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 a year 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. 1a)
• iPhone 5C
• Hudl (Fig. 1c)
• John Wirtz, David Graff and Brian Kaiser
• Goniometer (Fig. 1b)
• 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 (20 degrees/minute) Accuracy Mean and SD

<table>
<thead>
<tr>
<th>Joint</th>
<th>Device</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Hip flex</td>
<td>Goniometer</td>
<td>87.80</td>
<td>1.80</td>
</tr>
<tr>
<td></td>
<td>Hudl</td>
<td>90.74</td>
<td>3.95</td>
</tr>
<tr>
<td></td>
<td>Hudl</td>
<td>87.70</td>
<td>1.80</td>
</tr>
<tr>
<td>Passive Hip ext</td>
<td>Goniometer</td>
<td>91.20</td>
<td>2.10</td>
</tr>
<tr>
<td></td>
<td>Hudl</td>
<td>94.05</td>
<td>2.15</td>
</tr>
<tr>
<td></td>
<td>Hudl</td>
<td>81.20</td>
<td>1.85</td>
</tr>
<tr>
<td>Passive Knee flex</td>
<td>Goniometer</td>
<td>85.30</td>
<td>2.15</td>
</tr>
<tr>
<td></td>
<td>Hudl</td>
<td>85.00</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>Hudl</td>
<td>83.50</td>
<td>2.50</td>
</tr>
<tr>
<td>Functional Hip flex</td>
<td>Goniometer</td>
<td>86.50</td>
<td>2.50</td>
</tr>
<tr>
<td></td>
<td>Hudl</td>
<td>85.00</td>
<td>2.50</td>
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<tr>
<td></td>
<td>Hudl</td>
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<td>Functional Knee flex</td>
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<td>84.00</td>
<td>2.50</td>
</tr>
</tbody>
</table>

Note: * indicates significant difference (p < 0.05) 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.

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.

REFERENCES


