Lateral Meniscus Centralization Restores the Residual Instability after Anterior Cruciate Ligament Reconstruction

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I have no financial conflicts to disclose.
Residual Rotational Instability after ACLR

- Worsening functional outcomes  
  Ayeni OR, KSSTA 2012
- Patient dissatisfaction  
  Kocher MS, JBJS Am 2002
- Development of osteoarthritis  

ACL and Lateral Meniscus

- LM dysfunction causes positive pivot shift of the knee after ACLR  
  Musahl V et al. AJSM 2010
- It should be treated concomitantly.

Irreparable Lateral Meniscus disorder

- Degenerative tear, post-meniscectomy, massive defect
- Loss of hoop function
- Loosening of lateral capsule  
  Kijowski et al. Radiology 2011
- Accelerate the osteoarthritis  
  Lee et al., KSSTA 2011
- Exacerbate the knee stability  
  Minami, Koga et al. KSSTA 2017
Background

Restoring function of the meniscus

- **Arthroscopic Centralization**
  - Re-tightening the mid-lateral capsule
  - Returning the middle segment of LM to the correct position

Purpose

Study the effect of lateral meniscus centralization on ACLR knee stability in human.

Hypothesis

LM centralization restores the stability of ACLR knees with massive LM defect.
Massive LM defect model

LM centralization

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Defect gap 20% of LM AP length

Method

Arthroscopic

Macroscopic
**Method**

- **Specimen**: human cadaveric knee, n=10, 45.0±17.7 y.o.
- **Protocol**
  - **ACL**
    - Intact
    - SB-Reconstruction
  - **LM**
    - Intact
    - Defect
    - Centralized

- **Robotic testing (6 degree of freedom)**
  - ATT (89N; 0°, 15°, 30°, 60°, 90°)
  - ER/IR (5Nm; 0°, 30°), valgus/varus (7Nm; 0°, 30°)
  - **Simulated Pivot-Shift** (7Nm valgus + 5Nm IR; 0°, 15°, 30°)
Results

LM centralization restores ATT in lower knee flexion angles
Results

Simulated pivot shift is significantly restored after LM centralization.
Results

No obvious effect for other kinematics
Discussion

- LM centralization accompanied with ACLR
  - significantly restores the simulated pivot shift
  - significantly improves ATT at lower flexion angles

- Non-contact ACL injury mechanisms
  - Quadriceps drawer
  - IR of tibia
  - Valgus with IR (Pivot shift)
  - Valgus with ER

  Controlling the knee rotation is a critical factor for ACL injury

LM centralization can help to suppress excessive rotational moment

The hypothesis was validated

Video analysis of non-contact ACL injury

Koga et al. AJSM 2010

ACL is torn during a valgus and IR moment at initial ground contact, and external rotation occurs after the injury
Discussion

Arthroscopic Centralization

Treatment for meniscus extrusion
Avoiding OA
Cartilage regeneration
Low invasive
Using remaining tissue

Ozeki et al. JOS 2017
Koga et al. Arthroscopy 2016

New benefit

Treatment for ACL + LM patients
Secondary rotational stabilizer for ACLR knee

This study adds the benefit of Arthroscopic Centralization
Limitations

- Time zero study
  - Long term effect should be confirmed by clinical study
- Over constraint?
  - Spontaneous adjustment will be expected in long term
  - No ROM limitation has been reported in 2-year outcome

**References**


**Conclusion**

Concomitant ACLR and LM centralization can restore the anterior and rotational knee stability.

LM centralization can prevent not only OA progression but also residual rotational instability.