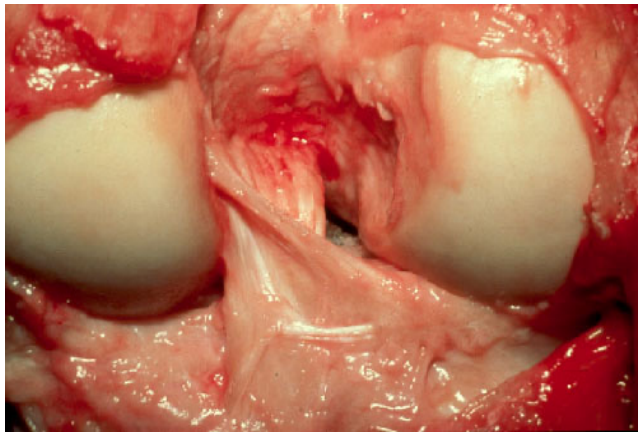
PCL Repair / Reconstruction

And the Place of the Artificial Ligament



David A Parker FRACS

Advanced Course on Knee Surgery

Val D'Isere 2025

Declaration of Interest

The author has the following disclosures:

- editorial board of: *AJSM, JISAKOS, AP-SMART Journal, OJSM*
- hold shares in: *Personalised Surgery*, *Ganymed Robotics*
- received royalties from: *Smith & Nephew*
- done consulting work for: *Smith & Nephew*
- given paid presentations for: *Smith & Nephew, Arthrex*
- received institutional support from: *Smith & Nephew*, *Zimmer*, *Corin*, *Arthrex*

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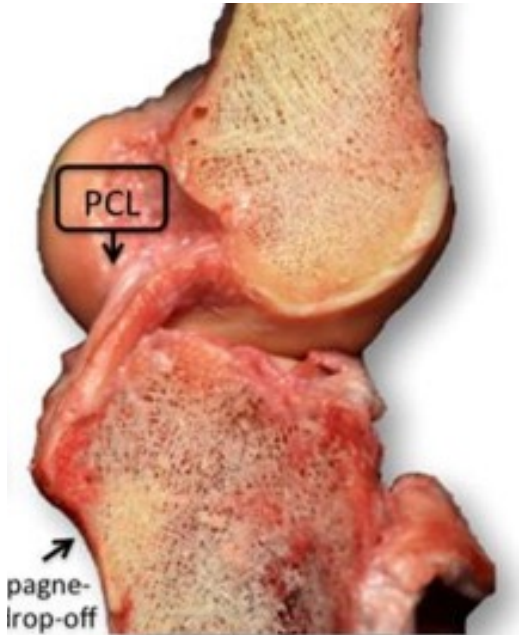
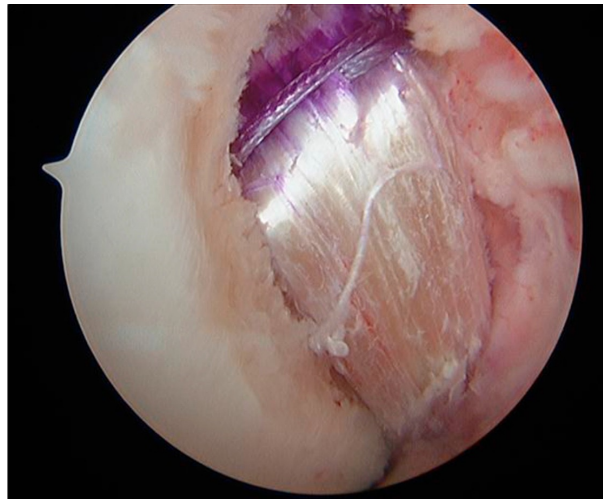
Management of PCL Injuries

- Background
- PCL Repair
  - Bony Avulsion
  - Soft Tissue Avulsion
- PCL Reconstruction
  - Single vs Double Bundle
- Role of Artificial Ligament
  - PCL Reconstruction
  - Synthetic Augmentation / Internal Brace





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Background

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I treat the majority of PCLs non-surgically

- Isolated PCL injuries – vast majority non-surgically
- Multiligament injuries – majority of my PCLR
- Minimal experience with artificial ligaments
- Have used IB to augment reconstructions

Vol. 41, No. 7, 2013

Minimum 10-Year Follow-up of Patients After an Acute, Isolated Posterior Cruciate Ligament Injury Treated Nonoperatively

K. Donald Shelbourne,*† MD, Melanie Clark,† BS, and Tinker Gray,† MA
Investigation performed at Shelbourne Knee Center, Indianapolis, Indiana

68 patients with isolated PCL injury
Avge followup 17.6 years
Annual PROMs , occasional examination
Quads strength 97%
ROM maintained

X-ray:
Normal – 59%
Near normal – 30%
Abnormal – 9%
Severely abnormal – 2%

PCL laxity grade did not correlate to severity of OA

Patients With Each Radiographic Grade of Arthrosis by Knee Compartment and Grade of PCL Laxity[a]

	PCL Laxity Grade											
	Medial Compartment			Lateral Compartment			Patellofemoral Compartment			Overall Radiographic and PCL Laxity Grades		
Radiographic Grade	1	1.5	2	1	1.5	2	1	1.5	2	1	1.5	2
Normal	11	1	13	17	4	18	16	4	17	11	2	13
Nearly normal	7	4	5	1	2	0	1	2	1	6	3	4
Abnormal	0	1	2	0	0	1	1	0	2	1	1	2
Severely abnormal	0	0	0	0	0	1	0	0	0	0	0	1
P value	.094			.130			.143			.150		

