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Non-Invasive *In-vivo* Evaluation of the Pivot Shift Using an Electromagnetic Device for the ACL-Deficient and Reconstructed Knees

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Introduction

- The intact ACL provides not only anteroposterior (AP) stability but also rotational stability.

- An anatomic two-bundle ACL reconstruction restored knee kinematics better than a single-bundle reconstruction.

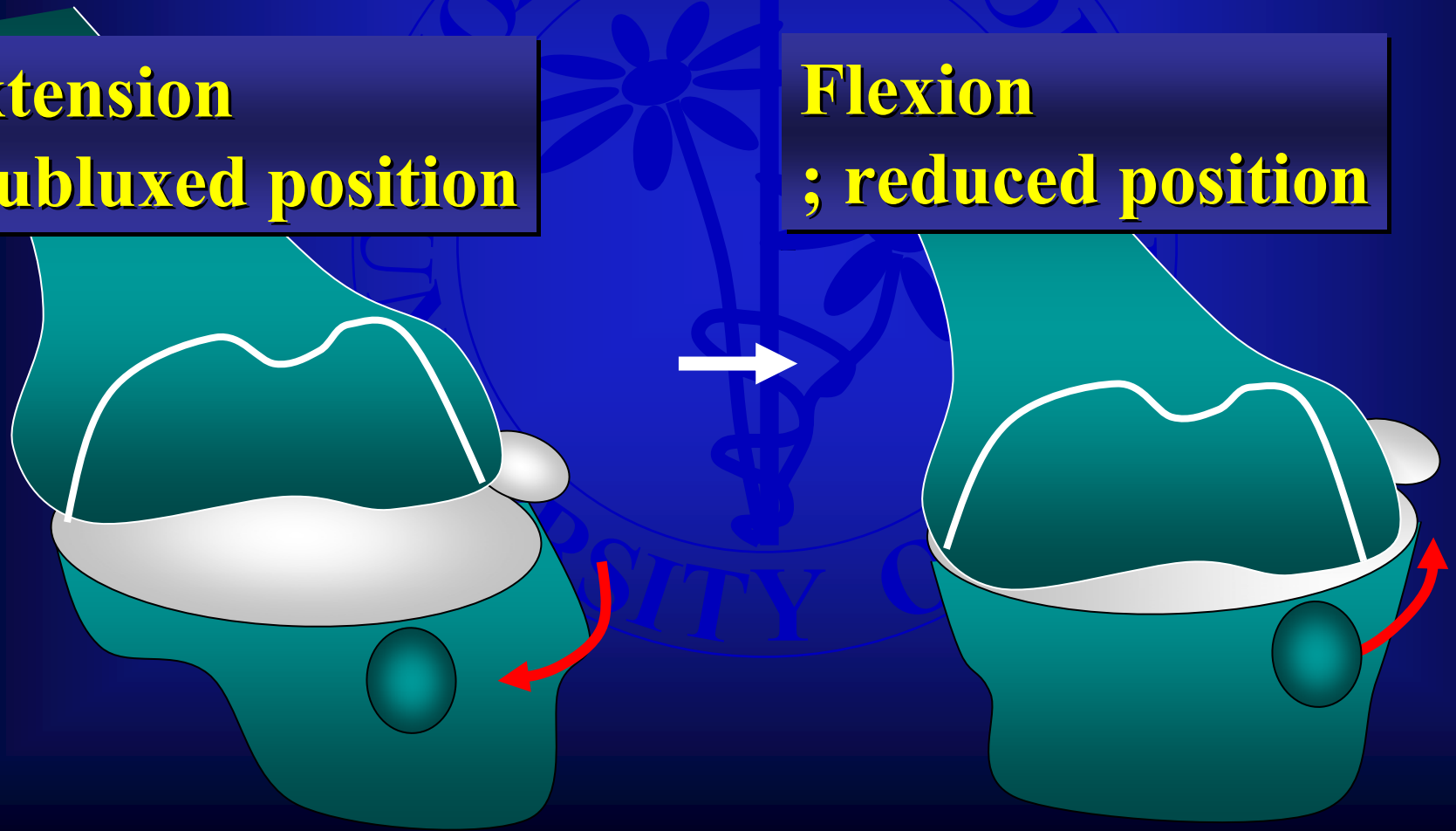
Introduction - Pivot Shift Phenomenon -

(First description)

Galway* ;*1972 JBJS

Extension
; subluxed position

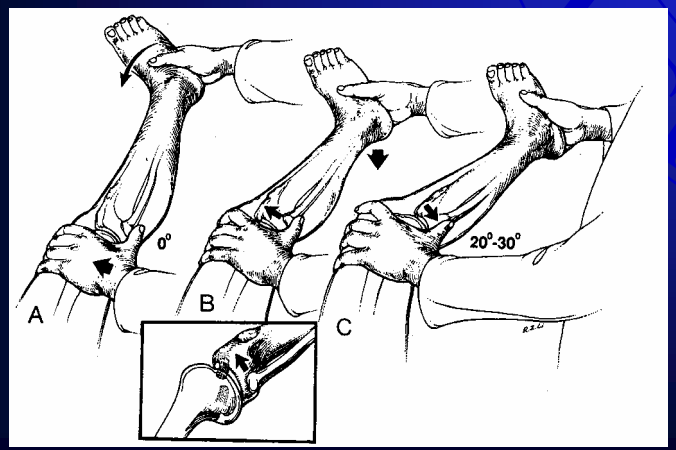
Flexion
; reduced position



Introduction

Lachmann test

Pivot shift test



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Purpose

- Develop a non-invasive measurement system for assessment of the complex instability of the knee during the pivot shift phenomenon
- Examine the clinical feasibility of such a system for the ACL-deficient and ACL-reconstructed knees.

