ISAKOS CONGRESS 2023

Boston
Massachusetts
June 18–June 21

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The PCL-PCA :

a reliable and accurate MRI method to quantify the buckling phenomenon of the PCL in ACL-deficient knees

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Rse :

*Occasional educational consultant S&N

*Occasional R&D consultant Olympus

*Editorial board member KSSTA

Rsi, CP & CM :

No Disclosure

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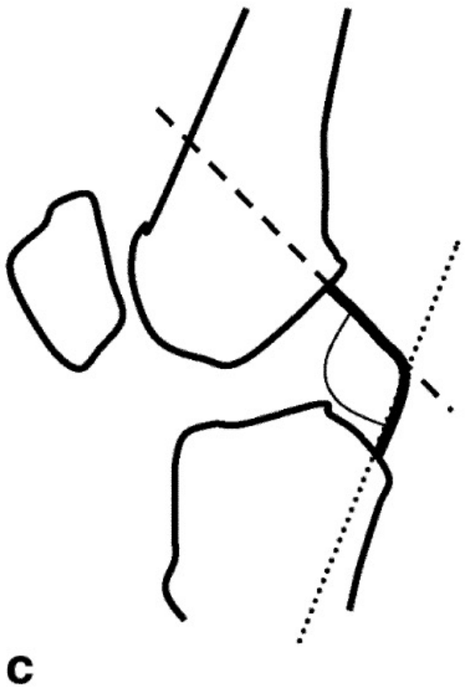
PCL angle as an indirect MRI sign of an ACL tear



	Gentili et al. [5]	Lee et al. [8]	McCauley et al. [9]	Murao et al. [11]	This study
ACL angle					
Normal ACL	55.6[a]	NC	NC	52.3[b]	53.5[c]
Torn ACL	29.9[a]	NC	NC	33.9[b]	25.9[c]
Cutoff	<45	NC	NC	≤45	≤45
Sensitivity (95% CI)	91	NC	NC	93	100 (92–100)
Specificity (95% CI)	97	NC	NC	84	100 (92 – 100)
Blumensaat angle					
Normal ACL	–1.6	-4.1	NC	NC	–8.2
Torn ACL	25.8	27.9	NC	NC	21.4
Cutoff	>9	>9	NC	NC	>0
Sensitivity (95% CI)	91	94 (70–100)	NC	NC	90 (78–96)
Specificity (95% CI)	86	96 (75–100)	NC	NC	98 (89–99)
PCL angle					
Normal ACL	123	122	113–114	NC	128.9
Torn ACL	106	105.7	96–97	NC	111.5
Cutoff	<107	<114	<105	NC	≤115
Sensitivity (95% CI)	52	74 (51–96)	72–74	NC	70 (55–82)
Specificity (95% CI)	94	71 (51–91)	79–86	NC	82 (68–91)

Mellado et al. Knee Surg Sports Traumatol Arthrosc. 2004;12(3):217-24

PCL angle as an indirect MRI sign of an ACL tear

Correlation of Magnetic Resonance Imaging Findings with the Chronicity of an Anterior Cruciate Ligament Tear

By Jong Pil Yoon, MD, Chong Bum Chang, MD, PhD, Jae Ho Yoo, MD, PhD, Sung Ju Kim, MS, Ja Young Choi, MD, Jung-Ah Choi, MD, PhD, Sang Cheol Seong, MD, PhD, and Tae Kyun Kim, MD, PhD

Investigation performed at the Joint Reconstruction Center, Seoul National University Bundang Hospital, Seongnam, South Korea

Group	PCL Angle† (deg)
Acute (n = 67)	125.1 ± 15.1
Subacute (n = 19)	116.2 ± 14.1
Intermediate (n = 23)	110.4 ± 15.4
Chronic (n = 36)	98.7 ± 18.2

< 6 weeks
6 weeks to 3 months
3 to 12 months
> 12 months

Original Article

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KSRR
Knee Surgery & Related Research

Morphologic Changes of the Posterior Cruciate Ligament on Magnetic Resonance Imaging before and after Reconstruction of Chronic Anterior Cruciate Ligament Ruptures

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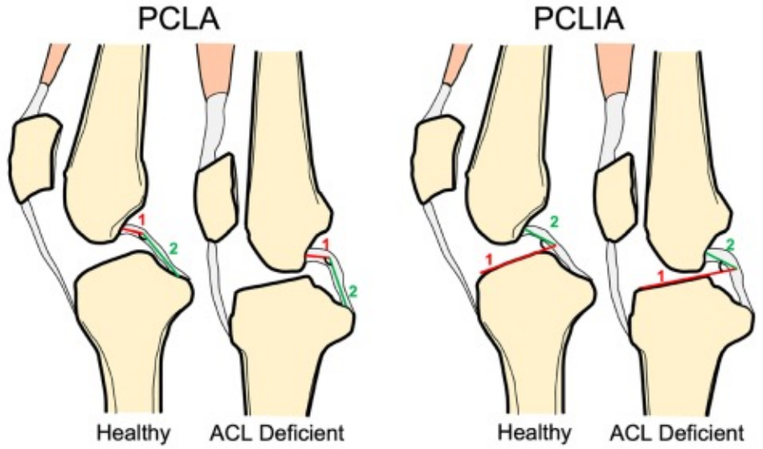
PCL angle:
- evolves with chronicity of tear
- is modified by ACL reconstruction

Sign of anterior tibial translation and knee decompensation ?

