Comparison of Muscle Length in Dominant Versus Non-Dominant Lower Extremity in Young Asymptomatic Individuals- A Research Protocol

Anushree Pawar[1], Pratik Phansopkar[2], KiranKumar[3]

[1]Final year B.P.T, Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha, Maharashtra. India, [2]Assistant Professor, Department of Musculoskeletal Physiotherapy, Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha, Maharashtra. India, [3]Associate Professor & HOD, Department of Musculoskeletal Physiotherapy, Ravi Nair Physiotherapy college, Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha, Maharashtra. India

Abstract

Background: Muscle length is defined as the length at which the maximum amount of force a muscle is able to produce. This length is determined by the joint angle corresponding to that muscle. Understanding the optimal muscle length as well as its comparison between the extremities is very important as a part of examination in physiotherapy, particularly in the cases of musculoskeletal disorders. Several tests are available for testing the muscle length. However standardize and reliable tests have been chosen to prevent the error while testing. Many studies have shown that there was difference in the lengths of muscle of lower extremity which was assessed in different players. However there is paucity of study on the muscle length of individuals who are completely normal and not the athletes.

Objectives: The objective of this study is comparison between the length of iliopsoas, hamstring, gastrocnemius, rectus femoris in dominant to non-dominant extremity in young asymptomatic individuals aged between 18-25 years.

Methods: Measurement of hamstring, iliopsoas, rectus femoris and gastrocnemius length will be acquired through standard goniometer. The methods of assessment that will be used are; active knee extension (AKE) tests the hamstrings, Thomas and modified Thomas test to evaluate iliopsoas and rectus femoris while prone, figure-four position accompanied by dorsiflexion for gastrocnemius.

Results: Once the study is completed, the parameters of outcome measure will be statistically analyzed and calculated.

Conclusion: Based on the previous data we assume that there can be a significant difference between the muscle lengths of lower limb in normal person.

Keywords: *Muscle length; Active knee extension (AKE) test; Modified Thomas test; Thomas test.*

Corresponding Author:
Dr. Pratik Phansopkar
Assistant Professor, Department of Musculoskeletal Physiotherapy, Ravi Nair Physiotherapy College, Datta Meghe Institute of Medical Sciences, Sawangi (M), Wardha, Maharashtra. India. Email:- drpratik77@gmail.com ORCID ID- http://orcid.org/0000-0003-3635-8840

Introduction

One important feature of the skeletal muscle is the length tension relationship that reflects possible strength with relevancy the length of muscle. Important parameter during length-tension relation is optimal length of muscle, described as length wherein maximal force will be produced by muscle. This is determined by the joint angle comparable to the optimal muscle length.

This optimum angle shows the operating range in the length-tension relation through the movement of joint along with the excursion of tendon. So knowledge of various aspects of muscle contraction together with its mechanics and physiology is important since it plays a vital role during surgical procedures wherein the optimal length reflects how efficient surgical process could be, it helps in designing primary guidelines for ergonomic advice and in structuring a rehabilitation program that would help to provide more benefit using the advantages of length-tension relationship for an individual muscle. Another concept namely muscle stress suggests of constant proportionality being balanced among maximum force of muscle and the physiologic cross sectional area. This parameter explains us the limitation in an individual muscle force[1].

It is common practice for physiotherapist to test length of muscle and flexibility as a section of assessment in patient with musculoskeletal disorders. Muscle length is simply measured by means of corresponding joint angle. Further length is determined on the basis of tests, comparison with normative values and between both the lower limbs. On the basis of this, exercises are been prescribed depending upon the information and other findings that is collected during examination time. Ranges that are obtained form an essential element during initial as well as recurrent clinic examination. Thus, identifying the length of muscle and their differences help us to know whether an individual would need any intervention focusing particular groups of muscle or joints. Also, the ranges obtained that of muscle length helps therapist to recognize individuals with reduced flexibility. This reduction in flexibility may be linked with an occurrence of painful event and injury to muscle of lower limb in future. To estimate the value of muscle length of extremity, it is necessary to make use of different techniques so as to get an objective measurement. Hence researchers have verified certain effectual techniques ensuring that the tests were easy to carry out, had higher inter and intra-tester reliability and they are clinical procedures usually practiced by the therapist[2].