Patients

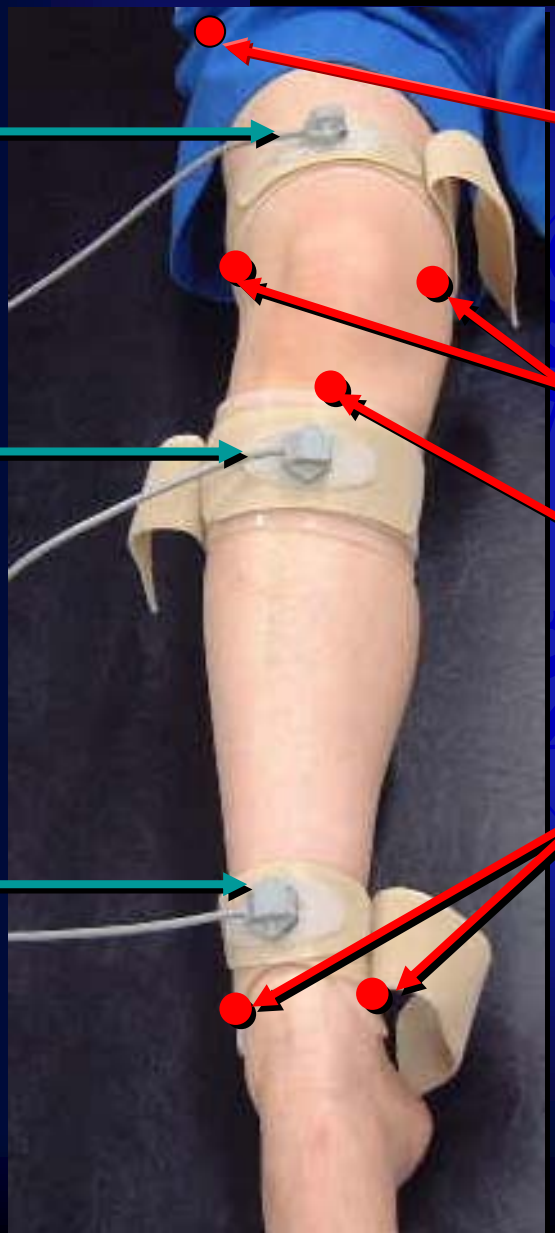
- Isolated ACL injury: 10 cases
  - Male: 5
  - Female: 5
  - Age:17- 38yr. (Av. 24yr.)
- ACL reconstruction: 10 cases
  - Male: 8
  - Female: 2
  - Age: 17-38yr. (Av. 23yr.)

Evaluation methods

- **Pivot shift test**
  - Clinical grade was determined by the examiner according to the IKDC criteria (grade 0 - 3).
  - Kinematics during the pivot shift phenomenon simultaneously recorded using three-dimensional electromagnetic sensors.