PCL and Decreased PTS

Increased Risk PCL Rupture

Yin et al. BMC Musculoskeletal Disorders (2022) 23:689
https://doi.org/10.1186/s12891-022-05653-7

BMC Musculoskeletal Disorders

RESEARCH Open Access

Decreased lateral posterior tibial slope and medial tibial depth are underlying anatomic risk factors for posterior cruciate ligament injury: a case–control study

Baoshan Yin[1,2], Pei Zhao[1], Jiaxing Chen[1,2], Wenlong Yan[1], Hua Zhang[1], Jian Zhang[1] and Aiguo Zhou[1*]

Knee Surgery, Sports Traumatology, Arthroscopy
https://doi.org/10.1007/s00167-023-07308-z

KNEE

Decreased medial posterior tibial slope is associated with an increased risk of posterior cruciate ligament rupture

Lingzhi Li[1] · Jun Li[1] · Peng Zhou[1] · Yanwei He[1] · Yuan Li[1] · Xiangtian Deng[2] · Hao Jiang[1] · Juncai Liu[3] · Zhong Li[4]

Increased risk PCL Graft Failure

Effect of Posterior Tibial Slopes on Graft Survival Rates at 10 Years After Primary Single-Bundle Posterior Cruciate Ligament Reconstruction

Kyoung Ho Yoon,* MD, Jong-Hwan Lee,* MD, Sang-Gyun Kim,† MD, Jae-Young Park,‡ MD, Hee-Sung Lee,§ MD, Sang Jin Kim,* MD, and Yoon-Seok Kim,||¶ MD
Investigation performed at Kyung Hee University Hospital, Seoul, Republic of Korea

Knee Surgery, Sports Traumatology, Arthroscopy (2022) 30:3277–3286
https://doi.org/10.1007/s00167-021-06760-z

KNEE

Low posterior tibial slope is associated with increased risk of PCL graft failure

Philipp W. Winkler[1,2] · Nyaluma N. Wagala[1] · Sabrina Carrozzi[1] · Ehab M. Nazzal[1] · Michael A. Fox[1] · Jonathan D. Hughes[1] · Bryson P. Lesniak[1] · Dharmesh Vyas[1] · Stephen J. Rabuck[1] · James J. Irrgang[1,3] · Volker Musahl[1]

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PCL Repair

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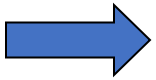
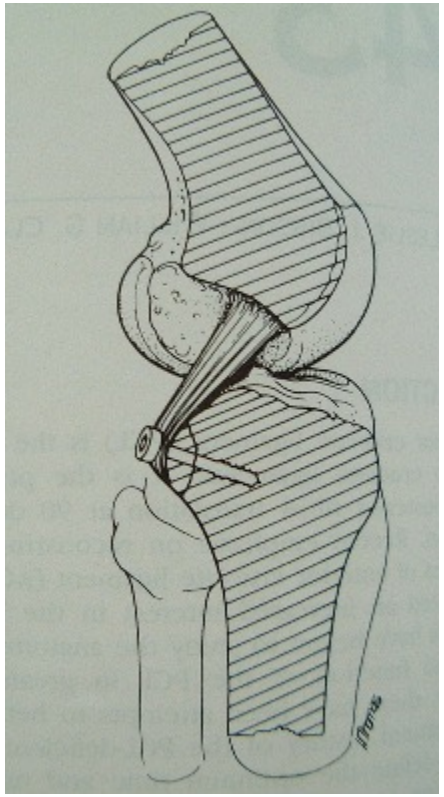
PCL Repair

- Femoral or Tibial Avulsions
  - Soft Tissue (Femoral)
  - Bony (Tibial)
- Mid-substance?

