Research

Reliability and Validity of I Handy Android Application on Measurement of Lumbar Spine Movement in Patients with Low Back Pain

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ABSTRACT

Purpose: The purpose of this study was to investigate the reliability and concurrent validity of active spinal mobility measurements using a gravity-based bubble inclinometer and an android application.

Objective: This study was to examine the utility of an android application as a measurement tool in measurement of lumbar range of motion in low back pain patient

Methods: It is a descriptive study design with a sample size of 30 patients.

Results: Interclass correlation coefficients were used to analyze the ability of Samsung tab 2 and I handy application for measuring lumbar ROM in LBP patients.

Conclusion: The I handy application has good Intra and inter-tester reliability and it can be used to measure the lumbar spine range of motion.

Keywords

MDC -Minimal detectable change, ROM – Range of motion, LBP- Low back pain

INTRODUCTION

Low back pain (LBP) is a major health problem associated with disability and work absenteeism [1]. LBP is a very prevalent condition, which requires the high cost for treatment [2]. Back pain is a symptom and not a specific health condition or disease. During the clinical examination of patients with low back pain, one of the recommendations is the evaluation of the range of movement (ROM) of the trunk. Its measurement is used to facilitate the functional assessment as well as to analyze the evolution of the treatment of these patients. According to the APTA Guide to Physical Therapist Practice the examination of joint integrity and mobility is necessary in order to select appropriate physical therapy interventions. With regard to the lumbar spine, measuring its range of motion has always been important for physicians and physiotherapists. This evaluation forms part of an orthopaedic physical examination since limitations on movement have a variety of clinical correlations. Although range-of-motion examinations are nonspecific, they identify spinal diseases at different levels and thus also serve as an instrument for assessing the therapeutic response. Waddell G measured the lumbar range of motion and concluded that there was an association between measures that restricted the range of motion and occurrences of lumbar pain [2]. Saur PM measured the range of motion

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in individuals with and without lumbar pain [3]. Mayer TG said there are several methods that quantify ROM such as observation, the Schober's method, goniometry, electrogoniometer, inclinometer, and radiological analysis [4].

A great deal of research has gone into examining different tools for measuring spinal mobility. Tools available for clinical use include plumb line, goniometry, fingertip to floor, flexi curve, tape measures, visual-photographs, motion analysis and dual inclinometer. These methods vary in complexity of use and costs. There are a small number of studies on the reproducibility of these instruments in patients with low back pain. The method or instrument clinician uses may vary and is often dependent on the accessibility of the instruments to the clinician, cost, educational dogma, and the specific movements being evaluated. Goniometry has been used widely due to its portability and low cost. A limitation of goniometry is that it requires the clinician to use both hands, and locate anatomical landmarks, making stabilization of the patient's position more difficult, thus increasing the risk of error by inaccurate reading or incorrect placement. Additionally, goniometry does not allow the differentiation between the pelvic and lumbar contributions to spinal mobility. The inclinometer is an alternative to goniometry that incorporates the use of constant gravity as a reference point. Bubble inclinometers are portable, lightweight, inexpensive, and require training similar to that of goniometry. Disadvantages of inclinometer may be their accessibility in clinics and familiarity with measurement procedures by clinicians. A study by Samo found that the source of greatest variability of inclinometer measurements may be caused by the examiner and or technical errors [4]. Procedural errors such as misplacement of the inclinometer at a region distant to the land mark, failure to maintain constant pressure during movement, and technical errors, such as holding the inclinometer slightly off plumb, could give inaccurate readings.

Despite the growing popularity of smart phones in recent years, this evolution of technology has not been studied as a clinical instrument for measuring lumbar ROM. Research to determine the reliability of smart phone applications is necessary prior to implementation of such equipment in the clinical setting. Therefore, the purpose of this study was to investigate the intra rater and inter rater reliability of spinal ROM measurements of total thoracolumbo-pelvic flexion, total thoracolumbo-pelvic extension, isolated lumbar flexion, and thoraco lumbar lateral flexion using both a Samsung smart phone (On5) with I Handy Level application, as well as a bubble inclinometer. Additionally, the authors sought to investigate there liability and concurrent validity of the android Application.

