

# Large posterolateral cartilage slope is a risk factor for non-contact ACL injury

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# COI Disclosure Information

**Lead Presenter/Responsible Researcher:**

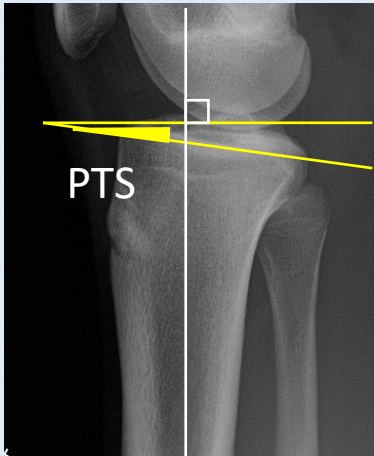
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**Kensuke Hotta**

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**I have no financial relationships to disclose.**

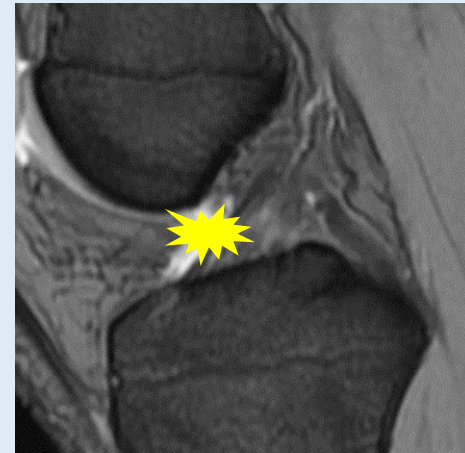
# Background



Increased posterior  
tibial slope (PTS)



anterior translation  
of the tibia



Increased risk of  
ACL injury

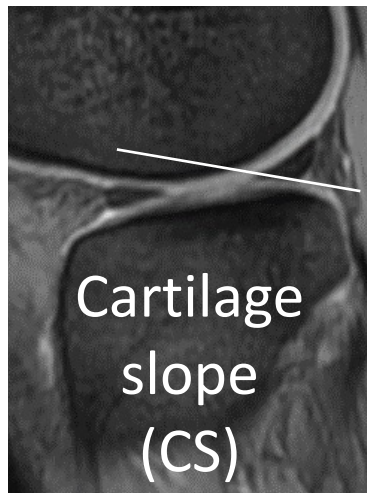
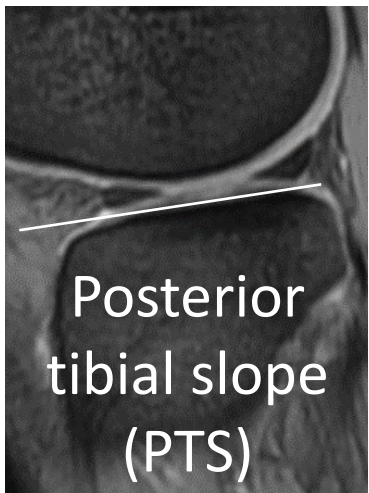
*Song et al. AJSM 2018 <sup>1)</sup>*  
*Zeng et al. KSSTA 2014 <sup>2)</sup>*

## Which is the risk factor?

- bone, meniscus, or cartilage?
- medial or lateral?

# Purpose

The purpose of this study is to investigate the relationship between non-contact ACL injury and the morphology of the proximal tibial articular surface.



**PTS:** the tangent line to the bony articular surface

**MS:** connecting the superior aspects of the anterior and posterior segments of the meniscus

**CS:** connecting the anterior and posterior borders of the inferior aspect of the posterior segment of the meniscus

# Patient selection

## 【Inclusion criteria】

- Patients who have undergone knee MR imaging due to knee pain between 2015 and 2020.
- Age between 16 and 39 years old.

## 【Exclusion criteria】

- Presence of osteoarthritis.
- Cases with difficult measurements due to meniscal injury.
- With a history of knee surgery.



