EFFECT OF HAMSTRING TIGHTNESS ON CONGRUENCE OF MEDIAL LONGITUDINAL ARCH AND CALCANEAL FRONTAL PLANE POSITION AMONG COLLEGIATE STUDENTS

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Abstract

Aim and Objectives: The aim of this research to study the effect of hamstring tightness on Calcaneal Frontal Plane position and congruency of Medial Longitudinal Arch. The posterior compartment of the thigh, hip and knee joint comprise large muscle groups, including the semitendinosis, Semimembranosus and bicep femoris. These muscles are prone to tightness, which can lead to various musculoskeletaldisorders.

Methods: A total 80 Subjects (40 Subjects in experimental group and 40 Subjects in control group) were recruited from undergraduates and postgraduate students of college. Experimental group has hamstring tightness and control group is present without hamstring tightness. Hamstring tightness is measured by Active knee extension test. Calcaneal Frontal Plane position and Congruency of medial longitudinal arch are the two component of Foot posture index. The rear foot was assessed via the inversion or eversion of the calacaneus. The posterior aspect of the calcaneus was visualized in line with the long axis of the foot. A pronated foot will demonstrate a more everted heel position and a supinated foot will exhibit a more inverted heel position.A pronated foot will demonstrate a low arch with flattening in the central position, where as a supinated foot will demonstrate a higher arch acutely angle toward the posterior portion.

Result: The mean values in group A (hamstring tightness) for age, weight, height and BMI are 20.88 $\pm$ 2.232 years, 54.38 $\pm$ 8.649 kg, 161.47 $\pm$ 8.24 cm and 20.79 $\pm$ 2.37 kg/m^2 respectively. The mean values in group 2 (without hamstring tightness) for age, weight, height and BMI are 20.95 $\pm$ 2.02 years, 54.38 $\pm$ 8.99 kg, 160.38 $\pm$ 6.18 cm and 21.04 $\pm$ 2.40 kg/m^2 respectively

Conclusion: Based on the findings of the study, 13% of individuals are pronated and 12% are everted. This shows that, when compared to group B (which does not have hamstring tightness), group A (with hamstring tightness) displays a higher prevalence of pronated and everted feet. Consequently, it is essential to pay attention to hamstring stretching to prevent musculoskeletal disorders.

Key Words: Foot Posture, Muscle tightness, Hamstring Muscle

Introduction

The hamstrings are made up of three large muscles, the semitendinous, semimembranous, and biceps femoris, which have their origins in the infero-medial impression on the upper part of the Ischial tuberosity and are inserted on the upper parts of the posterior surface of the tibia. These muscles are located in the posterior compartment of the thigh and act on the hip and knee joint, making them flexors of the knee and extensors of the hip. Tight muscles are caused by a reduction in the muscle's deformation, which reduces the range of motion at the joint(Akipnelu et al., 2009 and shakya et al., 2018). Causes of hamstring muscle tightness are sedentary lifestyle, being overweight, increase age and gender. Some of the studies suggest that male is more prone to hamstring tightness as comparison to female. "Hamstring muscle tightness is typically the cause of discomfort or pain along the posterior thigh and knee, as well as the inability to fully extend the knee when the hip is flexed"(Bhavana et al., 2013). Hamstring muscle tightness is defined as Knee Extension Angle (KEA) greater than 20 degrees where KEA is the degree of knee flexion from terminal knee extension (Davis, et al., 2008). The Sit and Reach (SR), active Knee Extension (AKE), and straight-leg-raising (SLR) tests are ways to measure hamstring flexibility. (Davis and others, 2008). Since the SLR test is also frequently employed as a neurological diagnostic, its specificity has been called into question. Additionally, a cinematographic investigation revealed that the validity of SLR angle measurements may be impacted by pelvic rotation. The Sit and Reach (SR) test is a simple way to measure hamstring flexibility, although its validity is regarded as low (Shakya and Manandhar, 2018). The gold standard for measuring hamstring muscle length among them is KEA with plantar flexion, which has intra-tester reliability.(Davis, DS, et al 2008). Many studied suggested that hamstring tightness occurs in early childhood and it tends to increase with age. The progressive decline in flexibility which has been attributed to change in elasticity and decreased level of physical activities (Mistry et al., 2014).The effect of tightness of the hamstring are complex because bicep femoris cross both hip and knee joints. Significant tightness in the hamstrings can potentially result in knee flexion contractures, characterized by difficulty in fully extending the knee. Knee flexion contractures stemming from hamstring issues are often seen in individuals experiencing over activity or spasticity in these muscles. Elevated tension in the hamstring muscles is believed to be associated with a backward tilt of the pelvis while standing. Such a posterior pelvic rotation may lead to a flattening of the lumbar spine, which could increase the risk of experiencing low back pain. However, the connections between hamstring tightness, postural problems, and low back pain remain somewhat ambiguous. The flexibility of the hamstrings is frequently recognized as an important fitness component that is essential for health and well-being.(Mayorga et al., 2015).