Methodology

The descriptive study design was used for this study, further, the type of study used being correlation in nature. For examination the inclusion criteria considered was the patient with potent pain in the low back for the minimum duration of 6 months, the age group considered was from 20 years to 40 years. Whereas caution was taken that the patient didn't have any prior history of cardiovascular dysfunction. The patients were selected on basis of whoever came with the above criteria. For examination bubble inclinometer and Samsung phone with I handy application was considered. Patients with other problems such as IVDP, spinal cord disturbance, infective conditions, OA, traumatic injury were not included for research.

Procedure

Patients first were selected based on the criteria fixed. The patients selected were first given warm up exercise for the duration of two minutes. The exercise selected was chosen as it primarily required lumbar rotation i.e., supine pelvic rotation with the knees bent at 90 degrees followed by rhythmical rotation of 30-45 degrees to the left and right for two minutes duration therefore did not influence the tested movement plans. After the warm up patients were asked to stand in a comfortable position, while their skin was marked approximately at T12 & S1 spinous process by the use of a dry erase marker. The iliac crest was used as a baseline landmark for L4-L5. Once the baseline was identified the examiners palpated down the S1 spinous process. These were used as the landmark for placement of inclinometer as described by waddle, thereafter all patients were informed about the five basic movements which were measured thereafter by the examiners. The five basic movements were thoracolumbo-pelvic flexion, isolated lumbar flexion, thoracolumbo-pelvic extension, and right and left lateral flexion. These five movements were demonstrated by the examiner with verbal clues .Thereafter patients were asked for one practice session of all five movements'. The purpose of the demonstration and practice

was to familiarize patients with requested movements. Followed by the practice trial, patients performed each of the five active ROM movements in consecutive order for each active repetition patients were requested to move to the limit of their end range and maintain the position while the angle was obtained with bubble inclinometer and Samsung tab2 I handy level application consecutively.

At first, the measurement was recorded by examiner 1. Each measurement was obtained twice with both the instruments before proceeding to the next movement plan. The mean value of the two measurements from each instrument was used for analysis. After completion of the measurement by the examiner 1, the patients were given a 10 min break before the next session of measurement by examiner 2. Examiner 2 followed the same procedure as examiner 1 giving warm up and then recording data of five basic active movements of the patient's .Both the examiners were blinded to the results.

The next fresh session of measurement by both the examiners was after 24-48 hours of the gap. Were the process consisted of 2 min warm up followed by 5 measurements by examiner 1 & 2 by each device.

Data Analysis

■ Statistical methods

Data analysis was performed using IBM SPSS version 20.0 for Windows statistical program. Descriptive data including mean measurement angles with standard deviations (SD) were calculated for each session. The reliability of all measurements was determined by the interclass correlation coefficient (ICC).

Results

30 LBA subjects were recruited for this study in which 18 male and 12 female. The demographic data of the participant were age 35.2, height 161.8 ± 8.13, and weight of the patients 65.55 ± 11.21**(Table 4)**.

The main aim of this study is to find out the inter and intra-tester reliability of the Android application used in Samsung smartphone (model). In this study was measured thorocolumbarpelvic flexion (TLPF), Isolated Lumbar Flexion(ILF), throcolumbopelvic extension(TLPE), lateral flexion right side(LFRT), Lateral flexion left side(LFLT). Each movement was measured with both examiners in a different time with Android Application as well as gravity assisted inclinometer **(Table 2)**.

Discussion

The aim of this study was to find out inter and intra-tester reliability of I Handy application of smart phone. There were 30 low back pain patients was participated in this study.

The Intra and inter-tester reliability were checked for five lumbar spine movement (TTLPE, ILF, TTLPE, RT TLLF, LT TLLF) because these movements were frequently measured when the patients are coming to the clinic. Most of the lumbar spine pathologies like Ankylosing spondylitis, back strain, osteoarthritis, scoliosis, fracture, spondylolisthesis [5,6]. The above mentioned conditioned are relatively affect the lumbar spine mobility and warrant the lumbar spine range of motion measurement. Hence the measurement of lumbar spine range of motion is mandatory for all lumbar spine pathology patients.

