

# Validation of the Kinematic Knee Sleeve for Measuring Joint Angle Changes in Active Young Adults

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## Introduction

Electric goniometers (EG) are valid and reliable in measuring joint angle changes during human movement. But EG can be costly and impractical for all athletic settings. As a result, an advanced textile sensor, the Kinematic Knee Sleeve (KiTT), was created to track a wide range of exercises and movements both indoors and outdoors. However, the KiTT has only been validated using motion capture technology. Thus, the purpose of this study was to validate the KiTT sleeve against an EG during a series of lower body exercises in active college-aged adults.

## Methods

A total of 13 college-aged adults (age =  $21 \pm 1.8$  yrs, body mass =  $61.5 \pm 3.4$  kg) participated in the study. Following a 5-minute warm up on a stationary bicycle, participants were fitted with the KiTT sleeve on their right leg and an EG on the lateral joint line of the left knee. Participants completed 6 exercises (squat jump, countermovement jump, broad jump, box jump, box drop, lateral hop) in a randomized order. A total of 3 sets of 8 repetitions per exercise were performed, with the exception of lateral hops, which consisted of 3 sets of 5 repetitions per leg being completed.

## Statistical Analyses

The Statistical Package for Social Sciences, version 29, was used for all analyses. Paired sample *t* tests were used to analyze differences in the degree of knee flexion for each exercise between the KiTT and the EG. Significance was set at  $p \leq 0.05$ .

## References

1. Toon, N., McMaster, S., Outram, T., & Faghy M. (2022). Assessing the Validity of a Kinematic Knee Sleeve in a Resistance-Trained Population. *Engineering Proceedings*, 15(10), 1-5.
2. Munro, B. J., Campbell, T. E., Wallace, G. G., & Steele, J. R. (2008). The intelligent knee sleeve: A wearable biofeedback device. *Sensors and Actuators*, 131(2), 541-547.

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## Results

No significant differences were found in knee flexion values between the EG and KiTT sleeve in squat jumps, countermovement jumps, broad jumps, box jumps, and box drop exercises ( $p \geq 0.05$ ). Lateral hop knee flexion was significantly higher in the KiTT compared to the EG ( $p < .001$ ).

**Table 1.** Average knee flexion range of motion values

Exercise	EG	KiTT
Squat jump	$99.7 \pm 9.56$	$106.1 \pm 3.47$
CMJ	$96.7 \pm 10.17$	$97.9 \pm 5.49$
Broad jump	$100.1 \pm 14.99$	$110.1 \pm 7.61$
Box jump	$85.6 \pm 9.86$	$97.5 \pm 9.17$
Box drop	$107.1 \pm 8.26$	$108.2 \pm 5.41$
Lateral hop	$93.3 \pm 3.53$	$107.6 \pm 2.83^*$

Note. All values are mean  $\pm$  standard deviation; \* =  $p \leq 0.05$ ; CMJ = countermovement jump.

## Conclusions

- The KiTT is an accurate device for measuring knee joint angle changes during lower body exercises.
- KiTT is an effective tool for use outside of a laboratory setting.
- The KiTT can be utilized during rehabilitation, practice, or game settings for measuring and monitoring knee range of motion.