Remnant Preservation and Its Effects on Cyclops Lesions and Postoperative Knee Instability in Anterior Cruciate Ligament Reconstruction: A Propensity Score-Matched Study

Ota K[1], Nozaki M[1], Fukushima H[1], Hanaki S[1], Abe K[1], Kobayashi M[2], Kawanishi Y[3], Kato J[4], Murakami H[1]

[1] Nagoya City University Department of Orthopedic Surgery, Nagoya, Japan
[2] Nagoya City University Midori Municipal Hospital, Nagoya, Japan
[3] Ogaki Municipal Hospital, Ogaki, Japan
[4] Kasugai Municipal Hospital, Kasugai, Japan

Faulty Disclosure Information

Nothing to disclosure

Introduction

- **Remnant preservation during ACLR**

  Revascularization ⇑ ⇒ Graft synovial coverage ⇑

  Wang H.D, et al. J Orthop Surg Res. 2018

- **Unclear points**

  ✓ **Incidence of cyclops lesions**

  McMahon PJ, et al. Arthroscopy. 1999
  Kambhampati SBS, et al. Orthop J Sports Med. 2020

  ✓ **Postoperative knee instability**

  Wang H, et al. Biomed Res Int. 2019
  Allende F, et al. Am J Sports Med. 2024

Purpose

To evaluate the effect of remnant preservation during ACLR

✓ **Incidence of cyclops lesions**

✓ **Postoperative knee instability**

Materials and Methods

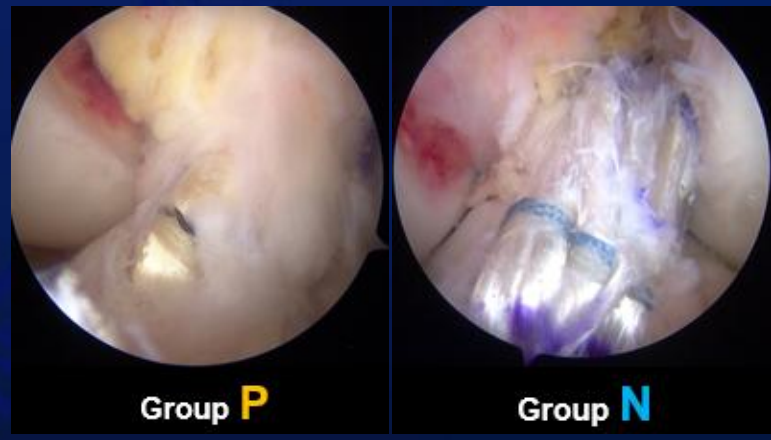
494 Primary double-bundle ACLR (2016.6-2023.4)

Exclusion
- Other ligament injury
- Contralateral knee injury
- No quantitative evaluation
- No 2nd look arthroscopy

164 2nd look arthroscopy

Group P (n=119)
Remnant-preserving ACLR

Group N (n=45)
Remnant non-preserving ACLR



Propensity score matching ➡ Group P, N (n=29)

Evaluation

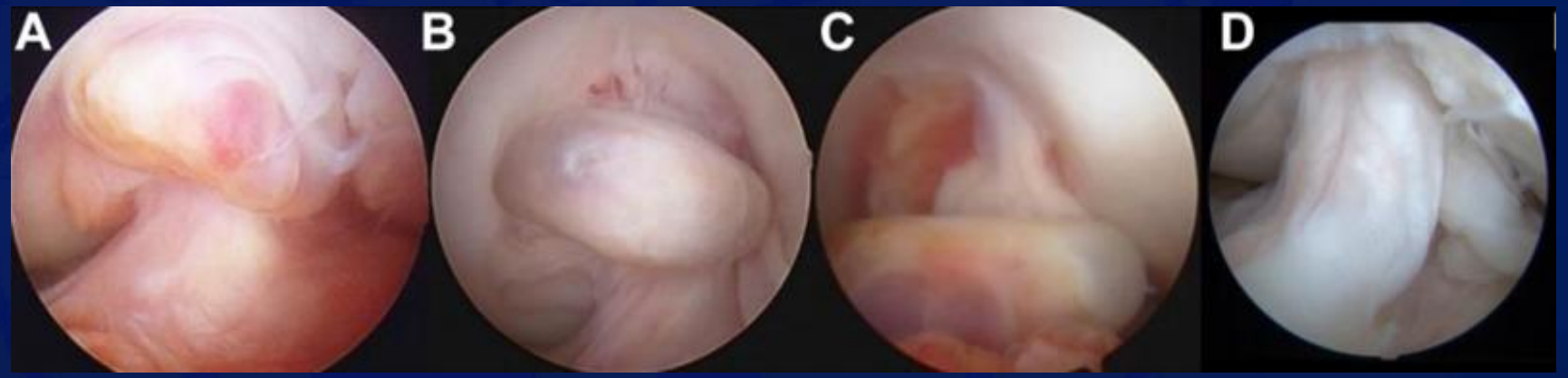
- **2nd look arthroscopic findings**
  - Incidence of **Cyclops lesions** and **Cyclops syndrome**
  - Graft synovial coverage : **Graft score**
- **Knee instability**
  - **Anterior tibial translation (ATT)** (Rolimeter)
  - **Pivot shift test** Subjective evaluation：IKDC grading
    Quantitative evaluation (Inertial sensor)
- **Statistical analysis**
  - Student's t-test, Mann-Whitney U test, Fisher's exact test
  - Statistical significance was defined as $P < 0.05$

