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Reliability of smartphone application for knee joint flexion range of motion

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Abstract
The purpose of the study was to check the reliability of smartphone based goniometer application fpr knee flexion range of motion. Study design used was an observational study. The participants were recruited using simple random sampling method. Total number of participants were 50 of age group between 20-60. Maximum active knee flexion was measured in supine position with Universal goniometer and Goniometer records by three qualified physiotherapists. Data was collected and analyzed using SPSS (version: 20) and Bland Altman Test was used. Results revealed that significant correlation were found between the application Goniometer Records (r=0.9409) and Universal Goniometer (r= 0.8149) methods for the mean of 3 trails. The two talied paired t-test indicated significant difference between the application Goniometer records mean and universal goniometer mean. The ICC and 95% confidence interval (CI) for Smartphone Goniometer was 0.9409 (95% CI, 0.9133-0.9599) and that for Universal Goniometer was 0.8149 (95% CI, 0.7363-0.871).It could be concluded that the Goniometer Records demonstrated acceptable test-retest reliability. The Goniometer Records exhibited high reliability.

Keywords: Universal goniometer, goniometer records, smartphone goniometer, knee flexion, range of motion

Introduction
Goniometer is one of the oldest instruments used to measure the angle or the angular position of the joint.The term goniometry is derived from two Greek words, Gonia, meaning angle, and Metron, meaning measure. Goniometer has been extensively used to measure range of motion of joints of body from last many decades. Therefore, goniometry refers to the measurement of angles, in particular the measurement of angles created at human joints by the bones of the body. The examiner obtains these measurements by placing the parts of the measuring instrument, called a goniometer. Goniometer is an important part of a comprehensive examination of joints and surrounding soft tissue [1]. Various methods have been used to evaluate the joint range of motion. The traditional method used to evaluate the ROM is by the Traditional universal goniometer. Recently, after the progression of information technology with increased number of smart phone users, several web developers has also developed goniometry application including visual estimation [2] electrogoniometers [3] gravity digital inclinometers [4]; digital compass goniometer [5]; and digital-photographic goniometric methods [6]. Consequently, a universal goniometer is most commonly used in clinical practice to measure joint angles and range of motion [7]. In order for functional and sport specific activities to occur, knee flexion and extension range of motion (ROM) is necessary. Loss of full ROM at the knee joint can be detrimental to the function of the lower extremity and treatment is needed to regain full function of ROM [8]. Prior studies have evaluated the minimum knee flexion required for specific functional activities: 57-69° for level walking [9], 83-99° for stairs [10], 84-120° to sit and raise from a chair [11], 131-138° to get in and out of a bath [12], 155° for higher flexion activities of squatting, kneeling or rising from the floor [13] Active knee flexion of 135° is considered acceptable for a healthy adult [14]. Knee flexion of at least 110° is needed to achieve satisfactory function in activities of daily living for most senior patients [15]. However, 110° is not satisfactory for younger patients, those who are more active or people from cultures that require greater flexion for squatting or kneeling [16]. Defining low, moderate or high knee flexion remains unresolved [17]. Restoration of range of motion following injury and surgery requires close monitoring for

The two main potential sources of error in joint angle evaluation are measurement error and instrument error. An accurate universal goniometer reading is reliant on the placement of the fulcrum over the centre of rotation of the knee joint and the correct alignment of the arms to proximal and distal bony landmarks [18]. Several of smartphone applications (Dr Goniometer (Dr. Goniometer 2011) and iGonio (iGonio 2011)) utilise the smartphone to measure joint angles from either x-ray or digital photographs and, as such, are subject to the limitations of standard digital-photographic goniometric measurement [19]. The iGoniometer [20] is a smartphone application that has adopted a novel approach to goniometry by utilising accelerometry for the measurement of knee joint angles. The objective of this study was to establish the reliability between a smartphone application named as Goniomrter Records and a Universal Goniometer.

Methodology and Materials

Subject

The healthy subjects were recruited using simple random sampling method. Total number of participants were 50 of age group between 20-60 years. Subjects recruited were free from any neurological and musculoskeletal conditions. Subjects having recent injuries were also excluded. Patients who had fixed deformities of lower limbs or were excluded. Ethical approval was obtained in accordance with the ethical principles.

Instrumentation

Universal Goniometer
Smartphone application named Goniometer records

Procedure

Ethical approval was taken from Ethical committee to proceed the study further**.** Before starting study all subjects received verbal and written information about the study including the method, aim. A written consent form was given to the subjects which they had to sign to participate in the study**.** Total 50 subjects (N=50) between age of 20 to 60 participated in the study and were selected by simple random sampling. This study was single blinded. Three qualified physiotherapists were the observer. The left knee of all the subject were chosen for determining the ROM**.** Knee flexion movement was measured for 50 subjects three times with two methods by each physiotherapist. Then all the data were record in data sheets. The Universal Goniometer was considered as a clinical standard technique. The 3 physiotherapists were unaware of the readings taken by the other 2 therapists.

