Establishing normal values for lower extremities muscle length and comparison of muscle length from dominant to non dominant side in Elite Cricketers aged 15-22 years

Chintan Parikh MPT (Sports Rehabilitation), Lecturer, Charotar Institute Of Physiotherapy (ARIP), Anand.
Maneesh Arora MPT (Sports Rehabilitation), Professor & HOD, Department Of Physiotherapy SBSPGI, Dehradun.
*Corresponding Author Tel.: +91 9427152358; E-mail address: parikhcm5@gmail.com

ABSTRACT

Objectives: To establish a normative range of values for muscle length & comparison of muscle length in the Hamstrings, Iliopsoas, Rectus femoris, and Gastrocnemius muscles from dominant to non dominant side of elite cricketers.

Design: Observational with descriptive in nature.

Setting: Lalbhai Contractor Stadium, Surat, Gujarat.

Participants: Hundred elite cricketers participated in the study.

Methods and outcome measures: Bilateral muscle length measurements of the Gastrocnemius, Hamstring, Rectus femoris and Iliopsoas muscles were obtained using a standard goniometer. The assessment techniques included: the prone, figure four positions with active Dorsiflexion for the Gastrocnemius, the active knee extension test (AKE) for Hamstrings, the modified Thomas test for Rectus femoris, and the Thomas test for Iliopsoas.

Results: Normative resting muscle length values were calculated from the group mean using goniometric measurements. There is significant difference in muscle length of dominant to non dominant side of Hamstrings, Iliopsoas & Gastrocnemius (p<0.05).

Conclusion: These data provides the sports physiotherapist with reference value for lower extremity muscle length. It Signifies difference in muscle length of Iliopsoas, Hamstrings, Gastrocnemius (p<0.05) from dominant to non dominant side in elite cricketers aged 15-22.

Key words: Muscle length, AKE, Modified Thomas Test

INTRODUCTION

Cricket is important game widely played in India and it is main sports. In terms of the intrinsic risk factors, lack of muscle flexibility is one of the most commonly postulated risk factors for the development of muscle injuries. Injuries due to lack of flexibility are very common in cricket & many of elite cricketer have lost important period of their prime carrier due to muscle injury. Zaheer khan
(Indian team fast bowler) advised to take 4-6 week rest due to Calf strain & he missed two tournaments in 2013 & also had Hams pull in 2003 & dropped for four crucial matches. It is not personal to Zaheer khan but also loss to Indian team. Sports injury prevention is the most desirable and cost effective way of reducing the risk of injury in sport. Muscle flexibility is key component to enhance the performance & to prevent recurrent musculoskeletal injury in athletes. Musculoskeletal screening of athletes is an assessment designed to detect internal abnormalities that may increase the risk of injury for an individual.

In cricket whether a batsman while taking run, a fielder while doing fielding and bowler during run-up for bowling requires good lower limb flexibility to prevent recurrent muscle injuries. Shorter hamstring muscle length associated with patellofemoral pain syndrome. A shortened rectus femoris may not allow full excursion of patella on the trochlea as the knee flexes, particularly when hip is extended. A decrease in hamstring or gastrosoleus flexibility may lead to increase knee flexion at heel strike and during stance phase of running cycle requires an increase in dorsiflexion. If the full range of dorsiflexion occurred at talocrural joint, further range is achieved by pronating the foot, particularly at subtalar joint. This causes an increase in the dynamic Q angle. These changes result in greater lateral patellar tracking and displacement and increase in patella femoral joint reaction force. Psoas tightness is accepted as a possible source of back pain. Tight Iliopsoas produces reciprocal inhibition of GM compromising more the intra-pelvic instability. Therefore, this study has chosen lower limb flexibility of cricketers as subject. I have selected cricketers from Surat city situated in south Gujarat where this sport is somewhat more popular.

After a review of literature, it was determined that there is less work done in the area of normative values for lower extremity muscle lengths in elite cricketers (age 16-22). It is therefore, the purpose of this study to collect such data to help sports physiotherapist attain a range of comparative normative values in upcoming bench of elite cricketers.

The muscle length testing methods and its normative values are important for sports physiotherapist for examination, to determine whether athlete needs specific intervention targeting muscle group or joint to prevent future injuries. This intervention is not limited to stretching programme but helps in strengthening programme also. Normative values for lower extremity muscle length are important in helping the sports clinician to identify athletes with decreased flexibility. A decrease in muscle flexibility may be associated with the development of pain and muscle injury in the lower extremity. There are so many tests available for measurement of muscle length.

