Bone–Patellar Tendon–Bone Autograft and Female Sex are Associated with the Presence of Cyclops Lesions and Syndrome After Anterior Cruciate Ligament Reconstruction (ACL-R)

Tomohiro Tomihara[1], Yusuke Hashimoto[2], Kazuya Nishino[2], Shuko Tsumoto[1]

[1] Shimada hospital, Habikino, JAPAN
[2] Osaka metropolitan university, Osaka, JAPAN

運動器ケア
しまだ病院
SHIMADA HOSPITAL

ISAKOS Congress 2023

COI Disclosure

Tomohiro Tomihara

Yusuke Hashimoto

Kazuya Nishino

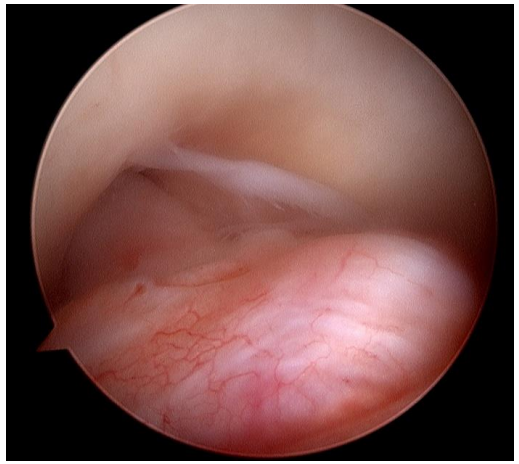
Shuko Tsumoto

We **DO NOT** have a financial interest or other relationship with a commercial company or institution in this presentation.

Introduction

Cyclops syndrome

- Cyclops lesions
- A loss of knee extension after ACL-R



Cyclops lesions (fibrovascular nodule)

✓ The majority of cyclops lesions: **Asymptomatic**[1]

✓ Most studies have not examined cyclops lesions using **MRI** or **second-look arthroscopy** [1-3].

Few studies have investigated risk factors for the development of cyclops lesions

Purpose

- To evaluate the presence of cyclops lesions using MRI at 6 and 12 months after ACL-R
- To investigate the associated risk factors of cyclops lesions and syndrome.

Hypothesis

✓ Bone-patellar tendon-bone (BTPB) autograft

✓ Female sex

⟹ Risk factors of **cyclops lesions** and **syndrome**

Methods

Inclusion criteria

- Primary ACL-R from 2008 to 2017 by a single surgeon [4,5]

BPTB autograft

Hamstring (HT) autograft*

*Double bundle reconstruction

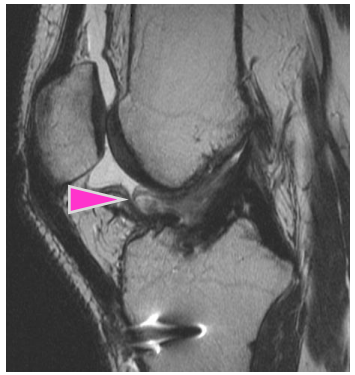
- MRI (6 and 12 months post-operatively)

Exclusion criteria

- Multiple ligament injuries
- History of surgery or other knee injuries in the affected and contralateral knees

Methods

Cyclops syndrome [2]



- Symptomatic extension deficit (> 5 degrees compared to the contralateral knee) at 3 months or more
- A cyclops lesion on post-operative MRI

Multivariate logistic regression analysis

Predictor variables

- Age
- Sex
- Body mass index (BMI)
- Time from injury to ACL-R (TI)
- Pre-injury Tegner activity score
- Graft (BPTB vs HT)
- Meniscal and cartilage injury (Outerbridge classification grade 2 or more: Injured)
- Notch width index on MRI (NWI)

Results

Patient demographic data

Number of patients (cases)	**455**
Age (y.o.)	28.0 (12.2)
Sex (Men / Female)	225 / 230
BMI (kg / m^2)	23.1 (3.5)
TI (mo)	24.4 (64.5)
Pre-injury Tegner activity score	7.1 (1.5)
ACL graft	
BPTB autograft	199
HT autograft	256

Intra-operative findings and MRI evaluation

Meniscal injury (intact / injured)	160 / 295
Cartilage injury (intact / injured)	159 / 296
NWI (%)	26.6 (2.7)
Cyclops lesion*	**104** (22.9%)
BPTB autograft	64 (32.2%)
HT autograft	40 (15.6%)
Cyclops syndrome	**20** (4.4%)
BPTB autograft	18 (9.6%)
HT autograft	2 (0.8%)

*All cyclops lesions were detected 6 months after ACL-R on MRI.

Data are presented as the average (SD or %).

