3d advanced course on knee surgery
Val d'Isère 2010

Focus on knee rotation.

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Definition

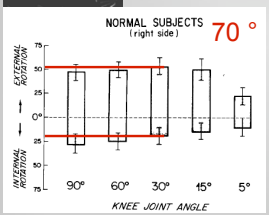
Anatomy:

- Which structures are responsible for knee rotation ?

Quantification:

- Are we able to quantifiy knee rotation ?
- How big is knee rotation ?
- How variable is knee rotation under physiologic and pathologic conditions ?
- Are we able to restore it after injury ?

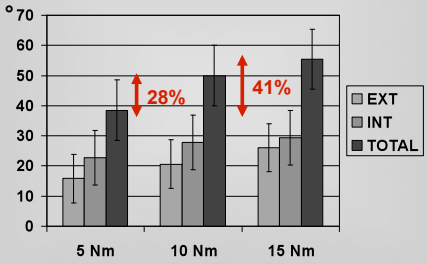
Rotational laxity



- Complex setting
- Low side-to-side variability
- High inter-subject variability
- Total rotation (int. + ext.) most reliable
- Definition of starting point difficult
- Force couple ?

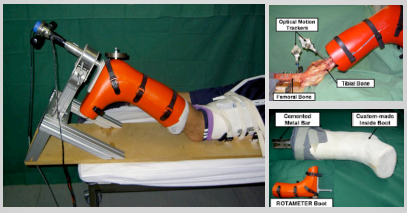
Zarins B 1984

Physiologic rotation (30 ° flexion)



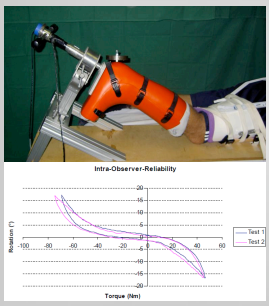
Lorbach O, AJSM, accepted for publication

Physiologic rotation (30 ° flexion)



Lorbach O, AJSM, accepted for publication

Rotational laxity

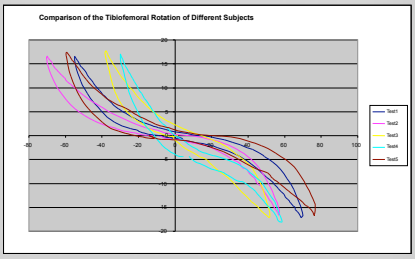


Low inter and intraobserver Variability

Low side-to-side variability

Lorbach O, KSSTA 2009

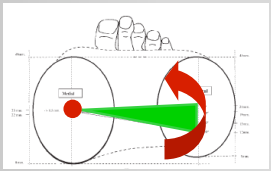
Rotational laxity



High interindividual variations.

Lorbach O, KSSTA 2009

Medial vs. lateral compartment



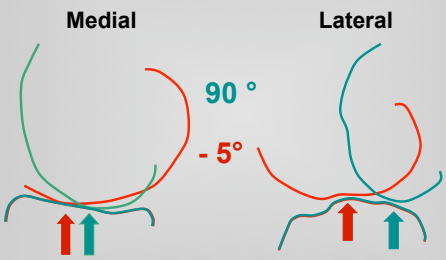
Tibiofemoral contact points
between 0 ° and 90 °
Of knee flexion

Medial tibiofemal
compartment
=
stability

Lateral tibiofemoral
compartment
=
mobility

Logan M 2004

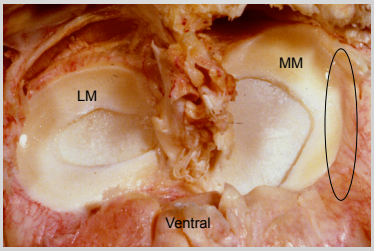
Medial vs. lateral compartment



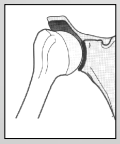
Tibiofemoral contact point

Pinskerova V 2004

Medial vs. lateral compartment



Medial vs. lateral compartment



From: Matsen FA Practical evaluation and management of the shoulder. WB Saunders, 1994

Medial tibiofemoral
compartment
=
bony guidance

Lateral tibiofemoral
compartment
=
capsuloligamentous
guidance

Logan M 2004

Medial vs. lateral compartment

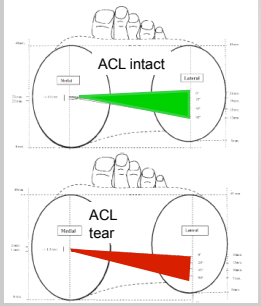
CONCLUSION:

Static stability
+
Dynamic stability

⬇

Rotation occurs in the lateral compartment

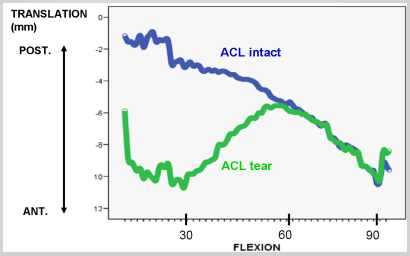
The „central pivot“ ACL injury



- Tibiofemoral contact points:
  Medial: unchanged
  Lateral: more dorsal
- ↑ ventral translation and internal rotation of the tibia under the femur.

Logan M 2004

The „central pivot“ ACL injury

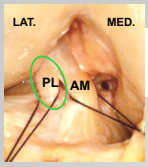


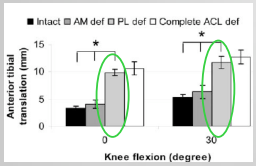
Potel JF. ESSKA 2008

The „central pivot“ ACL injury

[redacted]

The „central pivot“ ACL injury



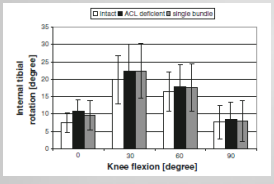


Between 0 and 30 ° of flexion PL bundle is main stabilizer against internal rotation and anterior tibial translation.

Valgus: 10 Nm
Internal rotation: 4 Nm

Zantop T 2007

The „central pivot“ ACL injury

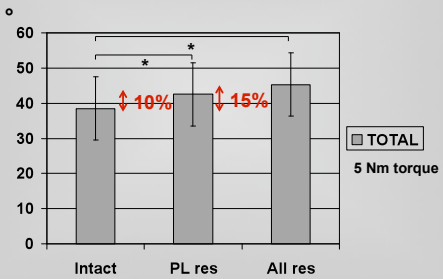


ACL deficiency does not increase the internal tibial rotation under a simulated pivot shift test.

Valgus: 10 Nm
Internal rotation: 4 Nm

Diermann N 2009

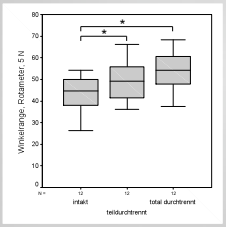
Pathologic rotation (30 ° flexion)



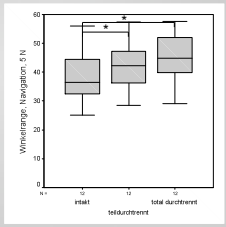
Lorbach O, AJSM, accepted for publication

Rotational laxity

Total rotation (Rotameter)



Total rotation (Navigation)

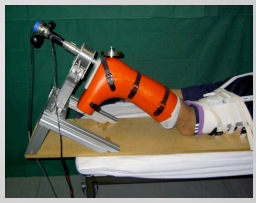


Lorbach O, accepted for publication

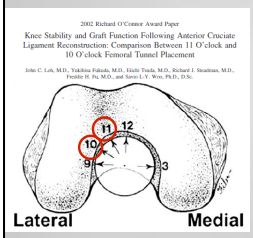
Pathologic rotation

Associated injuries ?

In vivo measurements ?



The „central pivot“ ACL reconstruction



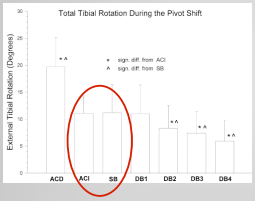
Single-bundle ACL reconstructions.

Horizontal femoral tunnel-placement improves restoration of tibiofemoral rotation.

None of the techniques restores knee laxity to normal.

Loh JC, 2003

The „central pivot“ ACL reconstruction



External tibial rotation

Single-bundle ACL-reco sufficient to normalize knee kinematics.

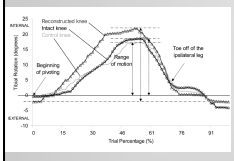
Excessive tension of PL bundle can lead to overcorrections.

Question the sense of double-bundle reconstructions.