The literature on muscle length testing showed that there are various ways to test Gastrocnemius muscle length including such as active range of motion, Passive range of motion and weight bearing techniques. The active Dorsiflexion test was chosen to determine Gastrocnemius length for its simplicity, minimal risk of researcher bias, ease of standardization and reliability. A common and reliable test used to evaluate the length of the hamstring muscle group is the active knee extension test (AKE). Examination of the Iliopsoas using the Thomas test as described by Magee. The Thomas test is a widely accepted and commonly used clinical tool for measuring Iliopsoas tightness. The modified Thomas test was used to measure the Rectus femoris length. This is a commonly used and reliable test.
METHODS

Sample description: Hundred elite cricketers from Surat district cricket association participated in the study through random sampling by lottery method. The mean age of all subjects was 17.33±1.99 years, height 5.56±0.29 feet, Body mass (kg) 60.13±10.06, BMI 21.03±3.354.

The inclusion criteria consisted of:

(1) Subjects between the ages of 18–22 elite cricketers only.

Exclusion criteria were as follows:

(1) Any previous surgery to the lower extremities or low back;
(2) Any recent injury or pathology of the lower extremities or low back within the last 1 month;
(3) Any variation of extreme posture including, but not limited to hyper/hypo-lordosis/kyphosis of the spine;
(4) Any medication or intake of substances that may cause alteration of function in the sympathetic nervous system;
(5) All of the subjects were measured at approximately the same time of day.

All subjects signed informed consent prior to participating in the study and the rights of these subjects were protected.

Equipment: Standardized goniometer is used to measure the length of Gastrocnemious, Hamstrings, Ilio psoas & Rectus femoris.

Data collection: Age, occupation, height, weight, weather athlete participate in cricket regularly or not (for the conformation of elite cricketers), past medical and surgical history recorded using questionnaire. Dominant leg was determined by asking the athlete preferential leg for kicking a football. The height and weight of athlete had recorded using standardised medical scale.

All the athletes warmed up for 5 minute before measurement. The four muscles were measured from distal to proximal. Right leg muscle’s length measured before left. The muscles were distributed in two groups, Gastrocnemious/ Hamstrings, Ilio psoas/ Rectus femoris. Standardized goniometric measurements were used.

Standardization of testing and positioning has been recommended to ensure reliability and minimize error when measuring joint range of motion.

For Gastrocnemious muscle length athlete was in prone lying in figure of eight position with measuring foot hanging at the edge of the couch. This position helps to keep the lower extremity in neutral position. Fulcrum of goniometer at the inferior aspect of lateral malleoli, stationary arm was parallel to fibula while movable arm was in line with lateral midline of calcaneus. The athlete was instructed to actively Dorsiflex the ankle actively until a stretch was feeling in Gastrocnemious. The therapist measured the range of dorsiflexion (Fig. 1).
Hamstring muscle length was assessed using active knee extension test the athlete was in supine position with contra lateral hip strapped down for stability.\textsuperscript{13, 20, 21}

The subject was then placed into 90 degree of knee flexion to be used as a starting reference point. The axis of the goniometer was placed on the lateral aspect of the knee through the centre of the joint line, the stationary arm was placed parallel to the shaft of the femur, and the moving arm was placed along the shaft of the fibula in line with the lateral malleolus.

The subject was asked to actively extend the knee until initial stretch was felt in hamstrings muscle & knee angle was measured at the same point.\textsuperscript{19}

For Rectus femoris muscle length, Modified Thomas was used. The subject stood at the end of the couch and was instructed to hold opposite knee to bring his chest by clasping with two hands. The subject then proceeded to lie supine on the table with the measuring leg hanging off.\textsuperscript{18} The fulcrum of

goniometer was placed at lateral femoral condyle, the fixed arm was on lateral femur in line with greater trochenter. Now measured the knee flexion angle of subject (Fig. 3).¹⁹

Fig. 3 Goniometric measurement of the Rectus Femoris muscle length

Iliopsoas muscle length was determined by Thomas test. The subject was instructed to lie supine on the table while heels hanging off the table. The opposite leg was pulled into the chest as far as possible in order to keep the lumbar spine flat against the table.¹⁸

The test measured the subjects’ hip flexion angle. The axis of the goniometer was placed on the greater trochanter with the stationary arm parallel to the midline of the trunk and the moving arm along the lateral thigh in line with the lateral condyle of the femur (Fig. 4).

Fig. 4 Goniometric measurement of the Iliopsoas muscle length
RESULTS

Subjects’ mean age, height and body mass were calculated and that data was also separated into males, females and combined groups (see Table 1). A majority of both males (92%) and females (93.6%) reported that their right leg was their dominant leg with the remaining subjects reporting left leg dominance. The mean values of muscle length for right & left side were given in table-1. The normative values of muscle length for dominant & non dominant side were given in table-2. Using SPSS software 17.0, we found statistical significant in difference (unpaired t test, p<0.05) of muscle length of Gastrocnemious, Hamstrings & Iliopsoas between dominant to non dominant side in elite cricketers aged 15-22 years (table-3). The Graphs had shown the normal distribution pattern for all four Gastrocnemious, Hamstrings, Rectus femoris & Iliopsoas muscles length.

