Lateral meniscal status, chronicity of ACL deficiency, and initial graft tension were associated with abnormal knee laxity after anatomical ACL reconstruction.

ACLSG 2024.1.30.

Shuji Taketomi MD, PhD
Yamagami R MD, Kawaguchi K MD, PhD, Kono K MD, PhD, Murakami R MD, Kage T MD, PhD, Arakawa T MD, Kobayashi T MD, and Tanaka S MD, PhD.

Department of Orthopaedic Surgery
The University of Tokyo

COI

ACLSG 2024

COI disclosure

Shuji TAKETOMI

There is no COI that should be disclosed in relation to this presentation.

ACL Study Group

Graft failure after ACLR

We sometimes experience a recurrence of abnormal laxity w/o trauma.

Causes of graft failure (recurrence of instability)

Non-Surgical factors

- Younger age — Kamien PM et al. AJSM 2013
- Male — Paterno MV et al. AJSM 2014
- Greater BMI

Surgical factors

- Non-anatomical tunnel location — Hosseini A et al. Int Orthop 2012; Parkinson B et al. AJSM 2017
- Graft material (HT>BTB) — Chen W et al. OJSM 2019
- Smaller graft size — Kamien PM et al. AJSM 2013
- Meniscus deficiency — Parkinson B et al. AJSM 2017
- Longer time from injury to surgery — Tanaka Y et al. OJSM 2018

ACL Study Group

Graft failure after ACLR

However, most of the previous studies that investigated graft failure targeted or included conventional single-bundle non-anatomical ACLR.

Surgeons sometimes experience graft failure or recurrence of instability without trauma, even though the tunnels were anatomically created.

As surgeons, we want to avoid graft failure after surgery.

Therefore, we decided to investigate what surgical factors are responsible for graft failure after anatomical ACLR.

ACL Study Group

Purpose

This retrospective study aimed to identify the surgical risk factors of abnormal knee laxity after anatomical ACLR.

Materials

- 291 patients (From Jul 2007 to Jun 2020)
- primary ACLR
- Min FU 24M

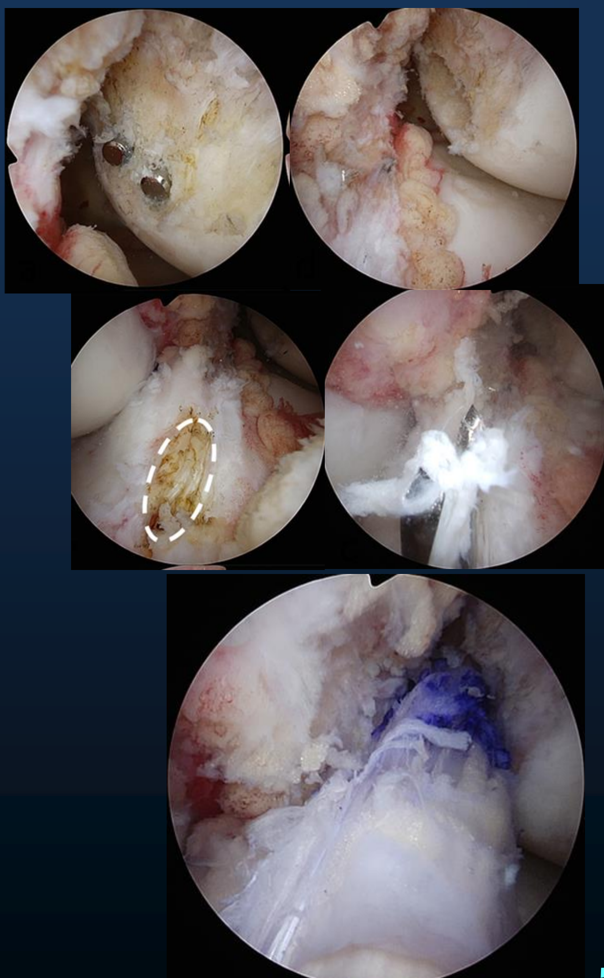
Patient information (n = 291).

Characteristic	
Demographic variables	
Sex (female/male)	130/161
Age (y)	30.2 ± 12.1
BMI	23.2 ± 3.7
Time to surgery (mo)	4 (0–360)
Preoperative side-to-side deference with arthrometer (mm)	4.0 ± 2.0
Preoperative pivot shift test (negative/glide/clunk/gross)	0/17/255/19
Surgical procedure	
Graft material (BTB/HT)	180/111
Initial graft tension (higher protocol/lower protocol)	104/187
Meniscal status	
Medial meniscus (intact/repaired/resected)	199/49/43
Lateral meniscus (intact/repaired/resected)	225/48/18

Data are expressed as number, mean ± standard deviation, or median (range). BMI = body mass index; BTB = bone–patellar tendon–bone; HT = hamstring tendon.

