Original Research Article

Reliability of goniometry to determine the hip range of motion

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Abstract

Purpose: The purpose of this study was to determine the intra-tester and inter-tester reliability of goniometric measurements when measuring the hip joint. Also this study aimed at determining the validity and reliability of goniometry as a tool to diagnose hip pathologies and record the hip range of motion. **Materials and Methods:** Fifteen recreationally active male participants (age 26.67 + 4.84 years) and five physiotherapists took part in this study. Measurement values were got by performing passive range of motion on each participant. Angles derived from the goniometry measurements were compared to the known standard angles of the hip range of motion. An intervention was also performed to see the difference in measurement values after sensitising the physiotherapists to methods of performing goniometry accurately and get precise and valid results. Intraclass coefficient correlations (ICC) were performed to see the correlation between inter-tester and intra-tester measurements. The Root mean square error (RMSE) was used to determine the accuracy of goniometric values got by physiotherapists after the intervention. The Root mean square error of goniometric measurements of the hip range of motion was calculated in reference to standard values (RMSE- 8-18). **Results:** The left sided hip internal rotation showed the highest deviation from the standard (RMSE- 16.20). Both sided hip extensions were the least deviated from standards (left- 8.00; right- 8.49). The intraclass coefficient correlations in intra-tester values were persistently higher than 0.70 whereas in the inter-tester setting, the values were less than 0.70. **Conclusion:** The intra-tester reliability was higher than the inter-tester reliability in our study. We observed that the goniometric measurement values were most reliable for hip extension and least for internal and external rotation, followed by hip abduction and adduction.

Keywords: Goniometry, Hip, Pathology, Reliability

Introduction

Sports is an essential part of many individuals lives; not only athletes performing at competitive levels, but also the common man for the purpose of fitness, leisure and entertainment. Over time, each sport places specific demands on musculoskeletal system, which may result in tissue adaptation or overuse injuries. As a result, many individuals who participate in sports experience injuries that relates to their participation [1,2,3]. Hip disorders leading to chronic pain have been significantly noticed in many sports like football, hockey, soccer, rugby, martial arts and tennis [4,5]. The pathology may arise either due to congenital malformations of the femur and acetabular rim or excess shear loads on the joints due to the demands of the sport [6,7]. These factors reduce the ability to participate in athletic exercises. The incidence of hip injuries in the athletic population it is 5-6% [8]. According to National Joint registry, a total of 800,683 primary hip replacements were carried out in England and Wales in 20015/16. Of these, 94 per cent were due to osteoarthritis. Although hip are most commonly related to extra-articular muscular strains or sprains, intra-articular lesions affecting the acetabular labrum, articular cartilage, and capsular and ligamentous structures are frequently the cause of intractable hip pain that may be difficult to diagnose accurately [9]. Studies have proven that clinical techniques like goniometric measurements of the range of movements of the hip in symptomatic adults have helped in the early diagnosis of FAI. Thus, following treatment

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have prevented OA. For hip screening to be utilized on a mass basis, should encompass features like easy availability, affordability, high reliability (both inter-observer and intra-observer) and validity. A reliable clinical instrument allows for measurement outcomes that are consistent, accurate, precise and predictable [10]. Over the past recent years, many developments have occurred in measuring ROM; from advanced goniometers to high speed cinematography.

However for clinical purposes, physiotherapists and orthopedicians still rely on goniometry as a tool to quantify baseline limitations of motion, decide on appropriate therapeutic interventions and document the effectiveness of those interventions [11,12,13,14]. The universal goniometer remains the most versatile and widely used instrument in practice. [14,15,16]. Many researchers agree that manual goniometry is the most frequent method in physical therapy practice with good to excellent reliability [17]. There are two kinds of reliability. One is intra-tester reliability and other is intra-tester reliability. Intra-tester reliability refers to whether the device is reliable when testing is administered repeatedly by the same individual. Intertester reliability refers to whether the device is reliable when testing is administered by different individuals. Both types of reliability are important when evaluating a device. Without evidence of reliability, the usefulness of a measurement device is questionable. In rehabilitation science early intervention of hip injury is vital for athlete's career. Goniometry is a popular first method of assessment for musculoskeletal impairments.

An understanding of normal and pathological range of motion using goniometry can help us by providing a differential diagnosis of the underlying hip pathology that helps to determine the need of surgical intervention. Goniometry is a convenient and easy assessment tool which can be readily used by health care professionals to identify acute and chronic injuries in athletes irrespective of availability of a laboratory or clinical set up. This study will focus on determining the reliability of goniometric measurements to be as exclusive indicator of need of surgical intervention. The values obtained using goniometric analysis will be compared with the standard age matched control values. It will also explore inter-tester and intra-tester reliability of goniometric measurements. The aim of this study is to establish use of goniometry as an intelligent and significant tool to diagnose hip pathology.