Markolf K 2008

The „central pivot“ Knee kinematics after ACL reconstruction

Kinematics not restored

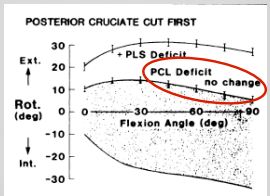


- Tibial rotation restored after ACL-reco during normal gait
- Abnormally increased tibial rotation during pivoting motions & load-bearing
- No difference between grafts
- Single bundle technique
- Surgery 5-10 months after injury

Georgoulis A 2003, 2006, 2007
Ristanis S 2003 & 2006
Stergiou N 2007, Tsepis E 2006
Chouliaras V 2007

The „central pivot“ PCL

External rotation



5 Nm torque

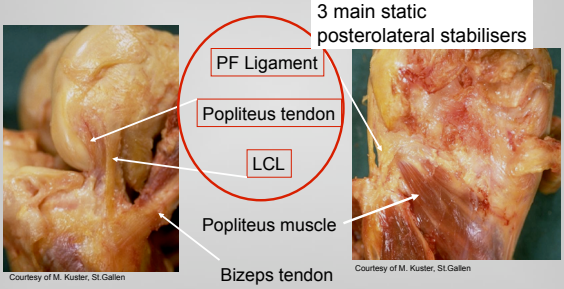
Grood ES, JBJS-A, 1988

The „central pivot“ PCL

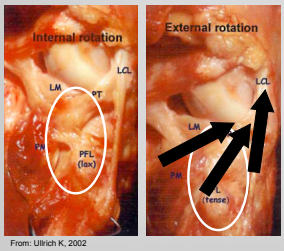
The isolated rupture of the posterior cruciate ligament (PCL) is in many cases symptom free, as it only results in posterior translation of tibia and no rotational instability.

Krogsgaard M, 2007

Posterolateral structures



Posterolateral structures



From: Ullrich K, 2002

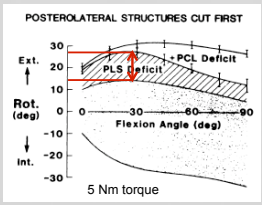
Popliteofibular ligament:

Loose in internal rotation

Tight in external rotation

Anatomy & biomechanics
Isolated PLS lesion

External rotation



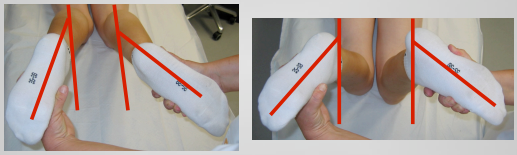
5 Nm torque

13 (5) ° at 30° knee flexion
(33 % increase)

Grood ES, JBJS-A, 1988

PLS: clinical evaluation
Dial test

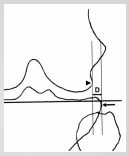
30° 90°



5° gr. I
10° gr. II
15° gr. III

Cooper DE, JBJS-A, 1991

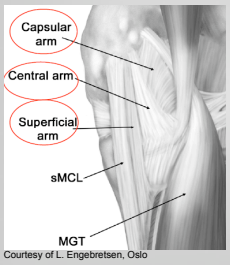
PLS: Stress x-rays
Radiologic dial test



D (mm)	
N	2,1
PCL	3,9
PLS	17,0*

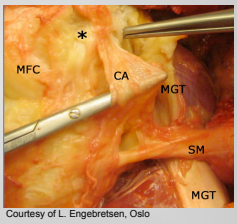
Chang CB, JBJS-A 2007

The periphery
Posteromedial structures



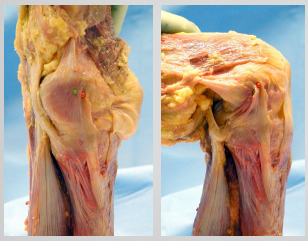
Courtesy of L. Engebretsen, Oslo

Posterior oblique ligament



Courtesy of L. Engebretsen, Oslo

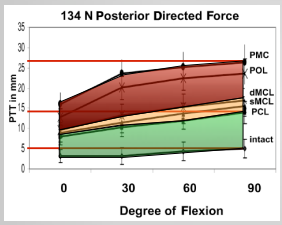
The periphery
Posteromedial structures


From: Wymenga A. Knee Anatomy for Orthopedic Surgeons - ESSKA, 2004

Tight in extension

Loose in flexion

The periphery
Posteromedial structures



POL injury doubles posterior laxity if associated with PCL tear.

Repair becomes necessary with combined postero-posteromedial injuries.

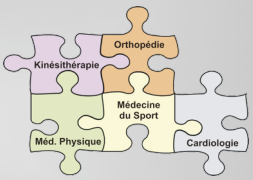
Rotation ?

Petersen W, 2008

Summary

Rotational laxity assessment:

- better characterization of individual knees / injuries
- role of specific knee structures
- improved treatment evaluation ?



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