**50** patients with ACL injury (ACL group)

**50** patients without ACL injury (Control group)

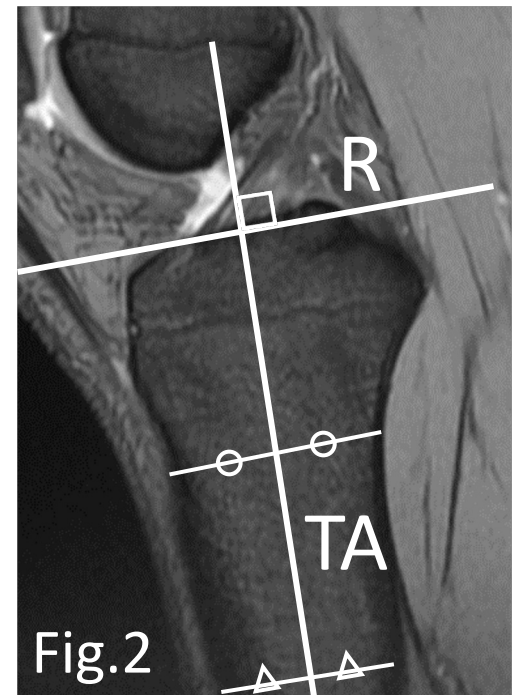
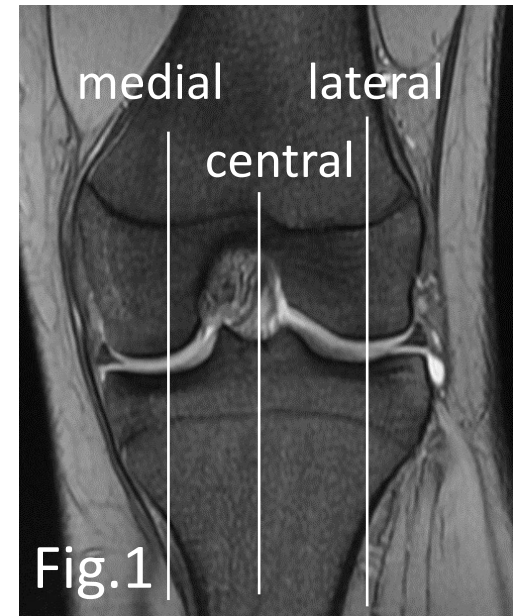
# Methods

The definitions of three planes (Fig.1)

- **Central:** midpoint of the intercondylar eminence
- **Medial:** midpoint of the medial tibial plateau
- **Lateral:** midpoint of the lateral tibial plateau

The definitions of the tibial axis (TA) and the reference line (R) are shown in Fig.2.

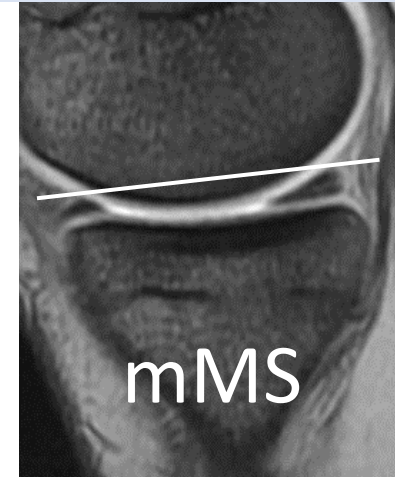
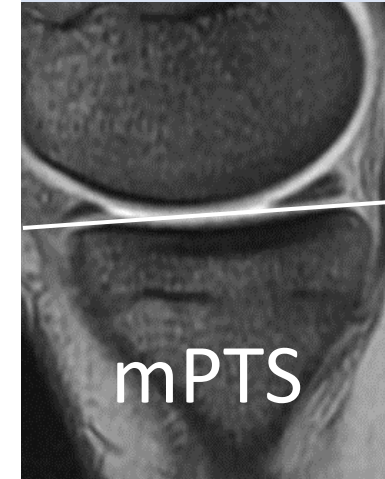
*Hashemi et al. AJSM 2010<sup>3)</sup>*



