Trochleoplasty and MPFL

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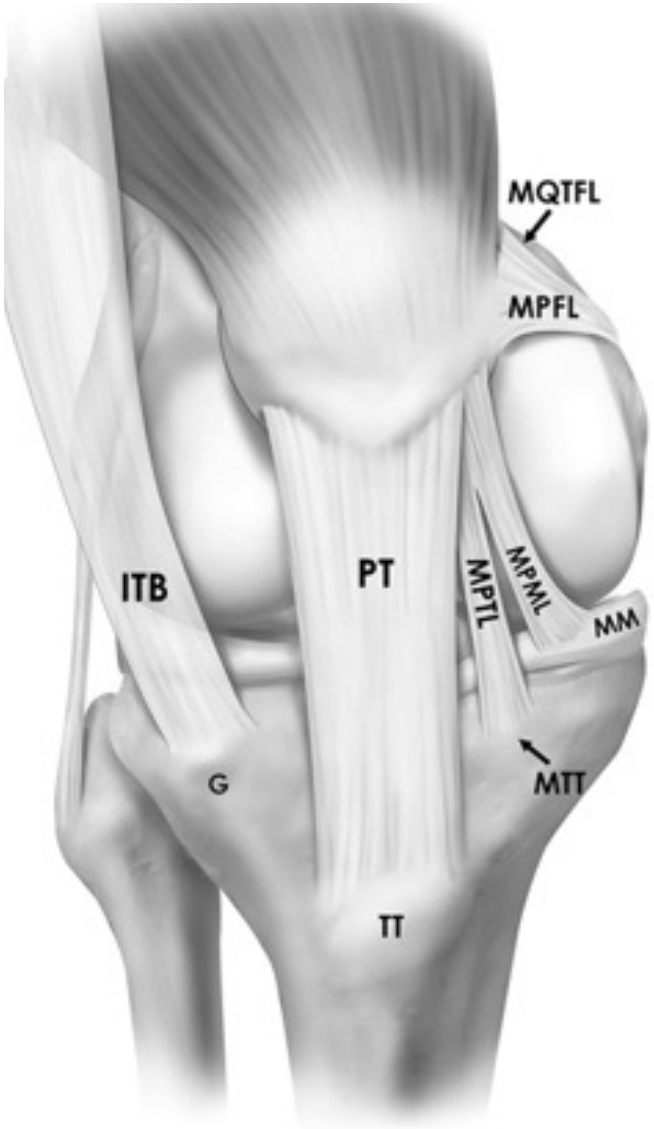
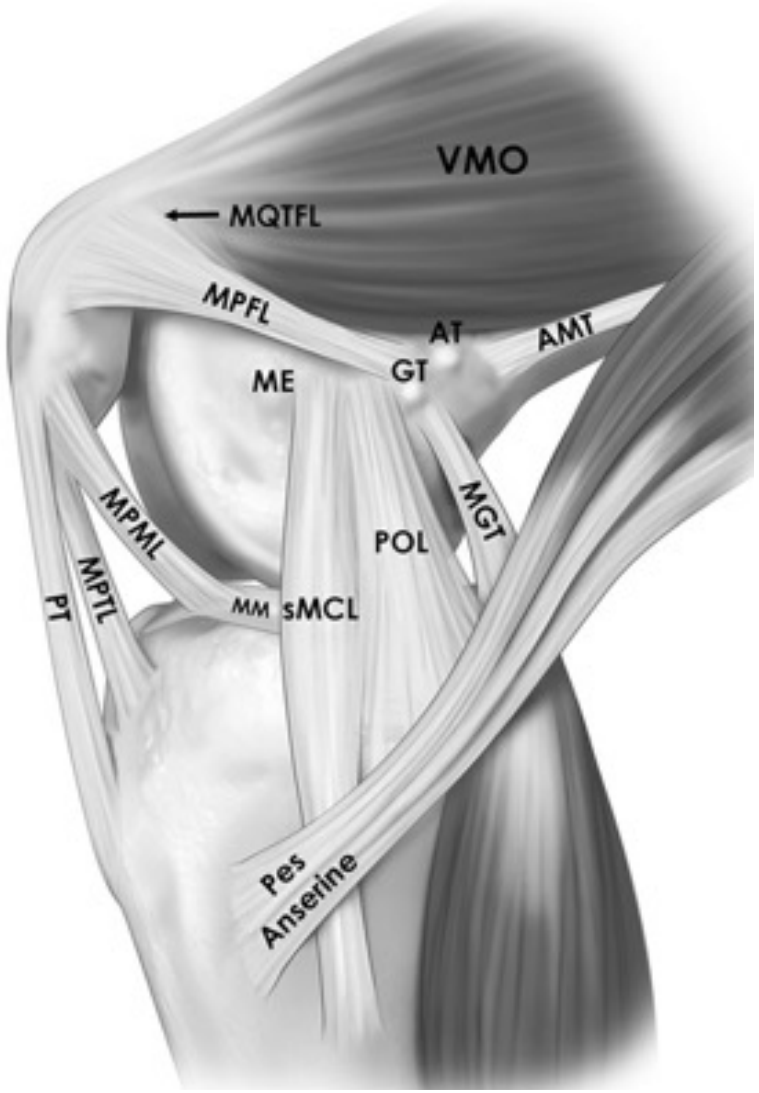
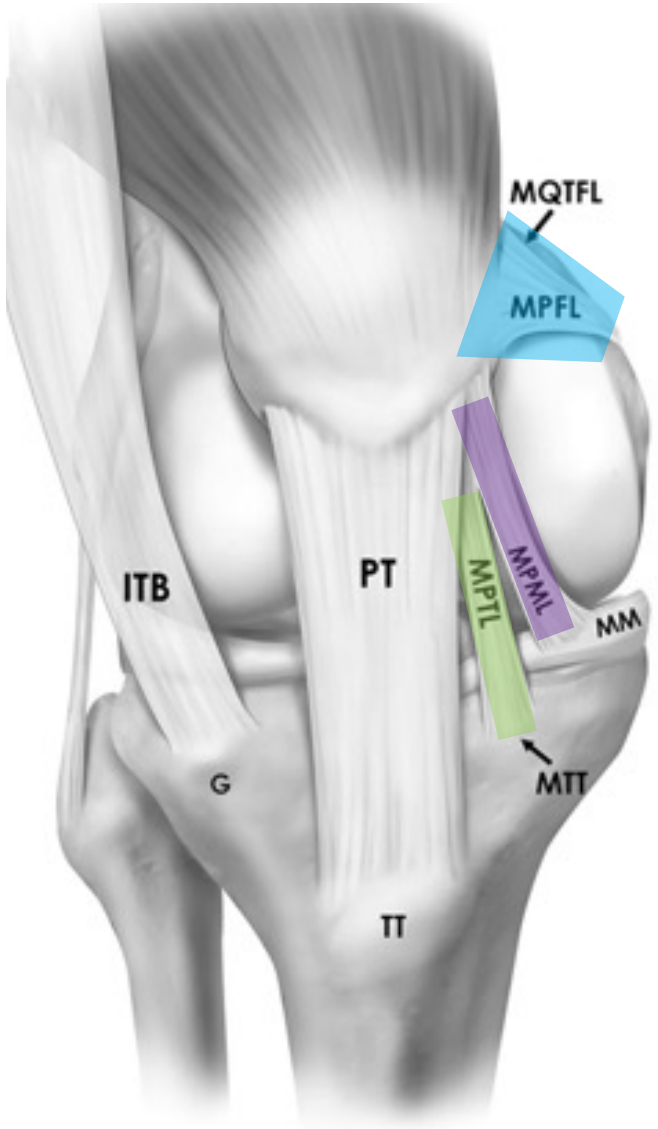
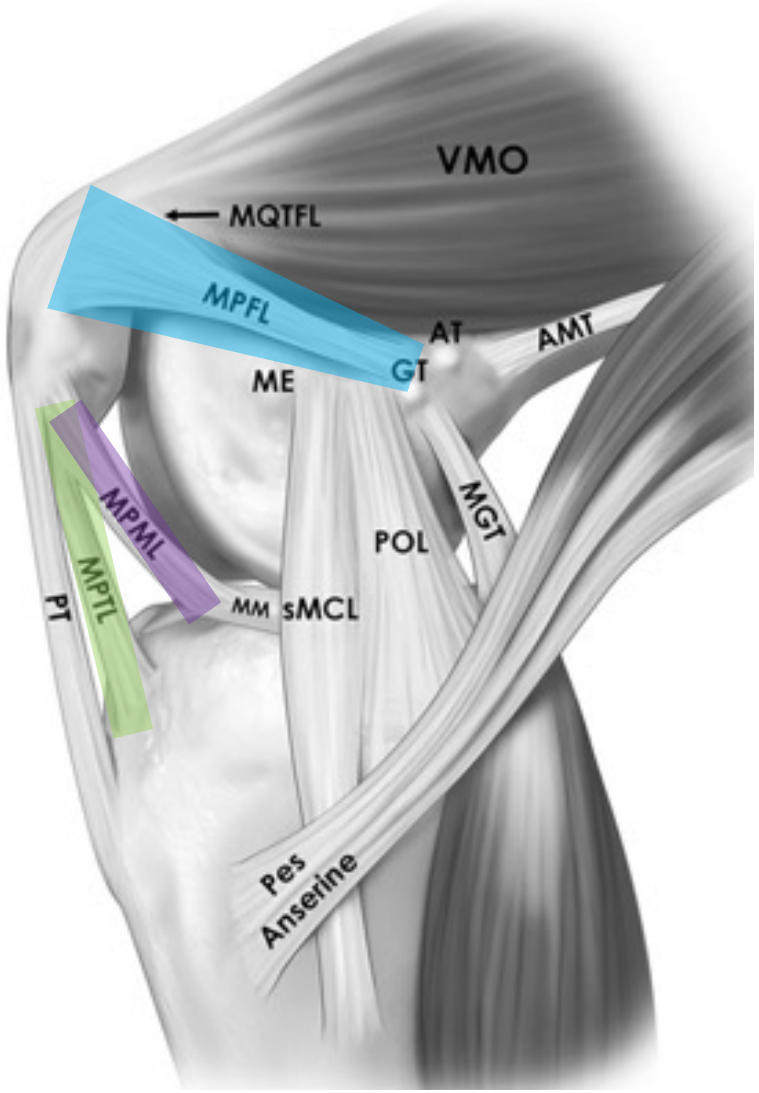
Medial Patellar Ligaments





