

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:

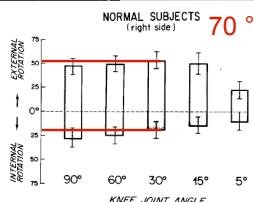
- Are we able to quantify knee rotation ?
- How big is knee rotation ?
- How variable is knee rotation under physiologic and pathologic conditions ?
- Are we able to restore it after injury ?

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Rotational laxity



NORMAL SUBJECTS (right side) 70 °

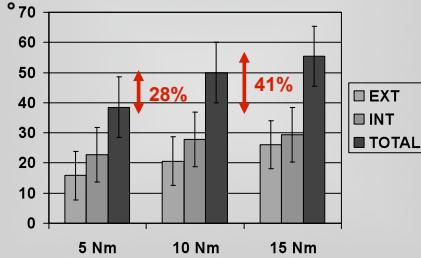


- Complex setting
- Low side-to-side variability
- High inter-subject variability
- Total rotation (int. + ext.) most reliable
- Definition of starting point difficult
- Force couple ?

Zarins B 1984

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Physiologic rotation (30 ° flexion)



Torque (Nm)	EXT (°)	INT (°)	TOTAL (°)
5 Nm	~15	~20	~38
10 Nm	~20	~25	~50
15 Nm	~25	~30	~55

28% increase from 5 Nm to 10 Nm
41% increase from 10 Nm to 15 Nm

Lorbach O, AJSM, accepted for publication

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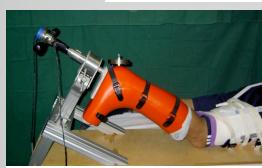
Physiologic rotation (30 ° flexion)



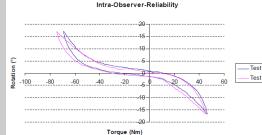
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Rotational laxity



Intra-Observer-Reliability



Low inter and intraobserver Variability

Low side-to-side variability

Lorbach O, KSSTA 2009

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The graph displays the range of tibiofemoral rotation for six different subjects. The x-axis represents knee flexion angle (from -40 to 100 degrees), and the y-axis represents rotation (from -20 to 20 degrees). Each subject's data is represented by a distinct colored line. The lines generally show a decrease in rotation as the knee flexes, with some subjects exhibiting more extreme lateral rotation than others at certain angles.

The diagram shows a cross-section of the knee joint with two circles representing the femur and tibia. A red dot at the center represents the center of rotation. A green arrow points from the center towards the left circle, indicating medial compartment contact. A red arrow points from the center towards the right circle, indicating lateral compartment contact. The text below the diagram specifies the contact points are between 0° and 90° of knee flexion.

Medial vs. lateral compartment

Medial tibiofemoral compartment = stability

Lateral tibiofemoral compartment = mobility

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

The diagram illustrates the Tibiofemoral contact point for medial and lateral compartments. It features two knee joint outlines. The left one, labeled 'Medial', shows a red contact line on the femur and tibia curving downwards from the top. A red arrow points upwards along this line, and a green double-headed arrow indicates its depth. The right one, labeled 'Lateral', shows a similar red contact line curving downwards, with a red arrow pointing upwards and a green double-headed arrow indicating depth. Between the two joints, a red circle contains the text '90 °' above '- 5 °', representing the range of motion.

The image shows a surgical dissection of a knee joint. The medial compartment is labeled 'LM' and the lateral compartment is labeled 'MM'. A black oval circle highlights a specific area on the lateral femoral epicondyle. The word 'Ventral' is written at the bottom left.

The diagram consists of two parts. The top part shows a lateral view of the knee joint with a circular marker indicating the medial tibiofemoral compartment. The bottom part shows a medial view of the knee joint with a circular marker indicating the lateral tibiofemoral compartment.

Medial vs. lateral compartment

Medial tibiofemoral compartment
=
bony guidance

Lateral tibiofemoral compartment
=
capsuloligamentous guidance

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

Logan M 2004

The slide features a title 'Medial vs. lateral compartment' at the top right, preceded by a vertical bar with three colored squares (blue, yellow, white). Below the title is a section titled 'CONCLUSION:' followed by a list of two items: 'Static stability' and 'Dynamic stability'. A large downward-pointing arrow is positioned between these two items. At the bottom left, the text 'Rotation occurs in the lateral compartment' is displayed.