Results: Logistic regression analyses of the relative contribution

Cyclops lesion

Characteristic	Crude odds ratio (95% CI)	*P* value	Adjusted odds ratio (95% CI)	*P* value
Age	0.98 (0.96–1.00)	0.047	1.00 (0.98–1.03)	n.s
Sex (female)	1.61 (1.03–2.51)	0.036	2.03 (1.27–3.25)	0.003
BMI	1.02 (0.96–1.08)	n.s		
TI	1.00 (1.00–1.00)	n.s		
Pre-injury Tegner activity score	1.16 (1.00–1.35)	0.055	1.05 (0.86–1.29)	n.s
Graft (BPTB)	2.56 (1.63–4.01)	<0.001	2.85 (1.75–4.63)	<0.001
Meniscal injury	0.71 (0.45–1.11)	n.s		
Cartilage injury	0.66 (0.42–1.04)	0.074	0.66 (0.38–1.14)	n.s
NWI	0.076 ($2.40e^{-5}$–229.0)	n.s		

Cyclops syndrome

Characteristic	Crude odds ratio (95% CI)	*P* value	Adjusted odds ratio (95% CI)	*P* value
Age	0.99 (0.95–1.03)	n.s	1.00 (0.95–1.04)	n.s
Sex (female)	1.49 (0.60–3.72)	n.s	3.27 (1.07–10.0)	0.038
BMI	1.11 (0.99–1.24)	0.070	1.21 (1.05–1.39)	0.008
TI	1.00 (0.99–1.01)	n.s		
Pre-injury Tegner activity score	1.12 (0.82–1.53)	n.s		
Graft (BPTB)	12.6 (2.89–55.1)	<0.001	18.0 (3.67–88.3)	<0.001
Meniscal injury	1.66 (0.59–4.66)	n.s		
Cartilage injury	1.27 (0.48–3.36)	n.s		
NWI	$2.23e^{-9}$ ($1.59e^{-16}$–0.03)	0.018	$6.37e^{-8}$ ($7.55e^{-16}$–5.38)	n.s

Discussion: The incidence of cyclops lesions and syndrome

Authors	Grafts	No. of cases	Cyclops lesions	Cyclops syndrome
Gohli [6]	HT	47	46.8%	10.6%
Fujii [7]	HT	57	NA	12%
Kiekara [8]	HT	66	3.0%	NA
Current study	HT	256	15.6%	0.8%
Barie [9]	BQT	387	NA	3.61%
Sonnery-Cottet [3]	HT, QT	55	27.3%	10.9%
Current study	BPTB	199	32.2%	9.0%

BQT: bone-quadriceps tendon, QT: quadriceps tendon, NA: not available

The incidence of cyclops lesions and syndrome after ACL-R using BPTB in this study was higher than those using other autografts.

Discussion: Graft (BPTB vs HT)

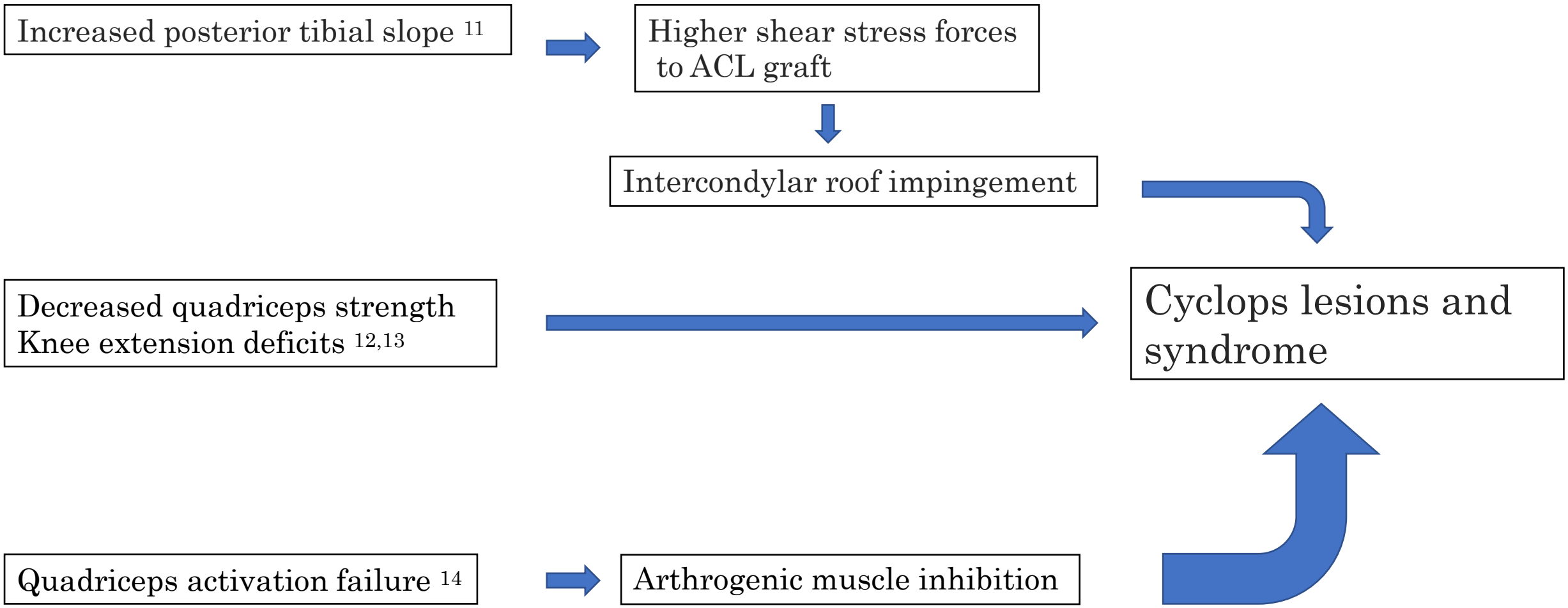
Graft-tunnel mismatch in diameter in tibial tunnel[10]