Finding the accurate tool to measure the lumbar spine range of motion will help the clinician and benefit to the patient. The existing methods including inch tape, inclinometer, goniometer are expensive and difficult to use it by all the healthcare providers.

There are few published studies measuring the reliability and validity of I Handy apps and they were done it with normal individual [7,8]. This is the first study attempted with patients and the result of this study shows that few movements TTLPE, ILF has good intra-rater reliability and TTLPE, LT TLF has good inter-reliability. These results are similar to previous studies **(Table 3)**. The other movements RT TLF, LT TLF of intra-tester and RT TLLF of inter-tester reliability shows poor correlation. This may due to skin movement and slippage during extreme lateral flexion, extension [7].

The concurrent validity of I handy app was done with gravity assisted inclinometer and the result shows that I handy app has good validity correlation (p=0.05).

One advantage of using the I Handy app over the gravity-based inclinometer is that the app is available anytime, anywhere and can be downloaded for free from play store **(Table 4)**. Moreover, this app is also available for free for Apple store. As the number of smartphone users

Table 1: Demographic data.

Age	Gender	Height	Weight
35.20	18(M), 12 (F)	161.84	65.55

Table 2: Descriptive data.

Instrument	TLPF	ILF	TLPE	LF Right Side	LF Left Side
I Handy android Application	80.1(9.5)	16.8(12.9)	25.87 (12.9)	30.9(6.8)	33.6(10.3)
Gravity assisted Inclinometer	78.26 (21.8)	24.8(12.9)	23.7(12.9)	26.1(7.9)	25.5(8.4)

Table 3: Intrarater Reliability of Android Phone for Rater A.

Instruments	Total Thoroco Lumbar Pelvic Flexion	Isolated Lumbar Flexion	Total Thoroco Lumbar Pelvic Extension	Right Thoroco Lumbar Lateral Flexion	Left Throcolumbar Lateral Flexion
Android Phone Application	0.399*	0.399*	0.393	0.195	0.303
ICC inter tester reliability was TLPF 0.726, ILF 0.399, TLPE 0.546, LF RT 0.249, LT LF 0.585					

Table 4: Interrater Reliability of Android Phone.

Instrument	Total Thoroco Lumbar Pelvic Flexion	Isolated Lumbar Flexion	Total Thoroco Lumbar Pelvic Extension	Right Throroco Lumbar Lateral Flexion	Left Throcolumbar Lateral Flexion
Android Phone Application	0.726**	0.399*	0.546**	0.249	0.585**
The validity of android application was done by using gravitational inclinometer, all the movements were measured both gravity assisted inclinometer, and android application. The ICC values are in Table 5.					

Table 5: The ICC values.

Measurement	ICC
Total Thoroco Lumbar Pelvic Flexion	0.525**
Isolated Lumbar Flexion	0.191
Total Thoroco Lumbar Pelvic Extension	0.415*
Right Throroco Lumbar Lateral Flexion	0.294
Left Throcolumbar Lateral Flexion	0.422*

has been increasing since the last decade, utilizing a valid and reliable app instead of traditional instruments can provide an easy, simple and cost-effective measurement of joint ROM [8].

This study has many limitations, the examiners face trouble to find out the reference point for marking due adiposity. Another limitation was during the measurement the patients were complaining about increased pain, fear of movement **(Table 5)**. Hence the future research may be done with different body mass index (BMI) and ease the patient fear of movement belief [9-19].

Conclusion

Lumbar spine disorders are more and it needs an extensive assessment for finding accurate pathology by the physiotherapist. The lumbar spine range of motion measurement is compulsory for all the lumbar spine disorders. This study result shows that I handy app can be used to measure the lumbar spine isolated flexion, extension, lateral flexion.

Conflicts of Interest

All authors have none to declare.

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