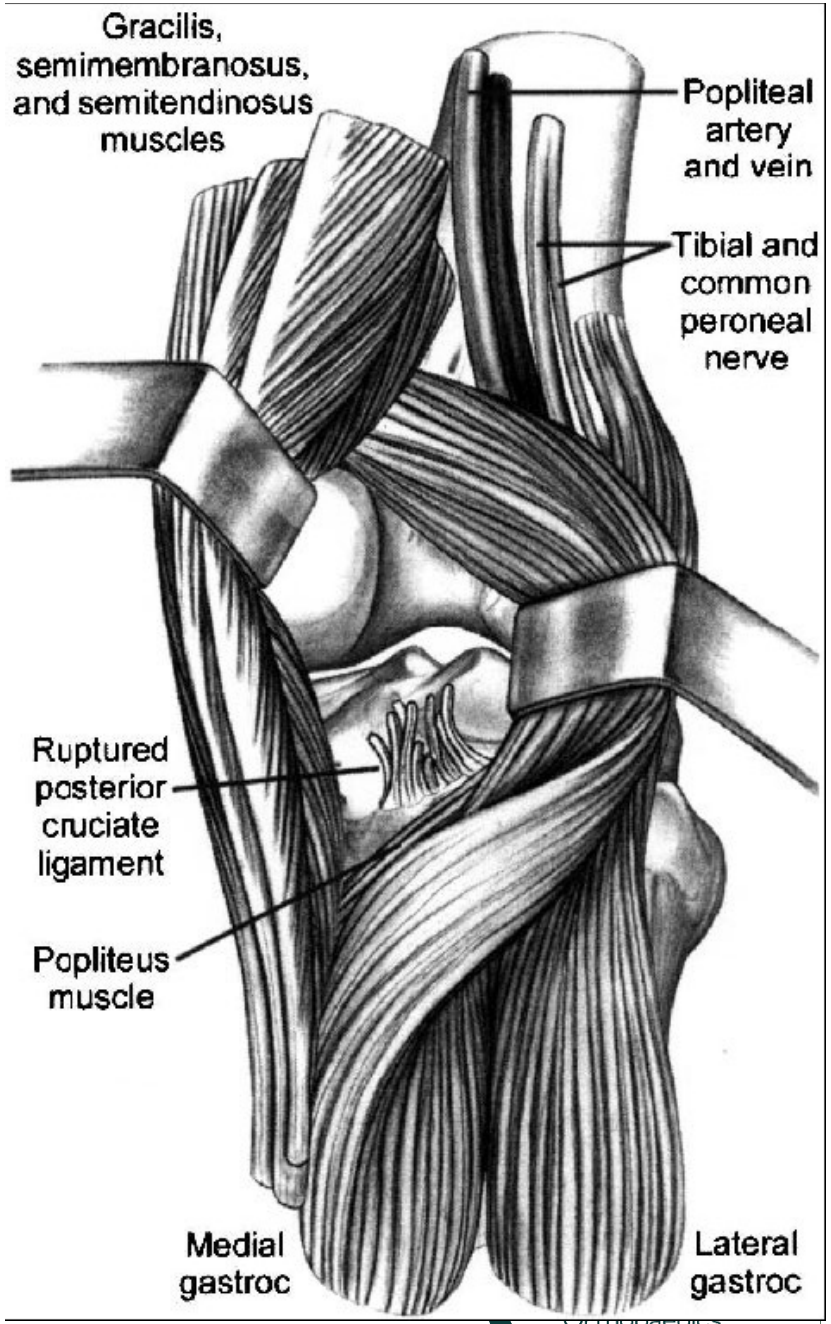
Repair of Avulsions

Tibial Bony Avulsion

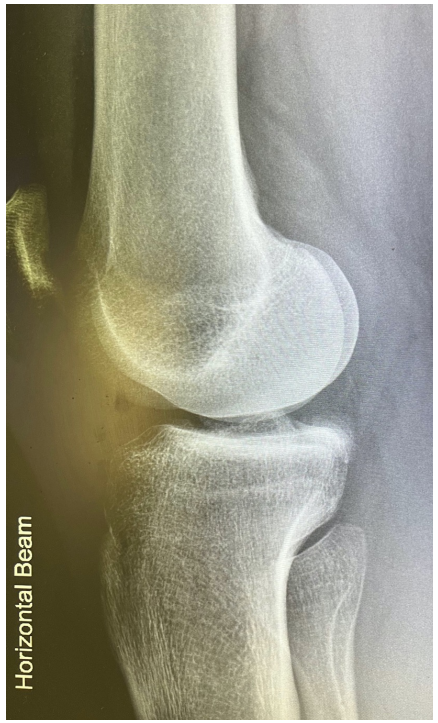




Posteromedial Approach



Arthroscopic Repair of Avulsion



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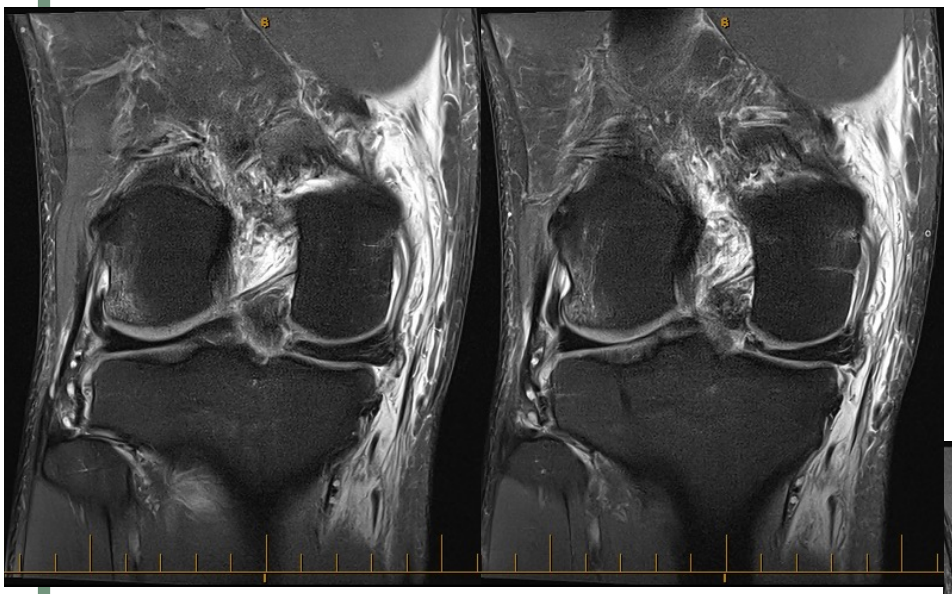
19yo Male