Materials and Methods

This study was done on 15 recreationally active male participants. This study was given ethical clearance by the Ethics committee of the institution after submission of ethical and laboratory risk assessment forms.

Study Design: Cross-Sectional, Observational study.

Inclusion Criteria

1. 18-40 year old healthy young male.
2. Willingness to participate in the study.
3. Physiotherapists interested in carrying out the assessments.

Exclusion Criteria

1. Hip pain
2. Past or present hip injury
3. Skin diseases

Participants: The mean age of participants was 26.67 ± 4.84 years and the mean height was 173.7 ± 10.68 cms. The mean weight of the participants was 79.41 ± 12.45 kgs). All the participants including the physiotherapists were selected by public notice.

Setting: Written consent forms were obtained from all participants before the study began. 15 participants and 5 physiotherapists were selected for inter-tester and intra-tester reliability test of goniometry. The measurements were carried out in the following order: Hip flexion, abduction, adduction, extension, internal rotation and external rotation for the ease of participants. Five long arm goniometers were used in this study. The 360º goniometers were made of clear transparent plastic with 1º intervals and the arms measuring 7 inches(Figure 1, Figure 2) The participants were asked to wear only a pair of shorts to facilitate the identification of anatomical surface markings on participants .The treatment couch was arranged so that the participants could lie down on it and physiotherapists could perform the passive ROM and collect data. All the movements for goniometry were done 3 times bilaterally by the physiotherapists.

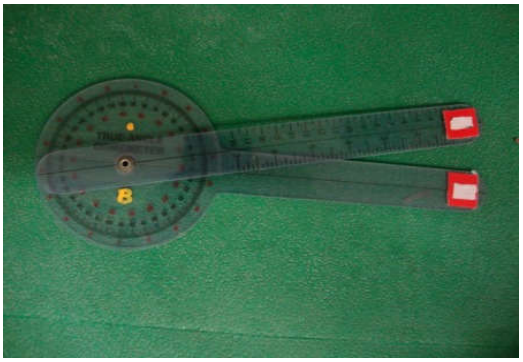

Figure-1: Long arm Universal goniometer

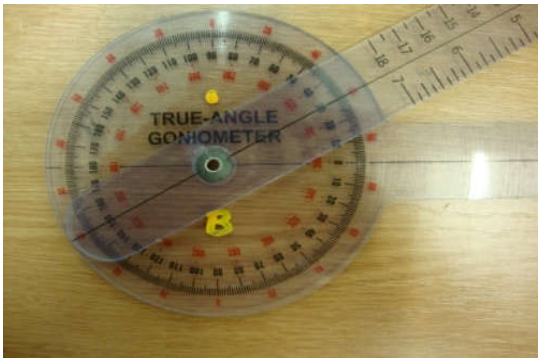

Figure-2: Universal goniometer close up view

Study size: 15
Quantitative Variables: Passive ROM was measured for goniometry.

Statistical Method: The SPSS software was used to perform all statistics in this study (version 11.0). For Intra tester and inter tester reliability, ICC was used. Portney et all suggested that values above 0.75 can be considered good reliability and those below 0.75 poor to moderate reliability [18].

Results

To determine the reliability of goniometric measurements and deviation from the standard ROM, we compared the goniometric measurements with the standard universally accepted clinical ROM for each hip movement. Table 1 shows RMSE for goniometric measurements in reference with standard values (RMSE 8-18).The left sided internal rotation shows the highest deviation from the standard values (16.20). Hip extension measurements using goniometry are least deviated from standards (left- 8.00; right- 8.49)

Table-1: Validating goniometric ROM measurements against standard clinically accepted ROM measurements for various hip movements.

Hip movement	Known standard measurements (in degrees)	Goniometry measurement (in degrees)
Left flexion	120	9.28
Right flexion	120	9.56
Left extension	30	8.00
Right extension	30	8.49
Left abduction	45	11.50
Right abduction	45	10.24
Left adduction	30	9.86
Right adduction	30	9.27
Left internal rotation	45	16.20
Right internal rotation	45	12.76
Left external rotation	45	9.82
Right external rotation	45	12.30

The efficiency of the assessor is an important factor in goniometry. This includes accuracy and precision of measurements taken along with proper techniques of performing goniometry. To determine this, we performed an Intratester reliability test on 2 physiotherapists. ICC was calculated for the measurements made by 2 physiotherapists on 5participants. Also, we tested the inter tester reliability of the physiotherapists performing goniometry. Here, 5 physiotherapists performed goniometry on 5 participants. The reliability is measured according to ICC value on a scale of less reliable < 0.40, moderately reliable < 0.40-0.70 and highly reliable > 0.70. According to this scale, Inter tester reliability demonstrated low reliability compared to intra tester (Table 2). Although the intra tester reliability is higher, it varies from person to person, thus efficiency and experience of the physiotherapist is a major contributing factor.