Calcaneal frontal plane position and congruence of medial longitudinal arch was the component of Foot posture index-6 (FPI-6). The foot posture index was first described in 2001 by Redmond et al in a paper presented at the Australian podiatry Council national Conference (Cornwall et al., 2008).This methodology is valid, reliable, multidimensional, and easily accessible for health professional in clinical contexts. Furthermore it does not require sophisticated equipment's. Measurement of foot posture is widely considered to be an important component of musculoskeletal examination in clinical practice and research as variations in foot posture has been found to influence of lower limb kinematics, muscles activity, balance and functional ability and predisposition to overuse injury. The poor posture of the foot and its misalignment increase the risk of injury to the lower limb, including medial tibial stress syndrome, patella-femoral pain and ankle injuries due to overuse, which arise from tension forces exerted by excessive movement. Postural changes in the feet can cause pain and discomfort in specific areas of foot (e.g. forefoot, midfoot and rear foot) that, overtime, can cause injuries due to change in the force and pressure on the sole of the foot, resulting in area of overloads. A lower medial longitudinal arch or pronated foot features a medial overload of the foot, which can lead to the transfer of large forces to proximal area such as the knee, hip and lumbosacral spine.

The enlarged medial longitudinal arch of the supinated foot lead to larger lateral plantar over loads, which might induce subtalar joint stiffness and hence create a heavier burden on the re gions of the forefoot and hind foot(Carwalho and Penha, 2017).

The purpose and need to initiate research on the topic of effect of hamstring tightness on calcaneal frontal plane position and congruency of medial longitudinal arch is explained as under. During my clinical posting in hospital, it has been found that patient coming with hamstring tightness having altered gait mechanism and somewhere disturbed foot biomechanics. It is observed that there is a tendency that with tightness in hamstring it may cause knee to be in some degree of flexion that thereby contributes to changes in foot mechanics and allowing calcaneum to deviate and hence the congruence of medial longitudinal arch get disturbed.

Therefore, it is necessary to work on the subject and provide real-world examples to support the issue further it was observed by (Lisa S. krivickas et al,)that male are prone to develop hamstring tightness in college athletes, therefore need of the study is to find out effect of hamstring tightness on calcaneal frontal position and congruence of medial longitudinal arch. Further clinical relevance of the study can be explained as we can use hamstrings stretching as a conventional method to correct foot posture in collegiate student. With a view to prevent injury to the muscles and soft tissues structure because lack of hamstring flexibility or hamstring tightness has been associated with lumbar back ache, postural deviation, gait limitation , risk of falling and susceptibility of musculoskeletal injury(Dixit and Samal., 2018).

To best of our knowledge, there is no documented evidence that describing the relationship of tightness and calcaneal frontal plane position and congruence of medial longitudinal arch. According to clinical observation tight hamstring muscles is found to be highly prevalent. Reduction in the hamstring flexibility in collegiate student increases the risk of damage in musculoskeletal system. The flexibility of hamstring tightness is important for general health and physical fitness (Dixit and Samal, 2018). Thus, the purpose of this study is to examine the effect of hamstring tightness on calcaneal frontal plane position and congruence of medial longitudinal arch in collegiate students.

Methodology

A total of 80 subjects (40 subjects in experimental group and 40 subjects in control group) were recruited from the undergraduate and post graduate students of College of applied education and health sciences. Research according to the inclusion and exclusion criteria.

INCLUSION CRITERIA

Sample within the age group of 18 to 30 years both male and female, with a mean age of 24 years, volunteered to participate in this study. Subjects with normal BMI <25kg/m2 were included in the study.

EXCLUSION CRITERIA

Subjects having lumbar and lower limb neurological compression, low back discomfort during the last two months, or any history of hamstring injuries within the previous two years were not included.