Medial Patellar Ligaments



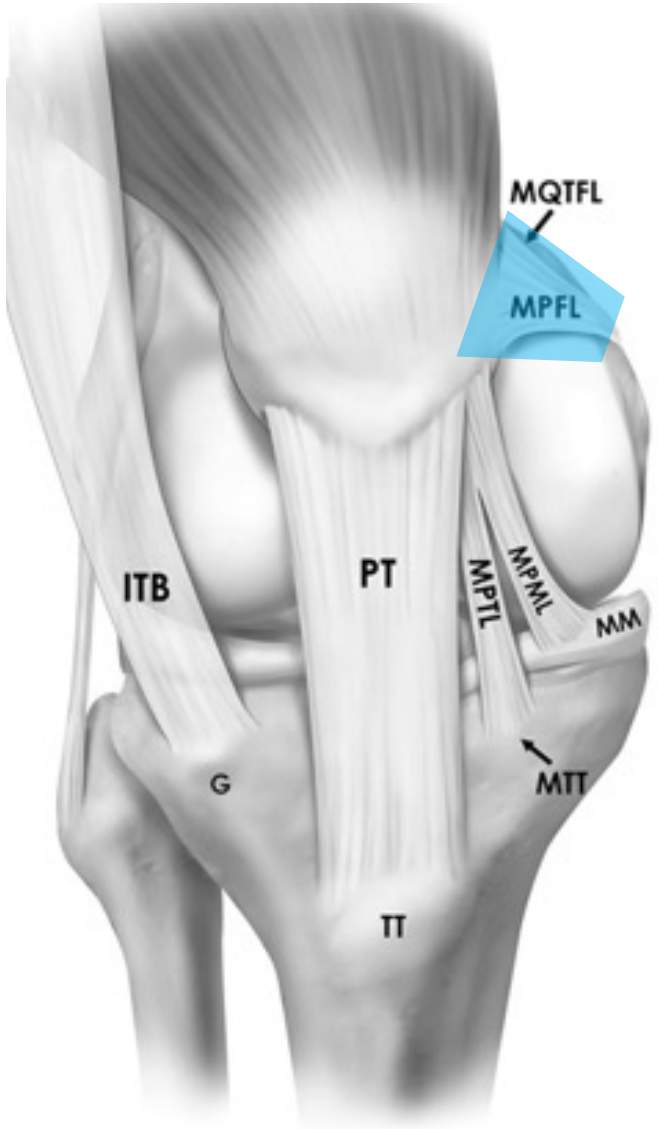


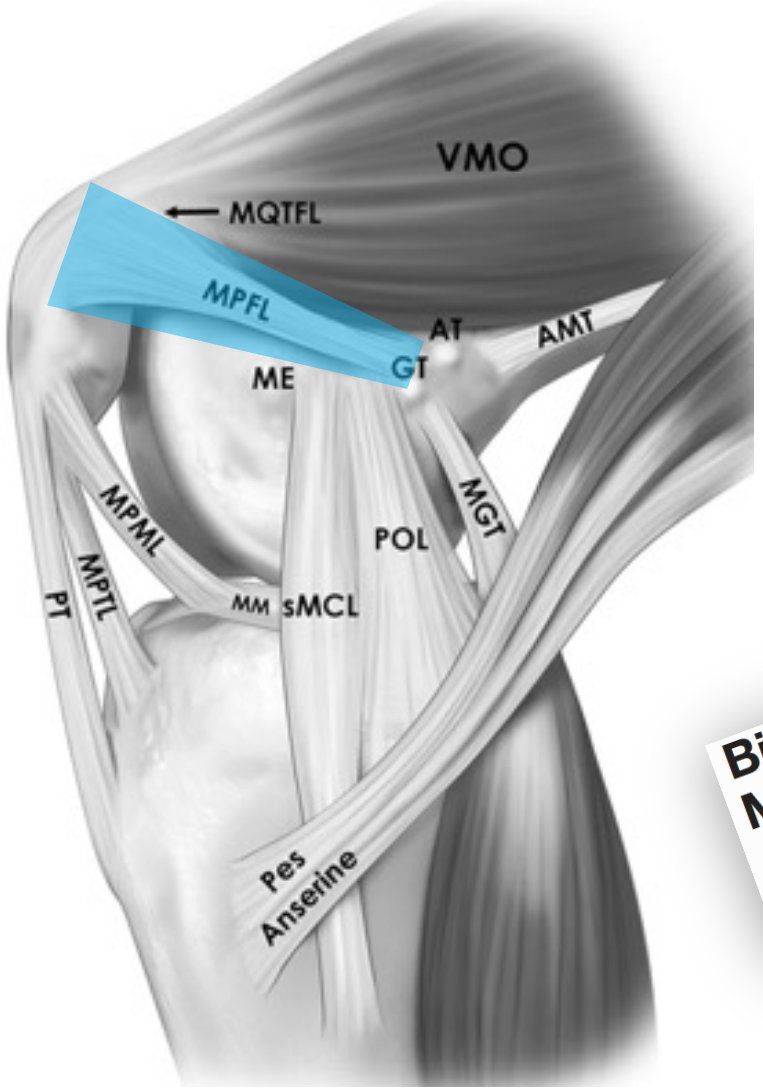
MPFL — Medial PatelloFemoral Ligament

MPML — Medial PatelloMeniscal Ligament

MPTL — Medial PatelloTibial Ligament

Medial Patellar Ligaments





MPFL

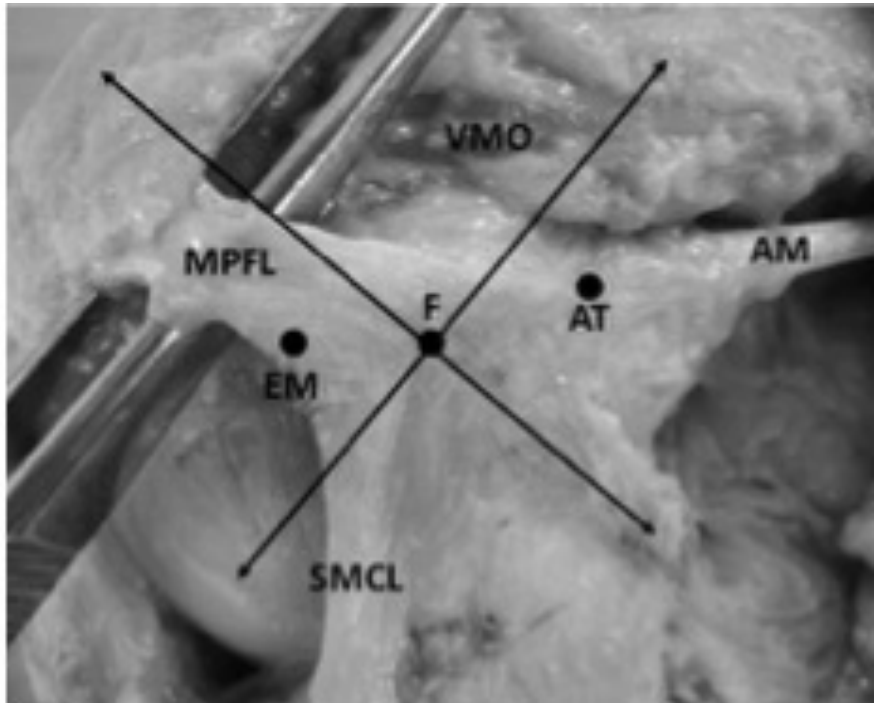
Medial PatelloFemoral Ligament

Biomechanical Evaluation of the Medial Stabilizers of the Patella

Matthew D. LaPrade,* BS, Samantha L. Kallenbach,* BS, Zachary S. Aman,* BA, Gilbert Moatshe,*†‡ MD, Hunter W. Storaci,* MS, Travis Lee Turnbull,* PhD, Elizabeth A. Arendt,§ MD, Jorge Chahla,* MD, PhD, and Robert F. LaPrade,*‖¶ MD, PhD

Dimensions

- ✓ **Length: 35 to 70 mm**
- ✓ **Width: 5 to 30 mm**
  - Femoral insertion: 12.2 ± 2.6mm*
  - Patellar insertion: 24.4 ± 4.8mm*
- ✓ **Thickness: 1mm**



Article	Number of knees	MPFL identified (%)	Length/breadth at the origin
Smirk and Morris [15]	25	100	58/NS
Hautamaa et al. [10]	17	100	NS
Conlan et al. [4]	27	90	NS/13
Steensen et al. [16]	11	100	NS/15.4
Reider et al. [14]	NS	35	NS/10
Panagiotopoulos et al. [13]	8	100	47/15
Nomura et al. [11]	20	100	58/12
Tuxoe et al. [17]	39	100	53/17
Our series	23	100	57/12

Philippot et al, KSSTA2009

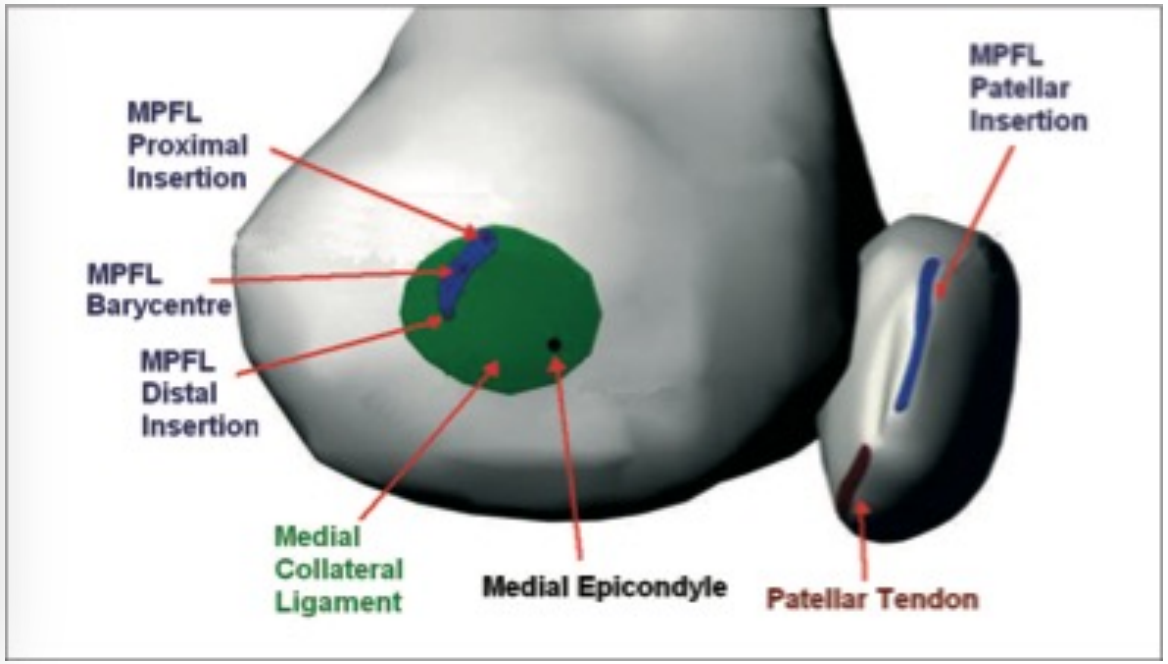
Femoral insertion

Joints

Patellofemoral anatomy and biomechanics: current concepts

STEFANO ZAFFAGNINI[1], DAVID DEJOUR[2], ALBERTO GRASSI[1], TOMMASO BONANZINGA[1], GIULIO MARIA MARCHEGGIANI MUCCIOLI[1], FRANCESCA COLLE[1], FEDERICO RAGGI[1], ANDREA BENZI[1], MAURILIO MARCACCI[1]

[1] 2nd Orthopedics and Traumatology Clinic, Laboratory of Biomechanics and Technological Innovation, Rizzoli Orthopedics Institute, Bologna, Italy
[2] Lyon-Ortho-Clinic, Lyon, France



"A cloud rather than a point"

Knee Surg Sports Traumatol Arthrosc (2017) 25:3755–3772
DOI 10.1007/s00167-016-4272-1

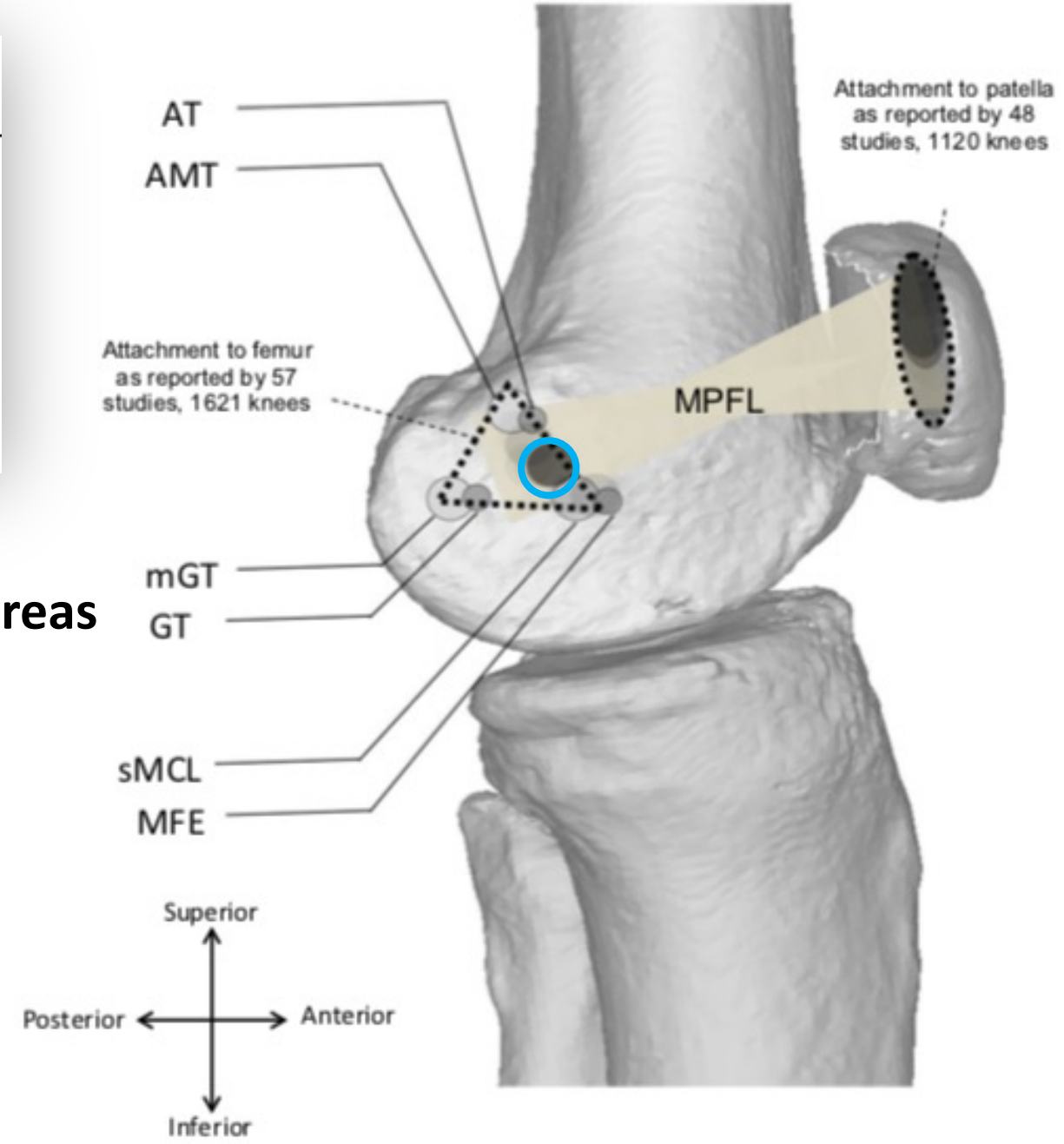
KNEE

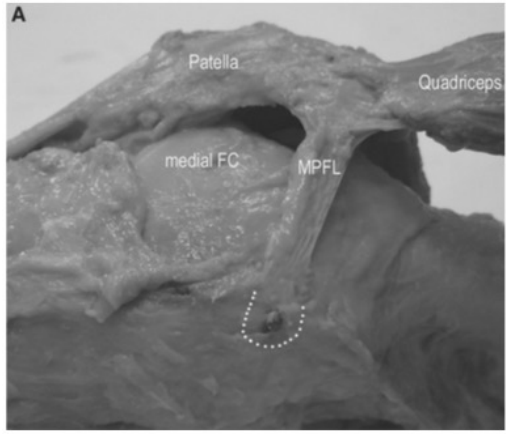
Origin and insertion of the medial patellofemoral ligament: a systematic review of anatomy

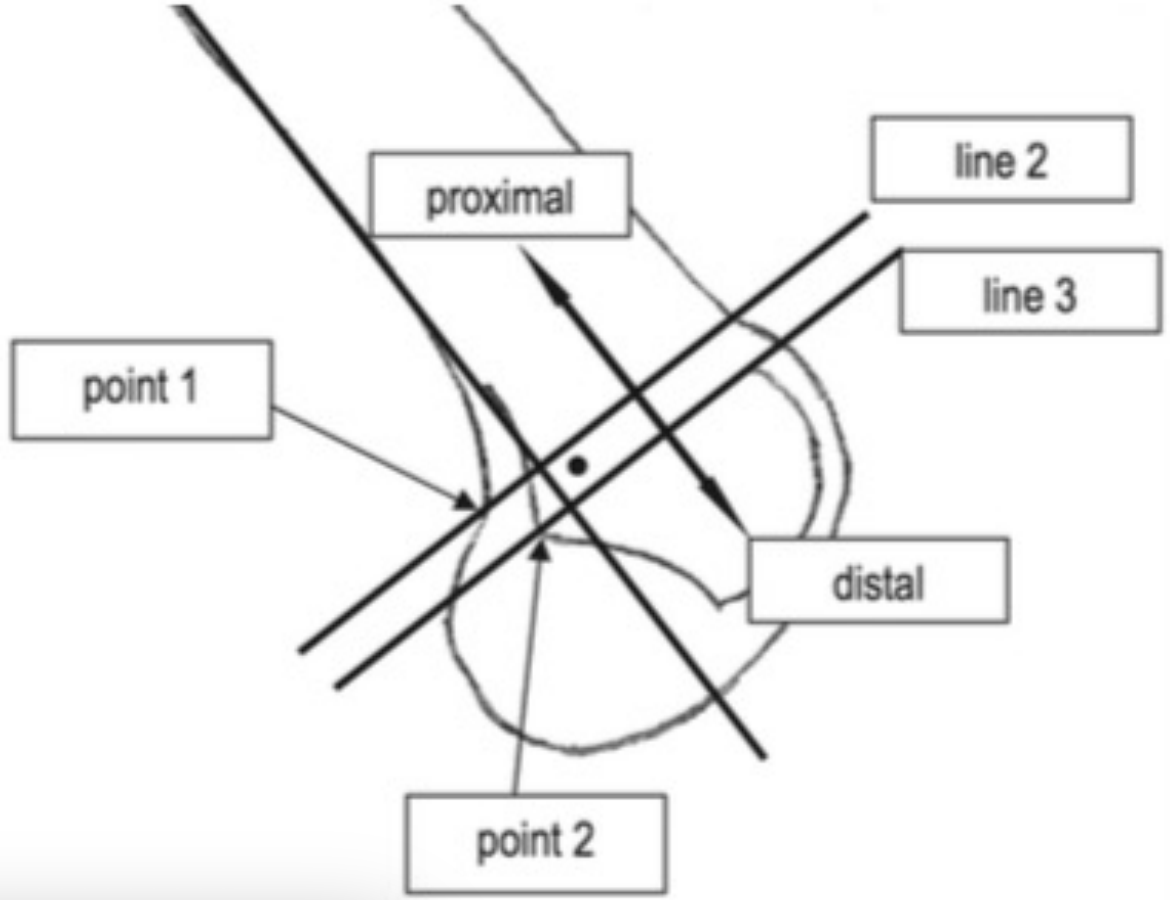
Arash Aframian[1,2,3] · Toby O. Smith[4] · T. Duncan Tennent[1,2] · Justin Peter Cobb[3] · Caroline Blanca Hing[1,2]