Medial vs. lateral compartment

CONCLUSION:

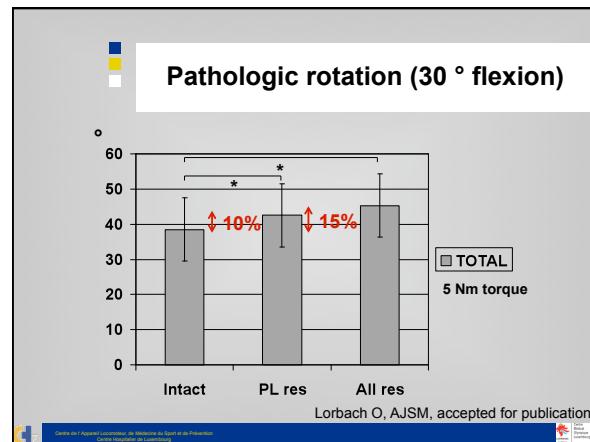
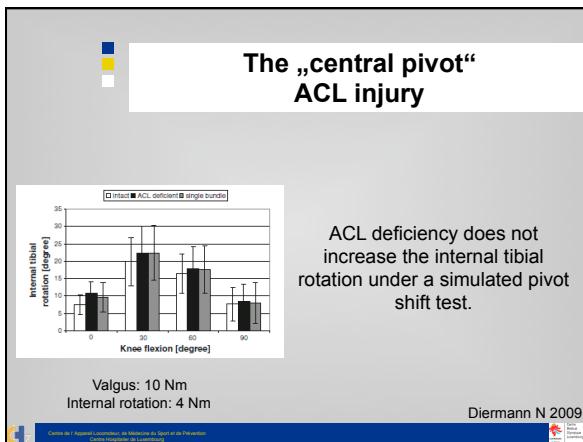
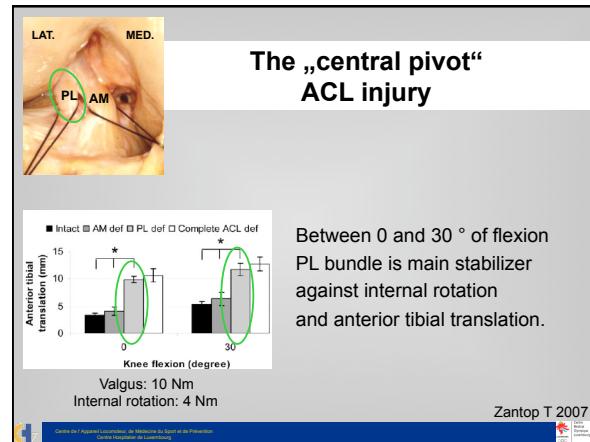
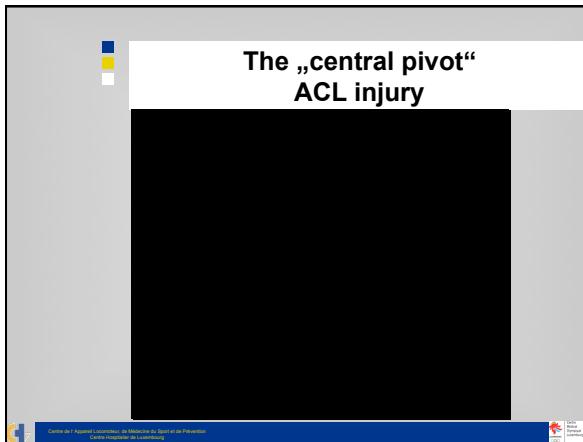
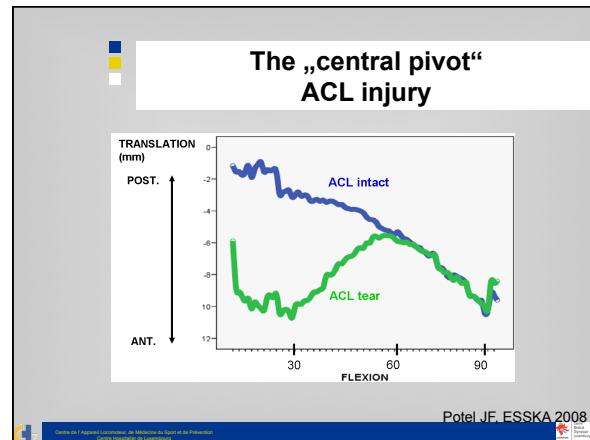
Static stability
+
Dynamic stability

