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### RESEARCH ARTICLE

#### RELIABILITY OF GONIOMETER RECORDS APPLICATION FOR MEASURING RANGE OF MOTION OF KNEE JOINT IN NORMAL HEALTHY INDIVIDUAL

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Reliability, Mobile Device, Goniometer  
Records, Range Of Motion

#### Abstract

**Background:** Evaluation of range of motion is integral part of assessment of musculoskeletal system. Range of motion is an essential outcome measure for any orthopedic management protocol. A new technology is developed to measure range of motion by using mobile phones. The objective of this study is to determine intra and inter-rater reliability of mobile device goniometer “goniometer records” in measuring knee flexion range of motion.

**Objectives :** To find out intra and inter rater reliability of goniometer records application.

**Material and Methods:** 100 students of physiotherapy aged between 19-25 years.

**Outcome Measure:-** Range of motion is the main outcome measure for this study.

**Result:-** 23 males and 77 females within normal body mass index participated. Mean age of participants was 20.39 years .by using student’s unpaired “t” test intra rater reliability for goniometer records application was high & inter rater reliability was moderate to high. (  $p < 0.05$ ).

**Conclusion:** “Goniometer Records” application has high intra-rater and inter-rater reliability was moderate to high..this device can be used to assess range of motion of knee joint.

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#### Introduction:-

Devices for measurement of range of motion of the joints of the body includes various instruments like the Goniometer and Inclinator which use a stationary arm, fulcrum, and moving arm to measure angle from axis of the joint<sup>[2]</sup> Evaluation of Range of motion is an important outcome measure for any orthopedic treatment protocol, as well as integral part of assessment of musculoskeletal system.

Universal Goniometry has long been regarded by the physiotherapist as the most frequently used objective tool for measuring articular ROM & contributes for accurate diagnoses & setting treatment Protocol. The goniometer is the most commonly used tool to assess ROM and has been validated for patients with knee Restrictions<sup>[3]</sup> For more than a decade, there has been debate around the best method for measurement of ROM in the Clinical setting, and the techniques and measuring devices vary among professionals. Some authors suggest that limb Goniometry may contain errors of between 5 and 10 degrees even when performed by experienced clinicians<sup>[6]</sup>

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Now-a-days Smart phones have become a staple in our society. They are essential for our day-to-day lives as well as a healthcare tool for measuring joint ROM. Mobile technologies, and in particular mobile applications ( apps ), are the one making most profound impact on both patients and healthcare practitioners.<sup>[18]</sup> Recently however, a range of smartphone applications that offers an alternative means for measuring joint range of motions have become available.<sup>[12]</sup> Recently Smartphone application developers have created mobile applications that are intended to Work like Universal Goniometer.

These type of applications use the accelerometers in phones to calculate the angles of joints Measured. A smartphone applications provide a simple & more accessible means of evaluating joint range of motion. Goniometer Records is an unique app as it is not only measures the range of motion at joints but also helps you keep a Record of all the readings so we can compare patient's readings at various visits. It is said to be the first known app which Combines goniometer readings with the basic records of patients. In this app, readings can be recorded with separate profile For each patient to keep a good record to check the sequential improvement in the range of motion at different follow up.

### Need Of Study:

Need of the study is to analyze the reliability of an android app as compared with traditional goniometry for measurements of joint range of motions. Sometimes it is so difficult to properly position and maintain the moving and stationary arms of the goniometer along the segments of the bones while measurement, and the axis of rotation is not everytime clear, especially While measuring for complex joints, so mobile application can be used for measuring accurate readings.

There are many applications are available for measurement of joint range of motion there were no applications are available with very high reliability, so the purpose of this study is to find out reliability of Goniometer records application. It is not possible to carry goniometer everywhere so if smartphone have this application it will be very easy to take assessment of range of motion anytime anywhere. such type of study has not been carried out with high sample size yet so this study will be helpful for further research.

### Objectives:-

1. To access intra rater reliability of Smartphone goniometer records application.
2. To access inter rater reliability of Smartphone goniometer records application.

### Procedure:

Participants were screen according to inclusion and exclusion criteria. The informed written consent was taken from the participant regarding the procedure prior to the study. Each participant was analyzed for accessing ROM of knee joint with Goniometer records application and then cross checked the readings with standard goniometry.

