Reliability of the KNEELAX3 Arthrometer for Anterior Knee Laxity Measurement in Healthy Female Subjects

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Introduction

- The diagnosis of ACL injuries is generally made by physical examination, mechanical tests, imaging and arthroscopy
  - Arthrometers such as KT-1000/2000 are commonly and widely used to quantitatively measure the anterior displacement
  - The KNEELAX3 is a device to measure anterior tibial translation (ATT) in millimeters recording procedure with computerized software
    - Daniel DM,et al. J Bone Joint Surg Am. 1985
    - Paine R, Lowe W. J Knee Surg. 2012
    - Mouton C, et al. Curr Rev Musculoskelet Med. 2016
- The aims of this study were to measure ATT of healthy Japanese women using KNEELAX3 and to determine the reliability and validity of the KNEELAX3

Materials and Methods

- Subjects
  - 120 knee in 60 subjects
    - Japanese healthy women
    - Age between 20 and 40 years old
  - Exclusion criteria
    - History of serious medical or surgical problems in the lumbar region or lower extremities
    - Persons who have symptoms in the knee joint
    - Pregnancy

- Evaluation methods
  - ATT at 132N (mm)
  - Measurement
    - Device:
      - KNEELAX3 (MR Systems, Haarlem, the Netherlands)
    - Position
      - 20° knee flexion in neutral rotation
    - Applied force
      - 132N
    - Measured by 3 examiners (A, B, C)
      - Random measurement of left and right
- Statistical analysis
  - SPSS Ver.25
    - Intra-/Inter-rater reliability
    - Intraclass correlation coefficients (ICC)
    - Bland-Altman (BA) analysis

Results

- 120 Knee in 60 people
  - All female
  - Age：27.0 ± 3.6 years
  - Height：159.8 ± 4.5 cm
  - Weight：51.6 ± 6.3 kg

- Anterior Tibial Translation (ATT)

	Right	Left
ATT (mm)	5.5 ± 1.9	6.5 ± 1.9
95% CI (mm)	5.0-6.0	6.0-7.0
Side-to-side difference (95% CI) (mm)	1.4 ± 1.2 (1.06-1.67)	