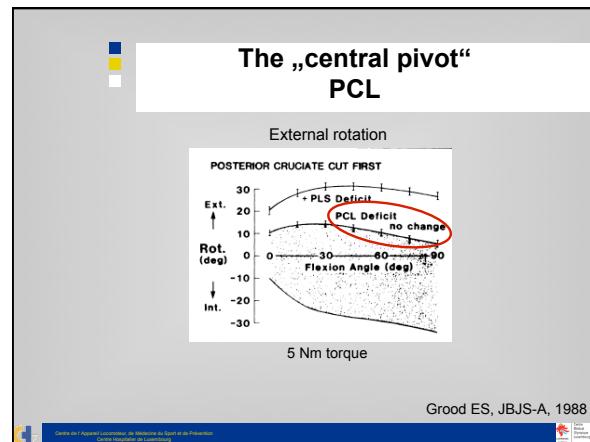
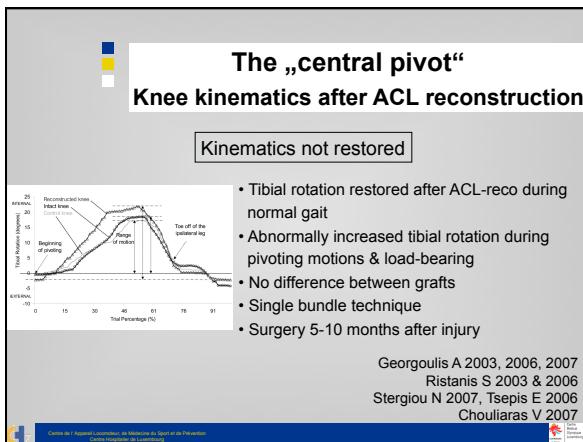
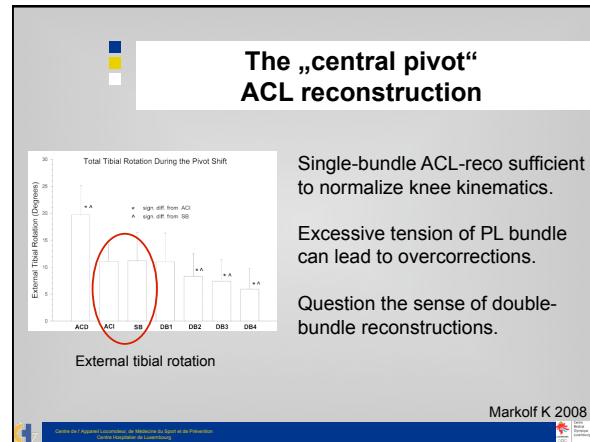
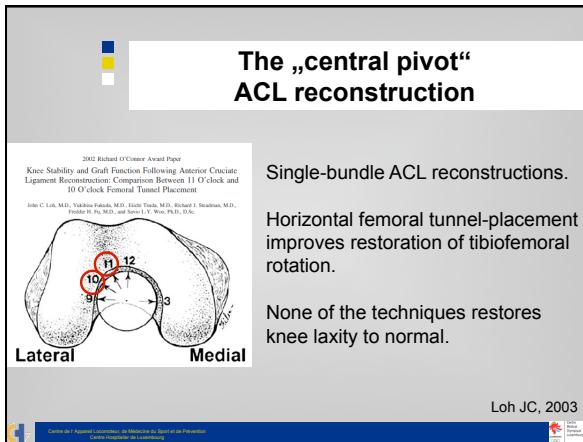
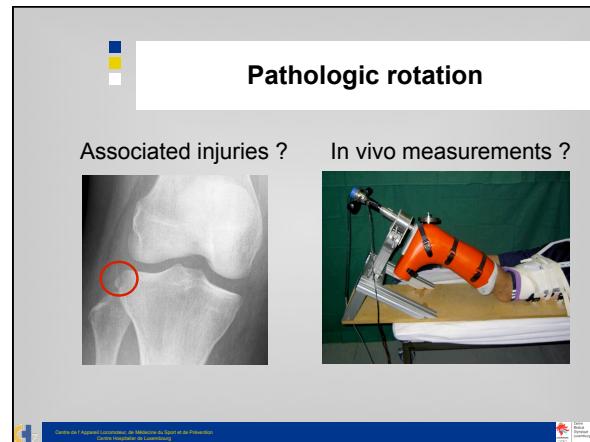
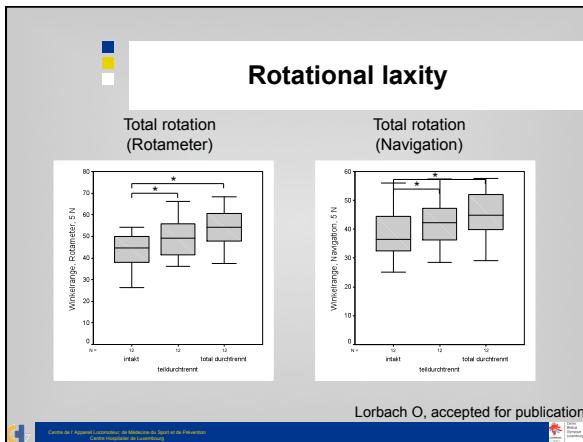
Rotation occurs in the lateral compartment