Cyclops lesions

Rougher texture [9]

Fibers sloughing off during the process of ligamentization

Discussion: Female sex



Conclusions

- ✓ All cyclops lesions were detected 6 months after ACL-R, and the majority of them were asymptomatic.
- ✓ BPTB autograft and female sex were the significant risk factors for the presence of cyclops lesions and syndrome.
- ✓ In addition, increased BMI was associated with a higher risk of developing cyclops syndrome.
- ✓ When BPTB autograft is used for a female patient, full active knee extension should be encouraged in the early period after ACL-R to prevent cyclops lesion formation.

References

1. Webster KE, Murgier J, Feller JA, Klemm HJ, Devitt BM, Whitehead TS (2021) Preservation of the tibial stump during anterior cruciate ligament reconstruction surgery did not increase the rate of surgery for symptomatic cyclops lesions. Orthop J Sports Med 9:2325967121992517.

2. Delaloye JR, Murar J, Vieira TD, Franck F, Pioger C, Helfer L, Saithna A, Sonnery-Cottet, (2020) Knee extension defcit in the early postoperative period predisposes to cyclops syndrome after anterior cruciate ligament reconstruction: a risk factor analysis in 3633 patients from the santi study group database. Am J Sports Med 48:565–572

3. Sonnery-Cottet B, Lavoie F, Ogassawara R, Kasmaoui H, Scussiato RG, Kidder JF, Chambat P (2010) Clinical and operative characteristics of cyclops syndrome after double-bundle anterior cruciate ligament reconstruction. Arthroscopy 26:1483–1488

4. Tomihara T, Hashimoto Y, Taniuchi M, Takigami J, Takahashi S, Nishida Y, Shimada N (2019) Shallow knee flexion angle during femoral tunnel creation using modified transtibial technique can reduce femoral graft bending angle in ACL reconstruction. Knee Surg Sports Traumatol Arthrosc 27:618–625

5. Tomihara T, Yoshida G, Hara Y, Taniuchi M, Shimada N (2014) Transparent 3-dimensional CT in evaluation of femoral bone tunnel communication after ACL double-bundle reconstruction: comparison between outside-in and transportal technique. Knee Surg Sports Traumatol Arthrosc 22:1563–1572

6. Gohil S, Falconer TM, Breidahl W, Annear PO (2014) Serial MRI and clinical assessment of cyclops lesions. Knee Surg Sports Traumatol Arthrosc 22:1090–1096

7. Fujii M, Furumatsu T, Miyazawa S, Okada Y, Tanaka T, Ozaki T, Abe N (2015) Intercondylar notch size influences cyclops formation after anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc 23:1092–1099

8. Kiekara T, Järvelä T, Huhtala H, Paakkala A (2012) MRI of double-bundle ACL reconstruction: evaluation of graft findings. Skeletal Radiol 41:835–842

9. Barié A, Köpf M, Jaber A, Moradi B, Schmitt H, Huber J, Streich NA (2018) Long-term follow-up after anterior cruciate ligament reconstruction using a press-fit quadriceps tendon-patellar bone autograft. BMC Musculoskelet Disord 19:368.

10. Meijer K, Saper M, Joyner P, Liu W, Andrews JR, Roth C (2018) Minimizing graft-tunnel mismatch in allograft anterior cruciate ligament reconstruction using blumensaat's line: a cadaveric study. Arthroscopy 34:2438–2443

11. Aldrian S, Valentin P, Wondrasch B, Krusche-Mandl I, Ostermann RC, Platzer P, Hofbauer M (2014) Gender diferences following computer-navigated single- and double-bundle anterior cruciate ligament reconstruction. Knee Surg Sports Traumatol Arthrosc 22:2145–2152

12. Kuenze C, Pietrosimone B, Lisee C, Rutherford M, Birchmeier T, Lepley A, Hart J (2019) Demographic and surgical factors affect quadriceps strength after ACL reconstruction. Knee Surg Sports Traumatol Arthrosc 27:921–930

13. Ueda Y, Matsushita T, Araki D, Kida A, Takiguchi K, Shibata Y, Ono K, Ono R, Matsumoto T, Takayama K, Sakai Y, Kurosaka M, Kuroda R (2017) Factors affecting quadriceps strengthrecovery after anterior cruciate ligament reconstruction with hamstring autografts in athletes. Knee Surg Sports Traumatol Arthrosc 25:3213–3219

14. Sonnery-Cottet B, Saithna A, Quelard B, Daggett M, Borade A, Ouanezar H, Thaunat M, Blakeney WG (2019) Arthrogenic muscle inhibition after ACL reconstruction: a scoping review of the efficacy of interventions. Br J Sports Med 53:289–298