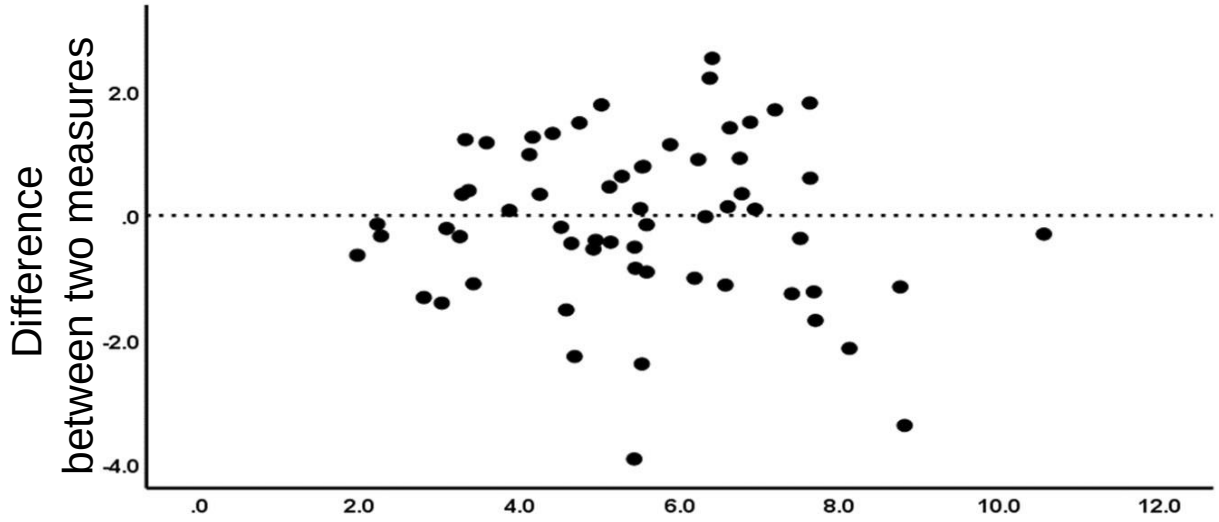
Mean ± SD

Results

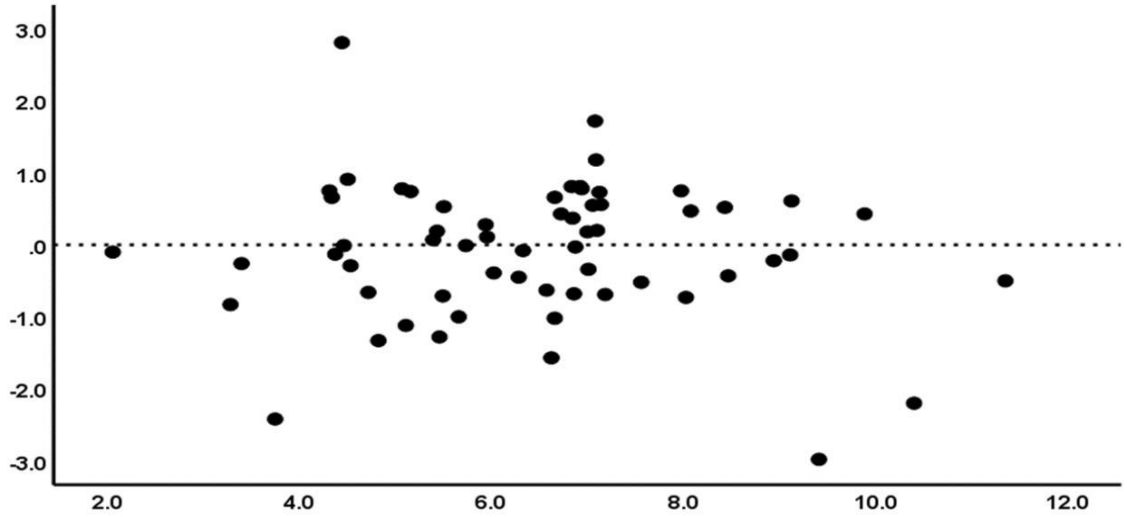
- Intra-rater reliability

	ICC (95% CI)	MDC95 (mm)	Systematic error
Right	0.77 (0.64-0.85)	1.73	None
Left	0.87 (0.80-0.92)	0.95	None

