Validation of Phone Applications on Measuring Passive and Functional Range of Motion

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ABSTRACT

Purpose: The study's purpose is to assess lower extremity (LE) measurements among three different devices. A universal goniometer, Hudl phone application and iPhone 5C Default compass phone application were used.
Methods: College age subjects of good health volunteered however, subjects with a significant LE injury within the past 2 years or who cannot hold a squat position for all measurements to be taken are rejected from the study. Subjects' bony landmarks are indicated with stickers, to ensure consistency. Passive range of motion (ROM) assessments are taken at the hip, knee and ankle of the right LE. Subjects then perform a squat, reaching near parallel with the ground where ROM measurements are taken at the 3 joints. Measurements are taken with the universal goniometer, Hudl and Default compass phone applications. To find statistical significance, the paired-sample T-test as well as One-way ANOVA are used in the analysis of our data collected.
Results: A relationship was noted between the accuracy of the three methods of ROM assessments.
Conclusion: Our findings suggest Hudl and Default compass phone applications are as accurate as the universal goniometer. These results are dependent on the size of the angle observed at each particular joint.

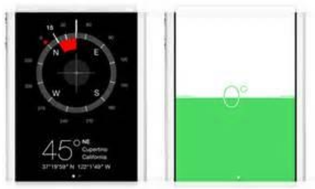
OBJECTIVES

Inclinometer phone applications will allow clinicians to use a phone app instead of the universal goniometer during range of motion measurements:

- Measurements to be completed quicker
- Easier to take measurements
- Gives patients visual feedback of their joint mobility
- Less training for instrumental use

INSTRUMENTATION

- Default Compass iPhone app (Fig. 1.a)
  - iPhone 5C
- Hudl (Fig. 1.c)
  - John Wirtz, David Graff and Brian Kaiser
- Goniometer (Fig. 1.b)
  - BASELINE 8 inch 360 degree plastic goniometer 12-1001



PROCEDURE

Passive ROM
Three examiners used the three devices to assess participants ROM
Fourth examiner directed participant through all measurements
Measured passive ROM of the hip, knee and ankle
- Hip Flexion/Extension
- Knee Flexion/Extension
- Ankle Dorsiflexion/Plantar Flexion

Functional ROM
Participant performed 3 bodyweight squats
Measured functional ROM of hip, knee and ankle
- Hip Flexion
- Knee Flexion
- Ankle Dorsiflexion

RESULTS

Table 1

Passive Range of Motion of the Three Devices Assessing Mean and SD

Joint	Device	Mean	SD
Passive Hip Flexion	Goniometer	87.89	10.66
	Hudl	88.74	8.38
	Compass	87.66	11.44
Passive Hip Extension	Goniometer	21.83	6.91
	Hudl	24.06*	6.11
	Compass	23.26	6.67
Passive Knee Flexion	Goniometer	138.23	7.07
	Hudl	139.17	6.55
	Compass	137.57	7.66
Passive Knee Extension	Goniometer	-.26	4.64
	Hudl	2.31*	4.88
	Compass	.20†	4.23
Passive Ankle Dorsiflexion	Goniometer	5.77	5.41
	Hudl	2.17*	7.64
	Compass	8.09*†	6.23
Passive Ankle Plantarflexion	Goniometer	56.14	9.40
	Hudl	57.26	7.96
	Compass	56.89	8.61
Functional Hip Flexion	Goniometer	118.80	15.54
	Hudl	114.20*	14.18
	Default	110.20*	14.52
Functional Knee Flexion	Goniometer	96.57	14.53
	Hudl	96.83	11.90
	Default	92.31	14.70
Functional Ankle Dorsiflexion	Goniometer	11.63	6.34
	Hudl	8.31*	4.78
	Default	11.97†	5.80

Note. * indicates significant difference ($p < .0167$) compared against goniometer; † indicates a significant difference compared against Hudl

To calculate our results we used paired sample T- test and One-way repeated ANOVA test. There was significant intra-rater and inter-rater reliability for the Hudl. Small joints posed challenges for our study as well as studies such as Ferriero (2013). Passive and Functional hip flexion was the most accurate among all the instruments. The least accurate measurements were of the smaller joint angles such as ankle dorsiflexion.

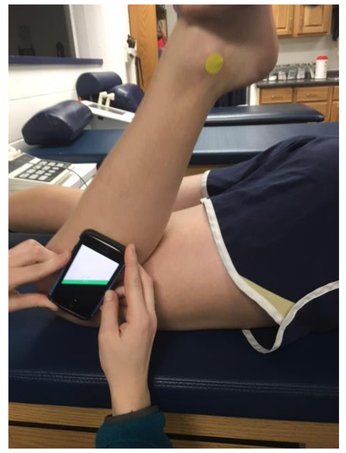


Figure 1a. Passive knee flexion ROM measurement with Default Compass

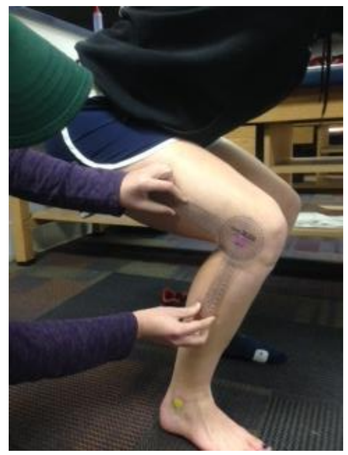


Figure 1b. Functional ROM measurement with universal Goniometer

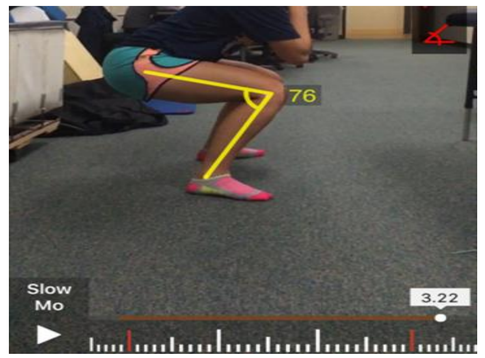


Figure 1c. Functional knee ROM measurement with Hudl

CONCLUSION

There was significant reliability of the phone applications compared to the goniometer with functional and passive range of motion assessments. Continual research can help make future phone applications more accurate to measure small joints. Technology is always changing--creating new ways to make a task faster, easier and more convenient.

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