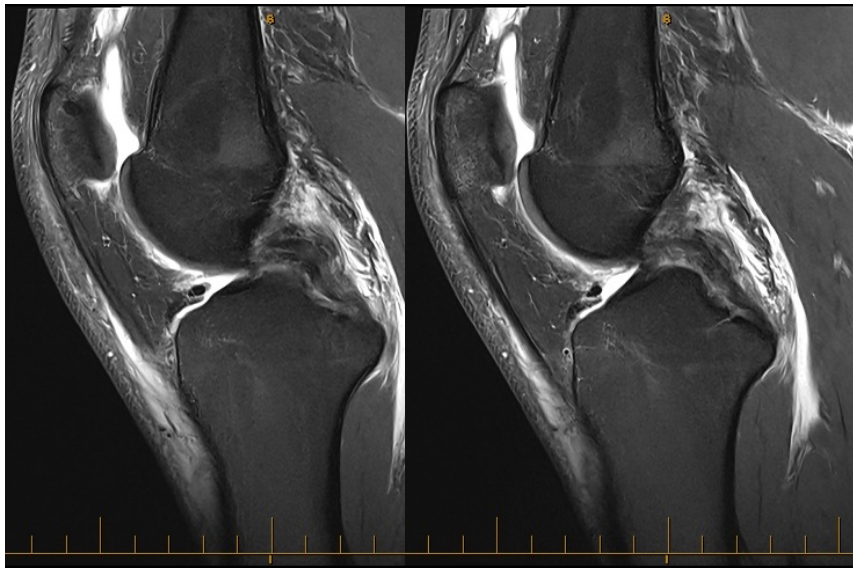
- Rugby Injury
- Pain / Swelling
- No previous injury

MRI



Medial meniscus root

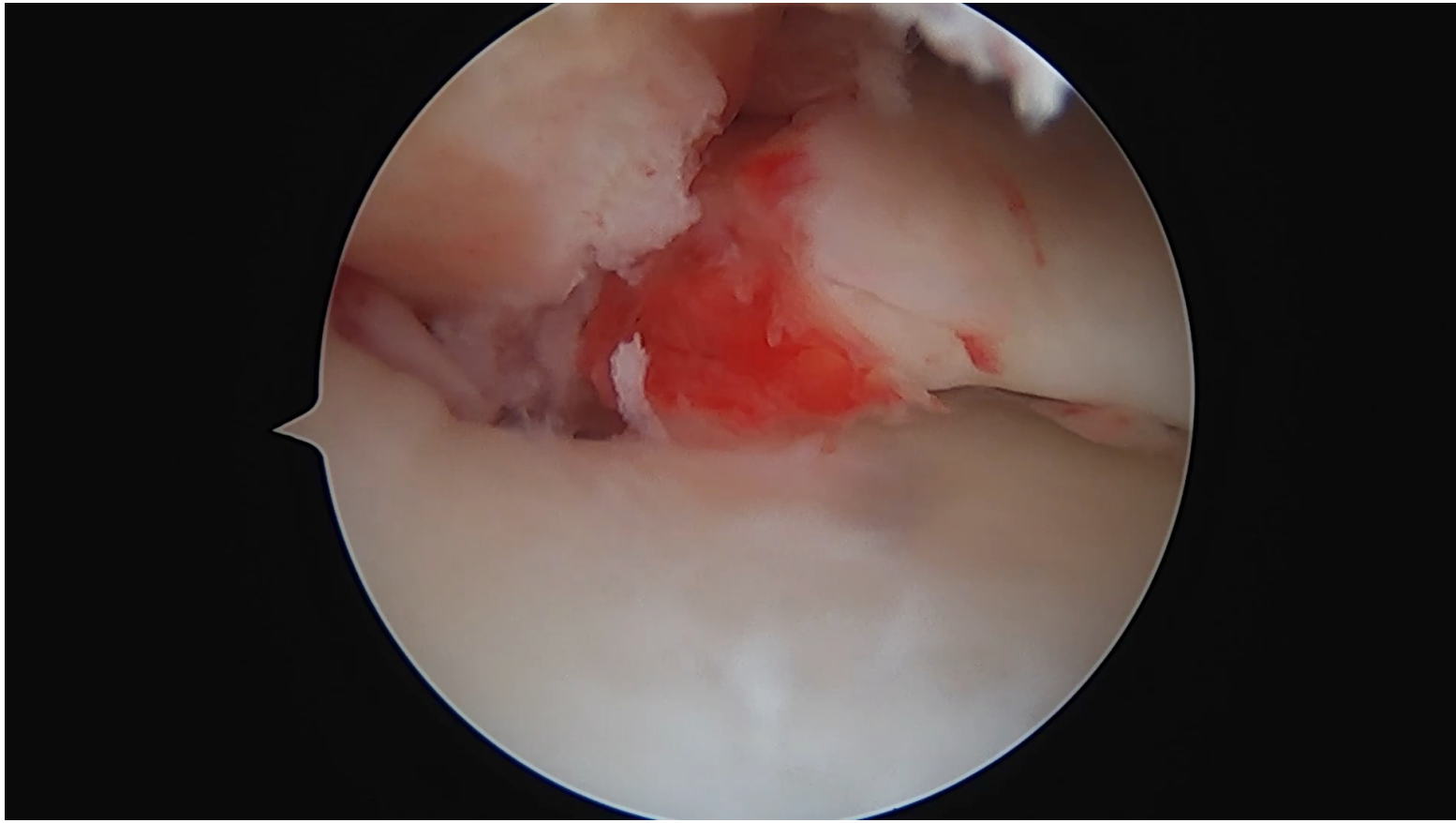
MCL



PCL

Management

- Open repair MCL
  - Deep to femur
  - Superficial to tibia
  - PMC direct repair
  - Internal Brace
- Medial meniscus transosseous root repair
- Repair PCL Femoral Avulsion
- Postop PCL Brace



