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A normative study to check isokinetic testing of calf muscle strength in dominant versus non-dominant lower limb among young adults

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ABSTRACT

Background

Researches for the evaluation of strength in the hip abductors, biceps brachi and quadriceps in the dominant and non-dominant limb have been done but the data for calf muscle strength has yet not been evaluated in normal adults.

Purpose

To form a normative data of isokinetic testing of calf muscle strength in dominant and non-dominant lower extremity in young Indian adults.

Method

83 normal young collegiate males and females were tested for isokinetic peak torque production during plantar flexion on the isokinetic dynamometer.

Results

Strength for the dominant calf muscle was 73.17±26.44 N and for the non-dominant calf muscle was 56.65±21.27 N. The paired t test was used to analyse the data to evaluate if there is a significant difference between the dominant and non-dominant calf muscle. Paired t-tests (p-value-0.000) indicated significant differences in peak torque among dominant versus non-dominant calf muscle group strength.

Conclusion

These results suggest that peak torque of dominant calf muscle group was more than peak torque of non-dominant calf muscle group.

Keywords: Strength, Isokinetic Testing, Peak Torque, Calf muscle

INTRODUCTION

The calf muscle is a very important muscle in the human body because the contribution of this muscle more than just being a simple muscle is that it works as a second heart. It plays a very important role in blood pumping from legs to heart and maintains a good venous return flow. This muscle is actually a group of seven muscles arranged into superficial and deep muscle groups. The superficial group includes the gastrocnemius, plantaris, soleus and the deep group includes the popliteus, flexor

digitorum longus, flexor hallucis longus and the tibialis posterior. Contracting these muscles helps in plantar flexion of ankle, curling of toes, knee flexion, walking, running and biking. The Achilles tendon is the strongest and thickest tendon in the body. It attaches the calf muscles (soleus and gastrocnemius) to the heel bone (calcaneus). The tendon transmits force from the contracting calf muscles to the calcaneus to cause the foot action of plantar flexion (foot pointed down) that is important in walking, running, jumping and change of direction activities. Although the Achilles tendon is the strongest tendon in the body, it is also the tendon most commonly torn or ruptured. The most common cause of rupture is a sudden plantar flexion (such as taking off to jump.

Direct trauma over the Achilles tendon or doing forceful dorsiflexion (foot moving upward) such as landing from a jump, stepping into a hole may cause injury to the Achilles tendon. [1] To do such type of work, calf muscle has to be strong enough to carry the body weight. Researches show that during running and jumping the Achilles tendon is subjected to load as high as 6 to 12 times of body weight. [2-4]

The limb dominancy is very important for good body dynamics or maintaining static balance as well as control of the body. Due to this the person feels more stable on his/her dominant body side. The limb dominance is defined as one limb demonstrating increased dynamic control as a result of an imbalance in muscular strength and recruitment patterns. Dependence on the dominant limb can increase stress on the joints of that extremity [6, 7, 8] and because of over-reliance on the dominant limb, weakness of the contralateral limb muscles may occur, which can further decrease the non-dominant extremity's ability to absorb large forces associated with activities. [9]

But as there is no numerical data available for strength difference between dominant and non-dominant calf muscle that may suggest the marginal strength gap or ratio of strength difference between both (calf muscle) the legs, these numerical values will be very helpful for the planning of making effective physiotherapy and rehabilitation protocol in calf muscle weakness cases and provide the target strength level for both the legs as well.

Newton RU (2006) conducted a study for determination of functional strength imbalance of the lower extremities. They concluded that a significant strength imbalance can exist even in collegiate level athletes. [9] Jones PA (2010) compared the isokinetic and functional methods of assessing bilateral strength imbalance. Significant differences ($p<0.01$) were found between strength in the dominant (D) and non-dominant (ND) limbs for all strength measures, ranging from 4.5% (hop test) to 12.4% (eccentric extension). No significant differences between the right and left limbs were found ($p>0.05$). No significant relationships between strength of D and ND ratios of isokinetic variables and the field tests were evident ($p>0.05$). [10]

Hans E. Berg et al and Ola Eiken et al 2007, conducted a study on hip, thigh and calf muscle atrophy and bone loss after 5-week bed rest inactivity. They concluded that a substantial loss in hip extensor strength and a smaller, yet significant atrophy of these muscles, demonstrate that hip muscle deconditioning accompanies losses in thigh and calf muscle mass after bedrest [11].

METHODOLOGY

A total of 83 subjects were taken from Jamia Hamdard University, New Delhi. Sample of convenience was used for subject selection. The subjects were screened and selected for the study according to the following inclusion and exclusion criteria:

Inclusion criteria

1. Age : 20-30 years
2. Males and females
3. Non-athletic subjects and not involved in any physical training of lower limb

Exclusion criteria

1. History of orthopedic diseases and dysfunction in lower limb.
2. History of neurological diseases and dysfunction in lower limb.
3. Uncooperative subjects.
4. Diabetes or any endocrine disorders.

Procedure

The subjects who met the inclusion and exclusion criteria were explained the test protocol for measurement of calf muscle torque. Subjects were assessed and explained about the purpose and

the nature of the study and subjects were asked to sign the informed consent form.