Cyclops lesion

✓ **Defined as nodule of fibrovascular tissue around the ACL graft whose size was >5 mm in long diameter**

McMahon PJ, et al. Arthroscopy. 1999
Kambhampati SBS, et al. Orthop J Sports Med. 2020

✓ **Location**



Hishimura R, et al. Orthop J Sports Med. 2022

(A) Type 1: femoral side (B) Type 2: midsubstance (C) Type 3: tibial side (D)Type 4: anterior

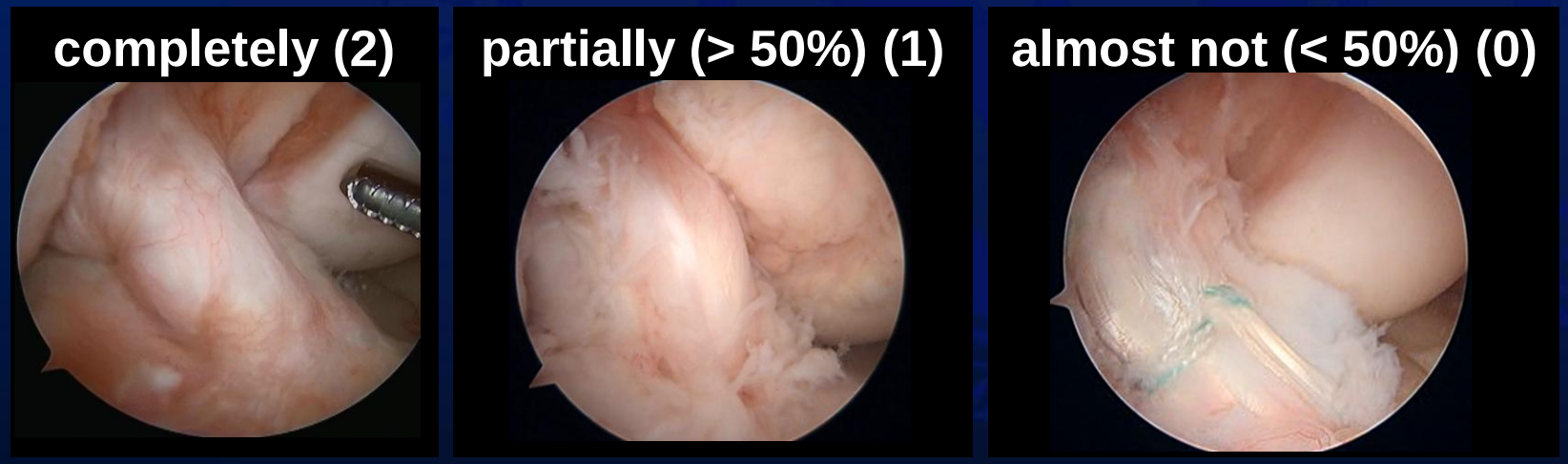
✓ **Cyclops syndrome :**
defined as a cyclops lesion with extension limitation (≧5°)

Jackson DW, et al. Arthroscopy. 1990

Graft score (2nd look arthroscopy)