There are several test available to measure the muscle length in lower extremity. Literature about muscle length testing had shown various techniques to test gastrocnemius length involving; passive range of motion, active range of motion, weight bearing techniques. Despite this, active dorsiflexion test is selected to check the length of gastrocnemius muscle because of its simplicity, reliability and standardization ease. A standard and reliable test that is chosen for the assessment of hamstring muscle length is active knee extension test (AKE) because its proven that it comprises of higher reliability that makes it a standardize test to use for an examination and stabilization of lower limb is achieved by this test, limiting the hip joint motion. Iliopsoas assessment to be done by the Thomas test while Modified Thomas test is chosen for testing the length of rectus femoris as one research have shown goniometer as a reliable tool to measure the hip extension using modified thomas test. It is a common and reliable test[3].

Parikh et al. 2015 conducted a study on establishing the typical values of muscle length of lower extremity, its comparison between dominant, non-dominant extremity of young elite cricket players having fifteen to twenty two years of age. It has been found that decreased flexibility is common risk factor in cricketers and the players can even lose carrier due to an injury. On account of this, a study was done over 100 participants from one stadium. Because there was need to assess flexibility since it has huge impact on player's performance and also it prevents musculoskeletal injuries, beside injury prevention is more desirable and better way for reducing injury in sports players. This research had helped the sports therapists to form specified muscle length norms. The result of study provided a reference range of muscle length in elite players. There was significant dissimilarity found between the lengths of rectus femoris, hamstrings, iliopsoas, and gastronemius of dominant and non-dominant side in these cricketers. Since the finding showed considerable difference between the dominant and non-dominant side in cricket players, it was suggesting the elite cricketers were more prone to the injury[3].

Marie corkery et al. 2007 done a study on establishing normative ranges for the lower extremities muscle length in seventy-two student of college. It aimed at obtaining the muscle length values in college students. Data was collected separately between males, females and a combined group. As per the result shown by the research a normative set of value was established for the lower extremity muscle length in resting state of

body. Implication of this study in clinical point of view incorporates individual's examination plus diagnosis. Further they advised use of flexibility as a measure for an injury prediction. Moreover the defined normative data helped to determine flexibility and direct the strategies to resolve the deficits. However, lack of analysis of reliability before beginning with the study was found as a limitation of this work. Certain differences were assumed to be present within the range of measuring error. Less number of subjects as well as restricted age group is the second limitation of this study[2].

Although many research have been done incorporating muscle length, its normal value and comparison between the extremities, there is need for my study because there is paucity of study that evaluates muscle length in asymptomatic individuals and whether there is any difference in dominant to non-dominant side. Therefore this study will guide the therapist to know whether there is presence of difference in the muscle length of individuals that are normal.

Objectives:

To compare the length of gastrocnemius, iliopsoas, rectus femoris and hamstring muscle from dominant to non-dominant side of young asymptomatic individuals.

Methods:

Study design: observational study

Setting: Datta Meghe Institute of Medical Sciences (DMIMS), Sawangi (M), Wardha.

Participants:

Inclusion criteria:

- Individuals willing to participate
- Individuals between ages 18 to 25

Exclusion criteria:

- Previous history of surgery in lower extremity or low back.
- Any pathology or recent injury affecting lower limb and lower back (during current three months).
- Medicines or substance intake that would cause an altered sympathetic function.
- No elite athletes are accepted.

Variables:

Outcome measures:

Age, height, weight, gender, past medical history and surgical history will be recorded prior to the study with the use of questionnaire. Dominant leg will be obtained by asking the subject 'what would be their preferred leg for kicking a football'. All four muscles will be measured initiating distally and moving proximally, right side before the left one. Both side lower limb muscle length measurement of hamstring, iliopsoas, rectus femoris and gastrocnemius muscle will be obtained using a standard goniometer. A goniometric measurement for the purpose of muscle length testing has shown to be reliable and also has better intrarater reliability than interrater reliability[2].