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

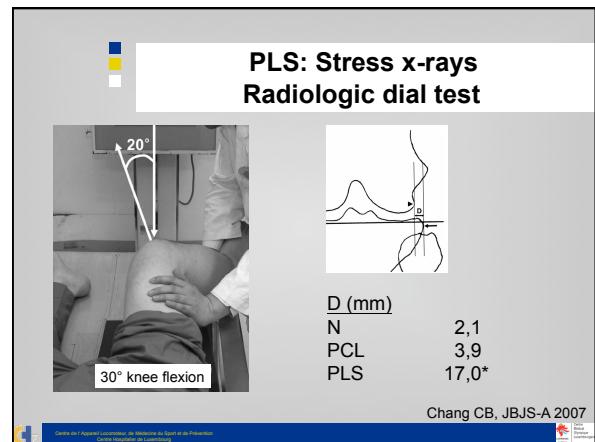
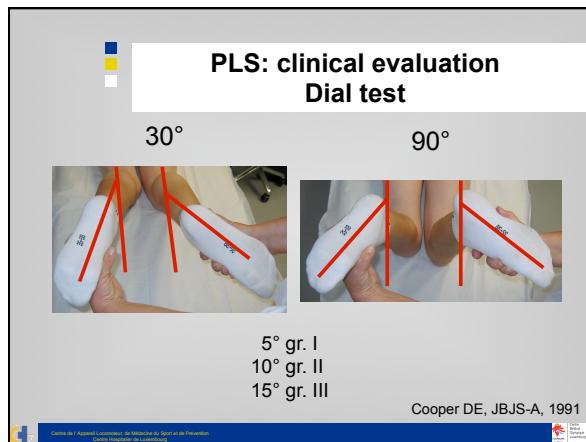
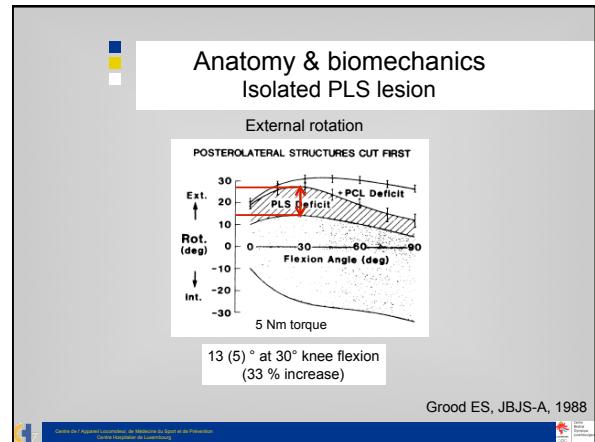
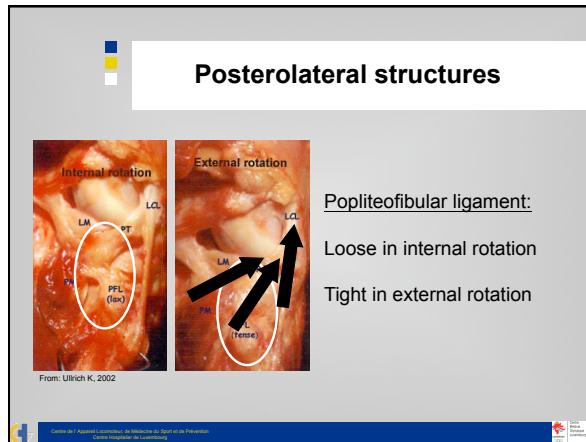
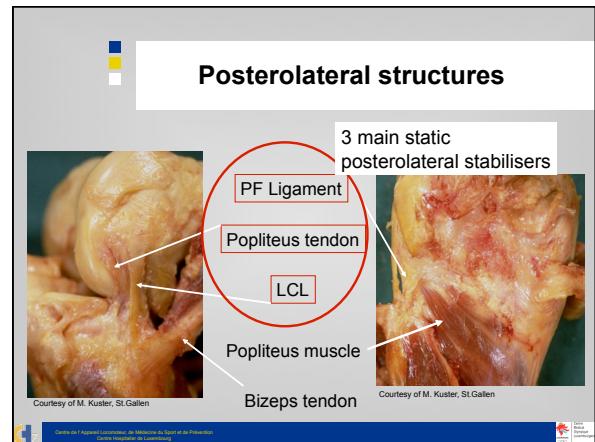