Measurement of calf muscle circumference

The measurement of calf muscle (right and left leg) circumference of the subjects was done by measuring flexible tape. The calf circumference was measured in the double limb standing position, with feet 20cm apart. The measurements were taken at the level of the widest circumference of the calf. [12]

Lower limb dominance

The lower limb dominance was checked by kicking of the soccer ball. The subject was asked to kick the soccer ball with his leg. The leg that was used for kicking was assumed to be the dominant lower limb.

Measurement of calf muscle isokinetic strength

Before starting to take the measurement of calf muscle isokinetic concentric contraction strength, it is necessary to set the personal data of the subject in the computer system of Isokinetic Dynamometer Machine, such as name, age, gender, height, weight and subject personal ID which were recorded in the machine.

Dynamometer was oriented at 90 degrees, tilt was set at 0 degrees, seat orientation was at 90 degrees, and seat tilt was 70-85 degrees. The subject was asked to sit on the dynamometer chair and the feet were secured at the foot attachment with knee in 20 to 30 degree flexion and hip at 80 degree flexion. Straps were placed around the thigh just above the knee for further stabilization[13]. Range of Motion (ROM) was determined individually by each subject. Before the test, the subjects were asked to perform a warm-up of 6 repetitions to become familiarized with the isokinetic dynamometer machine. The subjects were instructed to push and pull "as hard and fast as possible" through the full available ROM at every trial. All tests included 3 sets and 3 repetitions in each set and 30 seconds rest period was given. All tests started with dorsiflexion followed by plantar flexion. The machine was set on the isokinetic mode with 60 deg/sec [14].

STATISTICAL ANALYSIS

Data Analysis was performed by using SPSS 17 for windows software. Data was tabulated in the master chart. Descriptive statistics was used to analyze subject's characteristics such as age, BMI, calf muscle circumference and mean scores of peak torque in dominant and non-dominant calf muscle strength in young adults. Paired sample t test was used to find the comparison of peak torque between dominant and non-dominant lower limb. P-value of 0.005 was taken as significant value.

RESULTS

83 subjects had given their consent to participate in the study. The isokinetic calf muscle torque of dominant and non-dominant leg was measured and the value of dominant torque was put into group A [PTLLD] and peak torque value of non-dominant lower limb (PTLLND) was put into group B.

The mean age of 83 subjects was 23.40±2.33 and the mean BMI of subjects was 21.70±1.98. Group A contains 83 dominant lower limb calf muscle strength in young adults subjects. The mean score of peak torque in dominant lower limb was 73.17±26.44.

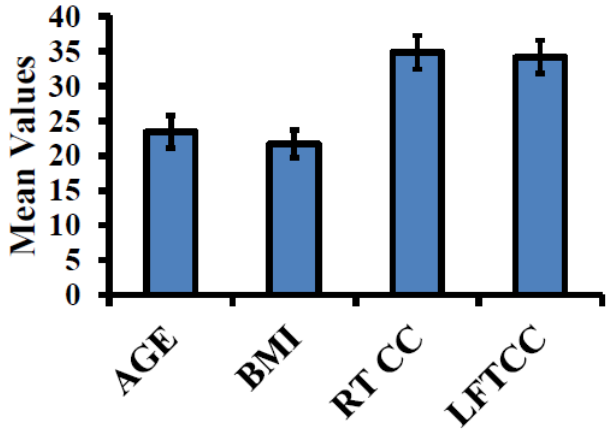
Group B contains 83 non-dominant lower limb calf muscle strength in young adults, the mean score of peak torque in non-dominant lower limb was 56.65±21.27.

The mean score of strength difference in dominant and non-dominant lower limb calf muscle was 16.52±5.17.

Table 1: Descriptive statistics of subject's characteristics.

Demographics	N	Mean	Standard deviation
Age	83	23.40	2.33
BMI	83	21.70	1.98
PTLLD	83	73.17	26.44
PTLLND	83	56.65	21.275

BMI- Body mass index; PTLLD- Peak torque of dominant lower limb; PTLLND- Peak torque of non-dominant lower limb



*RT CC- Right calf circumference; LFTCC- left calf circumference

Figure 1.1. Descriptive statistics of subject's characteristics.

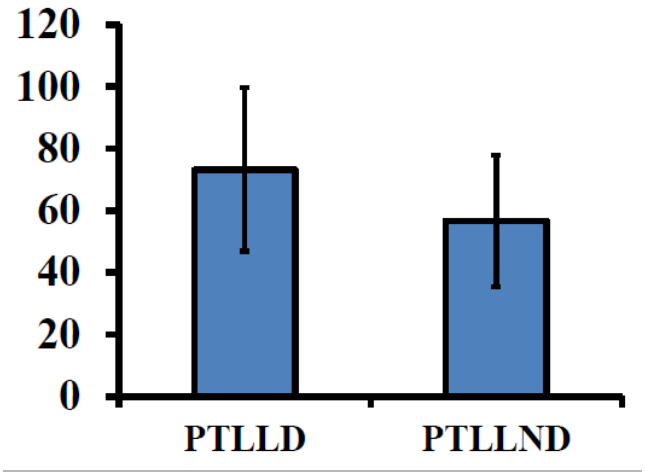


Figure 1.2. Descriptive statistics of subject's characteristics.

