Mehl<sup>1</sup>



- ✓ Mean IKDC 84
- ✓ Mean Lysholm 80
- ✓ 71% returned to same sport level
- ✓ Return to play at a mean time of 9 months

# Expected Outcomes : quad versus patellar tendon



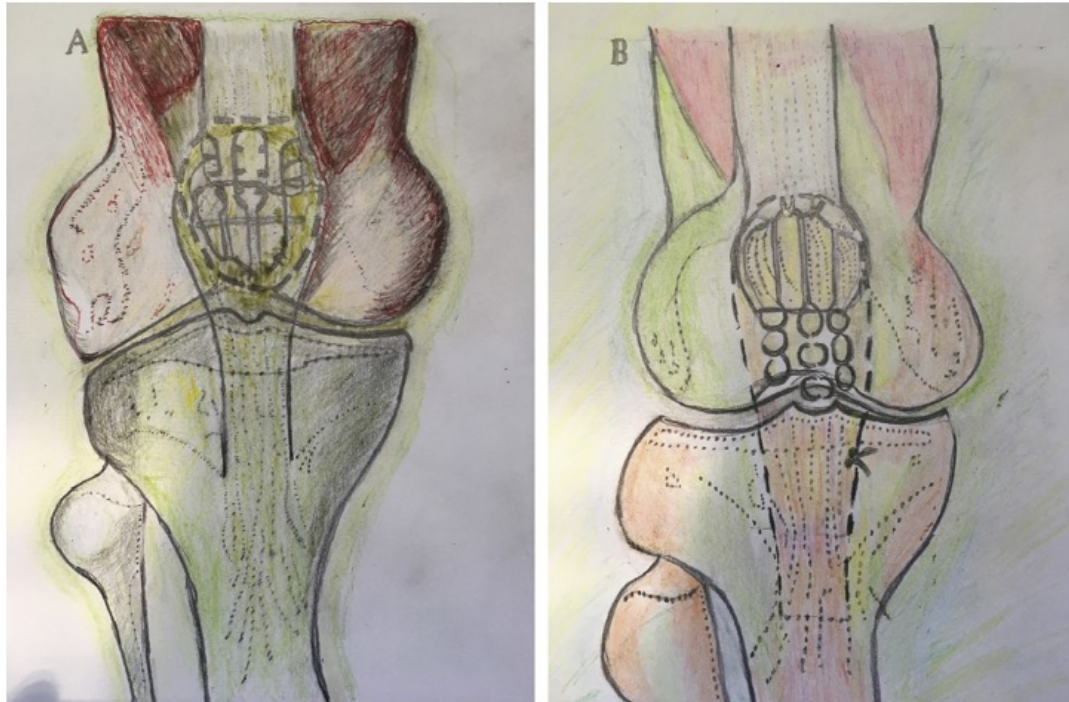
Original article

## Better knee function after surgical repair of acute quadriceps tendon rupture in comparison to acute patellar tendon rupture

Michael E. Hantes<sup>a,\*</sup>, Rejith Mathews<sup>b</sup>, Vasilios Raoulis<sup>a</sup>, Sokratis Varitimidis<sup>a</sup>,  
Theophilos Karachalios<sup>a</sup>, Konstantinos N. Malizos<sup>a</sup>

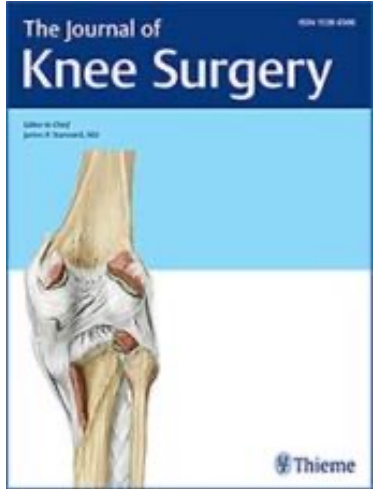
<sup>a</sup> Department of Orthopaedic Surgery, Faculty of Medicine, School of Health Sciences, University of Thessalia, Mezourlo, 41110 Larissa, Greece

<sup>b</sup> Department of Orthopaedic Surgery, Sri Narayani hospital and research centre, Vellore, Tamil Nadu, India




- ✓ N = 24 patients
- ✓ Mean follow-up: 6 years
- ✓ Kujala score: 88 QT vs 73 PT ( $p = 0.03$ )
- ✓ VAS Pain Scale: 1.2 QT vs 3.5 PT ( $p = 0.01$ )
- ✓ No difference in PFJ arthritis

# Expected Outcomes : males versus females



## Original Article

### Do Patellar Tendon Repairs Have Better Outcomes than Quadriceps Tendon Repairs? A Prospective Cohort Analysis

Sercan Yalcin , Brett McCoy , Lutul D. Farrow , Carrie Johnson , Morgan H. Jones , Michael Kolczun , Brian Leo , Anthony Miniaci , Robert Nickodem , Richard Parker , Alfred Serna , Kim Stearns , Greg Strnad , James Williams , Jin Yuxuan , Kurt P. Spindler

- ✓ N = 141 patients
- ✓ Follow-up: 1 year
- ✓ No difference in pain and function at 1 year.
- ✓ Female gender and low baseline KOOS scores were identified as predictors for worse outcomes.



# Risk Factors for Failure



## Risk Factors Associated With Poor Outcomes After Quadriceps Tendon Repair

Carlo Coladonato,\* MS, Adeeb Jacob Hanna,\* BS, Neel K. Patel,\* MD, John Hayden Sonnier,\* MD, Gregory Connors,<sup>†</sup> BS, Matthew Sabitsky,<sup>‡</sup> BS, Emma Johnson,\* MD, Donald W. Mazur,\* MD, Shyam Brahmabhatt,\* MD, and Kevin B. Freedman,\*<sup>§</sup> MD

*Investigation performed at Rothman Orthopaedic Institute at the Sidney Kimmel Medical College at Thomas Jefferson University, Philadelphia, Pennsylvania, USA*

- Increasing age
- BMI
- Female sex
- Retinacular involvement
- Smoking

were found to be risk factors for poor outcomes after quadriceps tendon repair.

*Merci  
beaucoup*