- **A-P transl**
  - Manual n ference
- **IKDC scor l knee)**

Measurement system



1

2

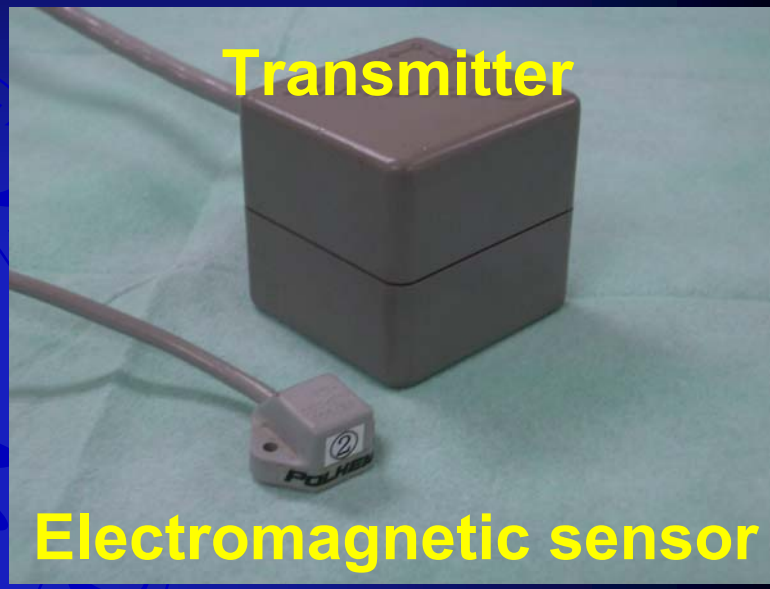
3

Greater trochanter of the femur

Medial and lateral Malleorus of the femur

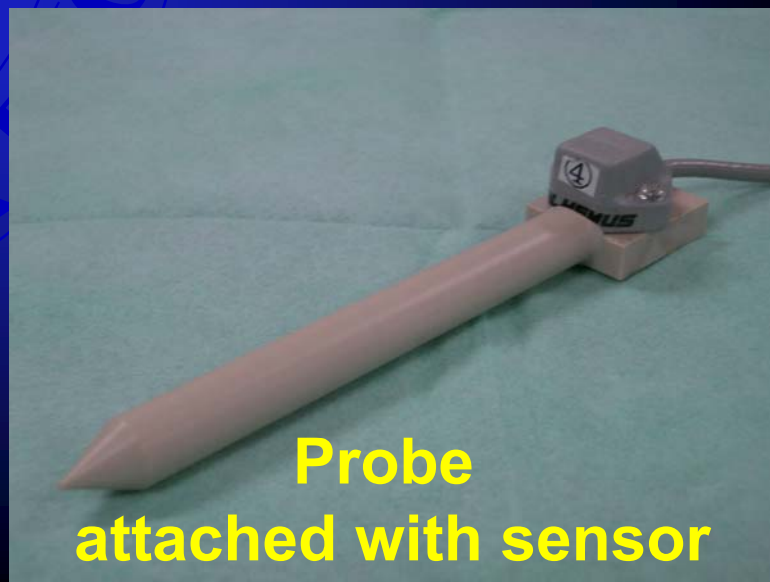
Tibial tubercle

Medial and lateral Malleorus of the ankle

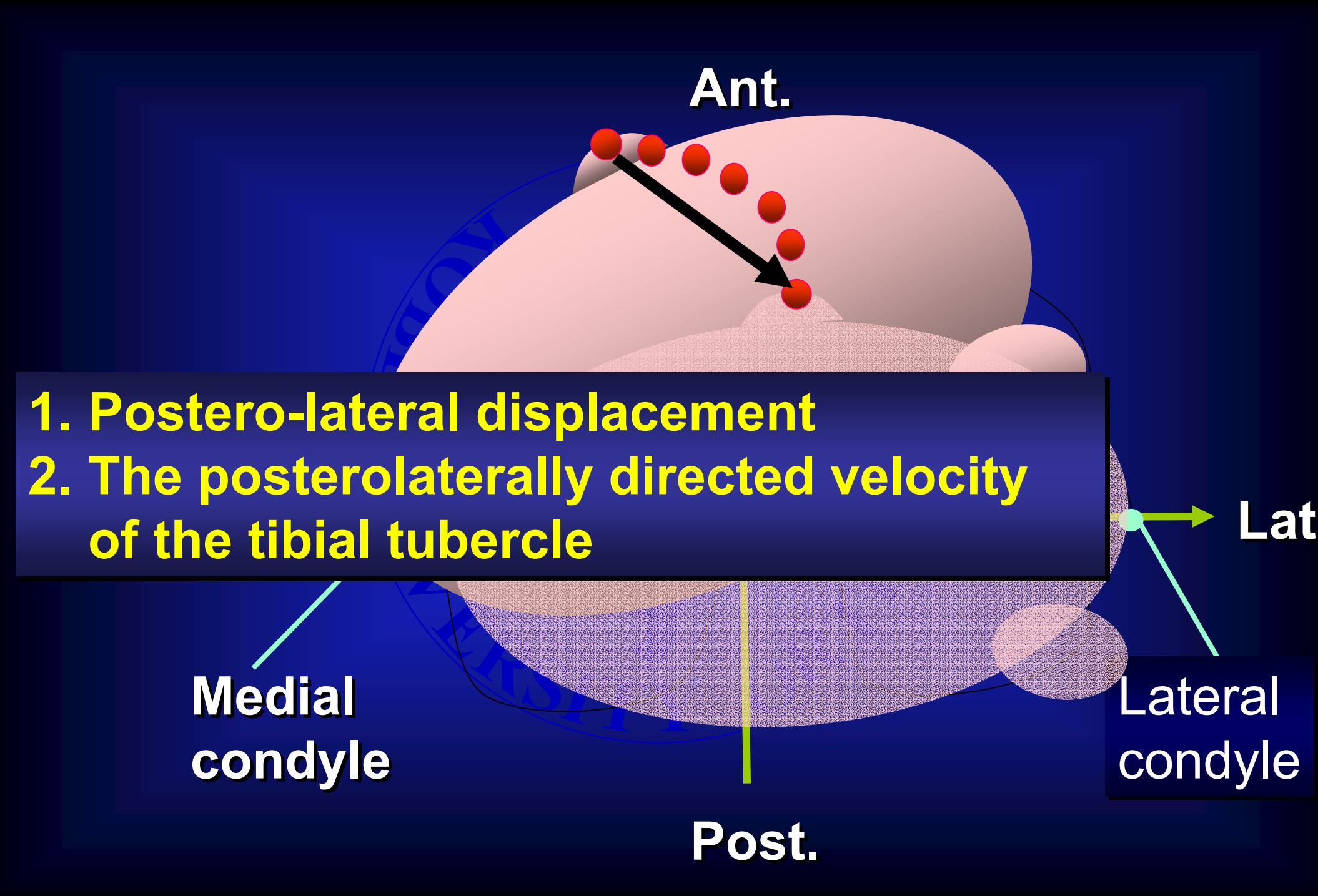


Transmitter

Electromagnetic sensor



Probe attached with sensor


Ant.
1. Postero-lateral displacement
2. The posterolaterally directed velocity of the tibial tubercle
Lat
Medial condyle
Lateral condyle
Post.