- BA plot



Right Knee



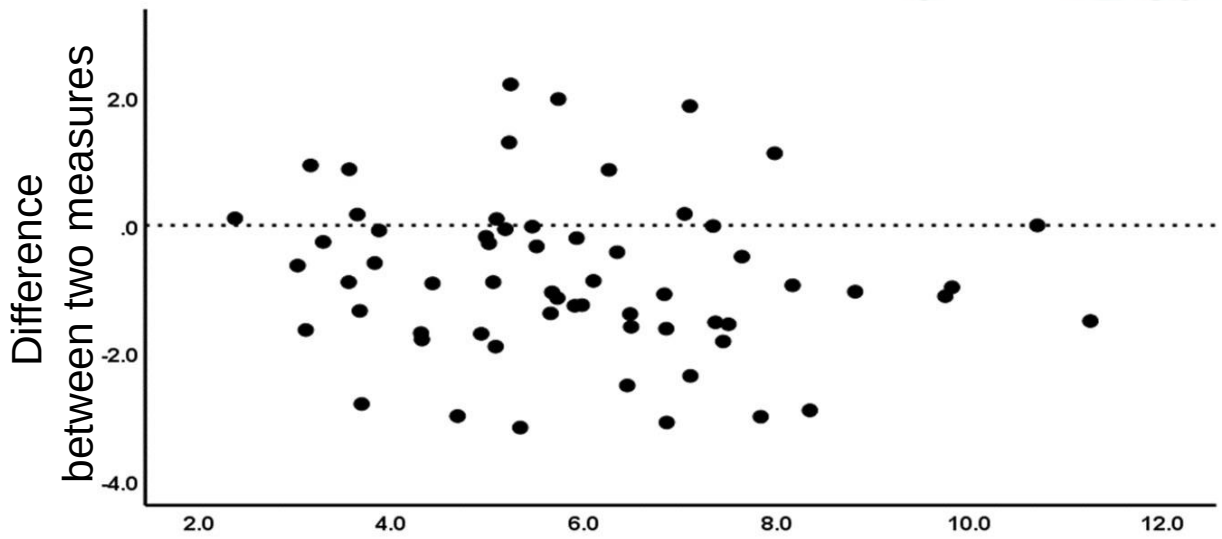
Left Knee

Results

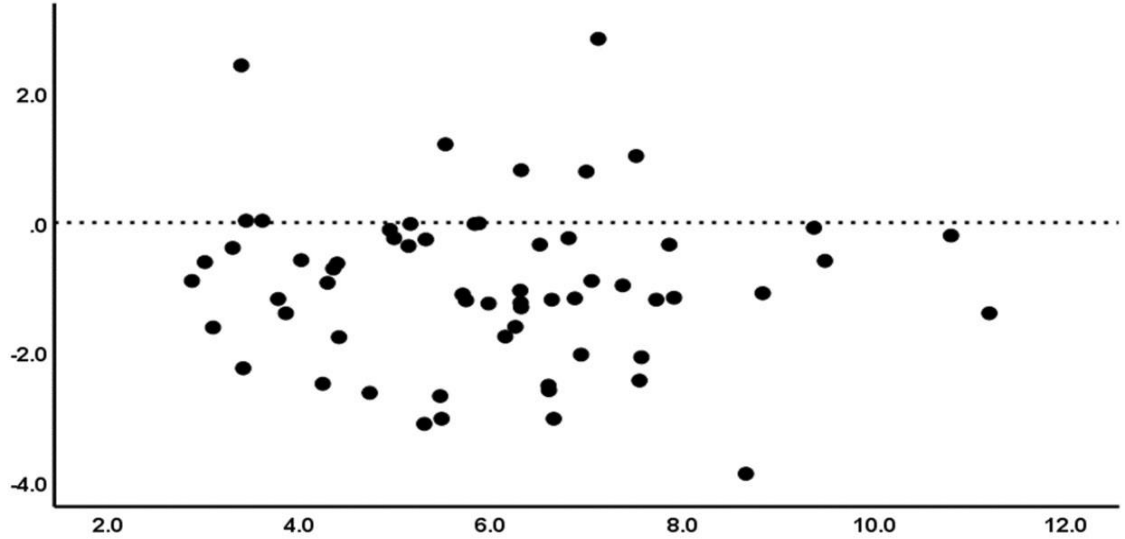
- Inter-rater reliability

	ICC (95% CI)	MDC95 (mm)	Systematic error
Right	0.71-0.82 (0.25-0.89)	1.46-2.89	The fixed error in the right knee between examiner A and other examiners
Left	0.83-0.89 (0.63-0.93)	0.82-1.77	

- BA plot



Right (examiner A-B)



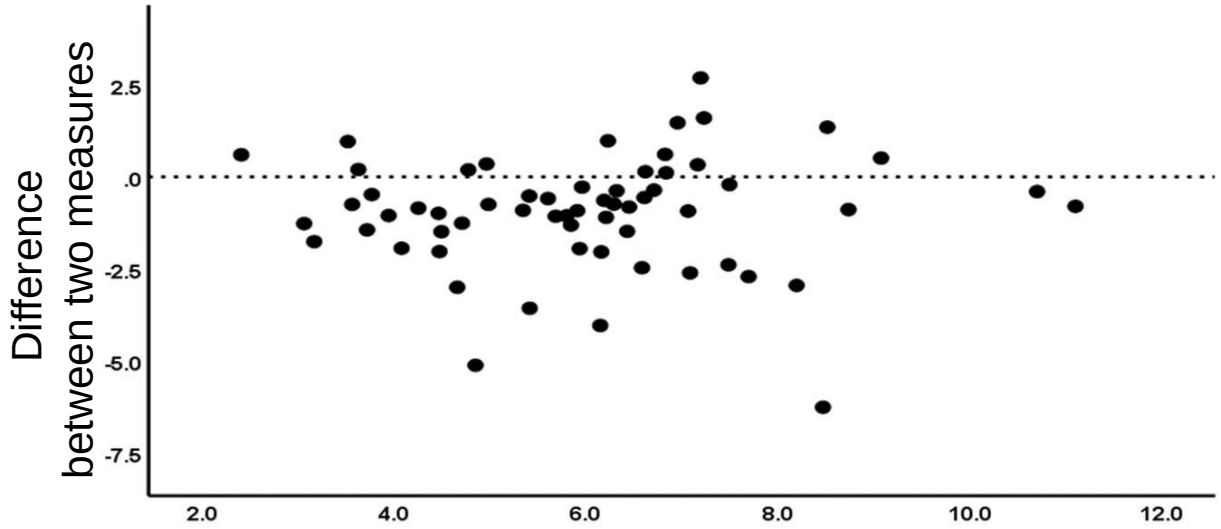
Right (examiner A-C)