<table>
<thead>
<tr>
<th>Muscles</th>
<th>Muscle length values (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Right side</td>
</tr>
<tr>
<td>Gastrocnemious</td>
<td>13.48±2.08</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>27.93±5.63</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>56.05±6.100</td>
</tr>
<tr>
<td>Ilio psoas</td>
<td>4.96±1.03</td>
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</tbody>
</table>
### Table 2 Mean muscle length value Dominant to Non Dominant side

<table>
<thead>
<tr>
<th>Muscles</th>
<th>Muscle length values (Mean ± SD)</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>Dominant</td>
<td>Non dominant</td>
</tr>
<tr>
<td>Gastrocnemious</td>
<td>13.39±2.09</td>
<td>13.99±2.37</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>27.64±5.66</td>
<td>25.72±5.21</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>55.63±6.33</td>
<td>55.10±6.83</td>
</tr>
<tr>
<td>Ilio psoas</td>
<td>4.94±1.03</td>
<td>3.88±0.99</td>
</tr>
</tbody>
</table>

### Table 3 unpaired t-test results for Dominant leg to Non Dominant leg muscle length comparison

<table>
<thead>
<tr>
<th>Dominant To Non Dominant comparison</th>
<th>Significance (unpaired t test)</th>
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<tbody>
<tr>
<td>Gastrocnemious</td>
<td>0.041</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>0.013</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>0.556</td>
</tr>
<tr>
<td>Ilio psoas</td>
<td>0.001</td>
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</tbody>
</table>
Table 4 intra-rater reliability for all four muscles

<table>
<thead>
<tr>
<th>Muscles</th>
<th>r value</th>
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<tbody>
<tr>
<td>Ilio psoas</td>
<td>0.998</td>
</tr>
<tr>
<td>Rectus femoris</td>
<td>0.995</td>
</tr>
<tr>
<td>Hamstrings</td>
<td>0.983</td>
</tr>
<tr>
<td>Gastrocnemious</td>
<td>0.987</td>
</tr>
</tbody>
</table>

Graph: 1 Normal distribution for muscle length of dominant side Ilio psoas
Graph: 2 Normal distribution for muscle length of non dominant side Ilio-psoas

Graph: 3 Normal distribution for muscle length of dominant side Rectus Femoris
Graph: 4 Normal distribution for muscle length of non dominant side Rectus Femoris

Graph: 5 Normal distribution for muscle length of non dominant side Hamstrings
Graph: 6 Normal distribution for muscle length of non dominant side Hamstrings

Graph: 7 Normal distribution for muscle length of dominant side Gastrocnemious
DISCUSSION

For the gastrocnemius muscle length the range obtained in study of Marie et al., 2006 was less than of this study & Wang et al., 1993 study probably because in this study as well as Wang et al., 1993 study subjects were elite sport person. In this study active Dorsiflexion test used & Wang et al., 1993 used passive Dorsiflexion test but results were same. This suggests if subjects are elite than type of the method will not affect the result.

Because in this study subjects were of younger age & elite sports person than that of other two studies so the hamstring muscle length obtained in this study was quite better in terms of flexibility. This study included younger male elite sports person, but in other two study (Youdas et al., 2005 & Marie Corkery et al., 2006) they include mixture of male & female, and as a general rule female are quite flexible than male. Decreased flexibility of the hamstrings in athletes has been found to be associated with an increased risk of hamstring strain.\(^1,6\)

In this study muscle length of Rectus femoris was similar to Harvey D. et al., 1998 study because he also included elite athletes in his study. But value is quite lower than Magee et al., 2000 but muscle length values in this study were supported by other two study.\(^18,24\) As previously mentioned tightness of the Rectus femoris muscle has also been associated with an increased risk of hamstring strain in athletes (Gabbe et al., 2005).\(^9\)

In this study & other study (Marie Corkery et al., 2006, Krivickas and Feinberg (1996) study iliopsoas muscle length values were nearly similar; in Wang et al., study values were quite smaller mainly because of elite runners in the study.
There was significant difference in muscle length of Iliopsoas, hamstrings & Gastrocnemious between dominant and non dominant side in elite cricketers, which will make elite cricketer more prone to have injury.\textsuperscript{25} In limitations, this study confined to one small place. Only one small ethnical group of cricketers included. Larger sample size could be included. For future study, Sports specific muscle length norms will be formed. Comparison of muscle length for other sports could be done. This data may help sports physiotherapist to identify cricketer with risk of injury due to decreased flexibility in pre competition assessment. It also provides with necessary rehabilitation programmes to address flexibility deficit.

**CONCLUSION**

These data provides the sports physiotherapist with reference value for lower extremity muscle length. It Signifies difference in muscle length of Iliopsoas, Hamstrings, Gastrocnemious (p<0.05) from dominant to non dominant side in elite cricketers aged 15-22.

**Conflict of Interest:** None

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**REFERENCES**

4. Lee et al, 2004


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