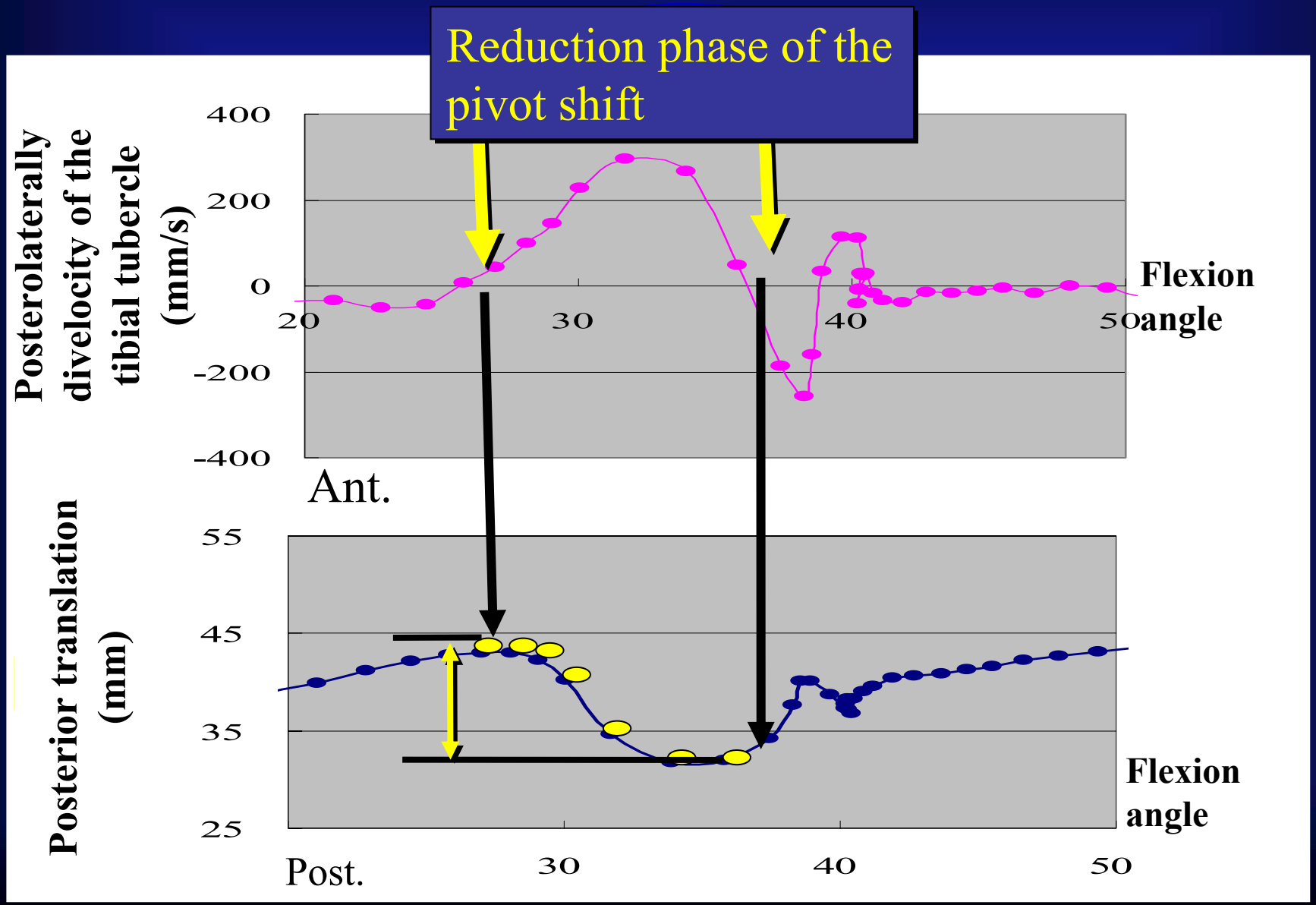
Evaluation methods

- **Pivot shift test**
  - Clinical grade was dete[illegible] by the examiner
    [illegible] IKDC c[illegible]
    matics [illegible]
    ng thre[illegible]
    electromagnetic sensors

Anterior instability

- **A-P translation**
  - Manual maximum side-to-side difference (KT-1000)