10yo Male

Rugby Injury

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Plain Radiographs

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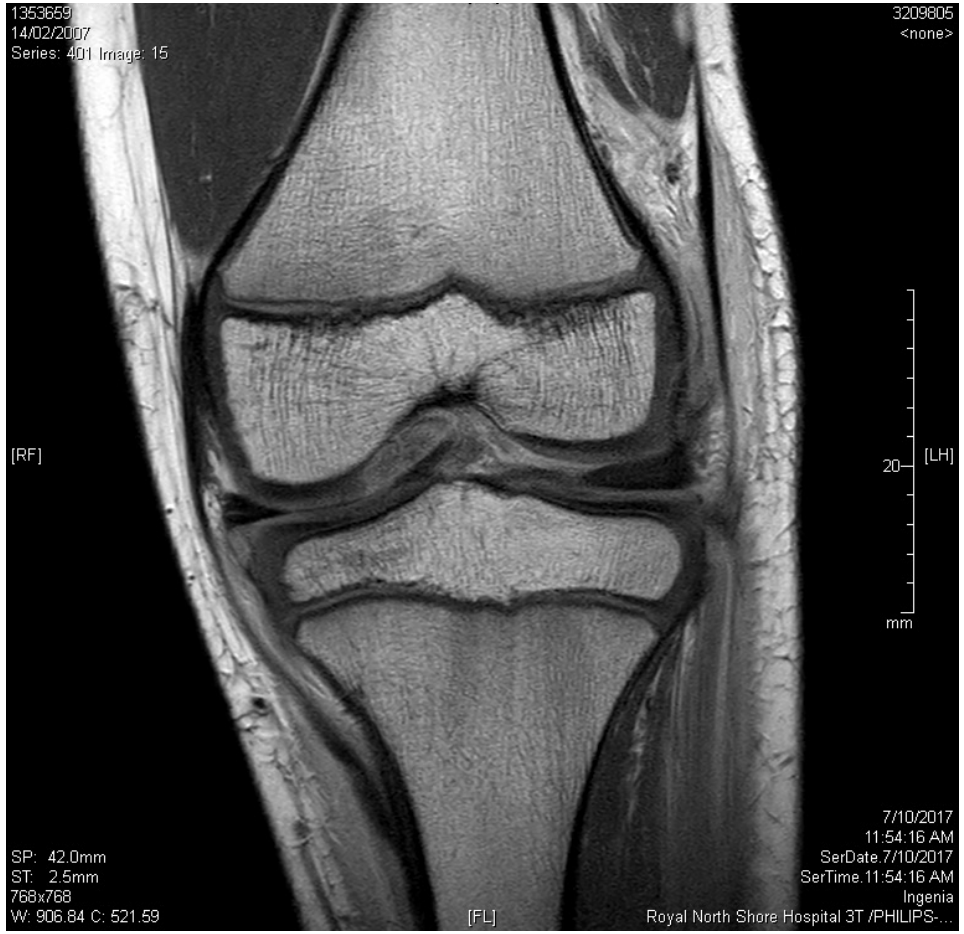
? Chondral defect MFC / Notch



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? Large loose fragment

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?PCL Avulsion

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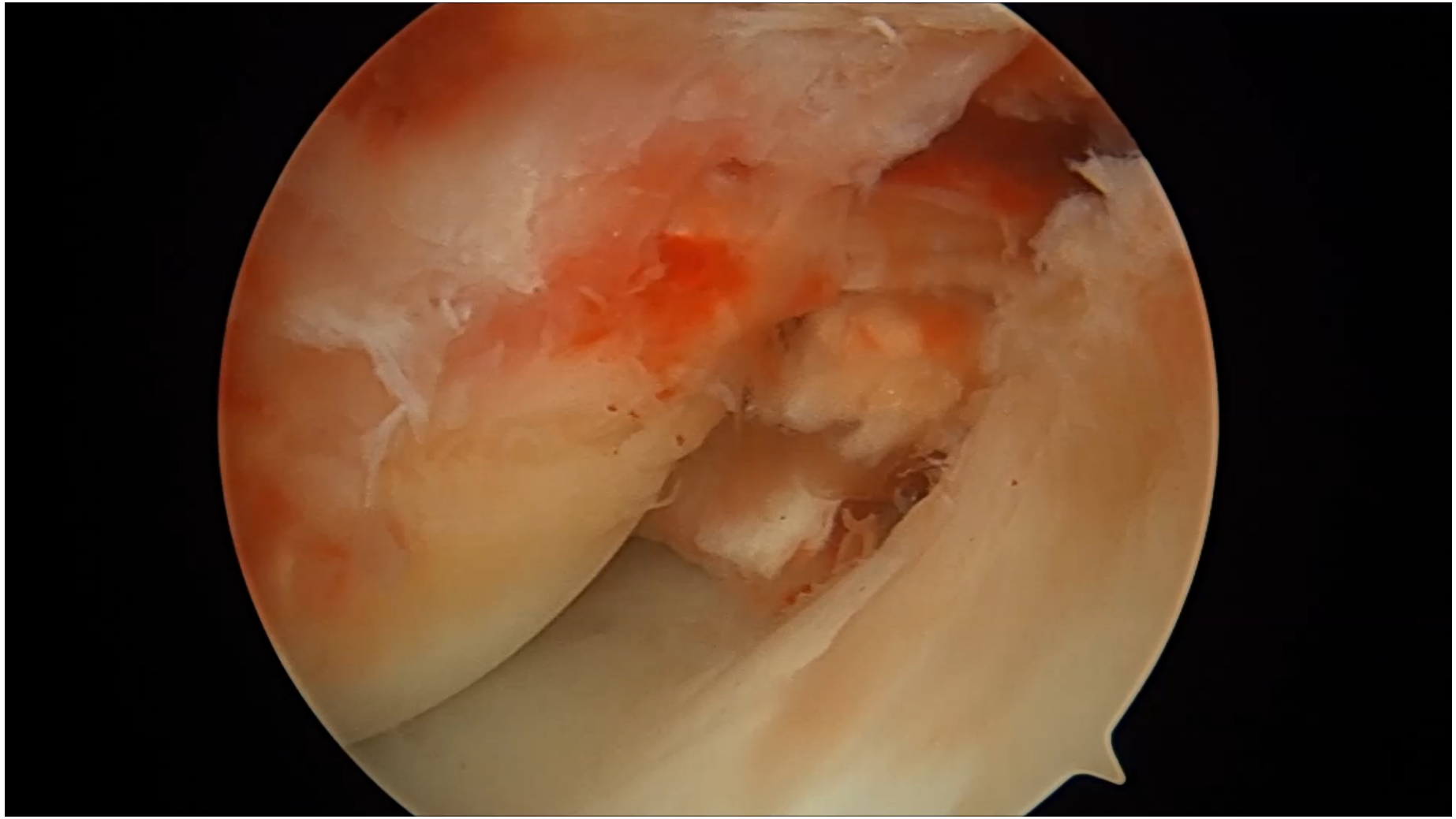