Table-2: Determination of inter tester and intra tester reliability in goniometric measurements.

Intra	Left flexion	Right flexion	Left extension	Right extension
Physiotherapist 1	0.959	0.932	0.979	0.937
Physiotherapist 2	0.858	0.900	0.843	0.897
Inter				
Physiotherapist 1-5 ICC	0.480	.384	0.188	.081
Cronbach's alpha	0.822	0.757	0.586	0.307
Intra	**Left abduction**	**Right abduction**	**Left adduction**	**Right adduction**
Physiotherapist 1	0.848	0.691	0.982	0.907
Physiotherapist 2	0.839	0.831	0.759	0.645
Inter				
Physiotherapist 1-5 ICC	0.349	.896	-0.63	.211
Cronbach's alpha	0.728	0.632	-.012	0.572
Intra	Left internal rotation	Right internal rotation	Left external rotation	Right external rotation
Physiotherapist 1	0.893	0.965	0.940	0.935
Physiotherapist 2	0.648	0.744	0.852	0.841
Inter				
Physiotherapist 1-5 ICC	0.478	0.260	-0.001	.295
Cronbach's alpha	0.821	0.637	-0.004	0.677

The table shows inter tester and intra tester ICC values for various hip movements. Intratester reliability is measured as ICC of measurements taken by each physiotherapist on five participants. Inter tester reliability is measured as ICC of measurements taken by five physiotherapist on five participants.

Discussion

The goal of any clinical method of assessment is to produce accurate and reliable results [19]. This would ensure that measurements taken with a particular instrument would reflect true changes within the patient, rather than measurement error. If the measurement device is not accurate and reliable, it is not possible be confident in the results of repeated measures.

Apart from pain, reduction in functional range of motion is a symptom of underlying hip pathology. As severity of the pathology increases, the ROM of hip becomes more restricted and affects not only in athletic activities, but also affects activities of daily living. Measurement of hip function is important to detect any underlying hip pathology or assessing the outcomes of surgery and therapy. Goniometer proves to be a widely used tool of assessment by clinicians to assess ROM.

It has the advantage of being easy to use and inexpensive. Goniometric readings have been reliable and accurate, but it depends on the assessor's previous experience. The participants were assessed by physiotherapists using universal goniometers. Measurement protocol (position of participant) was kept same for all the physiotherapists.

This may be since the ROM may be vastly varied amongst the participants. Also, while performing measurements, researchers and physiotherapists have neglected the effect of stabilization of pelvis, thus allowing compensatory movement to occur and increase in range of motion. This is one of the reasons why many clinicians prefer prone lying with knee bend technique to prevent hip movements while measuring hip rotations. Much variability is also seen in hip flexion.

During hip flexion, the pelvis needs to be stabilized. If the pelvis is not stabilized, additional ROM is acquired by Lumbo-pelvic rhythm. The lumbo –pelvic rhythm is a compensatory mechanism which occurs in hip flexion and abduction in both lumbar spine and pelvis, where the segment moves or tilts to produce a concomitant movement. In the intra tester and inter tester reliability, the goniometer has proven as a tool of precision. This study shows a higher Intra tester reliability than inter

tester reliability. This result is in agreement with results performed to assess inter tester and intra tester reliability of goniometry [20,21]. Though the intra tester reliability is greater than inter tester, it depends upon the expertise of the assessor.

Limitations- One limitation was the number of participants available for the study. It was difficult to gather more number of participants, since the time of study coincided with yearly vacations. Also, researchers failed to apply proper technique of performing movements on participants. For example, the hip was not completely stabilized during hip flexion, so values more than normal were recorded.

Conclusion

The present study has presented results from goniometric measurement of the hip ROM. The values from the study were most reliable for hip extension and least for internal and external rotation, followed by hip abduction and adduction. Intra tester reliably was seen higher than inter tester reliability in our study. The present study adds to our knowledge that a simple test like goniometry is accurate and reliable in detecting changes in the hip ROM. If this is considered, then goniometry can certainly be used as a valid measure to detect underlying pathology in hip and the surgical intervention can be done on basis of it.

Contribution of Authors

Bhamare DS: Conceptualisation and study design
Ayare PP: Conceptualisation and study design
Khandge AV: Materials and methods and discussion
Shroff AS : Statistics and discussion
Herode P: Statistics and discusiion

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