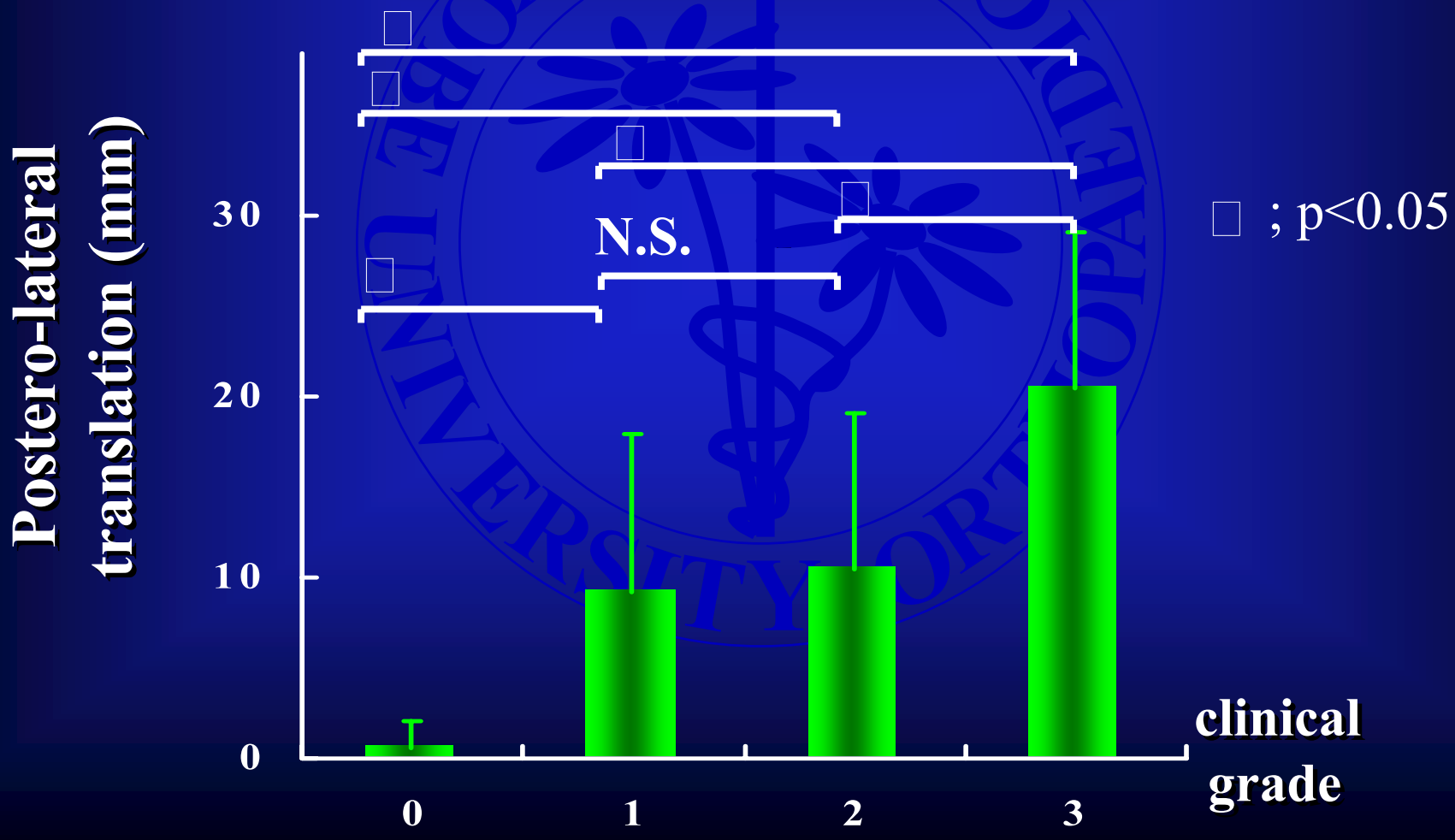
Manifestation of the Reduction Phase of the Pivot Shift