Table 2- Paired t-test analysis for dominant v/s non-dominant peak torque

Peak torque	Mean +SD	t -value	p value
PTLLD	73.18+26.44	11.666	
PTLLND	56.65+21.27		0.000

Comparison between dominated lower limb calf muscle strength and non-dominant lower limb calf muscle strength is t = 11.66 and p = 0.000 which is statistically significant.

DISCUSSION

The purpose of the study was to find out the difference in calf muscle strength between dominant & non-dominant lower limb in normal young adults. Upon analysis of the data, it was

revealed that there was a significant difference in the calf muscle strength between dominant & non-dominant lower limb. The calf muscle of the dominant limb were stronger than that of the non-dominant lower limb.

The subject's dominant lower limb calf muscle peak torque was 73.17±26.44 and non-dominant lower limb calf muscle peak torque was 56.65±21.27 (p= 0.876). This indicates that the difference was statistically significant. The average side to side strength difference was approximately 22.58%, which indicates imbalance in calf muscle strength. The side-to-side strength imbalances in the range of 10% to 15% in other muscle groups have been associated with increased injury rates.

Knapik et al reported increased lower extremity injury rates in female athletes demonstrating 15% strength deficits of either the left quadriceps or hamstring muscles. Burkett reported that a 10% side-to-side strength difference in the hamstrings was associated with an increased incidence of hamstring strains. Cale Jacobs et al showed that hip-abduction strength differences exist between the dominant and non-dominant legs. Measures of strength and fatigability were poorly related; therefore, clinicians may opt to assess hip strength and fatigability independent of each another.

LIMITATION

The finding of the study should be substantiated by a larger sample size.

CONCLUSION

When planning rehabilitation protocols for strength of lower extremity, these reference values could be used as a guiding measure and as there is a significant difference in the strength between the dominant and non-dominant extremity, the difference should always be kept in mind so that unrealistic goals are not set.

REFERENCES

[1]. Mandelbaum BR, Myerson MS, Forster R. Achilles tendon ruptures: a new method of repair, early range of motion, and functional rehabilitation. The American Journal of Sports Medicine. 23(4), 1995, 392-5.

[2]. Fukashiro S, Komi PV, Järvinen M et al. In vivo Achilles tendon loading 'during jumping in humans. European journal of applied physiology and occupational physiology. 71(5), 1995, 453-8.

[3]. Komi PV, Fukashiro S, Järvinen M. Biomechanical loading of Achilles tendon during normal locomotion. Clinics in sports medicine. 11(3), 1992, 521-31.

[4]. Ames PR, Longo UG, Denaro V, et al. Achilles tendon problems: not just an orthopaedic issue. Disability and Rehabilitation. 30(20-22), 2008, 1646-50.

[5]. Hewett TE, Myer GD, Ford KR, et al. Biomechanical measures of neuromuscular control and valgus loading of the knee predict anterior cruciate ligament injury risk in female athletes: a prospective study. The American journal of sports medicine. 33(4), 2005, 492-501.

[6]. Knapik JJ, Bauman CL, Jones BH, et al. Preseason strength and flexibility imbalances associated with athletic injuries in female collegiate athletes. The American journal of sports medicine. 19(1), 1991, 76-81.

[7]. Jacobs C, Uhl TL, Seeley M, et al. Strength and fatigability of the dominant and nondominant hip abductors. Journal of athletic training. 40(3), 2005, 203.

[8]. Myer GD, Ford KR, Hewett TE. Rationale and clinical techniques for anterior cruciate ligament injury prevention among female athletes. Journal of athletic training. 39(4), 2004, 352.

[9]. Newton RU, Gerber A, Nimphius S, et al. Determination of functional strength imbalance of the lower extremities. The Journal of Strength & Conditioning Research. 20(4), 2006, 971-7.

[10]. A.Jones, and T. Bampouras. "A comparison of isokinetic and functional methods of assessing bilateral strength imbalance", The Journal of Strength & Conditioning Research 24(6), 2010, 1553-1558.

[11]. Berg HE, Eiken O, Miklavcic L, et al. Hip, thigh and calf muscle atrophy and bone loss after 5-week bedrest inactivity. European journal of applied physiology. 99(3), 2007, 283-9.

[12]. Wijnhoven HA, van Bokhorst-de van der Schueren MA, et al. Low mid-upper arm circumference, calf circumference, and body mass index and mortality in older persons. Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences. 65(10), 2010, 1107-14.

[13]. Andersen H. Reliability of isokinetic measurements of ankle dorsal and plantar flexors in normal subjects and in patients with peripheral neuropathy. Archives of physical medicine and rehabilitation. 77(3), 1996, 265-8..
[14]. Tsiros MD, Grimshaw PN, Shield AJ, et al. Test-retest reliability of the Biodex System 4 Isokinetic Dynamometer for knee strength assessment in paediatric populations. Journal of allied health. 40(3), 2011, 115-9.

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