Patients position and point of reference for universal goniometer: The subject was in supine position with knees flexed, the fulcrum of the universal goniometer was placed on the lateral condyle of femur and the Stationary arm was parallel to the shaft of femur and the moving arm was in line with the fibula.

Patient Position and Point of Reference For Smartphone Goniometer: The subject was in supine position with. The smartphone was set on the zero point of horizontal line along the knee. The subject was asked to flex his/her knee and the angle was evaluated by the placing phone along the subject leg. Reference point for the lower leg was below the tibial tuberosity and for the thigh was the midthigh.

Result

The data was analyzed by SPSS (ver. 20) statistical software. The intraclass correlation coefficient was calculated to asses intra-rater correlation of both Universal Goniometer and Goniometer Records. Intraclass correlation coefficient value for GONIOMETER RECORDS was higher than 0.90 considered adequate to ensure resonable validity. Once the normal distribution of data was confirmed, the limits of agreement (LoA) were used to determine the agreement between the 2 instruments (Bland and Altman, 1986). The limit of agreement (LoA) define the range within which 95% of differences between measurement by the 2 methods are predicted to lie.50 healthy participants were recruited for the study population. A summary of descriptive statistics is shown in Table 1. Significant correlation were found between the application Goniometer Records (R=0.9409) and Universal Goniometer (r= 0.8149) methods for the mean of 3 trails. The two talied paired t-test indicated significant difference between the application Goniometer records mean and universal goniometer mean. The ICC and 95% confidence interval (CI) for Smartphone Goniometer was 0.9409 (95% CI, 0.9133-0.9599) and that for Universal Goniometer was 0.8149 (95% CI, 0.7363-0.871).

Discussion

The aim of the study was to check the reliability of Smartphone Goniometer application by comparing its measurement of the knee joint angle with that made by a Universal Goniometer. We believe that the present research is the first reported study to investigate the intra rater reliability of this specific application. A high degree of correlation was found between the means of 3 trails for each of two methodologies indicating good reliability between the Smartphone Goniometer and Universal Goniometer. All of the ICCs were greater than 0.70 indicating a clinically acceptable level of reliability and the Smartphone Goniometer was seemed to have good reliability based on Bland Altman 95% of limit of agreement (Fig. 1) (Bland and Altman 2007, 1986). Significant correlation were found between the application Goniometer Records (r=0.9409) and Universal Goniometer (r= 0.8149) methods for the mean of 3 trails. The two talied paired t-test indicated significant difference between the Smartphone Goniometer mean and Universal Goniometer. The ICC and 95% confidence interval (CI) for Smartphone Goniometer was 0.9409 (95% CI, 0.9133-0.9599) and that for Universal Goniometer was 0.8149 (95% CI, 0.7363-0.8718). When evaluating reliability it is important to distinguish between relative and absolute reliability as this can facilitate differentiation between measurement error and treatment efficacy. In the previous study a high degree of correlation (r = 0.932) was found between the means of the three trials for each of the two methodologies indicating relative reliability between the iGoniometer and the LAG. All of the ICCs were greater than 0.70 indicating a clinically acceptable level of reliability and the iGoniometer was deemed to have good absolute reliability based on the Bland and Altman 95% limits of agreement. Despite the fact that the iGoniometer was found to have good relative and absolute reliability, the

ICCs were lower than reported levels for experienced testers where ICCs greater than 0.90 have been found.

Conclusion

The Goniometer Records demonstrated acceptable test-retest reliability. The Goniometer Records exhibited high reliability.

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References

1. Cynthia Norkin C. 4th edition, Measurement of joint motion, 2011.
2. Van Trijffel, Watkins *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2010, 1991.
3. Myles Rowe Cleffken *et al.* Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2002, 2000, 2007.
4. Cleffken *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2007.
5. Yaikwawongs *et al.* Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2009.
6. Moncrieff, Livingston. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2009.
7. Jakobsen *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2010.
8. N. Am J Sports Phys Ther. 2008; 3(2):110-113.
9. Li, Myles, Jevsevar, Laubenthal *et al*., 2007, 2002, 1993, 1972.
10. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester.
11. Rowe, Jevsevar, Andriacchi, Laubenthal *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester. 2000, 1993, 1972, 1980.
12. Tully, Myles, Rowe, Jevsevar *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester. 2005, 2002, 2000, 1993.
13. Myles, Rowe *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2002, 2000,
14. Devers, Hemmerich, Weiss *et al*. 2011, 2006, 2002,
15. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester.
16. Myles *et al.* Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2002.
17. Devers, Li *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2011, 2007.
18. Li *et al.* Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2007.
19. Devers *et al*. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2011.
20. Su Mayr *et al*., Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2010, 2004.
21. Moncrieff, Livingston. Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2009.
22. The iGoniometer (Ockendon) (rebranded as Knee Goniometer in 2010, 4) Level of agreement between a novel smartphone application and a long arm goniometer for the assessment of maximum active knee flexion by an inexperienced tester, 2011.