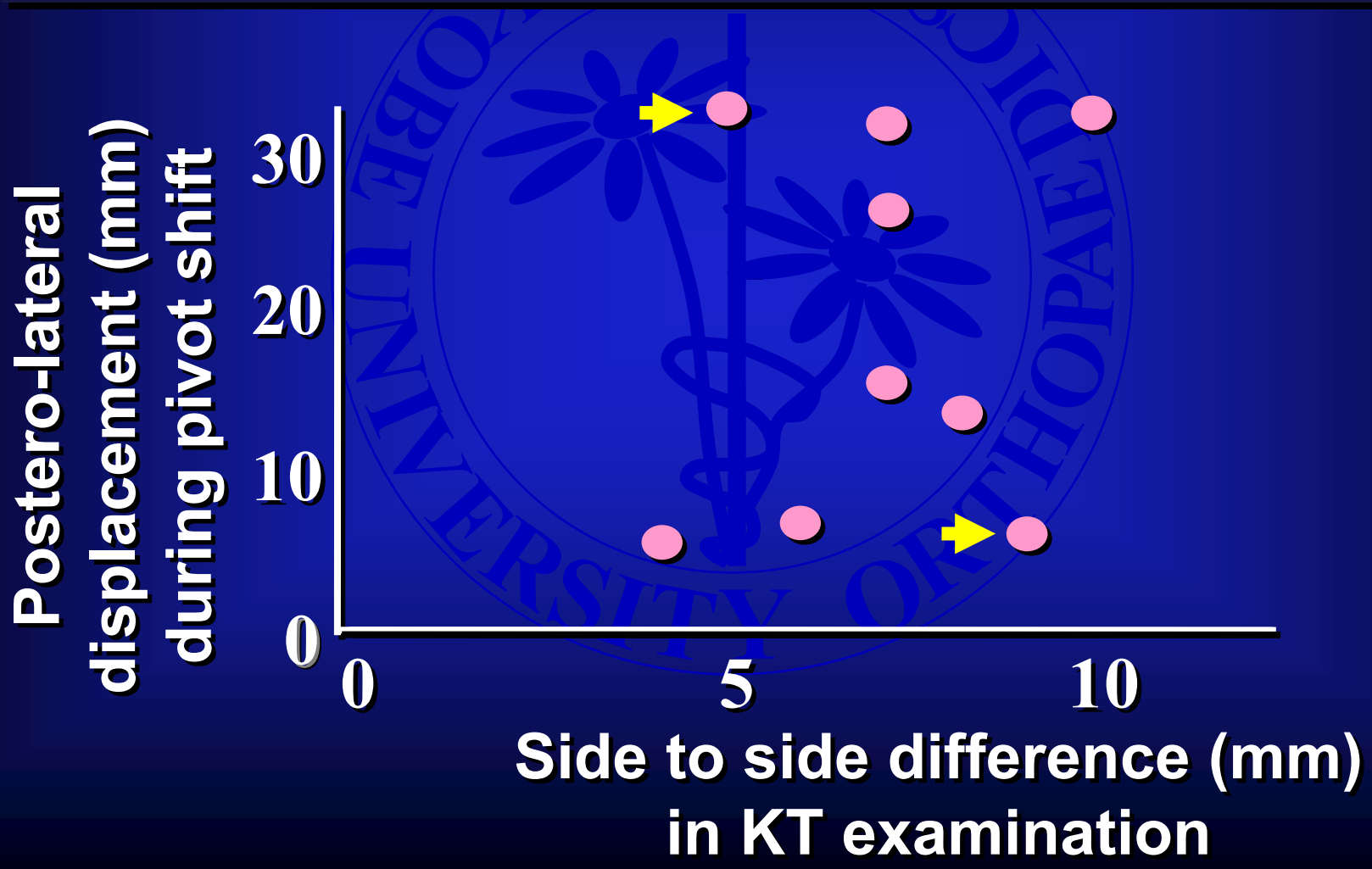
Results

Correlation Between Clinical Grading and Kinematic Results

- ACL deficient knee -



Comparison of anterior and rotational instabilities
- ACL deficient knee -



ACL reconstructed knees

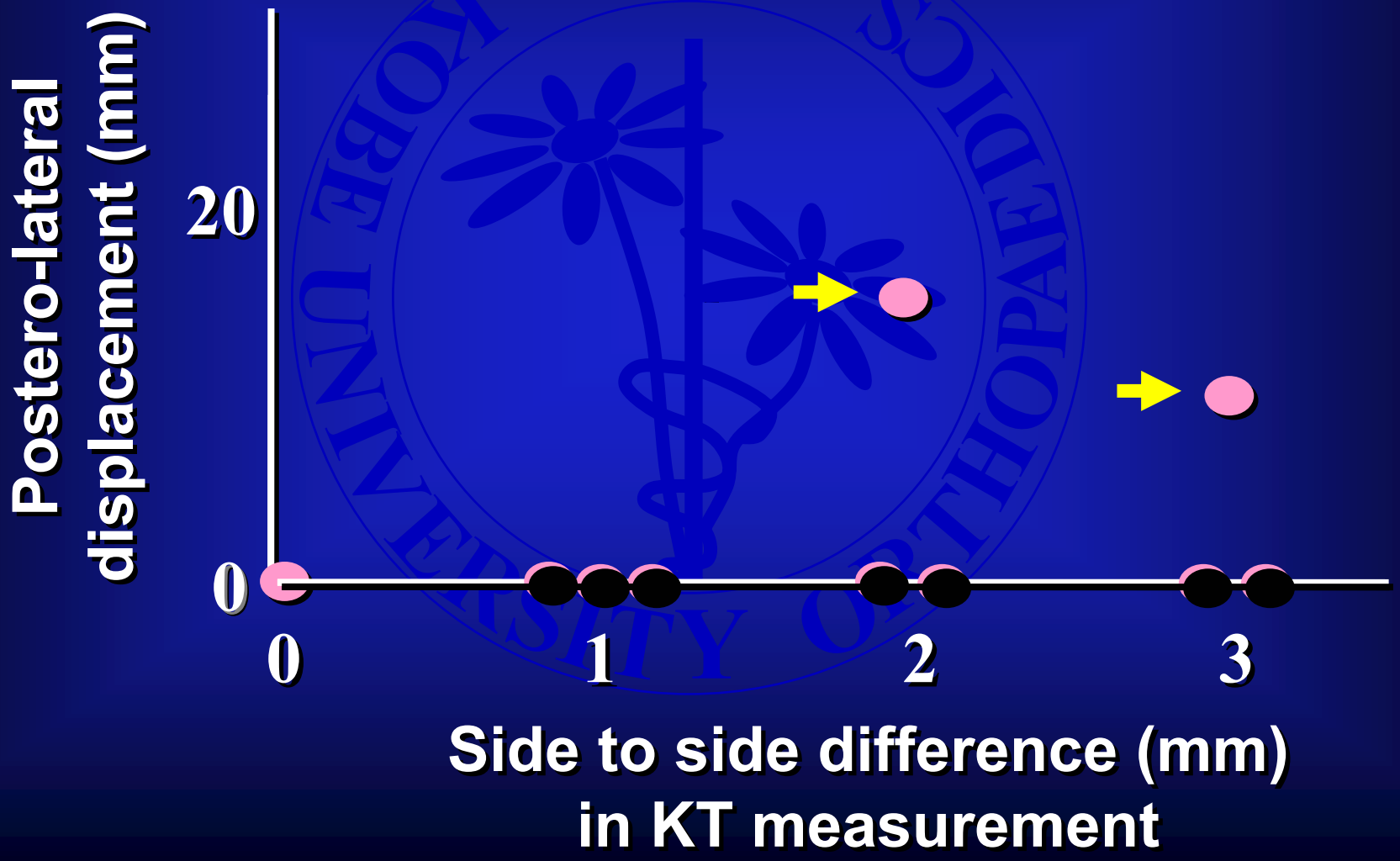
Clinical evaluation (IKDC)