Diagram summarising the MPFL attachment areas <u>darker shading represents study concordance</u>

AT adductor tubercle,
AMT adductor magnus tendon
GT gastrocnemius tubercle
mGT medial gastrocnemius tendon
sMCL superficial medial collateral ligament
MFE medial femoral condyle







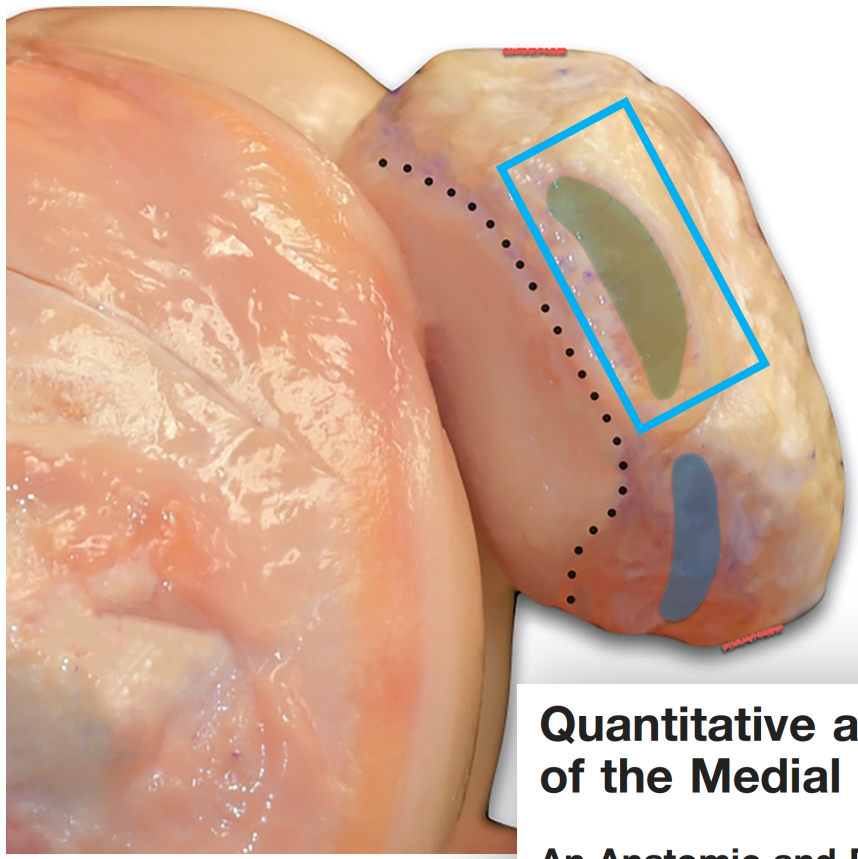
Schöttle point

Radiographic Landmarks for Femoral Tunnel Placement in Medial Patellofemoral Ligament Reconstruction

Philip B. Schöttle,* MD, Arno Schmeling, MD, Nikolaus Rosenstiel, MS, and Andreas Weiler, MD, PhD
From the Sports Traumatology and Arthroscopy Service, Center for Musculoskeletal Surgery, Charité, Free and Humboldt University of Berlin, Campus Virchow, Berlin, Germany

- ✓ 1.3 mm anterior to the posterior cortex extension
- ✓ 2.5 mm distal to a perpendicular intersecting the origin of the posterior medial femoral condyle
- ✓ 3 mm proximal to a perpendicular intersecting the posterior point of the Blumensaat line

Patellar insertion



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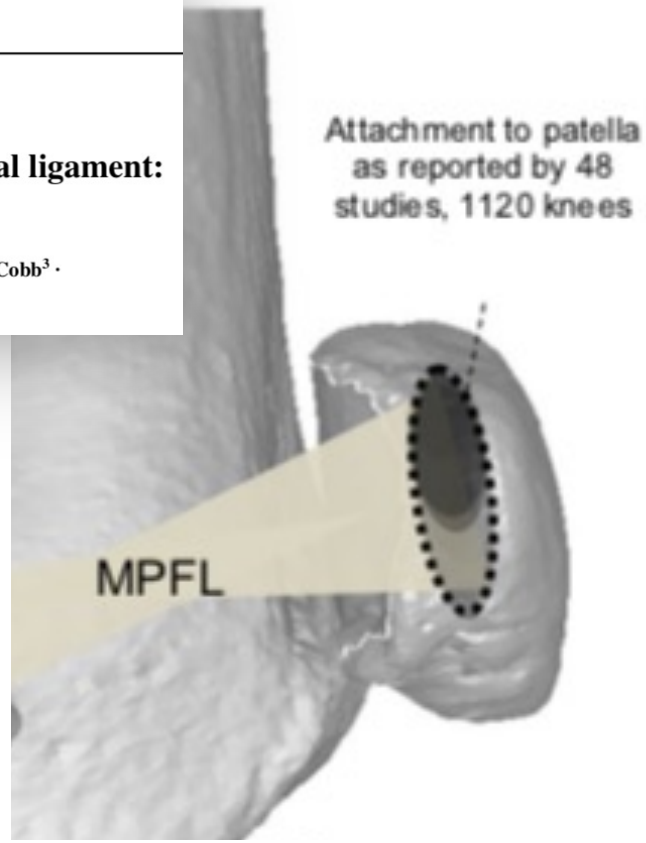


Quantitative and Qualitative Analysis of the Medial Patellar Ligaments

An Anatomic and Radiographic Study

Bradley M. Kruckeberg,* BA, Jorge Chahla,* MD, PhD, Gilbert Moatshe,†‡§ MD, Mark E. Cinque,* BS, Kyle J. Muckenhirn,* BS, Jonathan A. Godin,† MD, MBA, Taylor J. Ridley,‖ MD, Alex W. Brady,* MSc, Elizabeth A. Arendt,‖ MD, and Robert F. LaPrade,*†¶ MD, PhD
Investigation performed at Steadman Philippon Research Institute, Vail, Colorado, USA

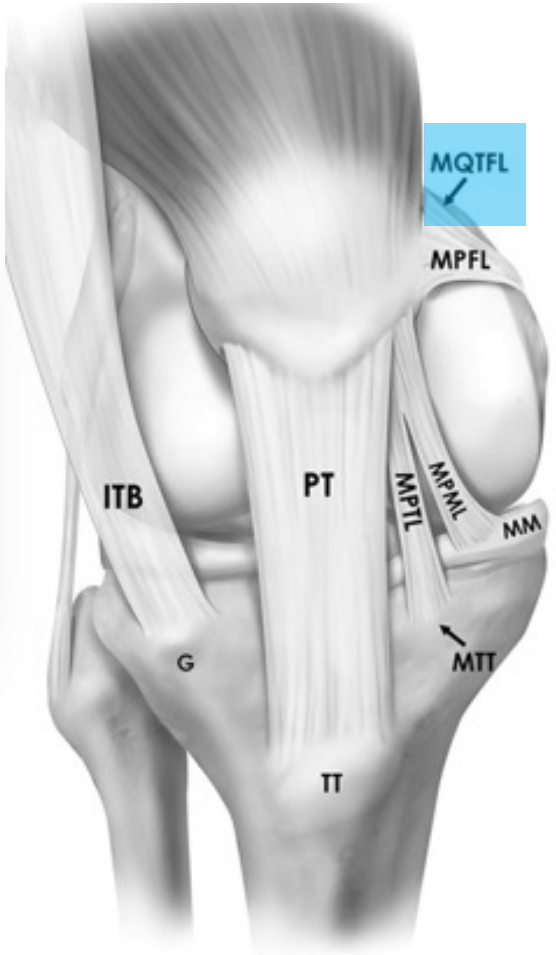
MQTFL Medial Quadriceps Tendon Femoral Ligament

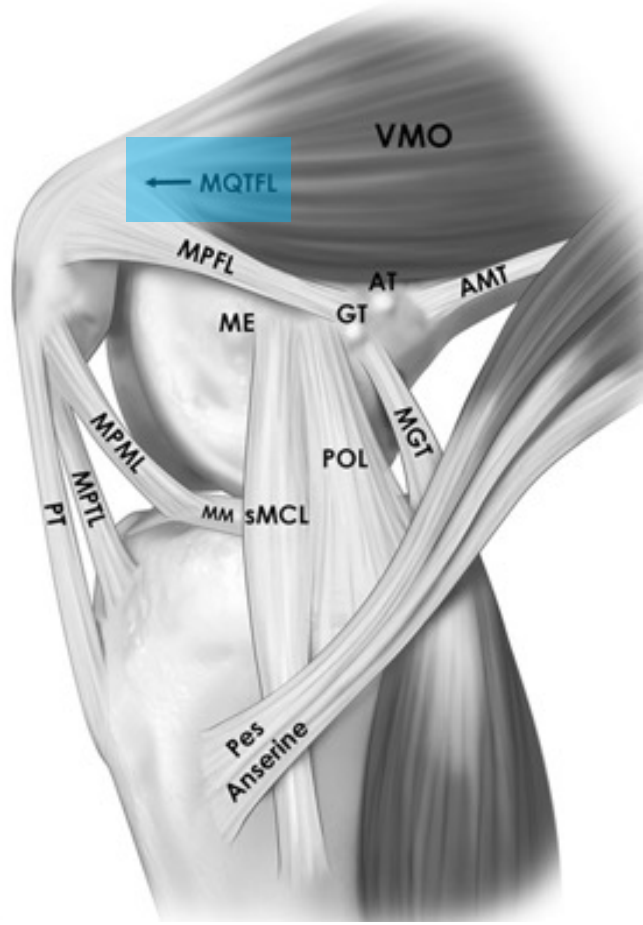
Knee Surgery, Sports Traumatology, Arthroscopy
https://doi.org/10.1007/s00167-018-5266-y

KNEE

Recognition of evolving medial patellofemoral anatomy provides insight for reconstruction

Miho J. Tanaka[1] · Jorge Chahla[2] · Jack Farr II[3] · Robert F. LaPrade[4] · Elizabeth A. Arendt[5] · Vicente Sanchis-Alfonso[6] · William R. Post[7] · John P. Fulkerson[8,9]





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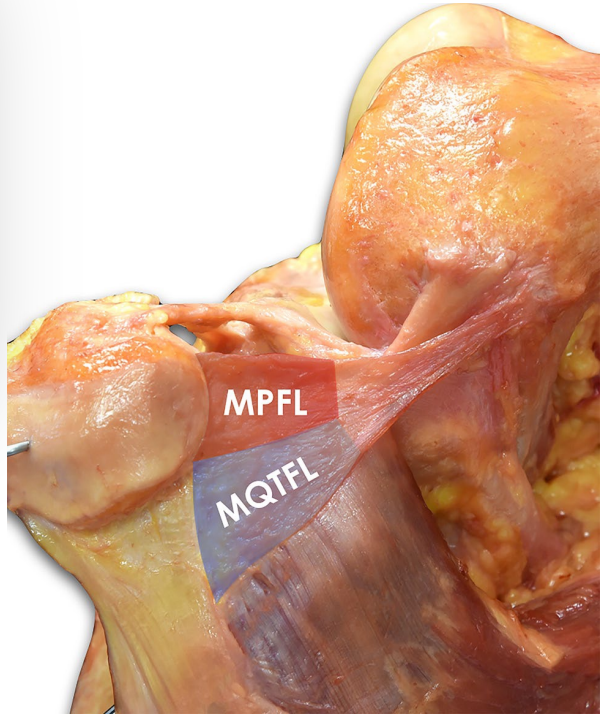
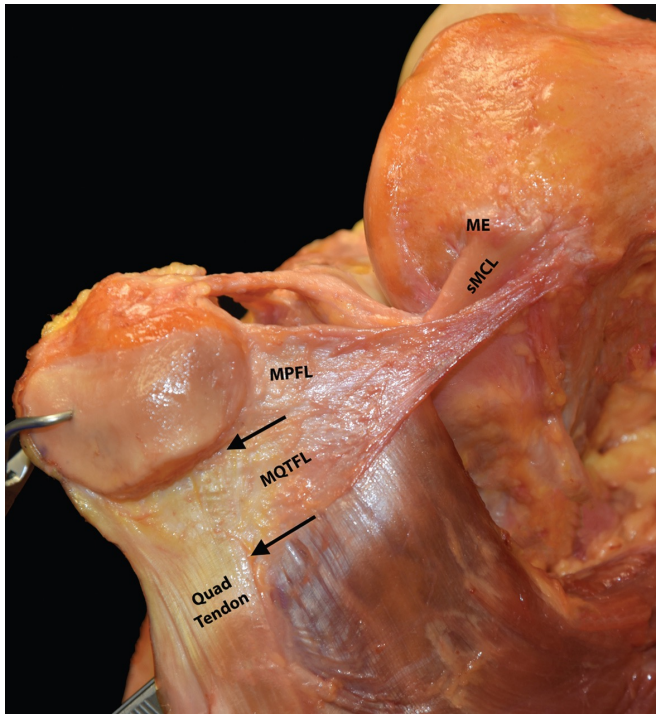
Medial PatelloFemoral Complex
MPFC = MQTFL + MPFL





Biomechanics

Biomechanical Evaluation of the Medial Stabilizers of the Patella

Matthew D. LaPrade,* BS, Samantha L. Kallenbach,* BS, Zachary S. Aman,* BA, Gilbert Moatshe,*†‡ MD, Hunter W. Storaci,* MS, Travis Lee Turnbull,* PhD, Elizabeth A. Arendt,§ MD, Jorge Chahla,* MD, PhD, and Robert F. LaPrade,*‖¶ MD, PhD

Failure Load

Failure Load, Stiffness, Failure Stress, and Modulus of the MPFL, MPTL, and MPML[a]

Structure	Failure Load, N	Stiffness, N/mm	Failure Stress, MPa	Modulus, MPa	Length, mm	Cross-sectional Area, mm^2
MPFL	178 ± 46 (91-270)	23 ± 6 (8-34)	5 ± 2 (2-9)	41 ± 19 (13-87)	69.5 ± 7.1 (53-79)	43.1 ± 13.8 (14.8-68.8)
MPTL	147 ± 80 (23-279)	31 ± 21 (6-75)	4 ± 2 (2-7)	35 ± 17 (23-47)	44.6 ± 8.8 (29-60)	34.8 ± 16.6 (25.5-79.5)
MPML	105 ± 62 (35-233)	14 ± 8 (5-30)	2 ± 1 (1-4)	14 ± 8 (5-32)	53.4 ± 10.7 (38-72)	55.3 ± 18.4 (10.5-63.8)

[a]Values are reported as mean ± SD (range). MPFL, medial patellofemoral ligament; MPML, medial patellomeniscal ligament; MPTL, medial patellotibial ligament.