Surgical Procedure

Anatomical rectangular tunnel ACLR using BTB



Anatomical double-bundle ACLR using HT

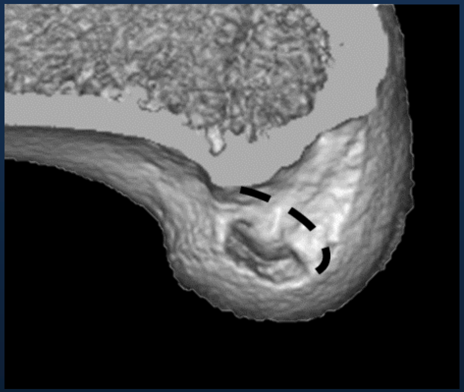
Taketomi S et al. J Knee Surg 2018

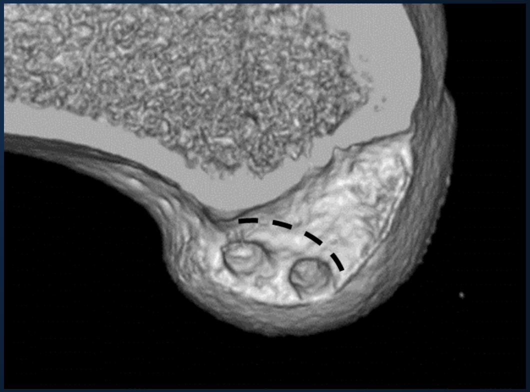
Validation of tunnel position

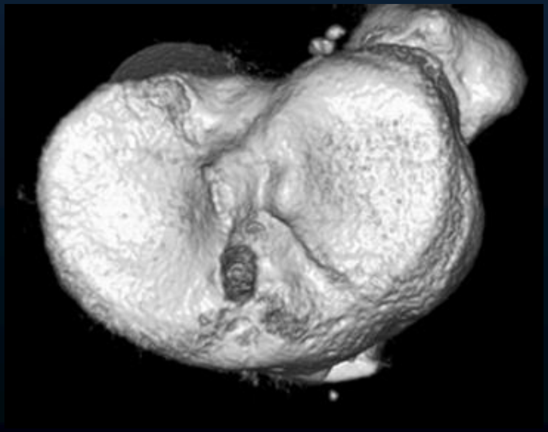
We confirmed the anatomic location of the bone tunnel on CT in all patients.

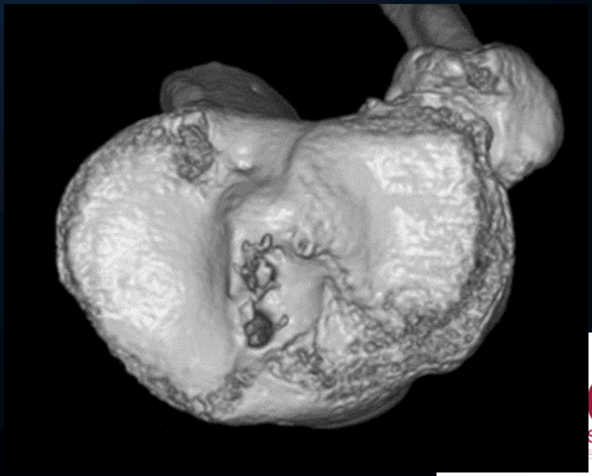
BTB

double-bundle with HT



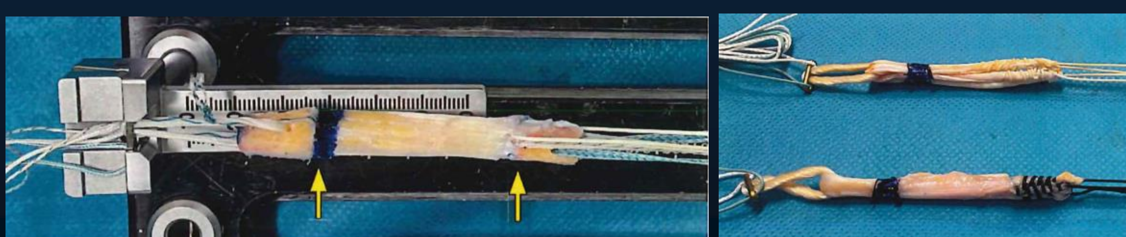






Evaluated variables

Gender (female/male)
Age
BMI (kg/m²)
Time to surgery
MM / LM procedure
Graft materials (BTB/HT)
Initial graft tension (higher/lower)



ACL Study Group

IGT protocols

IGT protocol in this series differs according to the time of surgery.

First half of the study period:

higher tension protocol

The graft was fixed at full knee extension with manual maximum pull.