PROCEDURE

Subjects who fulfilled the inclusion criteria were taken up for the study. The researcher asked if the volunteer had any questions, and then answered them appropriately. An informed consent was obtained from the subjects prior to the study. The subject was asked to change into the appropriate attire, shorts if needed. A detailed explanation was given of the testing procedures, including specific command that were going to be used. Once a subject will be determine to be eligible for participation in the study then assigned in the experimental group (hamstring tightness present) and the control group (without hamstring tightness). Examiner was performed active knee extension just prior to measurement of calcaneal frontal plane position and congruence of medial longitudinal arch.

HAMSTRINGS TIGHTNESS- ACTIVE KNEE EXTENSION TEST

The subjects were placed supine with the hip and knee of the tested leg in 90 degree of flexion. The contralateral lower limb remains extended on the bed throughout the test to minimize the pelvic motion. The subject actively extends the tested leg until reaching the maximal tolerable stretch of the hamstring muscle as indicated by the patient, keeping the foot relaxed. A universal goniometer was placed to the lateral side of the knee joint was used to determine the popliteal angle. It was centered on the lateral epicondyle of the femur and stationary arm was aligned with the greater trochanter of femur and moving arm with lateral malleoli of the fibula. The trials were conducted for each leg and the average of the three trials on each side was taken as final reading of popliteal angle.

CALCANEAL FRONTAL PLANE POSITION

Calacaneal frontal plane position was measured by foot posture index. The rear foot was assessed via the inversion or eversion of the calacaneus. In this subject stand in relaxed stance position with double limb support, the patients should be instructed to stand still, with their arms by the side and looking straight ahead. Ask the patient to take several steps, marching on the spots, and prior to settling into a comfortable stance position. Each patient was standstill for approximately two minutes in total in order for the assesment to be conducted. The posterior aspect of the calcaneus was visualized in line with the long axis of the foot. A pronated foot will demonstrate more everted heel position and a supinated foot will exhibit a more inverted heel position.

CONGRUENCY OF MEDIAL LONGITUDINAL ARCH

This height and medial arch congruence are noted. A foot that is pronated will have a low arch that flattens in the middle, whereas a foot that is supinated would have a higher arch that is strongly angled toward the back.

Figure 1:Relaxedstanceposition

Figure 2:Evertedheelposition–Pronatedfoot

Figure 3: Shows very low Medial longitudinal Arch height which Indicates Pronated foot

Figure 4:Showsnormalarch

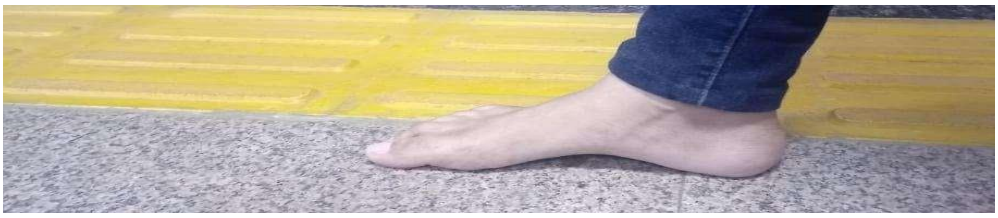

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Figure5:Showshigharch

Figure 6: Initial position of active Knee Extension Test

Figure 7: Ending position of Active Knee Extension Test

Data Analysis

The data entry was done on Microsoft excel 2013 and statistical analysis was done by using SPSS software version 24. The demographic profile was analysed using descriptive statistics. And effect of hamstring tightness on congruence of medial longitudinal arch and calcaneal frontal plane position was analyzed by using T- test by comparing means between two groups. The level of significance was set at p=0.05.