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Management

- Arthroscopic
  - MM Root repair
- Open
  - Repair PCL avulsion / chondral injury
  - Repair Posterolateral corner injury
- Postop
  - Prolonged bracing
  - Gradual return to sport after one year

2.5 years postop

- Good function
  - Cricket, Basketball, Tennis, Rugby

- PCL / PLC grade I

The Role of the Artificial Ligament

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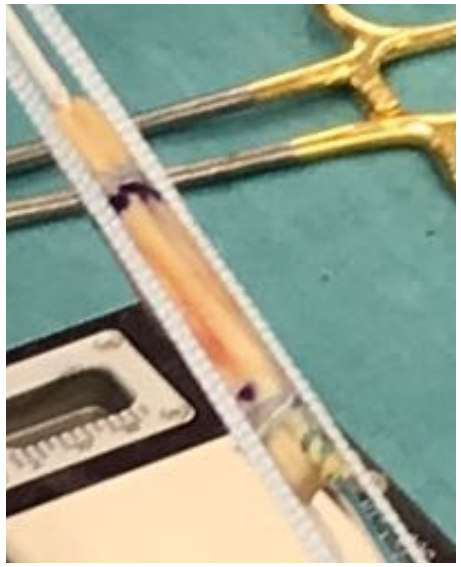
Synthetic Augmentation of Repair or Reconstruction(“Internal Brace”)



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IB Biomechanics - PCL

Original Research

Posterior Cruciate Ligament Reconstruction With Independent Suture Tape Reinforcement

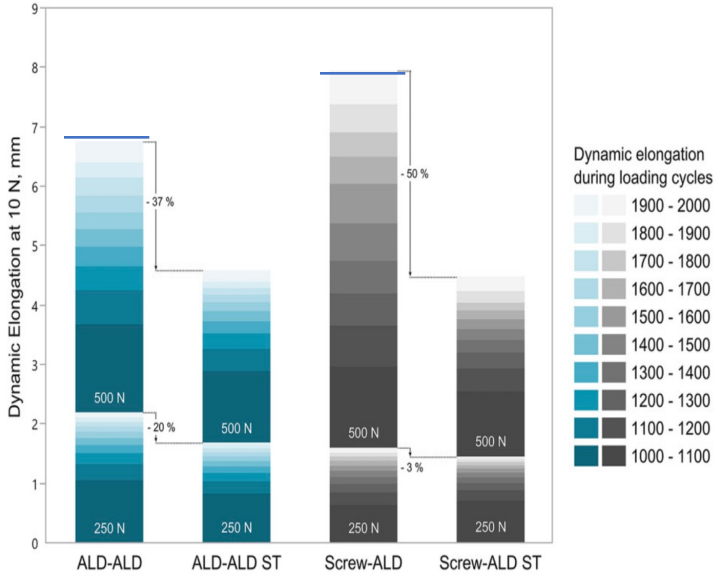
An In Vitro Biomechanical Full Construct Study

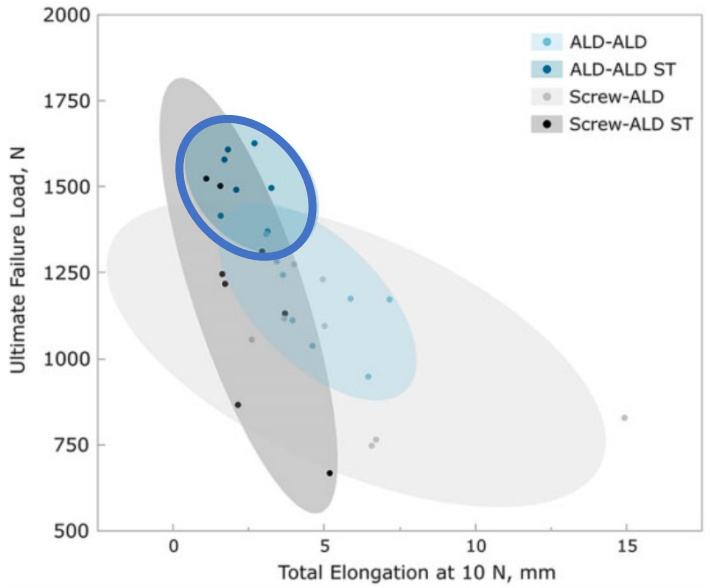
Bruce A. Levy,* MD, Marina Piepenbrink,† MSc, Michael J. Stuart,* MD, and Coen A. Wijdicks,‡§ PhD
Investigation performed at the Department of Orthopedic Research, Arthrex GmbH, Munich, Germany