- Normal: 6 cases
- Nearly normal: 4 cases

Side-to-side difference in KT examination

- 0 - 3mm
- Average: 1.8 mm

Comparison of anterior and rotational instability (ACL reconstructed knee)



Discussion

Quantitative evaluation of rotational instability (*in vitro*)

Electrogoniometer measuring tibial rotation and saggital translation (CA-4000)

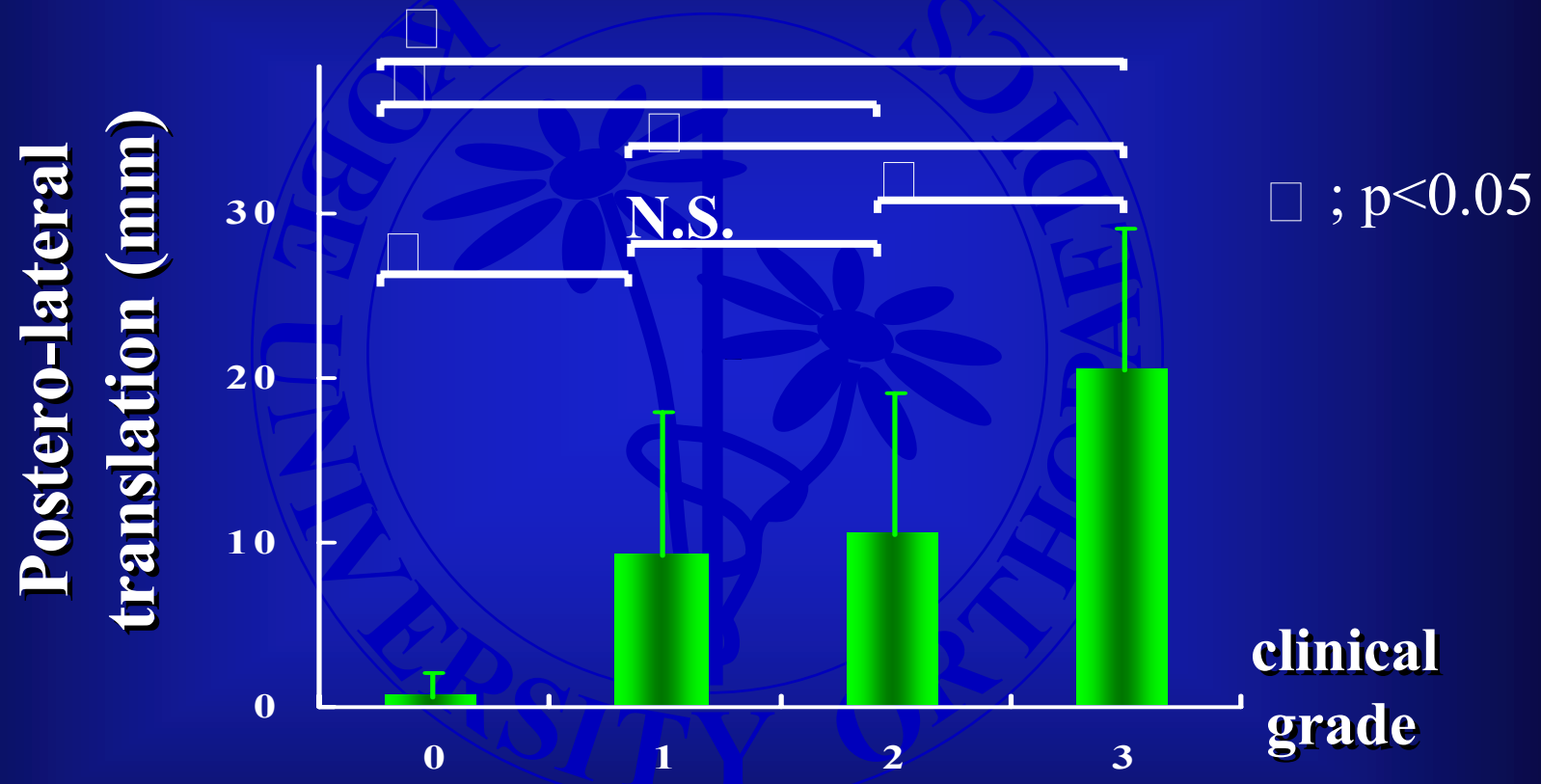
Kvist J, Gillquist J. 2001

Electromagnetic device fixed to femur and tibia using K-wire (invasive method)

Bull AM, 2002

Correlation Between Clinical Grading and Kinematic Results

- ACL deficient knee -



Clinical feasibility of our measurement method was confirmed.