Result

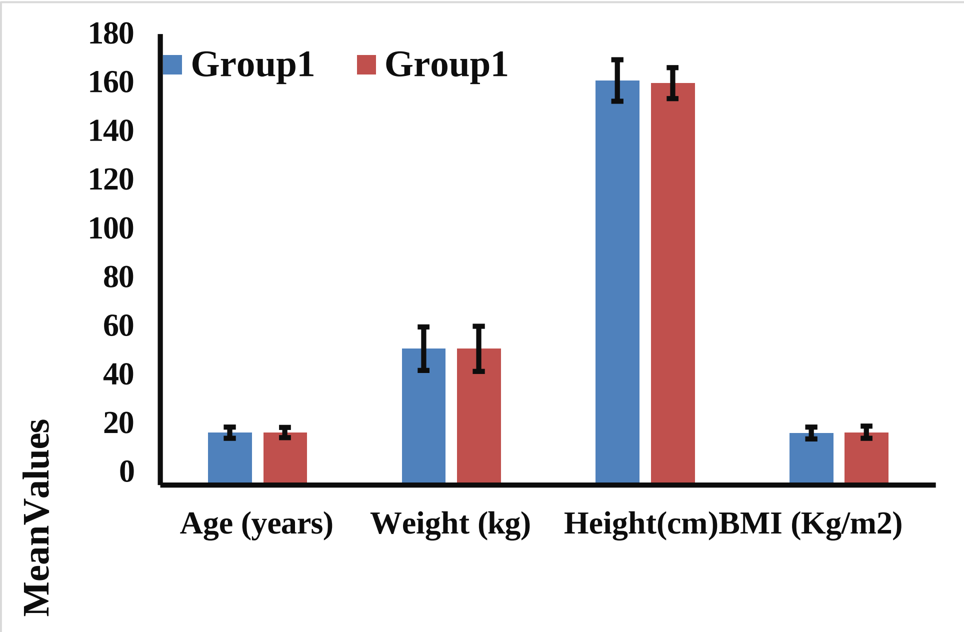
Demographic Profile of Subjects

A total of 80 individuals (40 in group A and 40 in group B) were included for the study. The mean values in group A (hamstring tightness) for age, weight, height and BMI are 20.88 ± 2.232 years, 54.38 ± 8.649 kg, 161.47 ± 8.24 cm and 20.79 ± 2.37 kg/m^2 respectively. The mean values in group 2 (without hamstring tightness) for age, weight, height and BMI are 20.95 ± 2.02 years, 54.38 ± 8.99 kg, 160.38 ± 6.18 cm and 21.04 ± 2.40 kg/m^2 respectively as depicted in table 1 and graph 1.

Table 1 Demographic Profile of Subjects for Group A and Group B

Variable	Group A		Group B	
	Mean	Std. Deviation	Mean	Std. Deviation
Age (years)	20.88	2.232	20.95	2.02

Weight (kg)	54.38	8.649	54.38	8.99
Height(cm)	161.47	8.24	160.38	6.18
BMI (kg/m^2)	20.79	2.37	21.04	2.40



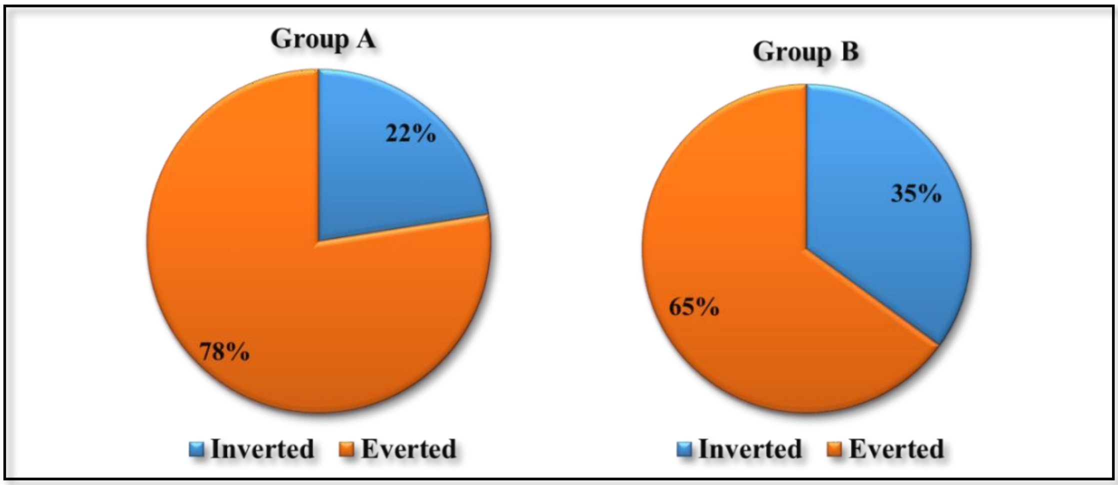
Graph1:Demographic profileofsubjectsofGroupAandGroupB

CalcanealfrontalplanepositioningroupwithHamstringtightnessversusgroupwithout Hamstring tightness

Group A (hamstring tightness) show 22.5 % inverted and 77.5% everted and group B (without hamstring tightness) show 35% inverted and 65% everted. According to the table, everted positions were more seen group A as compared to group B.