Second half of the study period:

lower tension protocol

Graft was fixed at 20° knee flexion with the varied from patient to patient and ranged from 5-20N pull.

Methods (main outcome)

Graft failure (abnormal knee laxity)

Abnormal knee laxity was defined as constituting one or both of the following criteria:

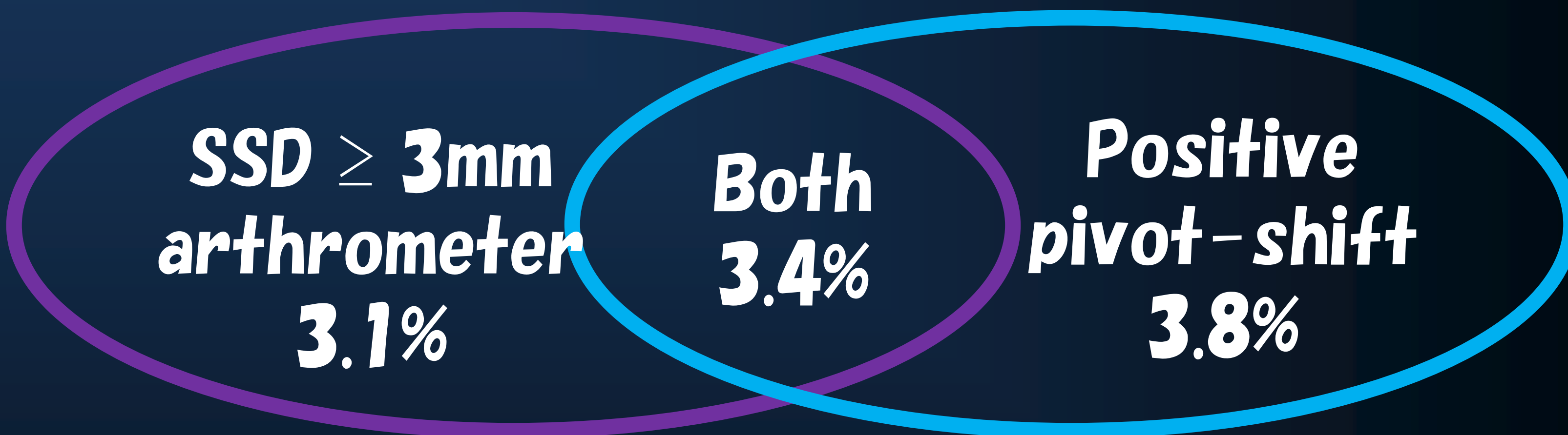
(1) a side-to-side difference of ≥3 mm on arthrometer (KneeLax3)

(2) a positive pivot-shift test, being "glide," "clunk," or "gross"

Study Group

Results 1

Abnormal knee laxity occurred in 30 cases(10.3%)
After postoperative ≥ 2years



None of 30 patients with abnormal knee laxity required revision surgery,
and none had subjective laxity problems.

Results 2

Univariate analysis of abnormal knee laxity ($n = 291$).

Characteristic	Unstable group ($n = 30$)	Stable group ($n = 261$)	p-value
Demographic variables			
Sex female (%)	63.3	42.1	0.01 *
Age (y)	30.3 ± 12.0	30.2 ± 12.2	0.97
BMI (kg/m^2)	21.8 ± 2.9	23.4 ± 3.7	0.03 *
Time to surgery (mo)	27 (1–300)	4 (0–360)	<0.001 **
Preoperative side-to-side deference with arthrometer (mm)	4.7 ± 2.6	3.9 ± 1.9	0.06
Preoperative pivot shift test (%)			
Glide	10.0	5.4	
Clunk	80.0	88.5	0.40
Gross	10.0	7.3	

Univariate analysis for abnormal knee laxity showed that a higher likelihood of abnormal knee laxity was associated with female sex, smaller BMI, and longer time to surgery.

ACL Study Group

Results 3

Univariate analysis of abnormal knee laxity ($n = 291$).

Characteristic	Unstable group ($n = 30$)	Stable group ($n = 261$)	*p*-value
Surgical procedure			
Graft material (%)			
BTB	46.7	63.6	0.07
HT	53.3	36.4	
Initial graft tension (%)			
Higher protocol	60.0	33.0	0.003 *
Lower protocol	40.0	67.0	

It showed that a higher likelihood of abnormal knee laxity was also associated with **higher initial graft tension (IGT) protocol**.

Although no significant difference was found, there was a tendency for HT grafts to have a higher risk of abnormal knee laxity (p=0.07).

Results 4

Univariate analysis of abnormal knee laxity ($n = 291$).