The „central pivot“ PCL

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



**The periphery
Posteromedial structures**

The diagram shows the posteromedial structures of the knee, specifically the three arms of the posterior oblique ligament (POL): Capsular arm, Central arm, and Superficial arm. The sMCL (superficial medial collateral ligament) is also labeled. The photograph shows an intraoperative view of the knee joint with the POL and other structures like MFC, CA, SM, and MGT visible.

Courtesy of L. Engebretsen, Oslo

Posterior oblique ligament

MFC, CA, SM, MGT

Courtesy of L. Engebretsen, Oslo

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

**The periphery
Posteromedial structures**

The photographs show the knee joint from different angles, illustrating its stability and movement. Labels indicate 'Tight in extension' and 'Loose in flexion'.

Tight in extension

Loose in flexion

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

**The periphery
Posteromedial structures**

The graph plots Posterior Tension (PTT) in mm against the Degree of Flexion (0 to 90 degrees). It compares four conditions: PMC (Posterior Cruciate Ligament), POL (Posterior Oblique Ligament), GMCL (Gastrocnemius Medial Collateral Ligament), sMCL (Superficial Medial Collateral Ligament), and PCL (Posterior Cruciate Ligament intact). The POL condition shows significantly higher PTT values than the others, especially at 30 and 60 degrees of flexion.

Degree of Flexion	PMC	POL	GMCL	sMCL	PCL intact
0	~10	~10	~10	~10	~10
30	~25	~28	~18	~18	~18
60	~28	~30	~22	~22	~22
90	~28	~28	~22	~22	~22

134 N Posterior Directed Force

PTT in mm

Degree of Flexion

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 ?

A photograph of a canal in Luxembourg with buildings in the background. To the right is a graphic of a puzzle where each piece represents a medical discipline: Orthopédie (Orange), Kinésithérapie (Pink), Médecine du Sport (Yellow), Méd. Physique (Green), and Cardiologie (Light Green).

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