- ✓ The MPFL and MPTL had comparable ultimate loads and stiffness, while the MPML had lower failure loads and stiffness
- ✓ Midsubstance failure was the most common type of failure

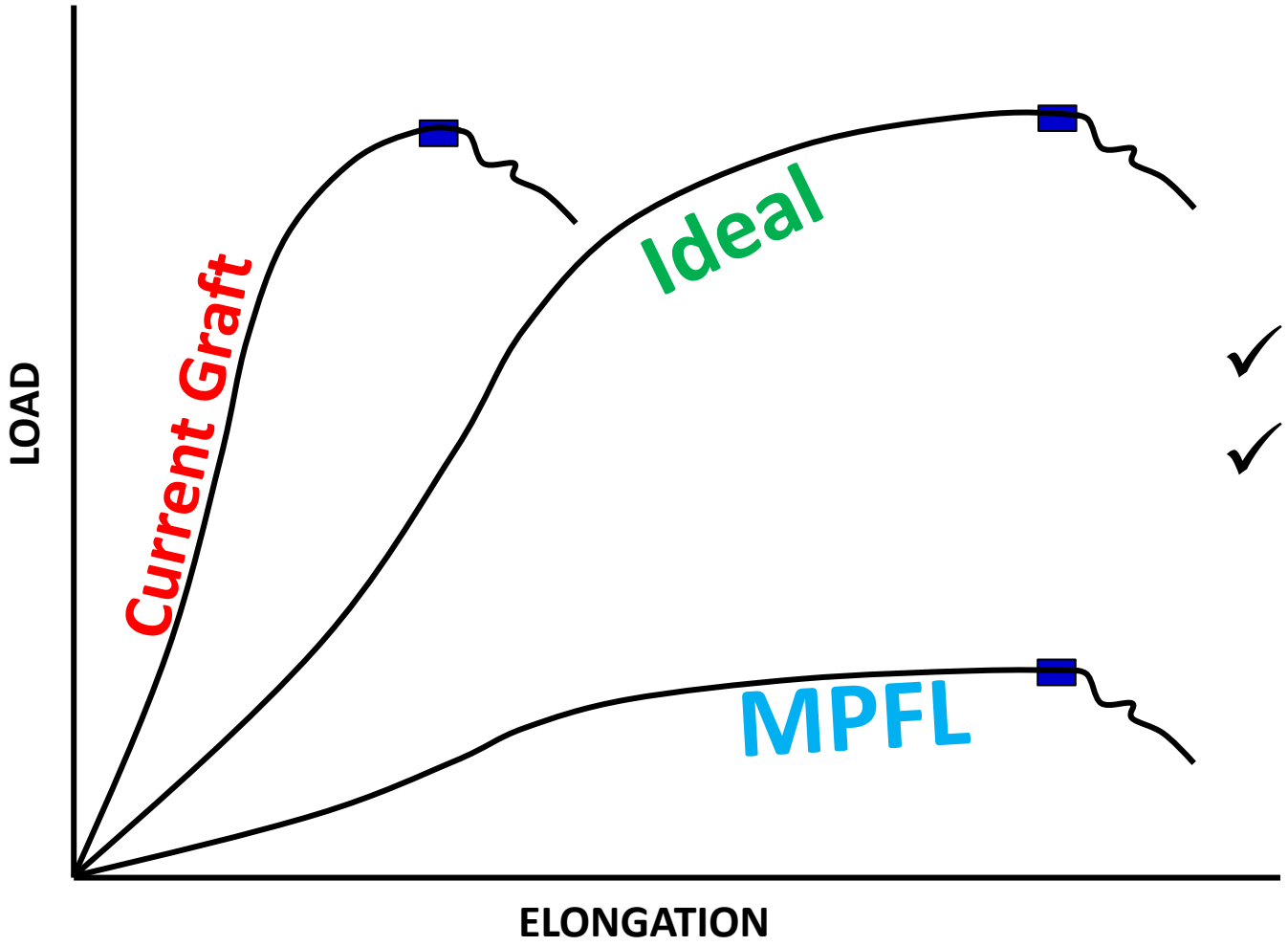
MPFL – Strength and Stiffness

Comparison of structural properties of various graft tissues commonly used for MPFL reconstruction

Tissue	Number of Specimens	Ultimate Load (N)	Stiffness (N/mm)	Reference
Semitendinosus	11	1216 ± 50	186 ± 9	Noyes *et al.*, 1984
Fascia lata	18	628 ± 35	118 ± 5	Noyes *et al.*, 1984
Gracilis	17	838 ± 30	171 ± 11	Noyes *et al.*, 1984
MPFL	10	208 ± 90	8	Amis, 2003
MPFL	12	145.6 ± 49	18.9 ± 1.3	Arendt, 2007

Courtesy of E. Arendt

MPFL – Strength and Stiffness



- ✓ Most of the grafts are stiffer
- ✓ Gracilis is enough

Biomechanics

Concepts of the Distal Medial Patellar Restraints: Medial Patellotibial Ligament and Medial Patellomeniscal Ligament

Betina B. Hinckel, MD, PhD, Lukasz Lipinski, MD,† and Elizabeth A. Arendt, MD‡*

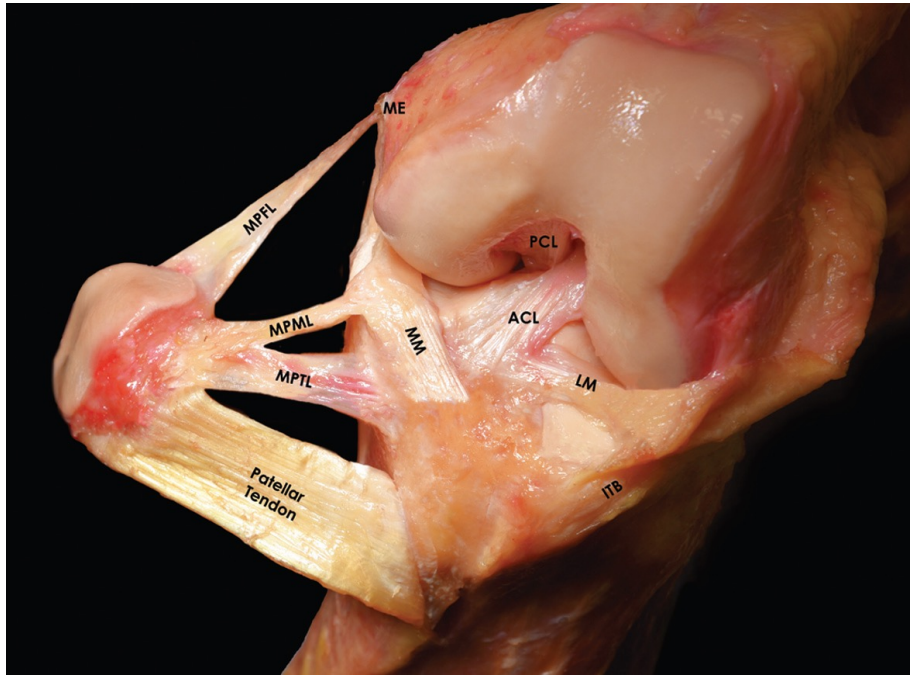
MPFL + MQTFL= proximal medial restraints

= primary stabilizer to lateral translation

50% to 60% of the restraint

MPTL and MPML = distal stabilizers

- ✓ *MPTL : 0% to 24% for the MPTL*
- ✓ *MPML: 8% to 38% for the MPML*
- ✓ *MPTL +MPML :* ***20% to 40%***



Biomechanics

Concepts of the Distal Medial Patellar Restraints: Medial Patellotibial Ligament and Medial Patellomeniscal Ligament

Betina B. Hinckel, MD, PhD, Lukasz Lipinski, MD,† and Elizabeth A. Arendt, MD‡*

MPFL = primary medial stabilizer of the patella in the first **30°** of flexion

MPTL and MPML : are important in 2 moments during ROM

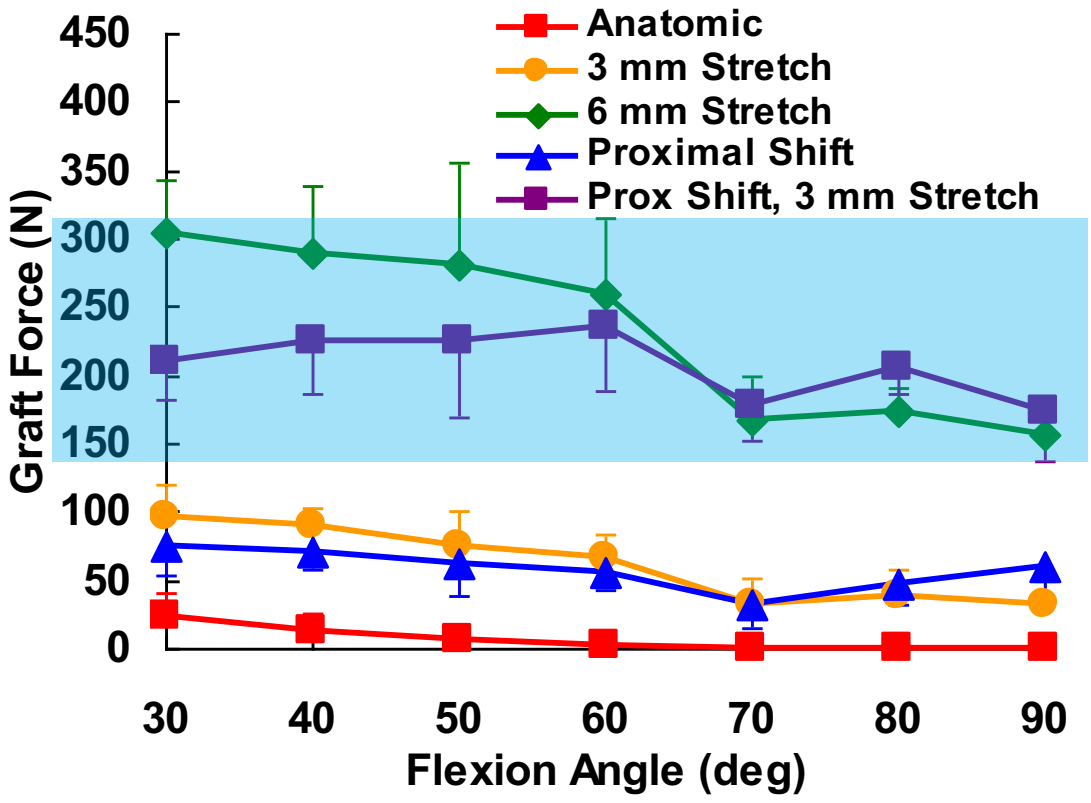
- **terminal extension**: counteracts quadriceps contraction
- **Deep flexion** : increased role in restriction of lateral translation, patellar tilt, and patellar rotation at 90° of flexion

(26% in extension, to 46% at 90°)

Effect of malpositioning

Simulated Surgical Errors

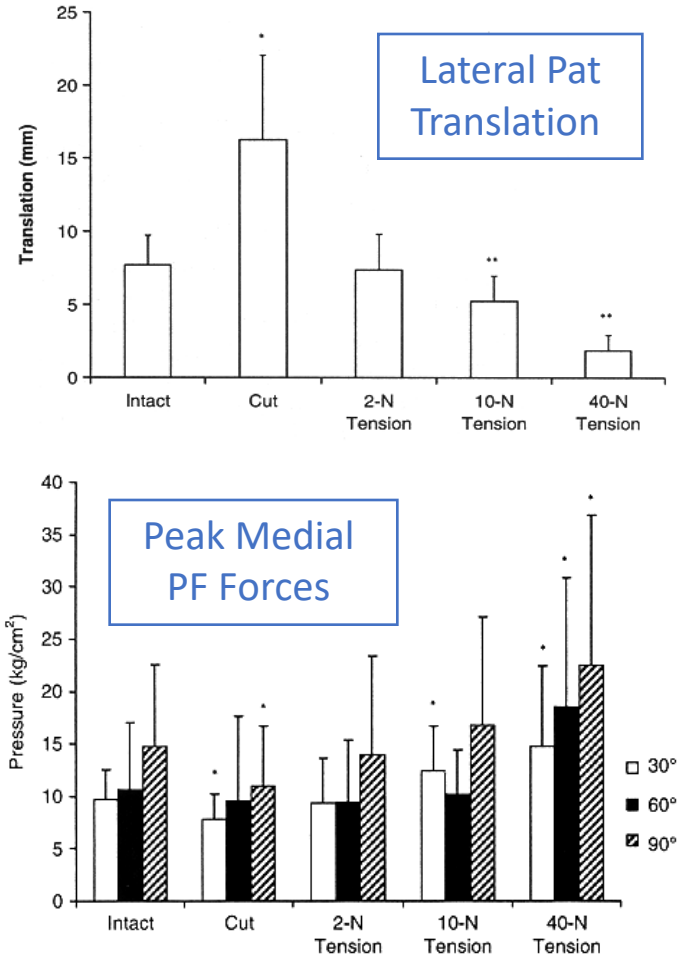
- ✓ **Over-tightening** the graft by 3 & 6 mm caused increased graft & PF forces
- ✓ **Malpositioning** the femoral tunnel by 5 mm caused increased graft & PF forces
- ✓ **Malpositioning or over-tightening the graft caused excessive graft and medial PF cartilage forces**



Elias & Cosgarea, AJSM 2006

Effect of over-tightening

- ✓ Low tension (2-N) applied to the MPFL graft reestablished normal patellar translation and normal PF contact pressures
- ✓ Higher tension (10-N, 40-N) restricted lateral translation and increased PF contact pressures
- ✓ **Over-tightening the graft caused increased PF pressure**



Beck et al, AJSM 37, 2007

Isometry ?