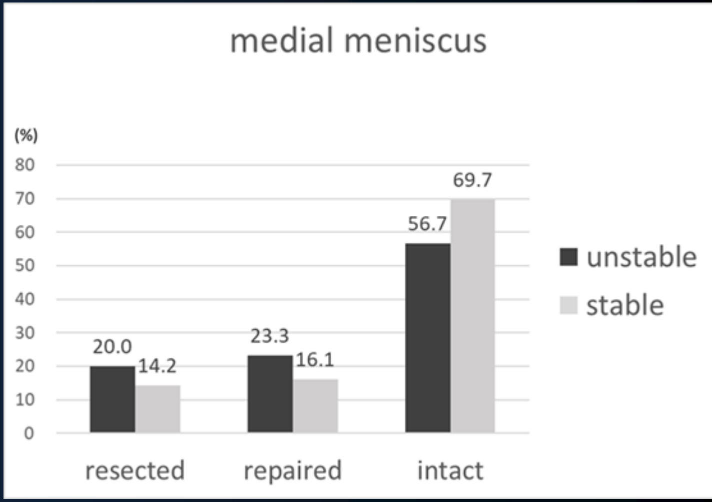
Characteristic	Unstable group ($n = 30$)	Stable group ($n = 261$)	*p*-value
Subanalysis of surgical procedure			
Initial graft tension (BTB) (%)			
Higher protocol	21.4	16.2	0.62
Lower protocol	78.6	83.8	
Initial graft tension (HT) (%)			
Higher protocol	93.8	62.1	0.013 *
Lower protocol	6.2	37.9	

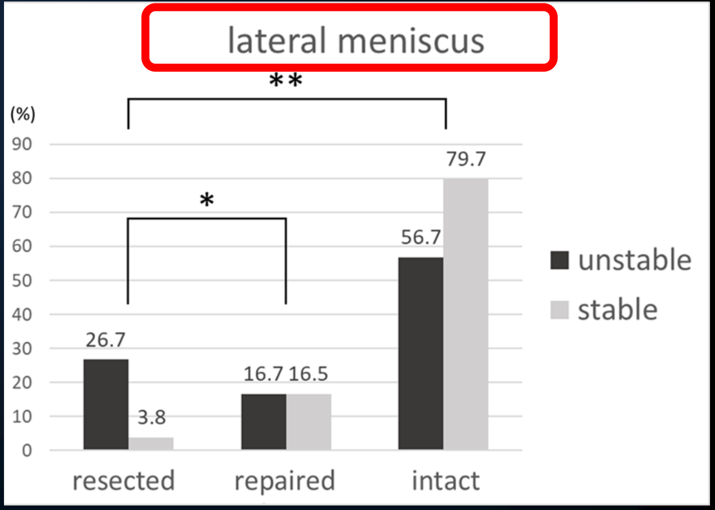
The result of the sub-analysis revealed that ACLR using **HT graft** was more susceptible to the effects of the **initial graft tension (IGT) protocol**.

Results 5

Univariate analysis of abnormal knee laxity ($n = 291$).

Characteristic	Unstable group ($n = 30$)	Stable group ($n = 261$)	p-value
Meniscal status			
Medial meniscus (%)			
Resected	20.0	14.2	
Repaired	23.3	16.1	0.34
Intact	56.7	69.7	
Lateral meniscus (%)			
Resected	26.7	3.8	
Repaired	16.7	16.5	0.001 *
Intact	56.7	79.7	





LM status also influenced abnormal knee laxity.

LM resected group had more abnormal knee laxity than repaired or intact group.

Results 6

Multivariate logistic regression analysis of abnormal knee laxity ($n = 291$).

	Odds ratio	95% CI	P value
Time to surgery (mo)	1.01	1.01–1.02	<0.001 **
Initial graft tension			
Higher protocol	3.5	1.4–8.5	<0.001 **
Meniscal status			
Lateral meniscus resection	12.8	3.9–43.4	0.006 *

Statistical significance between the two groups: $^{**}p < 0.001$; $^{*}p < 0.05$.
CI = confidence interval.

Multivariate logistic regression analysis showed
higher initial graft tension (IGT) protocol,
chronicity of ACL deficiency,
and **LM resection**
were risk factors for abnormal knee laxity after anatomical ACL reconstruction.

ACL Study Group

Limitations

- Retrospective study. There was a graft selection bias.
- Initial graft tension was not selected randomly but differed according to the study period.
- Only 2 different types of graft-tensioning protocols.
- Maximum manual pull was not quantitative.
- The number of patients was relatively small.
- Postoperative knee laxity was evaluated at only one time point.
- Morphometric variables (such as PTS) were not included in this study.

Summary

- We investigated the surgical risk factors of abnormal knee laxity after anatomical ACLR.
- Higher initial graft tension protocol, chronicity of ACL deficiency, and lateral meniscus resection were risk factors for abnormal knee laxity after anatomical ACLR.

ACL Study Group

The University of Tokyo

Thank you for your attention!