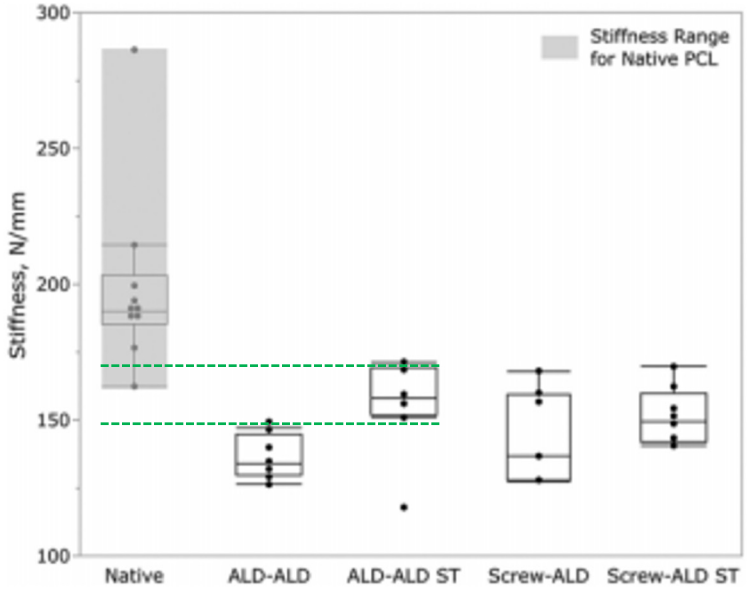
Background: Posterior cruciate ligament (PCL) reconstruction is commonly performed to restore joint stability and prevent posterior tibial translation at higher flexion angles. However, persistent knee laxity after reconstruction is often reported.
Purpose: To biomechanically evaluate the effect of independent suture tape (ST) reinforcement on different PCL reconstruction techniques.
Study Design: Controlled laboratory study.
Methods: PCL reconstruction using porcine bones and quadrupled bovine tendons was performed using 2 techniques: (1) an all-inside method using suspensory adjustable-loop devices (ALDs) in the tibia and femur and (2) a method using an interference screw on the tibial and an ALD on the femoral site. Both were tested with and without an additional ST for 4 groups (n = 8 per group). Each construct underwent biomechanical testing involving 3000 loading cycles in 3 stages. After position-controlled cycles simulating full range of motion, force-controlled loading from 10 to 250 N and then from 10 to 500 N were performed before pull-to-failure testing. Elongation, stiffness, and ultimate strength were evaluated.
Results: The highest ultimate load (1505 ± 87 N), a small total elongation (2.60 ± 0.97 mm), and stiffness closest to the native human ligament (156.3 ± 16.1 compared with 198.8 ± 33.5 N/mm; $P = .192$) was seen in the all-inside technique using ST. Intragroup comparison revealed that reinforcement with ST produced a smaller total elongation for the screw fixation (Screw-ALD, 6.06 ± 3.60 vs Screw-ALD ST, 2.50 ± 1.28 mm; $P = .018$) and all-inside techniques (ALD-ALD, 4.77 ± 1.43 vs ALD-ALD ST, 2.60 ± 0.97 mm; $P = .077$), albeit the latter was not significantly different. Elongation for constructs without ST increased more rapidly at higher loads compared with elongation for ST constructs. The ultimate strength was significantly increased only for constructs using the all-inside technique using ST (ALD-ALD, 1167 ± 125 vs ALD-ALD ST, 1505 ± 87 N; $P = .010$).
Conclusion: Adding an independent ST to PCL reconstruction led to improvement in the studied metrics by reducing the total elongation and increasing the ultimate strength, independent of the technique used.
Clinical Relevance: PCL reconstruction using additional ST reinforcement was biomechanically favorable in this study. ST reinforcement in the clinical setting could decrease knee laxity after PCL reconstruction, providing better joint stability and improved functional outcomes.
Keywords: PCL reconstruction; suture tape reinforcement; biomechanical testing; cyclic loading

Levy et al, OJSM 2021

- Adding IB reduced elongation in both constructs
- Bicortical ASF with IB had
  - Smallest elongation
  - Highest Ultimate failure load
  - Stiffness closest to that of native PCL







Orthopaedics

Reinforcement of Repair

Contents lists available at ScienceDirect

The Knee

journal homepage: www.elsevier.com/locate/thekne

Posterior cruciate ligament injuries managed with internal bracing

Ashley Arakkal *, Waldo Scheepers, Michael Held

Orthopaedic Research Unit, Division of Orthopaedic Surgery, Groote Schuur Hospital, University of Cape Town, Cape Town, South Africa

2025

- Multiligament Injuries
- 8 patients
- PCL repair if possible + Internal Brace
- STS Laxity 0 – 5mm
- Significant tunnel widening in 3
- Good PCL healing in 2
- *“Promising…..autograft reconstruction should still be seen as the gold standard…”*

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Synthetic Ligament for PCL Reconstruction

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ORIGINAL PAPER

Posterior cruciate ligament reconstruction for chronic lesions: clinical experience with hamstring versus ligament advanced reinforcement system as graft

D. Saragaglia[1] · F. Francony[1] · J. Gaillot[1] · R. Pailhé[1] · B. Rubens-Duval[1] · G. Lateur[1]

2019

- Retrospective study, 16 patients
- Isolated PCL injury → open PCL reconstruction
- Satisfactory outcomes both groups
  - Stability and functional outcomes
- No significant differences

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Contents lists available at ScienceDirect