Available online at www.sciencedirect.com
ScienceDirect
The Knee 14 (2007) 424–428
The Knee
www.elsevier.com/locate/knee

The favourable anisometry: An original concept for medial patellofemoral ligament reconstruction

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Received 2 June 2007; received in revised form 20 August 2007; accepted 24 August 2007

0-30° of flexion
Engagement into the trochlea

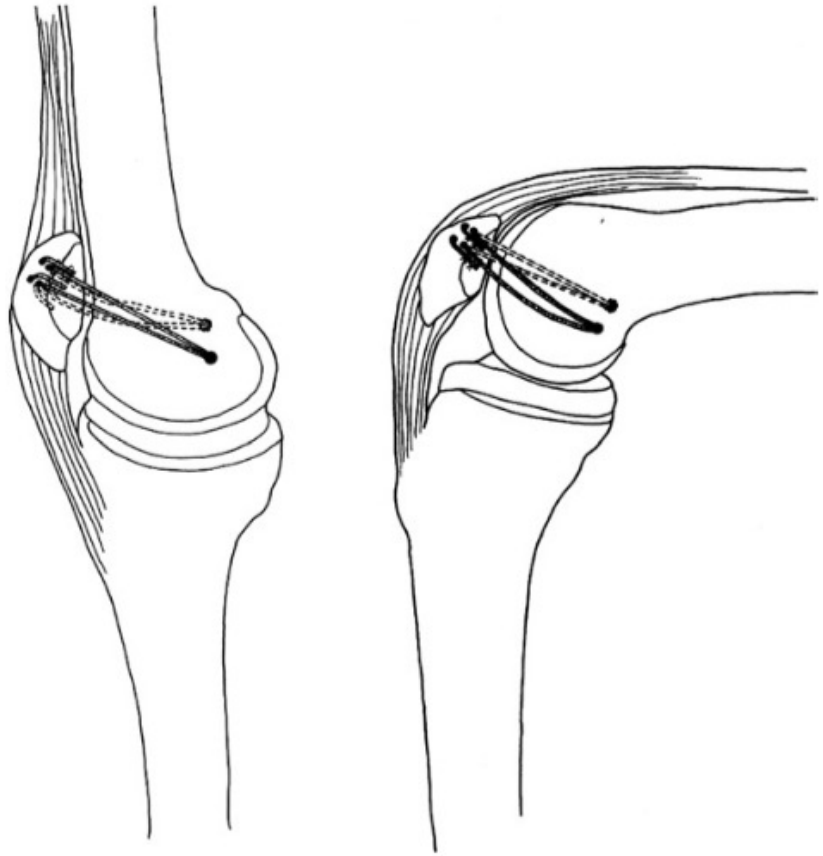


Fig. 3. Femoral fixation distal to the adductor tubercle just anterior to the most prominent point of the palpated epicondyle with tensioning performed in extension will result in a graft that has maximum tension in extension and progressively becomes lax in flexion. A more proximal placement (adductor tubercle) can lead to a reconstruction that overconstrained with knee flexion.

MPFL : some principles

1. Choice of graft
2. Double bundle
3. Positioning
4. Tensioning
5. Fixation
6. Rehabilitation
7. Indication

MPFL : some principles

1. **Choice of graft**
2. Double bundle
3. Positioning
4. Tensioning
5. Fixation
6. Rehabilitation
7. Indication

Gracilis is strong and long enough

> Knee. 2021 Dec;33:169-175. doi: 10.1016/j.knee.2021.09.007. Epub 2021 Oct 6.

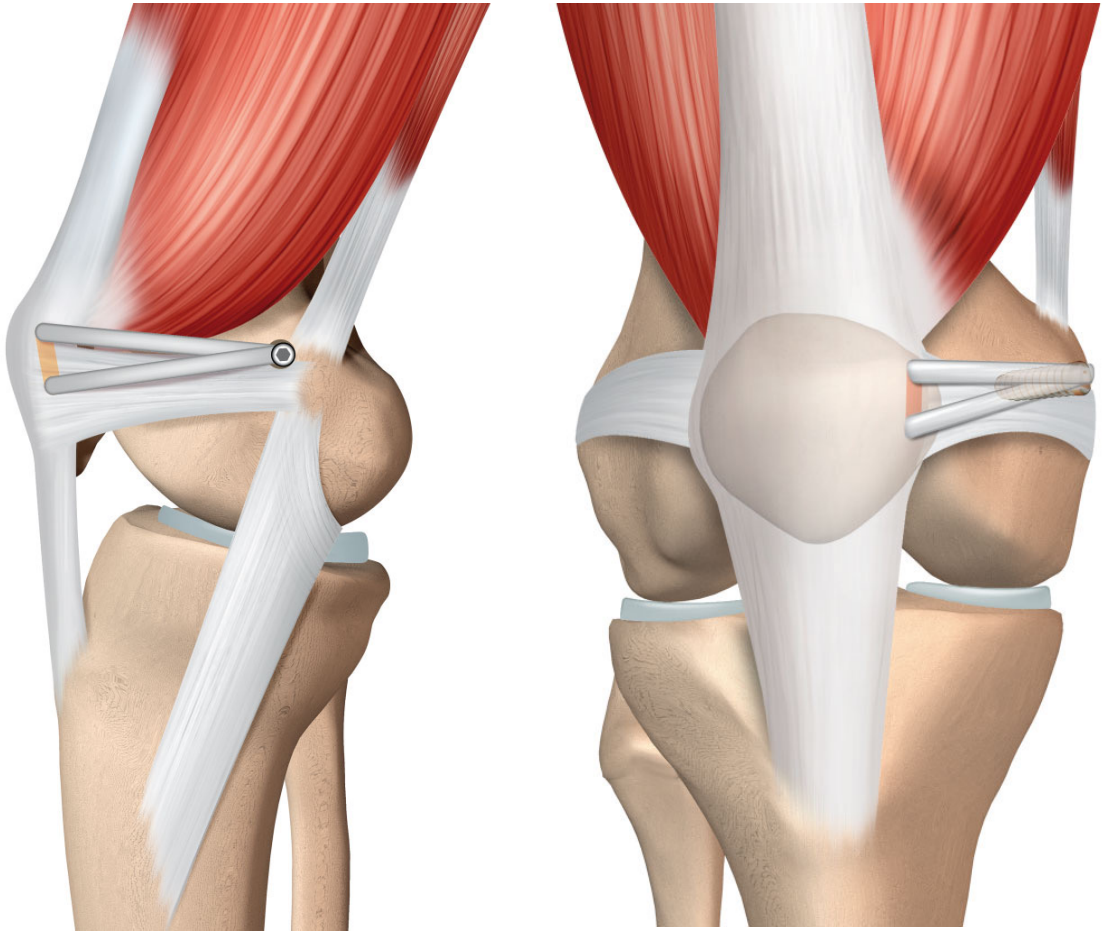
Biomechanical comparison of two medial patellofemoral ligament reconstruction techniques: Quadriceps tendon fixation versus single-tunnel patella fixation with gracilis autograft did not differ in load to failure and stiffness

Vasilios A Raoulis [1], Michael E Hantes [2], Apostolos Fyllos [3], Maria Dimitra Chiotelli [4], Alexis T Kermanidis [4], Michael-Alexander Malahias [5], Aristeidis Zibis [6]

QT vs Gracilis

MPFL : some principles

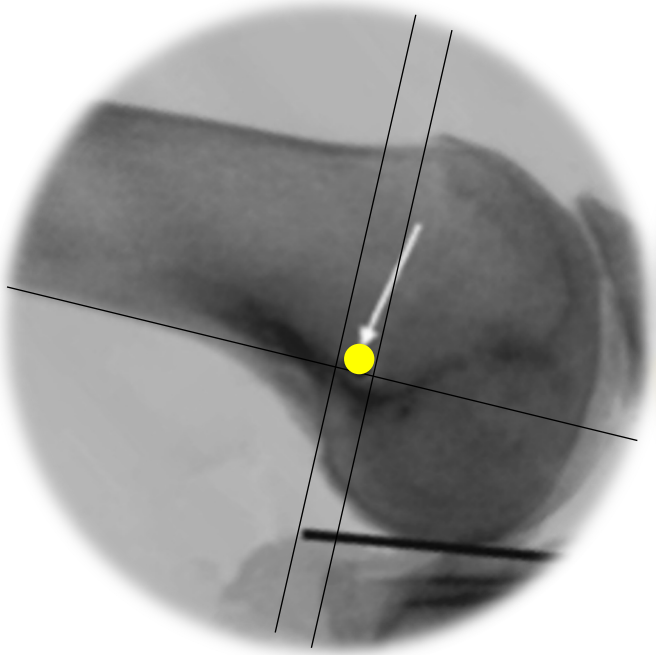
1. Choice of graft
2. **Double bundle**
3. Positioning
4. Tensioning
5. Fixation
6. Rehabilitation
7. Indication



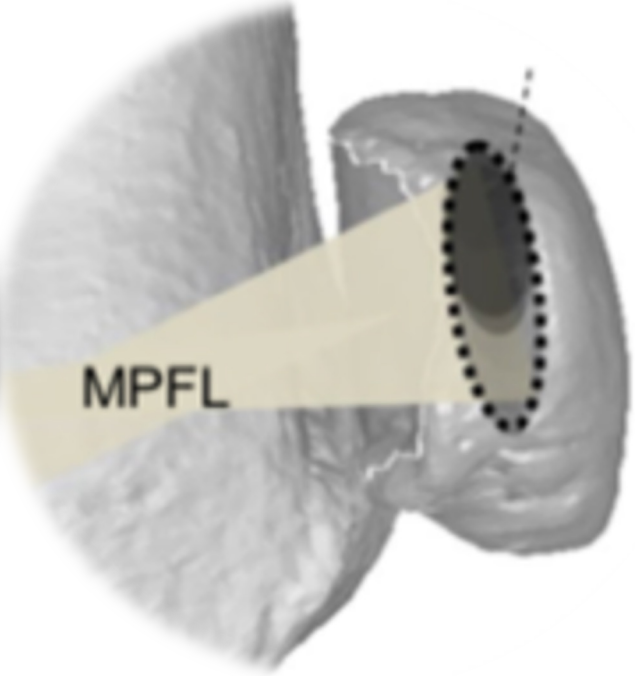
MPFL : some principles

1. Choice of graft
2. Double bundle
3. **Positioning**
4. Tensioning
5. Fixation
6. Rehabilitation
7. Indication

Femoral tunnel : Fluoroscopy



Patellar tunnel



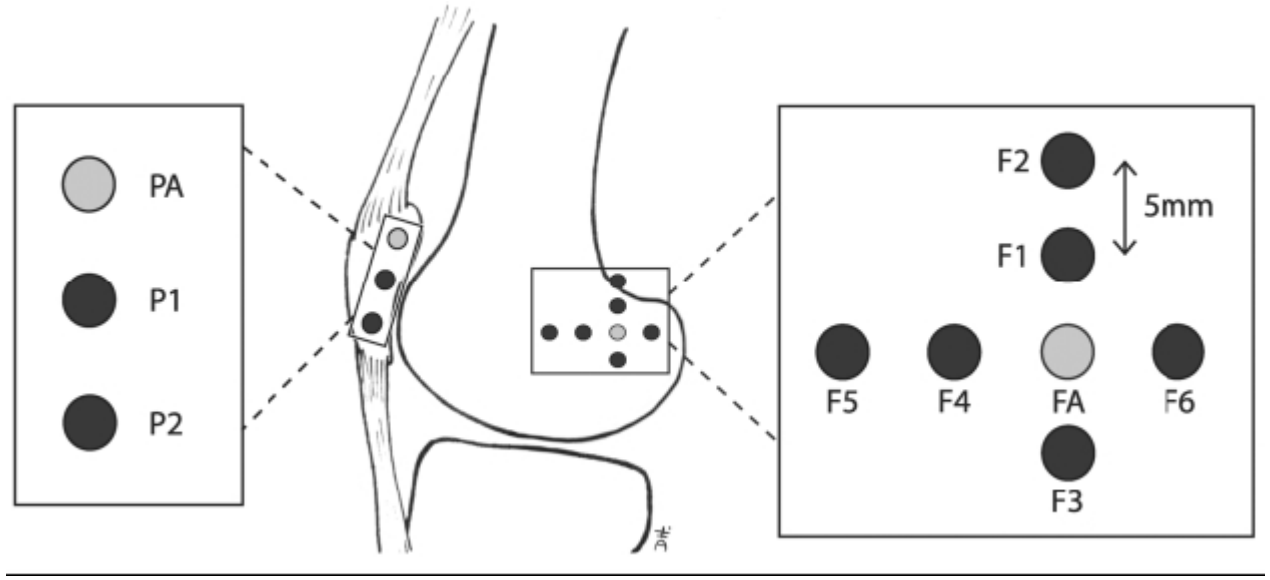
MPFL : some principles

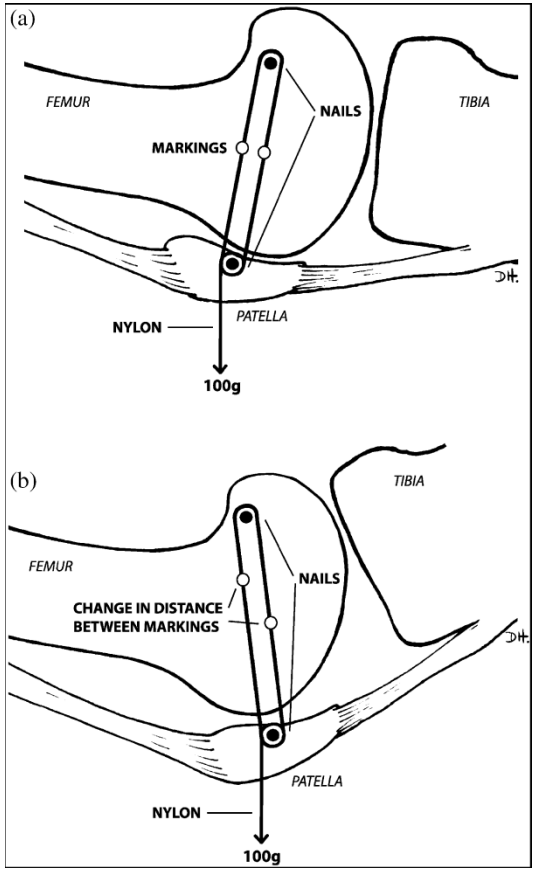
1. Choice of graft
2. Double bundle
3. Positioning
4. **Tensioning**
5. Fixation
6. Rehabilitation
7. Indication

- ✓ Loose better than Over-Tighten
- ✓ Check the isometry

Isometry : perop testing

Tension at 0-30° of flexion
Engagement into the trochlea
No tension in flexion





Courtesy of T. Néri

MPFL : some principles

1. Choice of graft
2. Double bundle
3. Positioning
4. Tensioning
5. **Fixation**
6. **Rehabilitation**
7. Indication

- ✓ Common fixation methods are stronger than native MPFL
- ✓ MPFL reconstruction is strong enough to allow “aggressive rehabilitation” with early weightbearing and unrestricted motion

Comparative Study > Arthroscopy. 2013 Apr;29(4):766-73. doi: 10.1016/j.arthro.2012.12.004. Epub 2013 Feb 8.

