Bicruciate lesion biomechanics – Treatment using a simultaneous tensioning protocol: ACL fixation first is better than PCL fixation first to restore tibiofemoral orientation

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Introduction

Bicruciate Lesion (PCL + ACL) Surgical Treatment:

• Two stages: PCL first followed by ACL

  Manual knee reduction to the normal step-off position

  Levy et al., 2009
  Fanelli et al. 2010
  Schenck et al., 2014

OR

• One stage: PCL fixation at flexion followed by ACL fixation at extension

  Manual knee reduction to the normal step-off position

  Zhao et al., 2006
  Strobel et al., 2006
  Hirschmann et al., 2010

  Piontek et al., 2013
  Denti et al., 2015
  Panigrahi et al., 2016
  Moatshe et al., 2018
Introduction

Bicruciate Lesion (PCL + ACL) Surgical Treatment:

- One stage: PCL fixation at flexion → ACL fixation at extension

<table>
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<tr>
<th>Posterior subluxation</th>
<th>Posterior drawer</th>
<th>Manual reduction</th>
<th>Overcorrection</th>
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Manual knee reduction to the normal step-off position

RISK OF OVERCORRECTION
Introduction

Simultaneous Tensioning:

• **Simultaneous tensioning** for tibial reduction: “checkrein” to avoid overcorrection

- PCL fixation first at flexion  →  ACL at extension
  - OR

- ACL fixation first at extension  →  PCL at flexion

Knee at extension is more stable than at flexion

Screw home position

Tensioned capsule

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Wascher et al., 1999
Mariani et al., 2001
Hayashi et al., 2008
Kim et al., 2014
De Carvalho et al., 2018
Objective

To compare tibiofemoral biomechanics between ACL graft fixation first and PCL graft fixation first in a simultaneous tensioning protocol for bicruciate ligament reconstruction.
Methods

- Experimental therapeutic study (Level V)
- Twelve cadaveric knees (six matched pairs)
- Data acquisition: 3D digitizing system - Microscribe 3DLX
- Custom testing system: 6 degrees of freedom
- Sample size: power 0.8; alpha 0.05
Methods

• Evaluation at 0°, 30°, 60° e 90° flexion
• Parameters: Neutral Tibial Position, AP translation, Varus/Valgus, External Rotation/Internal Rotation

Normal Knee (n=12)

Bicruciate Lesion (n=12)

Bicruciate Reconstruction (n=12)

PCL Fixation First (n=6)  
ACL Fixation First (n=6)

T: Biomechanical tests
Methods

• ACL: quadruple hamstrings – fixation always at extension
• PCL: quadriceps – fixation always at 90° (single bundle)
• Fixation: Interference Screw (post and washer added for PCL)
Results

- Statistical significant difference at 90° favoring ACL First
- CLINICALLY significant (around 5mm)
Results

- Statistical significant difference at 30°
- NOT CLINICALLY significant (1-2mm)
- No differences: Varus / Valgus; External / Internal Rotation

![Graph showing % Decrease AP Translation](image)

- ACL Fixation First
- PCL Fixation First

* P<0.05
Conclusion

Bicruciate ligament reconstruction using a simultaneous tensioning protocol with ACL fixation first, at full extension, resulted in a closer to normal tibiofemoral orientation.

This protocol may lead to superior results in comparison to the “gold-standard” PCL fixation first tightening sequence in the clinical setting.
References

- Zhao, J., Y. He, and J. Wang. 2006. 'Simultaneous arthroscopic reconstruction of the anterior and posterior cruciate ligaments with autogenous hamstring tendons', Arthroscopy, 22: 497-504.

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