The Knee

2020

Posterior cruciate ligament reconstruction implemented by the Ligament Advanced Reinforcement System over a minimum follow-up of 10 years

Liang-Yu Chiang [a,b,c], Cheng-Hung Lee [a,d], Kwok-Man Tong [e], Shun-Ping Wang [a], Kun-Tsan Lee [a], Wen-Chen Tsai [f], Chao-Ping Chen [a,f,g,*]

- DB reconstruction using LARS
- 38 patients
- 87% follow up at average 12 years
- Satisfactory PROMs
- Avge STS 4mm (KT-1000)
- Majority of MRI showed partial LARS rupture and minimal PCL healing
- *“an alternative option for PCLR when conventional autograft or allograft is not available”*

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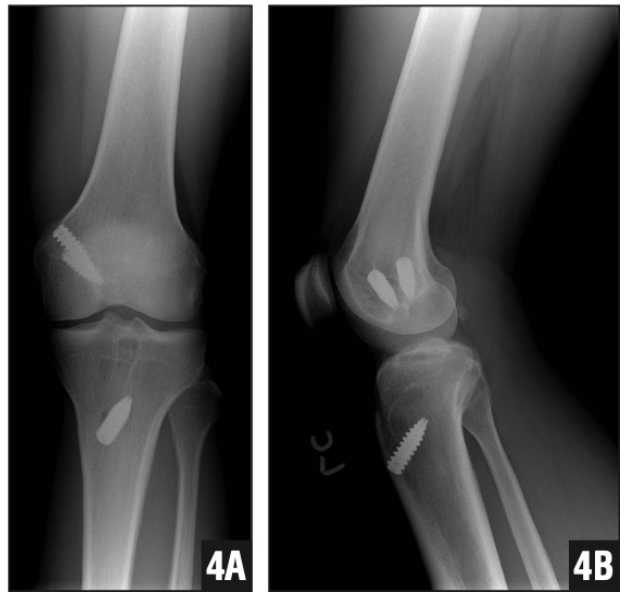
Outcomes of Arthroscopic Double-bundle PCL Reconstruction Using the LARS Artificial Ligament

2012

CHAO-PING CHEN, MD; YU-MIN LIN, MD; YUNG-CHENG CHIU, MD; HONG-WEN WU, PHD; CHENG-HUNG LEE, MD; KWOK-MAN TONG, MD; KUI-CHOU HUANG, MD

- 38 double bundle PCLR with LARS ligament (Taiwan)
- Mean age 33
- Mean follow up 3 years
- One case of synovitis requiring debridement
- Minimal tunnel widening
- Avge laxity 4mm
- *" may be an alternative treatment option"*



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ARTHROSCOPY AND SPORTS MEDICINE

Hamstring tendon autograft versus LARS artificial ligament for arthroscopic posterior cruciate ligament reconstruction in a long-term follow-up

Xinxian Xu · Tingting Huang · Zhongtang Liu · Hong Wen · Luyou Ye · Yuezheng Hu · Huachen Yu · Xiaoyun Pan

2014

- Retrospective study: SB PCLR
- 35 patients: 16 HS and 19 Lars
- Mean follow up 51 months
- Both groups significant improvements
  - PROMS, KT-1000
- No difference between groups
- One case of severe synovitis – good after debridement
- *"Both…are ideal grafts for PCL reconstruction"*

Invited Review

Ligament Advanced Reinforcement System (LARS) synthetic graft for PCL reconstruction: systematic review and meta-analysis

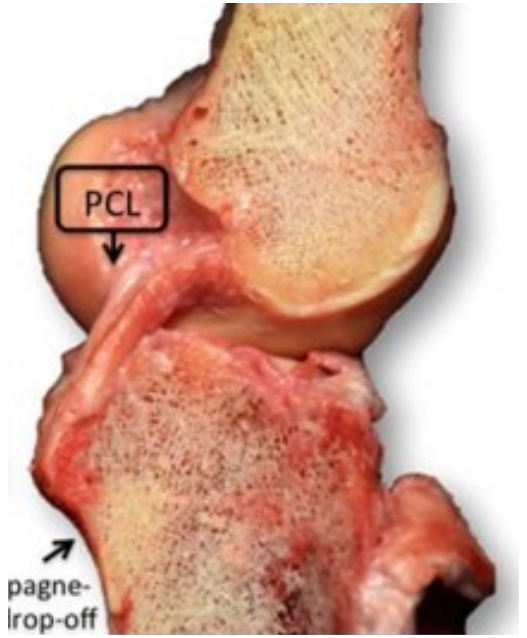
Filippo Migliorini[1], Andrea Pintore[2], Gianluca Vecchio[2], Francesco Oliva[2], Frank Hildebrand[1], and Nicola Maffulli[2,4,5]

2022

- 7 studies included
- Retrospective studies, Limited length of follow up
- 3 studies in meta-analysis – comparative studies
- *"LARS for PCL reconstruction is effective… results comparable to those achieved with 4SHT autografts"*

Conclusions

- Most isolated PCL injuries can be managed non-surgically
- PCL Repair
  - Possible in bony and some soft tissue avulsions
  - Mostly bony tibial and soft tissue femoral
  - Good rationale for synthetic augmentation, minimal evidence
  - Generally good results
- PCL Reconstruction with Synthetic Ligament
  - Minimal evidence
  - Reported results good
  - Possible useful option, especially if no autograft or allograft in multiligament scenario



Thank You

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ISAKOS CONGRESS 2025

MUNICH GERMANY

June 8–11

WELCOME

See you in Munich!

2025

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