Gastrocnemius length will be measured in prone, figure-four position; foot to be measured hanged at the edge of the table. This position maintains the neutral attitude of lower extremity. While giving instruction, prior to starting a test, any trick movement performed by the subject will also be observed. The fulcrum of goniometer will be kept inferior to lateral malleolus, stationary arm parallel to fibula and movable arm lined with lateral aspect of calcaneum. Then subject will dorsiflex ankle and degree of dorsiflexion will be noted. There are many ways for testing the length of gastrocnemius however this position is chosen due to simplicity, less risk of researcher bias and excellent intra-rater reliability[2].

Active knee extension (AKE) test is chosen for assessment of length of hamstring. The subject will be taken into supine position with contralateral hip stabilize and knee flex to 90^0 as a starting point of reference. Fulcrum of goniometer will be placed laterally at knee, stationary arm parallel to femoral shaft while movable arm parallel to shaft of fibula. Subject is instructed to perform extension of knee unless a stretch will be experienced in the hamstring muscle and the knee angle will be measured where the subject felt some resistance very initially in the hamstring[2]. A study was carried out for determining the reliability of active knee extension

(AKE) test among healthy adults. Also some consider that Active knee extension (AKE) is a gold standard test for assessing hamstring flexibility. One research have demonstrated that the active knee extension test is easy to perform and require single person to handle with portable, simple, without any expensive apparatus and had also shown excellent interrater reliability and interclass correlation coefficient (ICC) values are 0.87 and 0.81, standard error of measurement (SEM) = 3.5 and 3.8degree[4].

Assessment of rectus femoris length to be done by Modified Thomas test. The subject will stand at couch's end with an instruction of holding the opposite knee and bringing towards own chest and further proceed towards supine lying with the one leg hanging outside table. Fulcrum of goniometer will be placing over lateral femoral condyle; stationary arm will be parallel laterally to femur and movable arm aligned with fibula in a line of lateral malleolus. This test will measure the range for knee flexion[2]. A study on the examination of interrater reliability of goniometric measurement while assessing flexibility of hip extension, results of this study showed that goniometer was reliable instrument that can be used for measuring hip extension flexibility using modified thomas test. Interrater reliability (r=0.91-0.93), Interclass correlation coefficient (ICC) =0.89-0.92[5].

For assessing iliopsoas length Thomas Test will be used. The subject will be told to lie on table and the heels hanging out by the edge. The subject will then be instructed to pull leg towards chest to flattened lumbar spine on table. Fulcrum of goniometer will be placed over greater trochanter, stationary arm aligned with the midline of trunk, movable one parallel to lateral aspect of the thigh. This test measures the hip flexion angle. Thomas test has wide acceptance and common clinical tool to measure iliopsoas tightness[2]. One study has been done about the reliability of thomas test while examining range of motion corresponding to hip. It showed Intrarater reliability=0.52 interrater reliability=0.60, Standard error of measurement (SEM) =1 degree[6].

Study size: 300

Expected Results:

Significant differences have been found in muscle length evaluated in different players. However, it has not been checked in individuals with no symptoms. Hence my study would help in knowing details about normal populations muscle length. Once it is studied and analysis is done, it is going to be presented as research paper.

Discussion

Optimum muscle length is the major factor to be considered in the length-tension relationship, whereas joint angle helps in determining the functional range by means of joint movement. Identification and knowledge of muscle length is very important as it has several beneficial role in an individual's life including; need for an intervention strategies if any, while designing rehabilitation program for an individual, to evaluate pre-competition risk for injury in an athlete, testing the flexibility of muscle since decreased flexibility is commonly resulting into muscle injury. Many studies on the lower limb muscle length have been done in the past years. Such studies have given normative values as well as showed significant difference in an individual's muscle length of lower extremity so far. But the study was done in a group of players and the result showed significant difference between muscle length of dominant and the non-dominant extremities of this athlete. Also normative set of muscle length values were found for the athletes. This is quite helpful for the sports therapist to know reference data about the players muscle length. However my study will be the first of its kind that would be assessing length of lower extremity muscles in the individuals who are completely asymptomatic. Individuals with past history of lower extremity disease or injury as well as the elite players will be prohibited. This is helpful as we will be able to obtain a data about muscle length in absolutely normal individual. Moreover this study will employ widely used methods for examination which are having appropriate reliability and validity as well as accepted by the researchers, found in literatures and research papers.

Ethical Clearance: Taken from institutional ethical committee.

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