# Parameters

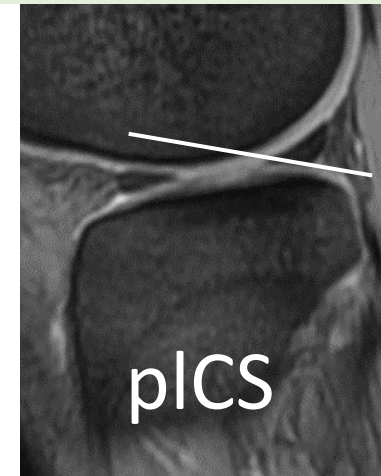
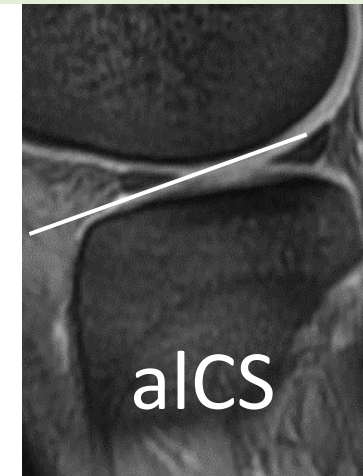
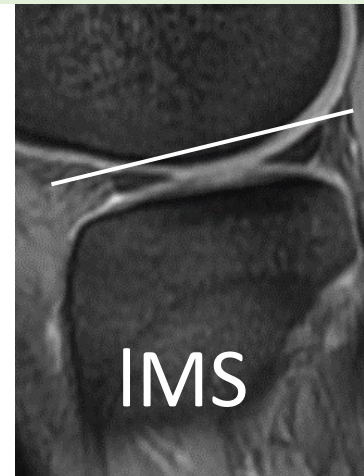
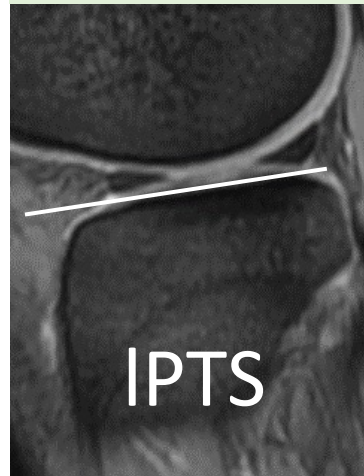
The following six parameters were measured as the posterior tilt angle with respect to line R. Statistical analysis involved the use of a t-test or chi-squared test for comparisons between two groups, and binary logistic regression analysis for multivariate analysis.

## Medial plane



## Lateral plane

PTS, posterior tibial slope  
MS, meniscus slope  
CS, cartilage slope  
m, medial; l, lateral  
al, anterolateral  
pl, posterolateral



# Results

## ACL vs Control:

IPTS, IMS, and pICS were significantly larger in the ACL group. (Table 1)

## Risk factor:

pICS was identified as an independent risk factor for ACL injury. (Table 2)

Table 1. Comparison of ACL group and Control group

	<b>ACL</b>	<b>Control</b>	<b><i>p</i></b>
n	50	50	
age	23.8	26.4	0.09
M/F	29/21	29/21	
mPTS	7.9 ± 3.4	8.7 ± 3.4	0.25
mMS	5.5 ± 3.6	4.8 ± 3.3	0.37
IPTS	8.3 ± 4.5	6.5 ± 3.6	<b>0.03</b>
IMS	4.1 ± 5.0	1.7 ± 3.5	<b>0.007</b>
aICS	-11.8 ± 7.6	-12.1 ± 7.3	0.85
pICS	22.0 ± 7.1	16.6 ± 7.3	<b>&lt;0.001</b>

Table 2. Multivariate logistic regression analysis of risk factors for ACL injury

	<b>OR</b>	<b>95%CI</b>	<b><i>p</i></b>
pICS	1.112	1.043-1.185	0.001



# Discussion

## Previous studies:

- **Lateral PTS** was associated with an increased risk of ACL tear.