Medial patellofemoral ligament reconstruction: fixation strength of 5 different techniques for graft fixation at the patella

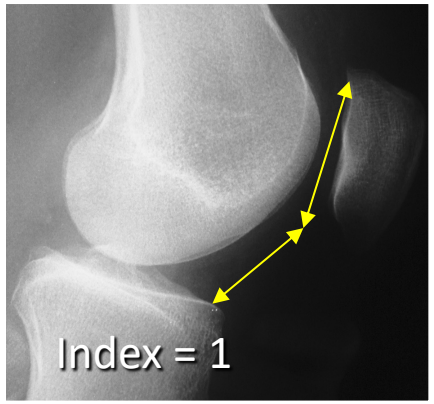
Simon Lenschow [1], Benedikt Schliemann, Jens Gestring, Mirco Herbort, Martin Schulze, Clemens Kösters

MPFL : some principles

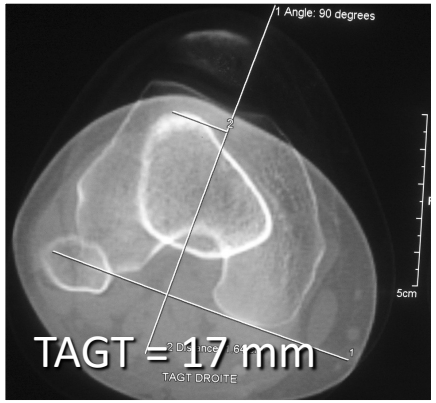
1. Choice of graft
2. Double bundle
3. Positioning
4. Tensioning
5. Fixation
6. Rehabilitation
7. **Indication**

The Best Indication :
Low Grade Abnormalities

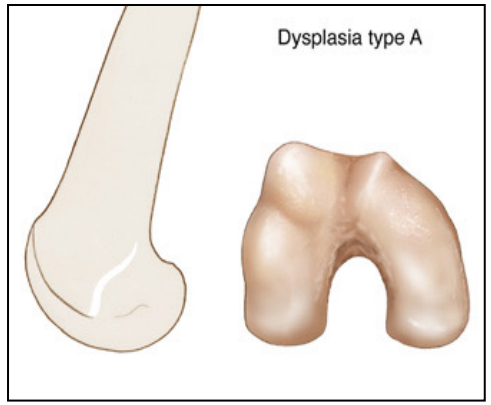
No patella Alta



TT-TG < 20 mm



Dysplasia Type A



MPFL rupture or distension

But when should we perform a trochleoplasty ?

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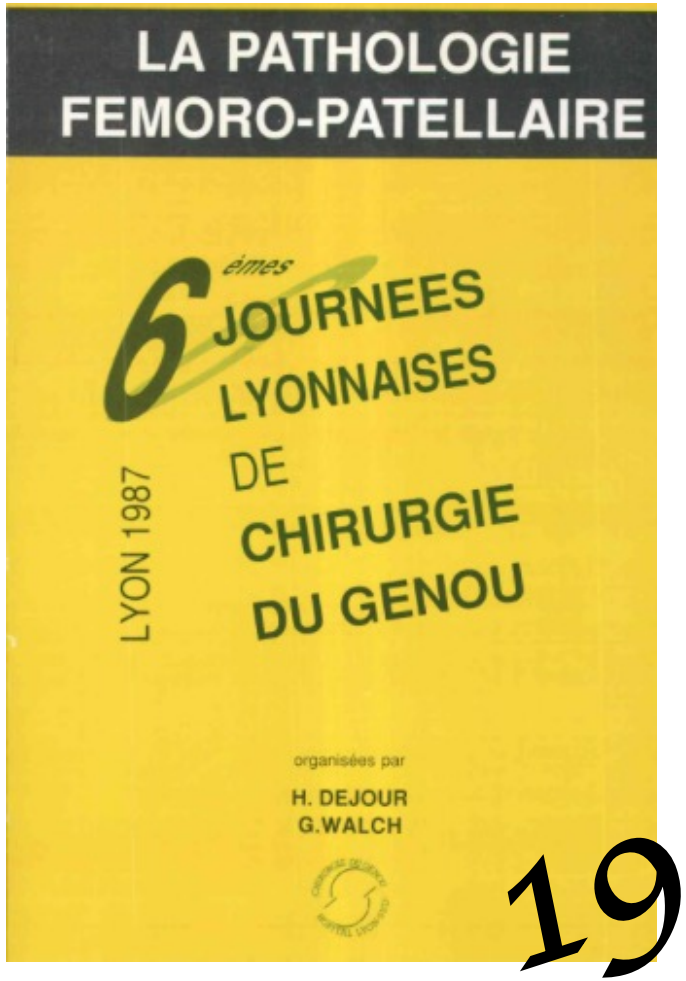
demeyguillaume@gmail.com

Factors of instability



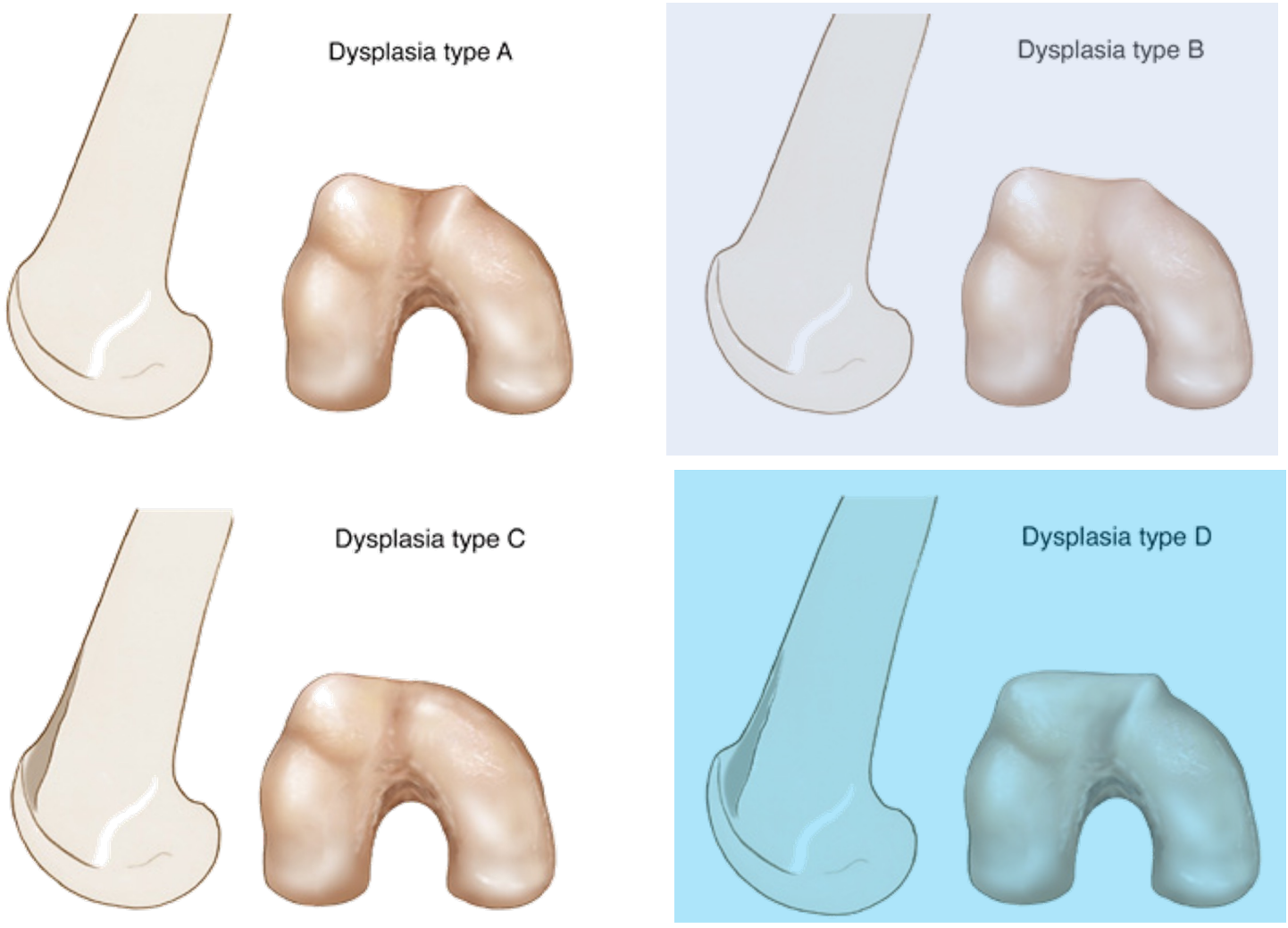
1987

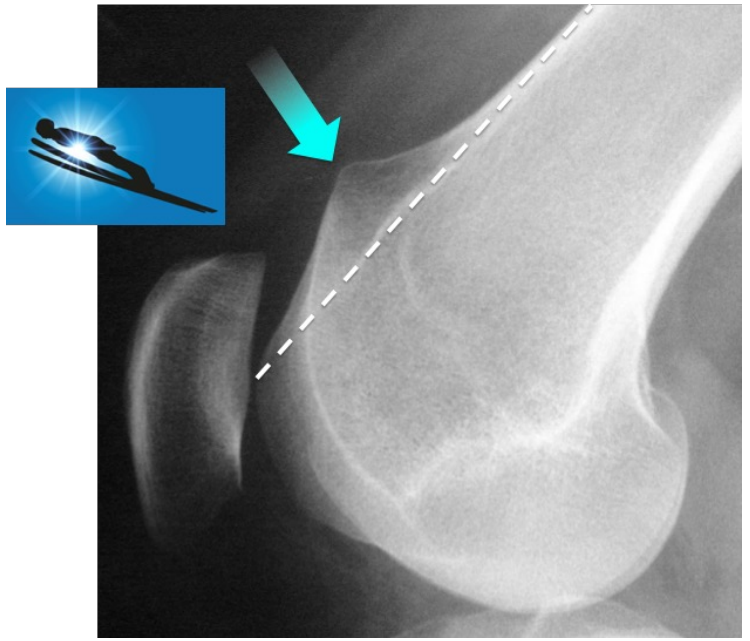
1987 Findings *(1800 patients analysis)*

4 Instability factors *(Statistical Threshold)*

1. **Trochlear Dysplasia 96%**
2. Patella Alta AT/AP ≥ 1.2
3. Excessive TT-TG ≥ 20 mm
4. Excessive Patellar Tilt > 20°

Trochlear Dysplasia





Dejour Classification (1998)

Trochleoplasty or not ?

Systematic Review

Arthroscopy 2014

Trochleoplasty Versus Nontrochleoplasty Procedures in Treating Patellar Instability Caused by Severe Trochlear Dysplasia

Guan-Yang Song, M.D., Lei Hong, M.D., Hui Zhang, M.D., Jin Zhang, M.D., Xu Li, M.D., Yue Li, M.D., and Hua Feng, M.D.

Combined Trochleoplasty

Isolated MPFL

REDISLOCATION RATE

0,9%

16,2%

Trochleoplasty or not ?

Knee Surg Sports Traumatol Arthrosc
DOI 10.1007/s00167-016-4365-x

Results of medial patellofemoral ligament reconstruction compared with trochleoplasty plus individual extensor apparatus balancing in patellar instability caused by severe trochlear dysplasia: a systematic review and meta-analysis

Peter Balcarek[1,2] · Stephan Rehn[2] · Nick R. Howells[3] · Jonathan D. Eldridge[3] · Keisuke Kita[4] · David Dejour[5] · Manfred Nelitz[6] · Ingo J. Banke[7] · Delphine Lambrecht[8] · Markus Harden[9] · Tim Friede[9]

Combined Trochleoplasty

Isolated MPFL

REDISLOCATION RATE

2,1 %

7,0 %

QOL & Trochlear Dysplasia

Does severity of femoral trochlear dysplasia affect outcome in patellofemoral instability treated by medial patellofemoral ligament reconstruction and anterior tibial tuberosity transfer?

G. Moitrel[a,b,*], T. Roumazeille[a,b], A. Arnould[a,b], H. Migaud[a,b], S. Putman[a,b], N. Ramdane[c], G. Pasquier[a,b]

OTSR 2015

Table 3
Mean IKDC Functional Score.