✓ **Overall ACL findings (point)** *Kondo E, et al. Am J Sports Med. 2015*

✓ **Synovial coverage (point)：AMB, PLB** *Ochi M, et al. Arthroscopy. 2006*



ACL findings: **0-2** points
+
AMB: **0-2** points
+
PLB: **0-2** points

⬇

Graft score : 0-6 points

Knee Instability Assessment

※Under general anesthesia

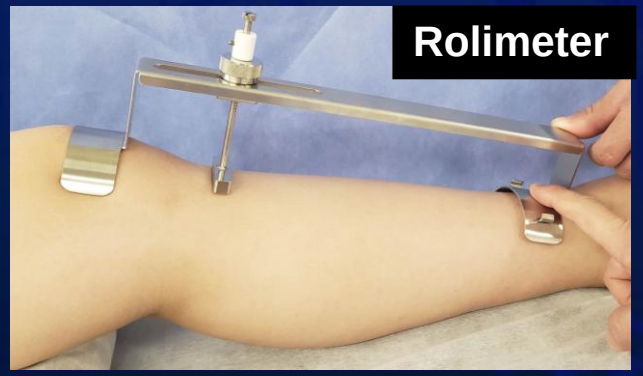
- ✓ **ATT (Rolimeter)** (SSD:side-to-side difference)
- ✓ **Pivot shift test**
  - **Subjective evaluation : IKDC grade (0-3)**
  - **Quantitative evaluation** (**Inertial sensor**) (SSR:side-to-side ratio)

Murase A, Nozaki M, et al. JOS 2017

① Acceleration (m/s^2)

② External rotational angular velocity (ERAV) (deg/s)

Aircast
DJO Global



MicroStone
Corporation

① Acceleration(m/s^2)
② ERAV(deg/s)

Result ①

Patient background

	Group P (n=29)	Group N (n=29)	P value
Sex (F:M)	19:10	19:10	1.000
Age (years)	23.5 ± 10.7	27.9 ± 15.3	0.213
BMI (kg/m^2)	21.7 ± 3.2	22.3 ± 2.7	0.439
Tegner activity scale	7.0 ± 1.9	6.4 ± 2.2	0.236
Time from injury to surgery (mo)	4.0 [2.0, 8.0]	2.0 [2.0, 5.7]	0.867
Time from surgery to 2nd look surgery (mo)	17.0 [14.0, 24.0]	18.0 [14.0, 22.0]	0.425
ATT (mm) (SSD)	5.5 ± 1.4	5.6 ± 3.1	0.879
Pivot shift grade (0, 1, 2, 3)	0:1:23:5	0:5:21:3	0.225
Acceleration (m/s^2) (SSR)	5.5 ± 2.6	5.6 ± 1.9	0.650
ERAV (deg/s) (SSR)	3.5 ± 1.6	3.8 ± 2.1	0.236
No. of patients with meniscus injury (n)	21	24	0.530
No. of patients with meniscus repair (n)	20	23	0.550

✓ No difference in each groups

Result ②

➢ 2nd look arthroscopic findings

	Group P (n=29)	Group N (n=29)	P value
Cyclops lesion(%)	4(13.8)	4(13.8)	1.000
Type 1, 2, 3, 4 (n)	2, 2, 0, 0	2, 1, 0, 0	
Cyclops syndrome(%)	0(0.0)	2(6.9)	.491
Graft score	5.0 ± 1.3	4.2±1.7	.064

No difference in each groups

✓ **Group P** showed the tendency for better **Graft score** (*P* = .064)

➢ Postoperative Knee Instability

	Group P (n=29)	Group N (n=29)	P value
ATT(mm) (SSD)	1.2 ± 0.8	1.5 ± 1.5	1.000
Residual pivot shift rate(%)	44.8	27.6	.274
Acceleration(m/s^2)(SSR)	1.8 ± 0.9	1.6 ± 0.9	.423
ERAV(deg/s)(SSR)	1.9 ± 1.3	2.1 ± 1.4	.762

No difference in each groups

Discussion

- **Remnant-preserving vs non-preserving ACLR**
  - ✓ Cyclops lesions：no difference (14.5% vs 17.4%) — *Kondo E, et al. Am J Sports Med. 2015*
  - ✓ Cyclops syndrome： no difference (12.0% vs 4.0%) — *Nakayama H, et al. The Knee. 2017*
  - ✓ ATT ⇓ (0.51 mm (*P* = .004))
  - ✓ Negative pivot shift rate : 88% vs 79% (*P*= .006) — *Allende F, et al. Am J Sports Med. 2024 (Systematic review and Meta-analysis)*

- **This study**
  - ✓ **Remnant preservation** did <u>not significantly</u> affect
    - Incidence of **cyclops lesions**(13.8% vs 13.8%) , **cyclops syndrome** (0% vs 6.9%)
    - **Postoperative knee instability**
  - ✓ showed the tendency for better **graft quality (Graft score: *P* = .064)**

  ➡ **This finding supports the usefulness of remnant preservation**

Conclusions

- **Remnant preservation during ACLR**
  - ✓ **Possibility of enhanced graft synovial coverage**
  - ✓ **No impact on postoperative knee instability, the incidence of cyclops lesions and cyclops syndrome**