### Individual and setting:

100 physiotherapy students (screened according to inclusion & exclusion criteria) participated in this study. For checking Intra rater reliability same therapist will take 3 readings at 3 consecutive days and for Inter rater reliability, 2 therapist will take readings at same time and then compared it with standard goniometric readings.

### Method:-

Subjects were placed in the supine position, The fulcrum of the goniometer was placed on the lateral condyle of the left femur, the fixed arm of the goniometer was situated on the lateral aspect of the femur pointing to the greater trochanter, and the movable arm was placed on the lateral aspect of the leg pointing to the lateral malleolus, then ask subject to flex the knee joint and measure the angle with the universal goniometer and then repeat the procedure with Smartphone application- "Goniometer Records".

### Data Analysis And Interpretation:

**Table No 1:-** Demographic Data.

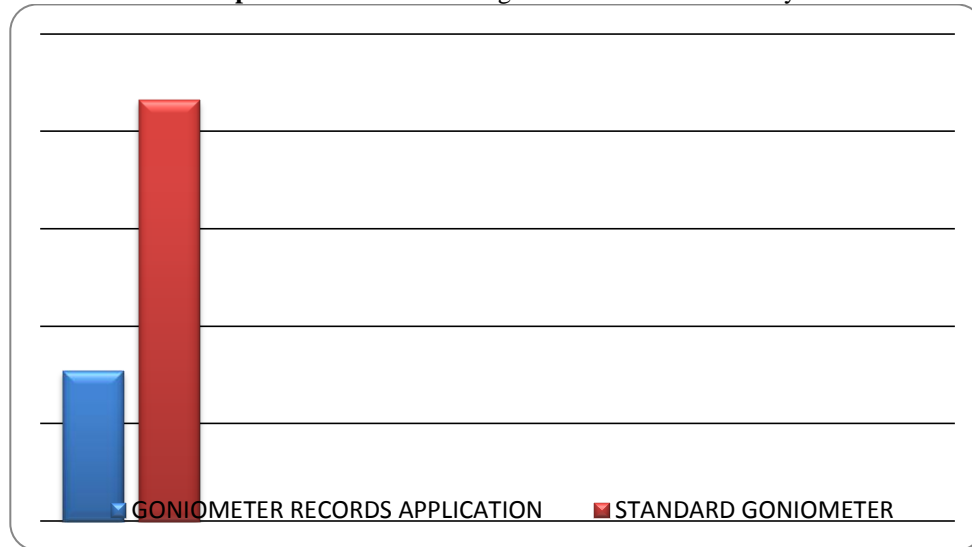
Demographic Characterstics	Values
Age ( years )	20.39±1.22
Gender ( F: M)	77 : 23

**Result:-**

The average age of the participants was 20.39+1.22 years and 77 of them were females and 23 of them were males.

**Table No 2:-** Mean Readings of Intra Rater Reliability.

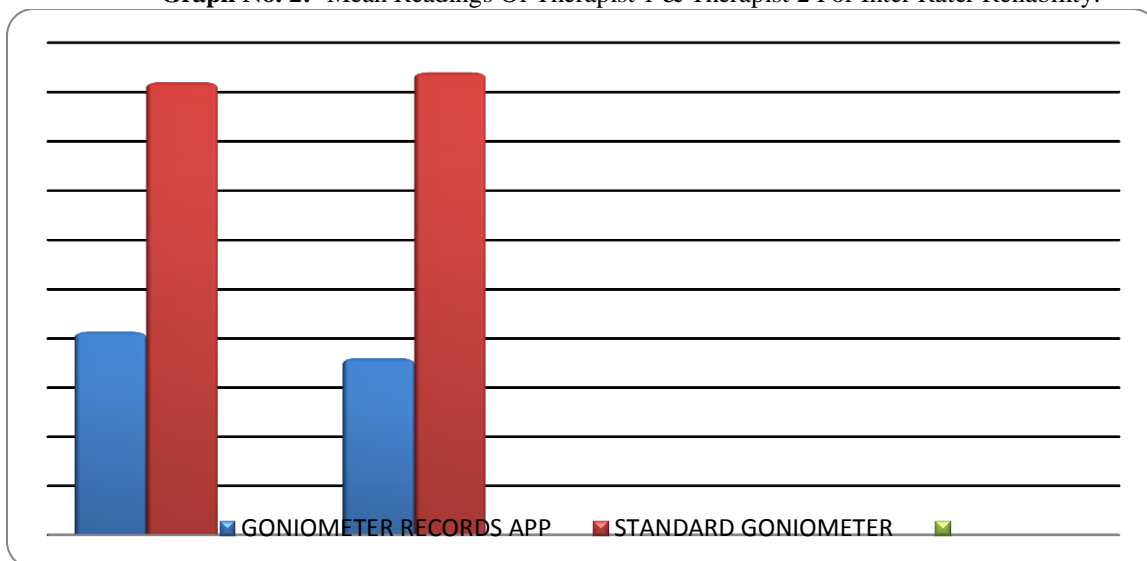
Reading	Goniometer records application	Standard goniometer
Mean	122.27	123.66