*Bojicic et al. OJSM 2017 <sup>4)</sup>*

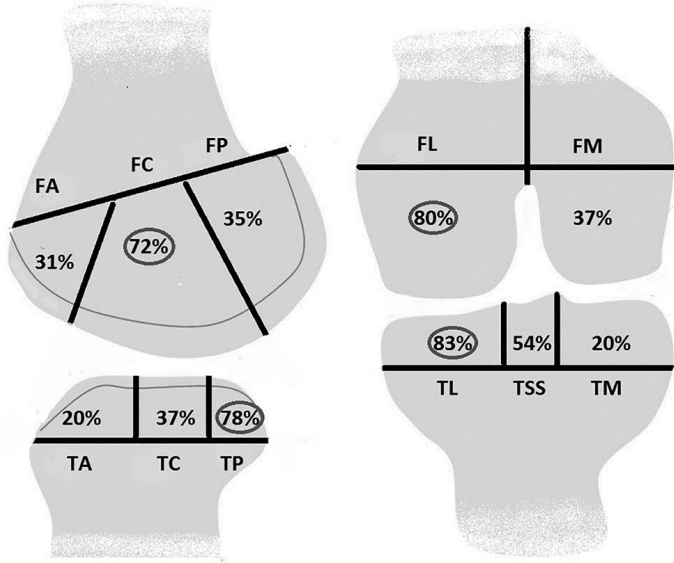
- **Both PTS and MS** were greater in ACL injured group than controls.

*Hudek et al. CORR 2011 <sup>5)</sup>*

## Present study:

- IPTS, IMS, and plCS were all larger in ACL group than in control group.
- **plCS** was identified as a risk factor for non-contact ACL injury.

# Discussion



*Bordoni et al. AJSM 2019 <sup>6)</sup>*

The most common relative bone bruise pattern was observed on only the **lateral side of both the tibia and the femur.**

*Shi et al. OJSM 2019 <sup>7)</sup>*

**Increased LMS** was associated with and could be an independent risk factor for lateral **bone bruise** in noncontact ACL injury.

*Li et al. KSSTA 2018 <sup>8)</sup>*

"The significant posterior tilt of the lateral parameters may lead to ACL injury and subsequent bone contusions in the lateral compartment."

# Limitations

- Small sample size
- Insufficient patient information, such as height, weight and BMI
- Exclusion of cases with difficult measurements due to meniscal injury.

# Conclusion

- **IPTS, IMS, and pICS** were significantly larger in patients with ACL injury.
- Large posterolateral cartilage slope is a risk factor for non-contact ACL injury.

# References

- 1) *Song GY et al. Greater Static Anterior Tibial Subluxation of the Lateral Compartment After an Acute Anterior Cruciate Ligament Injury Is Associated With an Increased Posterior Tibial Slope. Am J Sports Med. 2018 Jun;46(7):1617-1623*
- 2) *Zeng C et al. Is posterior tibial slope associated with noncontact anterior cruciate ligament injury? Knee Surg Sports Traumatol Arthrosc. 2016 Mar;24(3):830-7*
- 3) *Hashemi J et al. Shallow medial tibial plateau and steep medial and lateral tibial slopes: new risk factors for anterior cruciate ligament injuries. Am J Sports Med. 2010 Jan;38(1):54-62*
- 4) *Bojicic KM et al. Association Between Lateral Posterior Tibial Slope, Body Mass Index, and ACL Injury Risk. Orthop J Sports Med. 2017 Feb 13;5(2)*
- 5) *Hudek R et al. Is noncontact ACL injury associated with the posterior tibial and meniscal slope? Clin Orthop Relat Res. 2011 Aug;469(8):2377-84*
- 6) *Bordoni V et al. Bone Bruise and Anterior Cruciate Ligament Tears: Presence, Distribution Pattern, and Associated Lesions in the Pediatric Population. Am J Sports Med. 2019 Nov;47(13):3181-3186*
- 7) *Shi H et al. Bone Bruise Distribution Patterns After Acute Anterior Cruciate Ligament Ruptures: Implications for the Injury Mechanism. Orthop J Sports Med. 2020 Apr 15;8(4)*
- 8) *Li K et al. Increased lateral meniscal slope is associated with greater incidence of lateral bone contusions in noncontact ACL injury. Knee Surg Sports Traumatol Arthrosc. 2020 Jun;28(6):2000-2008*