Results

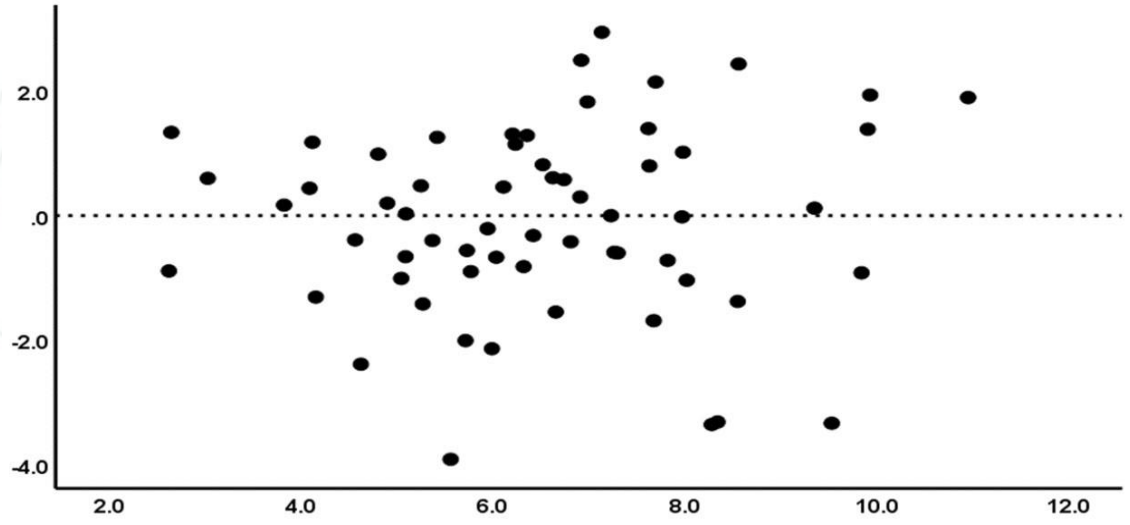
- Comparison between side-to-side for each examiner

ICC	MDC95 (mm)	Systematic error
0.60-0.71	2.15-2.70	The fixed error was observed for only examiner A

- BA plot



Examiner A



Examiner C

Discussion

- We determined the normal value of anterior knee laxity in healthy Japanese women by KNEELAX3 measurement
  - Similar results to previous studies
    - Paine & Lowe. J Knee Surg. 2012

	This study	Paine & Lowe (J Knee Surg. 2012)	
	KneeLax (132N)	KneeLax (134N)	KT-1000 (134N)
Right knee (mm)	5.5 ± 1.9	6.2 ± 1.6	7.6 ± 1.8
Left knee (mm)	6.5 ± 1.9	6.1 ± 2.3	7.5 ± 2.3
Side to side difference (mm)	1.4±1.2	0.9	1.3

Mean ± SD

Discussion

- This study demonstrated that there were good intra-rater reliability and moderate to good inter-rater reliability of measuring ATT using the KNEELAX3
  - Intra-rater reliability (right/left): ICC=0.77/0.87
  - Inter-rater reliability (right/left): ICC=0.71-0.87/0.83-0.89
  - However, the fixed error was found between one examiner and others, whereas no proportional error was found in any of the measurements.
- Caution is needed in interpreting results
  - Reproducibility is relatively high in the same examiner, but the results may differ between examiners
  - Right and left sides are highly similar to each other, but not symmetrical
- Factors affecting measurements
  - Candidate/case variability
    - Side-to-side differences in knee shape, muscle volume, etc.
    - Test condition: awake or under anesthesia
  - Examiner factors
    - Stability of device fixed onto the knee with straps
    - Degree of traction force, direction or speed (skills)
- There is a possibility that the error caused by these can be minimize by practice or repeating the measurement

Conclusions

- There were good intra-rater reliability and moderate to good inter-rater reliability of measuring ATT using the KNEELAX3 based on the results measured in healthy Japanese females
- The measurement of ATT with use of KNEELAX3 is reliable, but the measurement technique should be standardized and established in consideration of the physical characteristics of the subjects to minimize the measurement errors

Thank You!

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