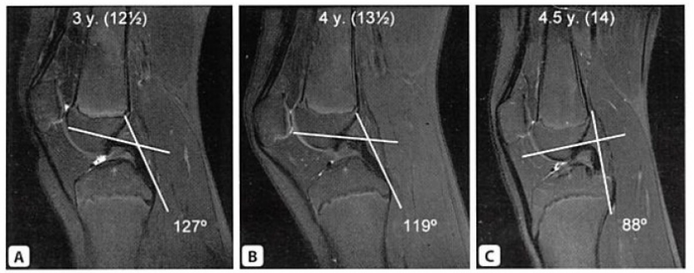
Existing methods

- PCL angle (PCLA) [McCauley et al. Am J Roentgenol. 1994]
- PCL inclination angle (PCLIA) [Gali et al. KSSTA. 2022]

→ Complex with low reproducibility



As anterior tibial translation increases in the ACL deficient knee, the vertical part of the PCL runs increasingly parallel to the posterior femoral cortex



Seil et al. Knee Surg Ann Jt 4:31 2019

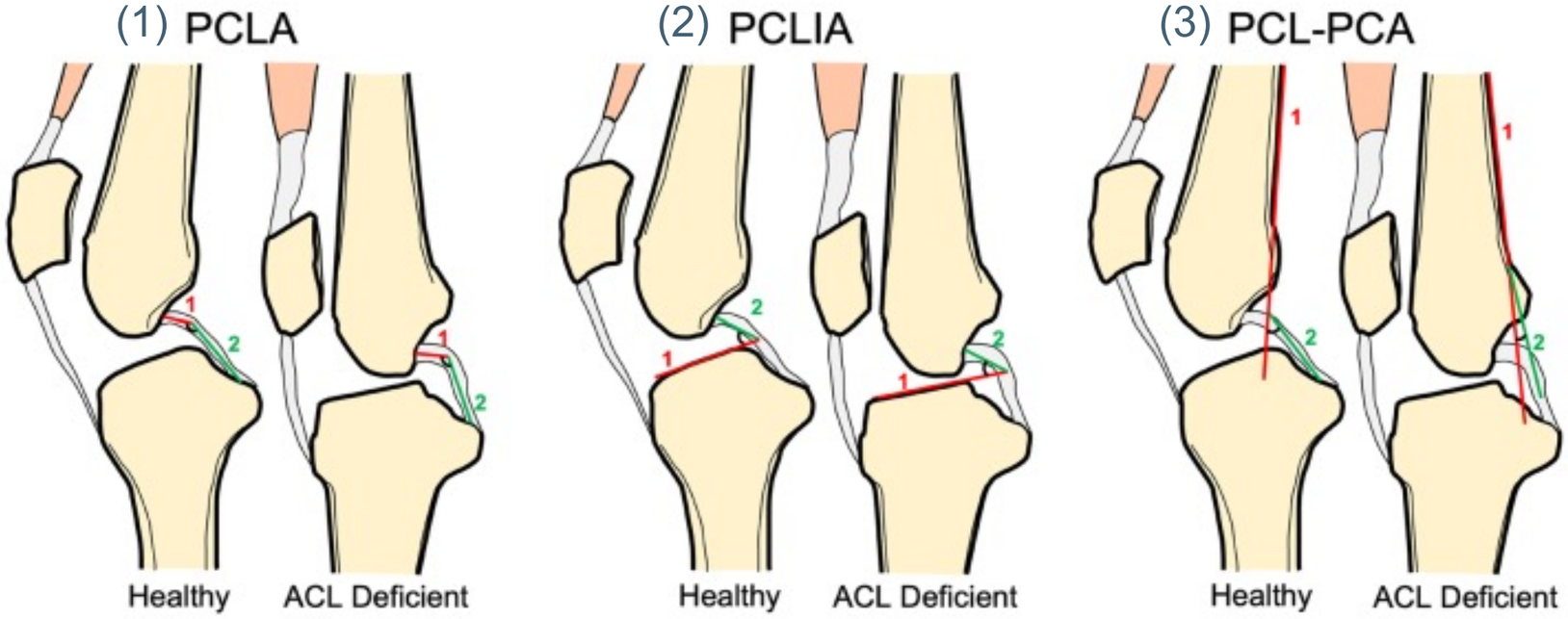
Purpose: To validate a new MRI method to measure the buckling phenomenon of the PCL by comparing its reliability and accuracy with existing methods.