ACL reconstruction

Conventional ACL reconstruction is sufficient during anterior tibial loading however, does not limit rotatory loading.

Woo SL, 2002

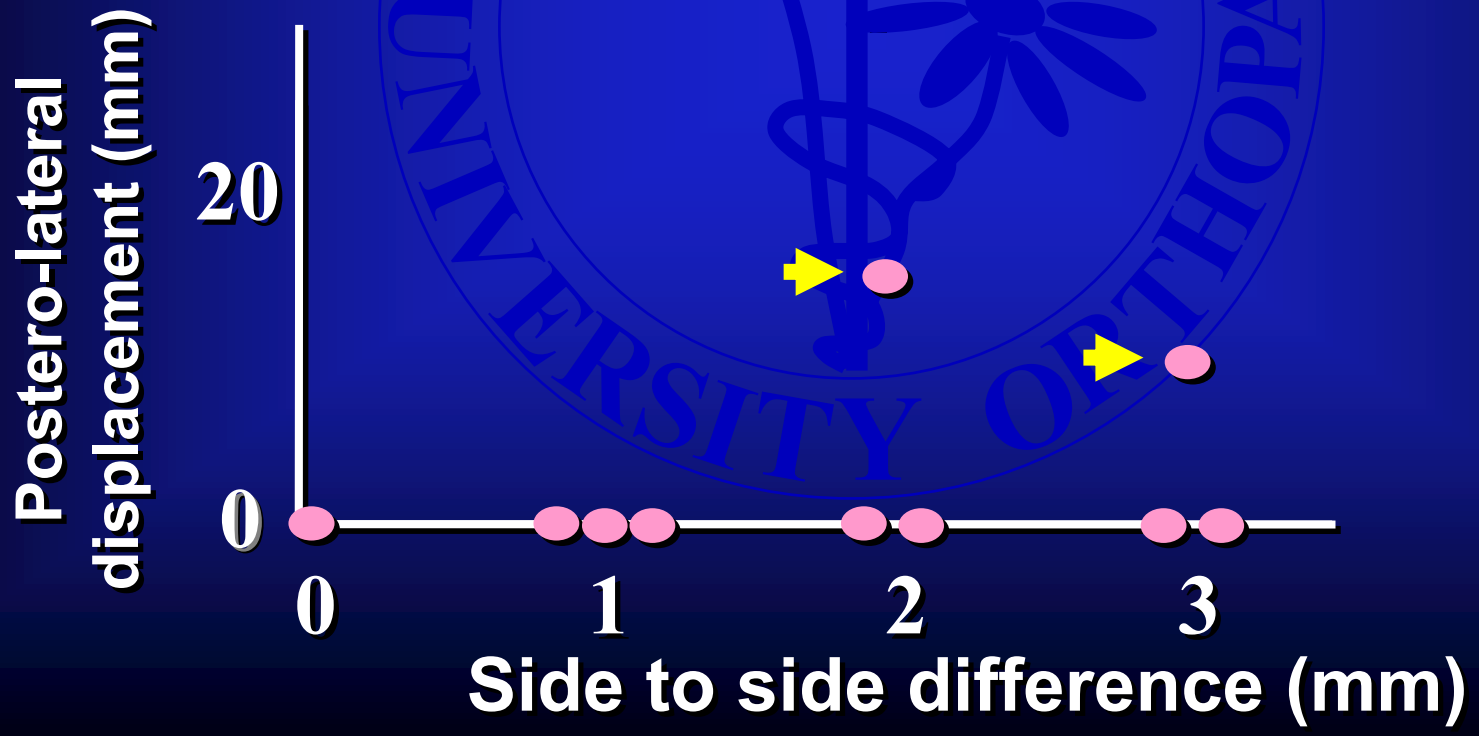
Instrumented knee laxity and Lachman examination had no significant relationships with symptoms and function.

Pivot-shift examination had significant associations with satisfaction and overall knee function

Kocher MS, 2004

Postero-lateral displacement after ACL reconstruction

Abnormal posterolateral translation was detected by this method even in the knees with acceptable AP stability after ACL reconstruction.



Conclusions

ACL deficient knees

- Significant correlation was observed between the results of clinical grading and kinematic measurement in the evaluation of the pvot shift test

- Manual side to side difference in KT examination did not correlat with postero-lateral displacement during pivot shift test.

Conclusions

ACL-reconstructed knees

- Abnormal posterolateral translation was detected by this method even in the knees with acceptable AP stability after ACL reconstruction.

- Quantitative measurement of the pivot shift phenomenon would be important in evaluation of the functional stability before and after ACL reconstruction.


Thank you
Kobe, JAPAN