The Role of Lateral Meniscus and Anterolateral Structure Injury on Rotatory Laxity in the Anterior Cruciate Ligament Deficient Knee

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Declaration of Interest

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COI Disclosure Information
Presenter: Munehiro Ogawa

I have no financial conflicts to disclose.
Introduction

- Anterior cruciate ligament (ACL) reconstruction is largely thought of as a successful procedure
  - Yasuda K et al. Arthroscopy 2004, 2006
- Meniscus and anterolateral structure (ALS) as a secondary restraint of patients with ACL injury is currently debated
  - unrepaired secondary stabilizers may be a cause for reconstruction failure.
    - Bedi A et al Knee Surg Sports Traumatol Arthrosc 2010
    - Sonnery-Cottet B et al Arthroscopy 2016
    - Claes S et al. J Anat 2013
- Residual pivot-shift after ACL reconstruction
  - 11～30%
  - crucial factor related to poor clinical outcome.
    - van Eck CF et al. Arthroscopy 2012
    - Ferreti A et al. Arthroscopy 2017
Introduction

- The pivot-shift test
  - identified as an important clinical examination
  - to assess dynamic rotatory knee laxity in anterior cruciate ligament (ACL) insufficient knee.
- However, this test is evaluated by examiners subjectively,
  - there has still not been an established quantitative evaluation
    - Electromagnetic tracking system
    - Navigation
      - Ishibashi Y et al. Arthroscopy 2009
- We developed a newly developed non-invasive measurement system
  - non-invasive
  - easy to handle measuring system
    - Inertial Sensor (Triaxial Accelerometer)
The purposes of this study

• To investigate the influence of concomitant lateral meniscus (LM) and ALS injuries on rotatory knee laxity in ACL deficient knee.
Material & Methods

• 6 cadaveric knees
  • No OA and history of knee injury
  • Whole body cadaver

• The rotatory laxity was quantified in different conditions of instability
  • ACL intact (Control)
  • Dissection of the ACL (A1)
  • ACL+LM (A2)
    • LM root cut arthroscopically
  • ACL+LM+ALS (A3)
    • Joint line level
      • Monaco E et al Knee Surg Sports Traumatol Arthrosc 2012
Material & Methods

• Evaluation
  • The standardized pivot-shift test was performed
  • The peak acceleration values during the pivot-shift test were measured
  • The pivot-shift test was also graded subjectively on the scale of 0–3 based on the IKDC criteria.
  • The relationship between quantitative values and grade of the pivot-shift test
Results 1

- The A1, A2 and A3 showed significant higher mean acceleration values than the control intact knees.
- The pivot shift was undetectable (grade 0) in all knees with control.
- A1 continued to be minor (grade 1) on the pivot shift with all six knees.
- A2 and A3 resulted in an increase in the grade of the pivot shift.
- High-grade rotatory knee laxity (pivot shift grade 2 to 3) were 0%, 66% and 83% in the conditions of A1, A2 and A3, respectively.

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**The A1, A2 and A3 showed significant higher mean acceleration values than the control intact knees.**
**The pivot shift was undetectable (grade 0) in all knees with control.**
**A1 continued to be minor (grade 1) on the pivot shift with all six knees.**
**A2 and A3 resulted in an increase in the grade of the pivot shift,**
**High-grade rotatory knee laxity (pivot shift grade 2 to 3) were 0%, 66% and 83% in the conditions of A1, A2 and A3, respectively.**

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**High grade Pivot Shift (Grade II or III)**

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* * * P<0.01
* * P<0.05

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<table>
<thead>
<tr>
<th>Control</th>
<th>ACL Cut</th>
<th>ACL+LM Cut</th>
<th>ACL+LM+ALS Cut</th>
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<tbody>
<tr>
<td>G1(6)</td>
<td>G1(2)G2(4)</td>
<td>G1(1)G2(2)G3(3)</td>
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</tbody>
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The relationship between quantitative values and grade of the pivot-shift test

- A moderate correlation between the peak acceleration values and grade of the pivot-shift test
- The subjective grading of the pivot-shift test correlated with objective quantification.

\[ rs = 0.69, \ p < 0.01 \]
Discussion

• We investigated the influence of concomitant LM and ALS on rotatory knee laxity in ACL deficient knee in cadaver
• The present study has demonstrated that a newly developed non-invasive measurement system using inertial sensors was able to objectively identify and quantitatively assess the pivot shift phenomenon
• High-grade rotatory knee laxity (pivot shift grade 2 to 3) were the result of these concomitant injuries in ACL deficient knee.
• the subjective grading of the pivot shift test correlated with objective quantification.
Limitation

- This system may be useful for quantitative assessment of the pivot shift test.

- Validity of this device
  - Fixation of this device in the skin
  - Interobserver ICC(2,3)=0.79  (95%CI: 0.16-0.95)
  - Intraobserver ICC(1,3)=0.89  (95%CI: 0.71-0.96)

- Cadaveric cutting study
  - The role of this structure by its transection.
  - It is unclear how closely this mimics knee injuries encountered in clinical settings

- Further research is needed to develop clinical relevance of the quantitative pivot shift measurements system.
Conclusions

• The findings of this study demonstrated that an ACL injury associated with LM and ALS may predispose the knee to higher rotatory laxity.

• Careful assessment and proper treatment of injuries to these secondary stabilizers should be considered,
  • especially in knees with a high grade of the pivot-shift.