	Preoperative	Follow-up
Whole series	54 ± 11 (27–77)	74 ± 17 (21–92)*
S– (without trochlear spur)	58 ± 10 (42–77)	79 ± 19 (21–92)*,¥
S+ (with trochlear spur)	50 ± 12 (27–67)	68 ± 13 (35–84)*
P value, S– vs. S+	NS	0.0123

Clinical functional results were poorer in patients with trochlear spur

QOL & Trochlear Dysplasia

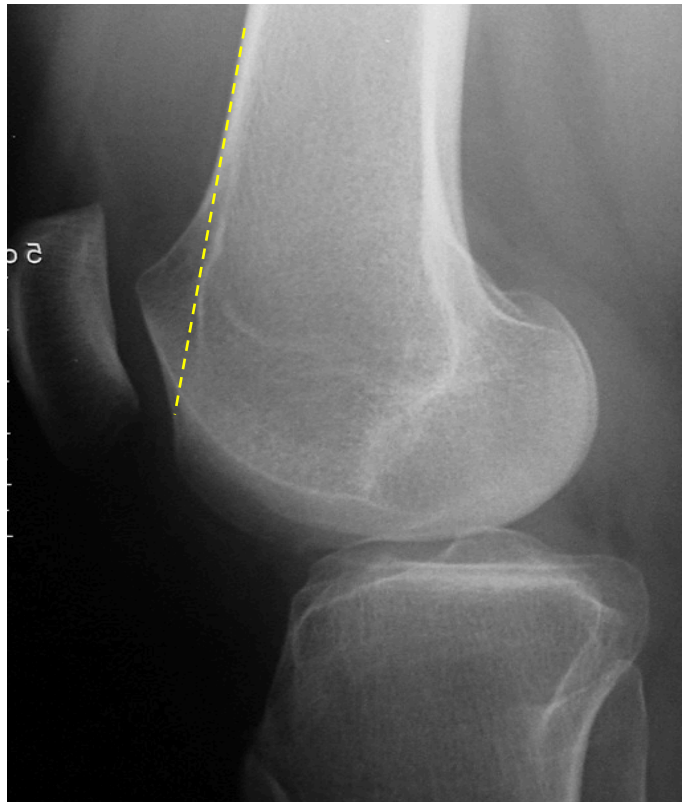
Effect of Trochlear Dysplasia on Outcomes After Isolated Soft Tissue Stabilization for Patellar Instability *Am J Sports Med* 2016

Laurie A. Hiemstra,*†‡ MD, PhD, FRCSC, Sarah Kerslake,†§ MSc, Michael Loewen,† MD, FRCSC, and Mark Lafave,‖ CAT(C), PhD

Trochlear bump of 5 mm was associated with lower postoperative BPII scores

Banff Patella Instability Instrument (BPII)

Significant correlation between the presence of **high-grade trochlear dysplasia and disease-specific quality of life** an average of 2 years after MPFL-R surgery

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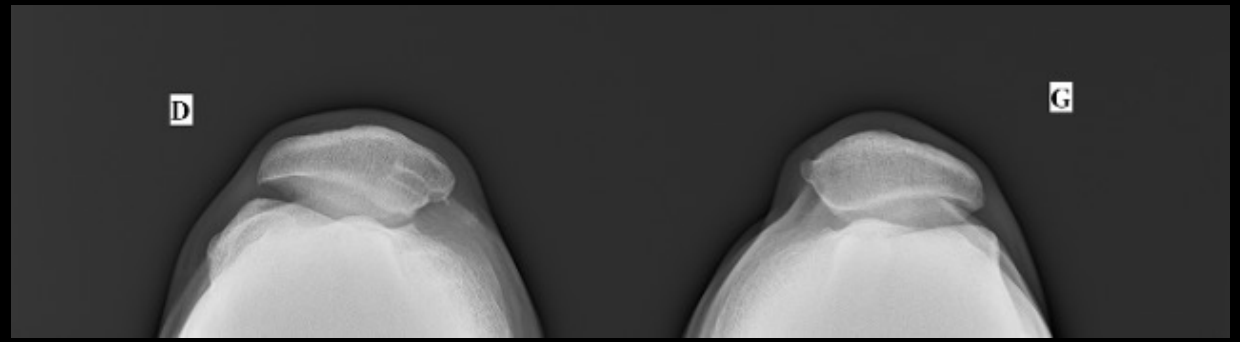
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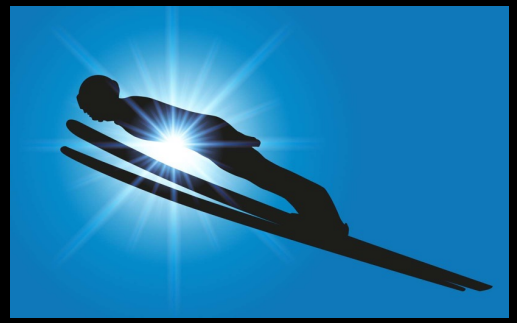
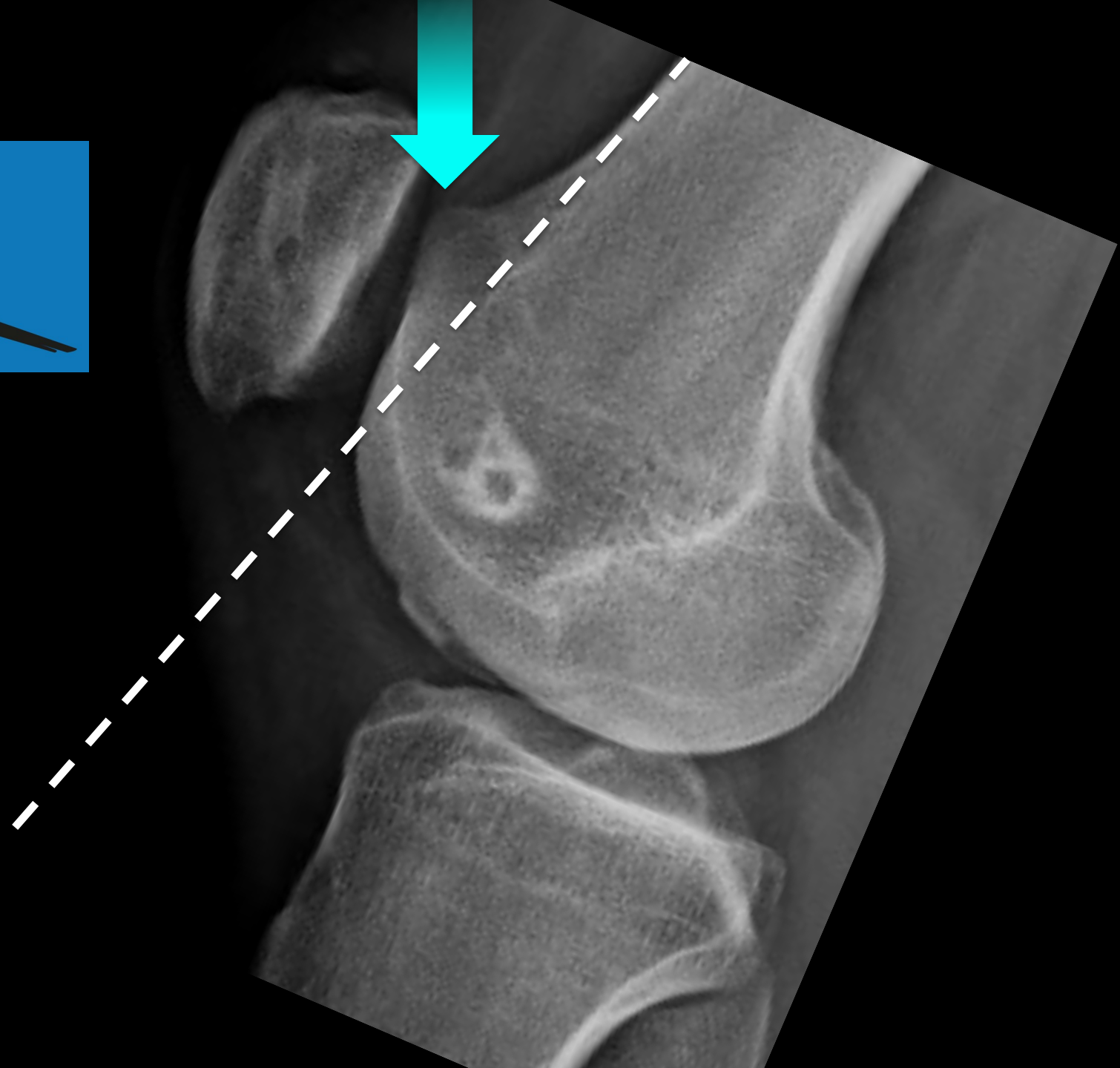


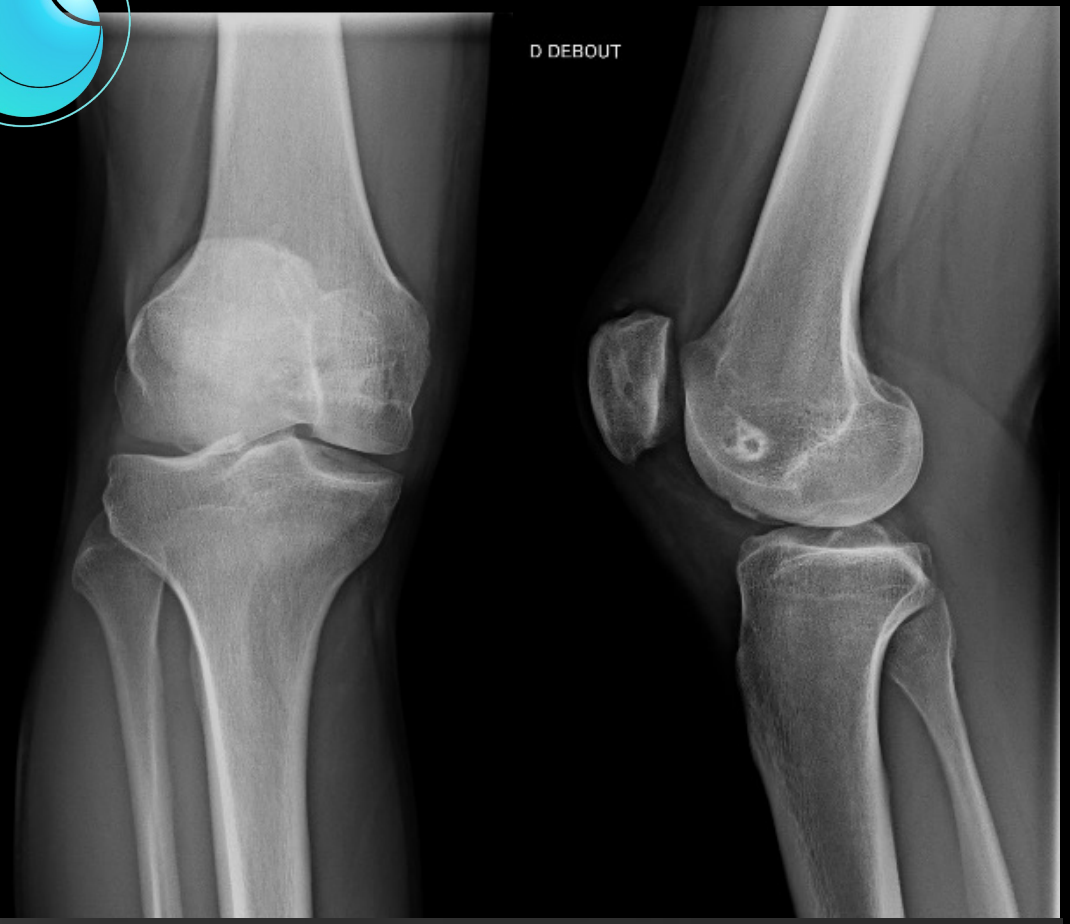


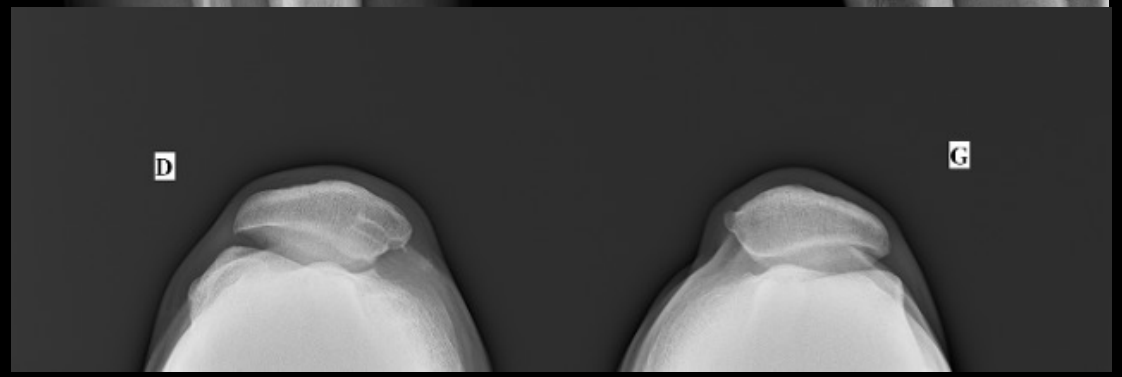
LYON KNEE
SCHOOL of SURGERY

LYON ORTHO CLINIC

THE LYON'S SULCUS DEEPENING

TROCHLEOPLASTY

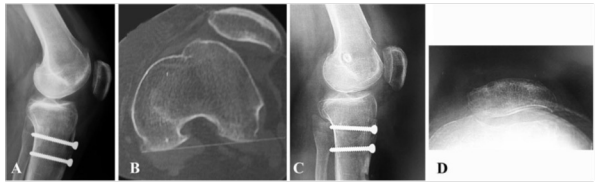




LYON KNEE SCHOOL of SURGERY

FU

Short and midterm results



International Orthopaedics (SICOT)
DOI 10.1007/s00264-012-1746-8

ORIGINAL PAPER

The Lyon's sulcus-deepening trochleoplasty in previous unsuccessful patellofemoral surgery

David Dejour · Pieter Byn · Panagiotis G. Ntagiopoulos

Received: 27 November 2012 / Accepted: 1 December 2012

2010
Revision cases (n=24 knees)
5y FU

AJSM PreView, published on April 15, 2013 as doi:10.1177/0363546513482302

Midterm Results of Comprehensive Surgical Reconstruction Including Sulcus-Deepening Trochleoplasty in Recurrent Patellar Dislocations With High-Grade Trochlear Dysplasia

Panagiotis G. Ntagiopoulos,* MD, PhD, Pieter Byn,† MD, and David Dejour,*‡ MD
Investigation performed at Lyon-Ortho-Clinic, Clinique de la Sauvegarde, Lyon, France

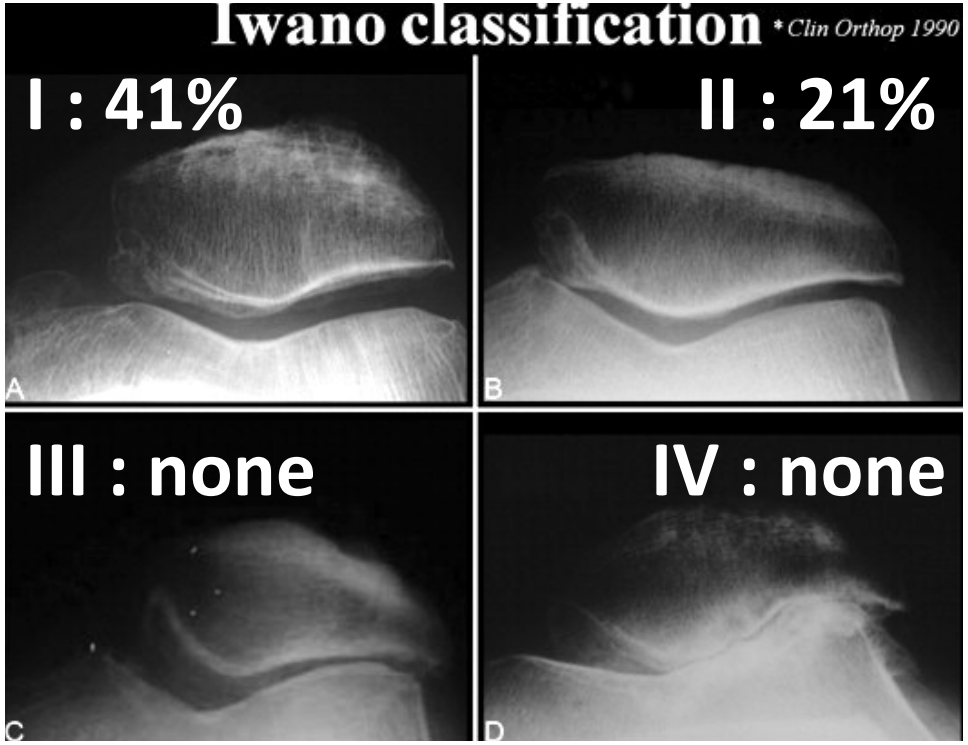
2012
Primary (n=31 knees)
7y FU

Long term results

n=34 knees
@ Mean FU 14.8y
No OA

Sulcus-Deepening Trochleoplasty Results in Low Rates of Patellar Redislocation and Patellofemoral Arthritis at 10 to 20 Years Postoperatively

David Dejour,* MD, Tomas Pineda,* MD, Guillaume Demey,* MD, Floris van Rooij,†‡ MSc, and Amedeo Guarino,* MD
Investigation performed at Lyon-Ortho-Clinic, Clinique de la Sauvegarde, Ramsay Sante, Lyon, Paris



Very long term results

n=11 knees

FU 23 to 30y

Received: 26 October 2023 | Accepted: 3 June 2024

DOI: 10.1002/ksa.12316

KNEE

Knee Surgery, Sports Traumatology, Arthroscopy WILEY

Sulcus-deepening trochleoplasty grants satisfactory results with minimal patellofemoral arthritis at 23–30 years of follow-up

David Dejour | Amedeo Guarino | Tomas Pineda | ReSurg | Guillaume Demey

TABLE 1 Demographics and adjuvant procedures.

