The Biomechanical Effect of **ALL Reconstruction Augmented to ACL Reconstruction on ACL Deficient Knee with Gross Instability**

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I have no financial conflicts to disclose.
Residual pivot shift: 8~25% \(^1\) \(^2\) in post-ACL reconstruction (ACLR)

Greater preoperative pivot shift (gross instability)
⇒ The risk of residual pivot shift \(^3\)

Anterolateral ligament (ALL)
✓ Secondary stabilizer to the ACL \(^4\)
✓ High-grade pivot shift
⇒ Higher prevalence of ALL injury \(^5\)

Effectiveness: ACLR + ALLR \(^6\) \(^7\)

Purpose: To evaluate the biomechanical effect of augmented ALLR to ACLR in ACL deficient knee with gross instability
Materials & Methods

<Subjects>
✓ ACL injury + pivot shift grade 3 (IKDC criteria)
✓ ACL + ALL reconstruction

= 26 knees (2016.8~2019.2)

Inclusion: 13 knees (8 male, 5 female, mean age: 28.5)

Exclusion
- BPTB graft: 7
- Revision surgery: 5
- Lack of measurements: 4
- Single-bundle hamstring graft: 3
- Other ligament reconstruction: 2

<Measurements>
✓ Lachman test
  ① Anterior tibial translation (ATT;mm)

✓ Pivot shift test
  ② Acceleration (m/s²)
  ③ External rotational (ER) angular velocity (deg./s)

Rolimeter®
Inertial sensor
① ATT (mm)
② Acceleration (m/s²)
③ ER angular velocity (deg./s)

【Intact】・・・・ Contralateral knee pre-op.
【ACLD】・・・・ ACL-deficient knee pre-op.
【ACLR】・・・・ after ACLR intra-op.
【ACLR+ALLR】・・ after ACLR and ALLR intra-op.

⇒measured at each phase

Temporary graft fixation
Quantitative evaluation of pivot shift test using inertial sensor

Inertial sensor
tri-axial accelerometer + tri-axial gyroscope
MVP-RF8-HC®
(MicroStone Corporation, Japan)

✓ The cutaneous inertial sensor can be useful for quantitative assessment of rotational knee instability

② Acceleration
③ ER angular velocity
in pivot shift test

Reduction phase in pivot shift test

Statistical analysis
✓ Repeated measures ANOVA
   Holm post hoc
✓ Significant difference: p<0.05
Surgical Procedure

✅ **ACLR**
- Graft: Semitendinosus tendon autograft
- Anatomical double-bundle reconstruction

✅ **ALLR**
- Graft: Gracilis tendon autograft, 2strand
- Tibial tunnel: the middle point 【Gerdy tubercle - Fibula head】
- Femoral tunnel: posterior/proximal to Lateral epicondyle
- Fixation: 30° flexion, neutral rotation, 20N interference screw
**Results**

1. **ATT (mm)**
   - ACLR ⇒ Improved (*Over constrained*)
   - ACLR+ALLR ⇒ No change

2. **Acceleration (m/s²)**
   - ACLR ⇒ Improved (*Intact level*)
   - ACLR+ALLR ⇒ No change

3. **ER angular velocity (deg./s)**
   - ACLR ⇒ Improved (not *Intact level*)
   - ACLR+ALLR ⇒ Improved (*Intact level*)
The ratio to Intact

②Acceleration (m/s²)

● Acceleration
ACLR+ALLR ⇒ No change

③ER angular velocity (deg./s)

● ER angular velocity
ACLR+ALLR ⇒ Improved
ACL + ALLR

✓ Inclusion: pivoting sports + younger age (16-30y)\textsuperscript{12}
  Graft failure rate ↓ [ACL + ALLR < ACLR]

✓ Inclusion: reinjury risk [≥1]\textsuperscript{13}
  (segond fx, chronic, pivot shift grade 3, high activity,
   pivoting sports, lateral femoral notch sign)
  ACLR + ALLR follow-up > 2y no specific complications

◇ This study: pivot shift grade 3 (intraoperative evaluation)

● ATT, Acceleration:
  Isolated ACLR ⇒ Improved (Intact level)

● ER angular velocity:
  Isolated ACLR ⇒ Improved (not Intact level)
  ACLR + ALLR ⇒ Improved (Intact level)
Tibial rotation during pivot shift

- **ALL-cut** in ACLD $\Rightarrow$ **internal tibial rotation** $\uparrow$
- ACLD + **ALL-cut** states
  - **ACLR** $\Rightarrow$ residual instability
  - **ACLR+ALLR** $\Rightarrow$ improve instability

**Function of ALL**

$\Rightarrow$ Stabilizing internal tibial rotation

**Discussion**

This study: **Augmented ALLR**

$\Rightarrow$ Reduction ER angular velocity

$\Leftarrow$ Stabilizing internal tibial rotation by ALLR

Rotational angular velocity $\approx$ Tibial rotation

Tibial rotation

Integration

Strong correlation
In ACLD knees with grade 3 pivot shift, after ACLR+ALLR, ER angular velocity was improved to Intact level.

Augmented ALLR contributed to a significant stabilizing effect for internal tibial rotation in ACLD knees with gross instability.
References