Retrospective study

	ACL deficient knee	Control
Inclusion	Primary ACL deficient knee No history of meniscal or cartilage surgery	ACL competent knee on clinical examination + MRI
Exclusion	Open physes PCL or collateral ligament injury (> grade II for MCL tear on MRI) Signs of osteoarthritis on X-RAY (K-L > 1) Tibial plateau fracture Previous ACL reconstruction Displaced bucket handle	
N	24	24 (6 minor sprains, 8 femoropatellar syndrome, 7 meniscal tears, 3 cartilage injuries)
Age (years)	24 (17–33)	23 (18–30)
Gender (H/F)	14/10	10/14
Side (R/L)	16/8	14/10

PCL angle assessment

- On T2 sagittal MRI slices
- (1) « PCL angle » (PCLA)
- (2) « PCL inclination angle » (PCLIA)
- (3) « PCL - posterior cortex angle » (PCL-PCA): posterior diaphyseal cortex of the femur/ central portion of the most vertical part of the PCL tibial insertion based on the image located at the most lateral portion of the insertion



Statistical analysis

Two measurements by two examiners on 48 patients at 6 weeks interval

➔ Intra- and inter-observer reliability and measurement accuracy
Intra-class correlation ICC (3.1)
Minimum detectable change (MDC=SEM× 1.96 × √2)

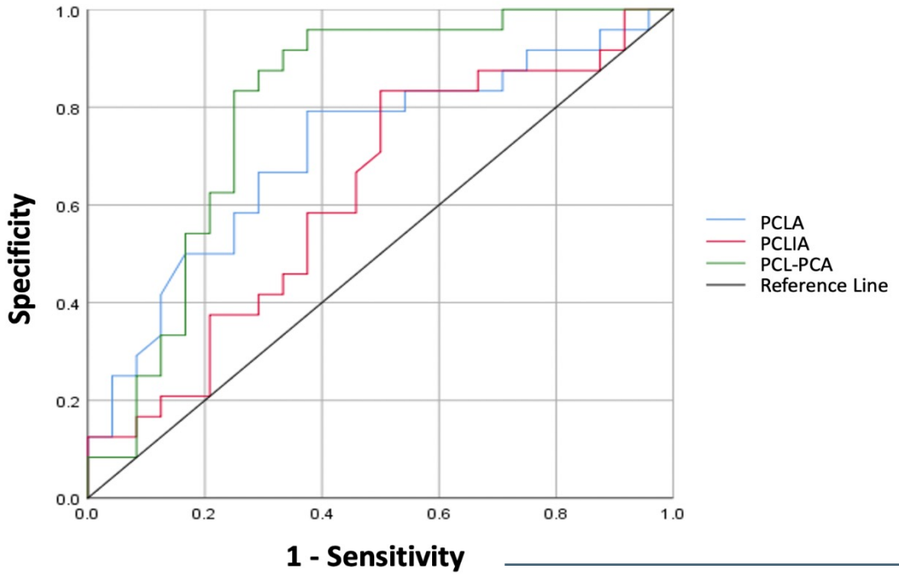
➔ Comparison of PCL angles between ACL-injured patients and controls
Student's t test for independent samples

➔ Optimal threshold to differentiate between intact and injured ACL knees
Receiver-operating characteristic (ROC) curves

Intra- and inter-observer reliability / precision

	Intra-observer			Inter-observer		
	ICC (95% CI)	SEM (°)	MDC (°)	ICC (95% CI)	SEM (°)	MDC (°)
PCLA	0.94 (0.90-0.97)	3.9	10.7	0.76 (0.61-0.86)	8.9	24.7
PCLIA	0.98 (0.96-0.99)	2.0	5.6	0.75 (0.59-0.85)	6.3	17.6
PCL-PCA	**0.99 (0.98-0.99)**	**1.2**	**3.4**	**0.95 (0.91-0.97)**	**2.7**	**7.5**

Distinction between ACL-deficient and intact knees



	PCLA	PCLIA	PCL-PCA
AUC (95% CI)	0.71 (0.57-0.86)	0.62 (0.46-0.78)	0.80 (0.67-0.93)
Optimal cut point (°)	≤ 117.9	≤ 21.35	≤ 22.65
Sensitivity (%, 95% CI)	63% (43.7-82.3%)	50% (30-70%)	**71% (52.8-89.2%)**
Specificity (%, 95% CI)	79% (62.7-95.3%)	83% (8-98%)	**88% (75-100%)**

Conclusion

The PCL-PCA method which is used to assess the PCL buckling on MRI was :

* The most reliable (inter-observer reliability at 0.95 and lowest measurement error: SEM at 2.7°)

* Provided an excellent distinction between patients with and without an ACL tear (sensitivity: 71% / specificity: 88%)

Thank you for your attention

Knee Surgery, Sports Traumatology, Arthroscopy
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KNEE

The posterior cruciate ligament–posterior femoral cortex angle: a reliable and accurate MRI method to quantify the buckling phenomenon of the PCL in ACL-deficient knees

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