	Initial cohort ($n = 11$)		Final cohort ($n = 9$)	
	Mean ± SD	Range	Mean ± SD	Range
Age at index surgery (years)	25.6 ± 6.9	(15–47)	25.6 ± 6.9	(15–47)
Female	5 (45%)		4 (44%)	
Side				
Right	3 (27%)		3 (33%)	
Left	8 (73%)		6 (67%)	
Surgical antecedents				
Arthroscopy	4 (36%)		4 (44%)	
TTO	2 (18%)		2 (22%)	
Judet	1 (9%)		1 (11%)	
None	4 (36%)		2 (22%)	
Adjuvant procedures				
TTO + VM Plasty	9 (82%)		7 (78%)	
Only TTO	1 (9%)		1 (11%)	
Only VM Plasty	1 (9%)		1 (11%)	

Abbreviations: SD, standard deviation; TTO, tibial tuberosity osteotomy; VM, vastus medius.

Very long term results

Received: 26 October 2023 | Accepted: 3 June 2024
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TABLE 2 Postoperative outcomes.

	Final cohort ($n = 9$)	
	Mean ± SD	**Range**
Follow-up (years)	24.4 ± 2.1	(23–30)
Recurrent dislocation	1 (11%)	
No apprehension	9 (100%)	
Iwano classification		
1	3 (33%)	
2	4 (44%)	
4	2 (22%)	
Range of motion (°)		
Extension	0.0 ± 0.0	(0–0)
Flexion	130.0 ± 8.7	(120–140)
Satisfaction (0–10)	9.2 ± 0.7	(8–10)
Kujala score (0–100)	76.9 ± 8.5	(68–89)
IKDC score (0–100)	65.5 ± 13.8	(45–82)
Patellar height (CDI)	0.97 ± 0.15	(0.73–1.10)

Abbreviations: CDI, Caton–Deschamps index; IKDC, International Knee Documentation Committee; SD, standard deviation.

FIGURE 1 Radiographs to assess patellofemoral osteoarthritis at preoperative and postoperative assessment.

Very long term results

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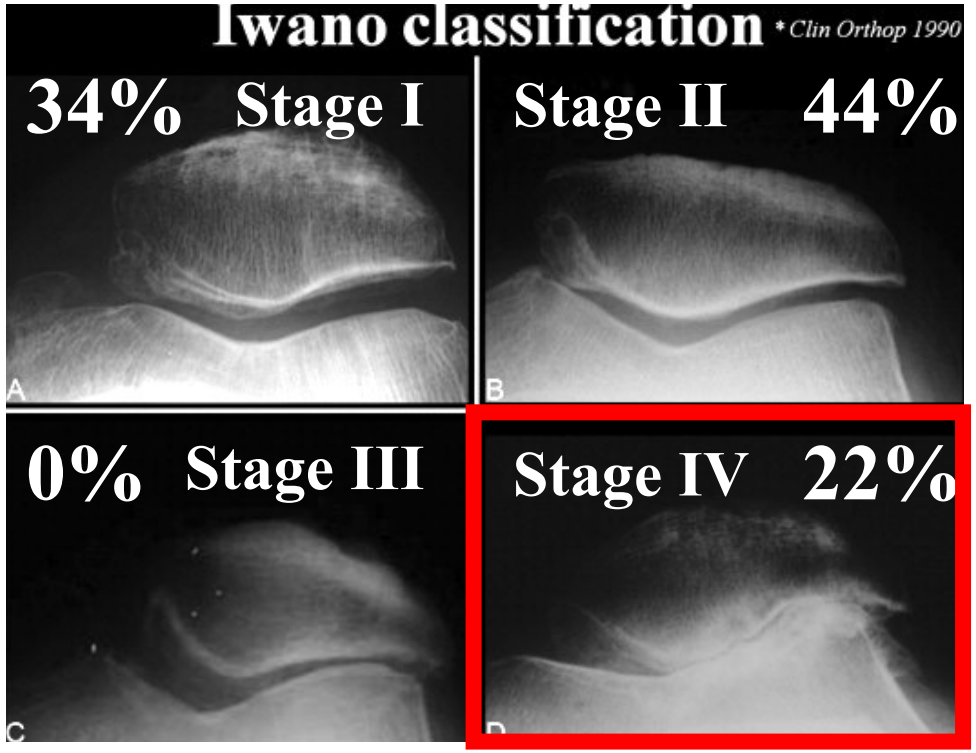
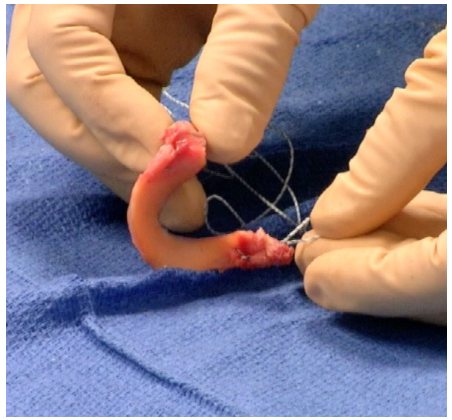


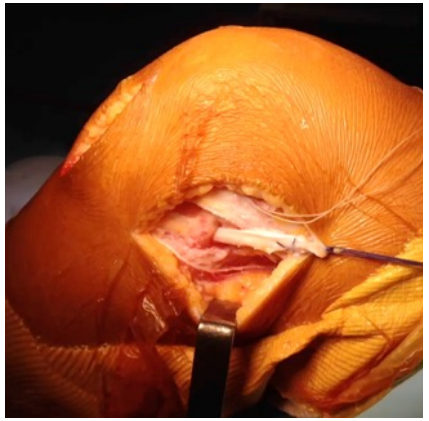
When should we perform a trochleoplasty ?

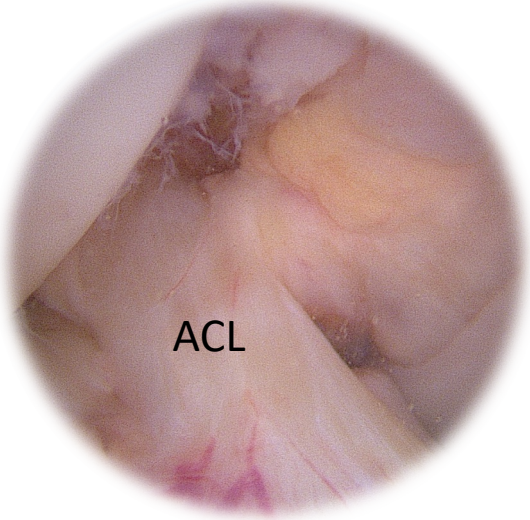
- ✓Sometimes
  - ✓In revision... But not only!!
  - ✓In primary +++
- ✓**Don’t miss the indication (grade D+++, grade B)**
- ✓**Factors of OA progression :**
1. **Cartilage status at the time of surgery**
2. **Revision setting**

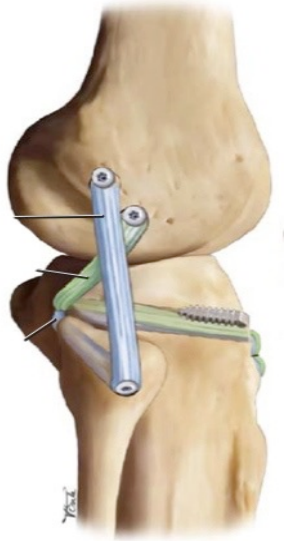
- ✓Personalized surgery in 2025!

ACL management in 2025

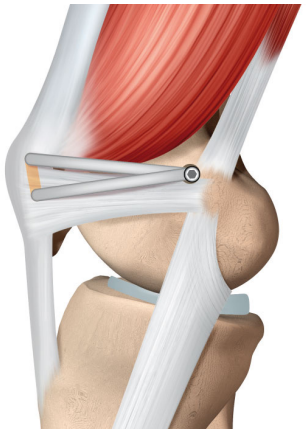


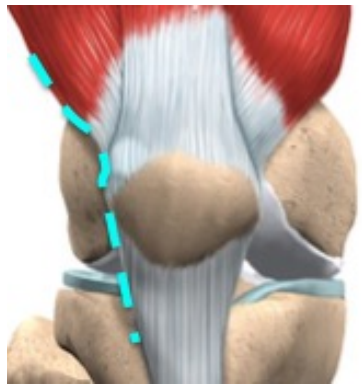


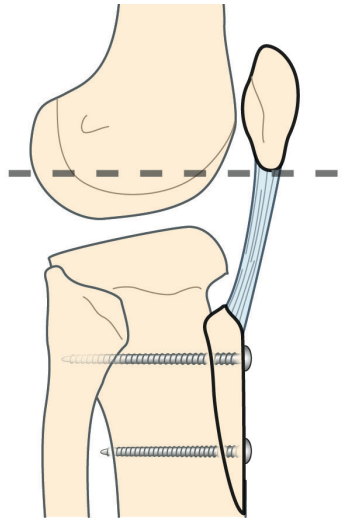


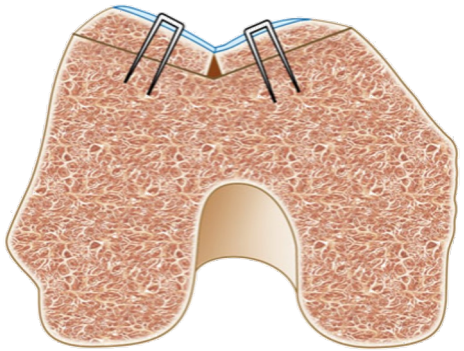


PF Instability in 2025





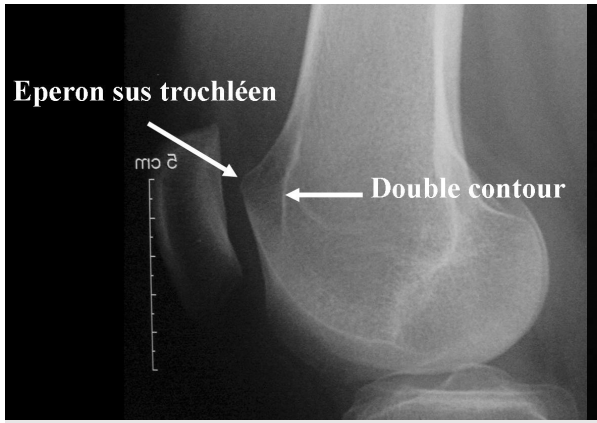


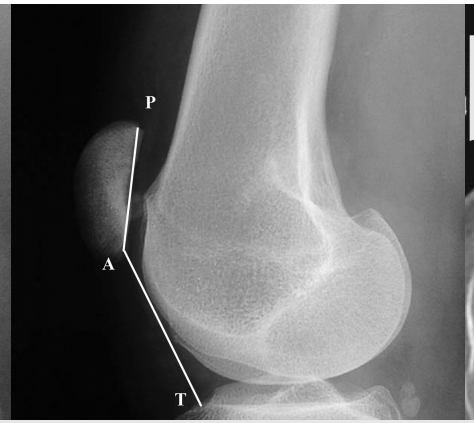


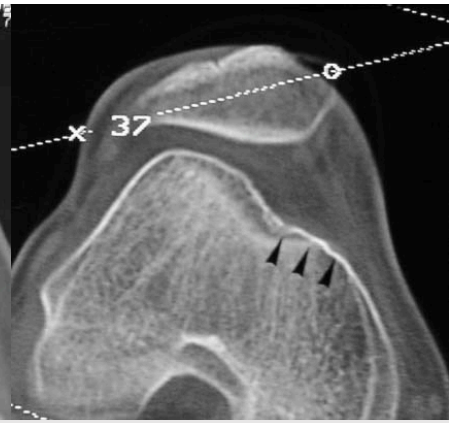
Correct one by one the anatomical abnormalities

Le "menu à la carte"

LYON KNEE SCHOOL of SURGERY

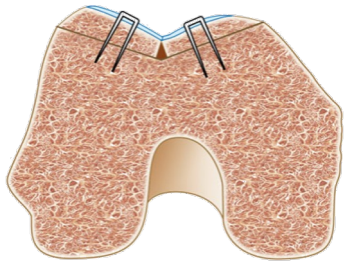


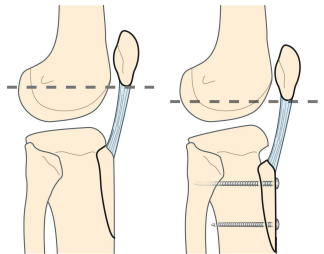


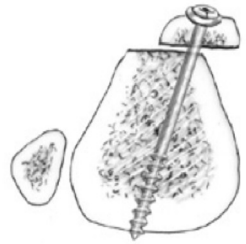


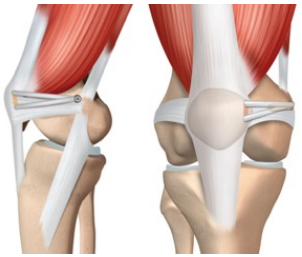
Trochlear Dysplasia B&D | **Patella Alta** | **TT-TG > 20mm** | **Tilt > 20°**

Trochleoplasty +/- **Distalization** +/- **Medialization** + **MPFL**







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