**Graph No. 1:-** Mean Readings Of Intra Rater Reliability.

Result No. 2 By applying Student's Unpaired "t" test there is no significant difference between mean readings of goniometer records application and standard goniometer.  
( $p < 0.05$ )

**Table No. 3:-** Mean Readings Of Therapist 1 & Therapist 2 For Inter Rater Reliability.

Mean readings	Goniometer records app	Standard goniometer
Therapist 1	122.07	124.6
Therapist 2	121.8	124.7

**Graph No. 2:-** Mean Readings Of Therapist 1 & Therapist 2 For Inter Rater Reliability.

**Result No. 3:-**

By applying Student's Unpaired "t" test there is no significant difference between mean readings of goniometer records application and standard goniometer taken by therapist 1 & 2.

**Result:-**

By applying Student's Unpaired "t" test, there is no significant difference seen between mean readings of Goniometer Records App taken by therapist 1 and therapist 2, when compared to standard goniometry readings taken by 2 therapists. 'p' value is less than 0.05 ( $p < 0.05$ ).

As the readings taken with Goniometer Records Application & standard goniometer are seen to be equal in normal healthy individuals, therefore the Goniometer Records Application can be used as reliable tool to measure knee joint range of motion.

**Discussion:-**

This study was carried out to find the intra rater reliability and inter rater reliability of Goniometer Records Application. In this study 100 healthy normal college students were included which include 27 male & 73 female participants. Assessment of every participant was taken by therapist 1 and therapist 2 for checking the inter-rater and intra-rater reliability. For intra rater reliability, as the mean of 3 readings & the standard goniometry readings seems to be almost equal; so according to the statistician of the university, after applying students unpaired t test results shows that there is no significant difference between the mean values taken with goniometer records application & standard goniometer readings. ( $p < 0.05$ ). For inter rater reliability also the values taken by therapist 1 & therapist 2 seems to be nearby: so according to statistician, by applying students unpaired t test there is no significant difference between mean values of goniometer records application taken by therapist 1 & 2, when compared to standard goniometer readings again taken by the therapist 1 and therapist 2. (i.e.  $p < 0.005$ )

Numerous researches are being done to find a gold standard method to measure the spinal ranges. Studies have been reported with regard to reliability of knee joint ROM using various types of testing tools and procedures in different positions,<sup>[19]</sup> all that studies were varied out with limited sample size, neither a single study proved the reliability of smartphone goniometer application with adequate sample size. This is the first known study to find out reliability of goniometer records application with adequate sample size of 100 participants. In this study we have managed to prove the reliability of Goniometer Records Application along with its clinical implication in the future.

Table no. 1 shows demographic data of the subjects included in the study in which 100 were included, (27 were male and 73 were female participants) with mean age of  $20.39 \pm 1.22$  years and none of the subjects dropped out during the study

Table no. 2 shows mean readings of Goniometer Records App & Standard Goniometer which are  $122.27^0$  &  $123.26^0$  respectively which shows only  $0.99^0$  difference. That shows the intra-rater reliability is high.

Table no. 3 shows mean readings of Goniometer Records App & Standard Goniometer taken by 2 different therapist which are  $122.07^0$  &  $124.60^0$  taken by therapist 1 &

$121.8^0$  &  $124.70^0$  taken by therapist 2 respectively, which shows the difference of  $2.53^0$  &  $3.62^0$  respectively by therapist 1 & 2. It shows that inter-rater reliability is moderate to high.

**Conclusion:-**

Result of the present study revealed that the Smart phone Goniometer Records Application has high intra rater reliability. The Inter rater reliability was also moderate to high. Therefore this device can be used in assessment of knee joint range of motion in healthy normal individuals.

**Clinical implimentation:**

Goniometer Records Application can be used as assessment tool for measurement of knee joint range of motion.

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