Table2:Showspercentageof evertedandinvertedfootforGroupA andGroupB

Calcanealfrontalplaneposition		
	GroupA	GroupB
Inverted	22.5	35
Everted	77.5	65



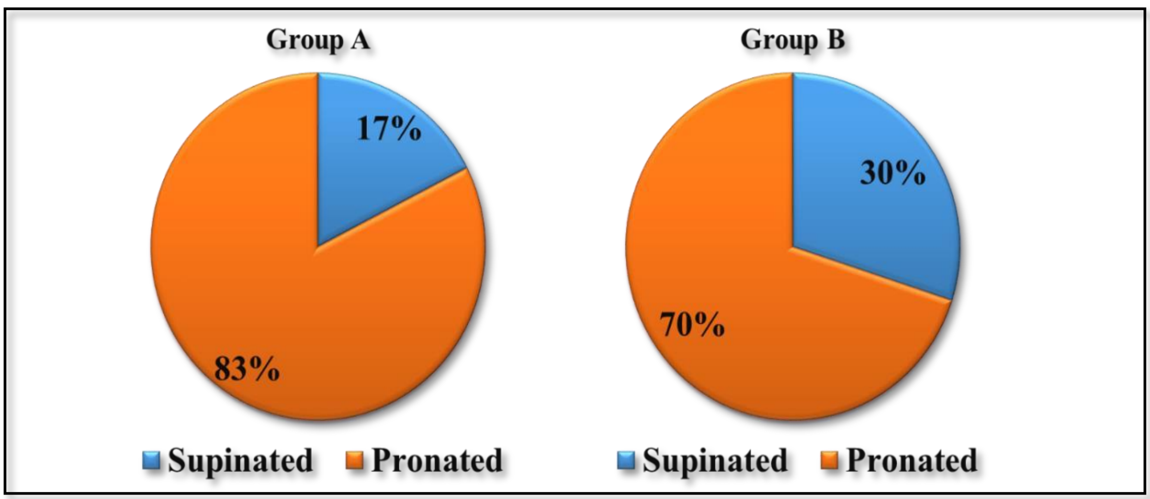
Graph 2: ShowsCalcaneal frontalplane position

Congruenceofmediallongitudinalarchingroup withHamstringtightnessversusgroup without Hamstring tightness

GroupA(hamstringtightness)show17.5%supinatedand82.5%pronatedandgroup B(without hamstringtightness)show30%supinatedand 70%pronated.Accordingto the table, pronated positions were more seen group A as compared to group B

Table3:Showspercentageofpronatedand supinatedfootofGroupAandGroup B

Congruenceofmediallongitudinalarch		
	GroupA	GroupB
Supinated	17.5	30
Pronated	82.5	70



Graph 3:Showscongruenceofmediallongitudinal arch

Discussion

Thisstudywasperformedtodeterminetheeffectofhamstringtightnesson congruency of medial longitudinal arch and calcaneal frontal plane position incollegiate students. The criterion for subject inclusion was tight hamstrings as definedby as knee extension range of motion less than 20 degree Active knee extension was measured using a goniometer. Hamstring tightness as measured on both legs of collegiate students and students who had more hamstring tightness resulted pronated foot as compared to control group.

The result of the study found that there was 12% more everted foot in group A (hamstring tightness) as compared to group B (without hamstring tightness) and 13% more pronated foot in group A (hamstring tightness) as compared to group B (without hamstring tightness). This identifies that tightness of hamstring muscles effect the component of foot posture index.Hamstring muscle tightness leads to decrease rangeof motion of lumbar spine and pelvic tilt. Back discomfort may result from this change in the lumbar spine's biomechanics (Vyas and Sheth et al 2014). When Harty et al. (2005) compared a group of subjects with plantar flexion to a control group, they found a substantial contracture of the hamstring muscles. Also Dominguez et al (2007) observedalimitedankledorsiflexionandkneeextensioninmostoftheplantar flexion subjects, which would confirm contracture of triceps surae and hamstrings tightness.

Labovitz et al (2006) found that increased hamstring tightness cause early contraction of the posterior leg muscles through the gait cycle and limit dorsiflexion. These functional biomechanics deficit causes significant increase in the tension of the plantar fascia, which is known to have minimal elasticity. Patients with hamstring tightness were about 8.7 times as likely to experience plantarfascitis with patients without hamstring tightness. The results of the above-mentioned studies support the functional deficit of the plantar fascia caused by hamstring shortening. That is tight hamstringscouldincreasekneeflexion,whichinturnwouldinduceprolonged forefootloadingandwouldengagethewindlass mechanism.

Additionally, when there is a tight group of muscles in the posterior leg, the range of motion in the ankle is restricted, which might be compensated for by excessive pronation of the subtalar joint, leading to tension on the plantar fascia (Bolivar, Padillio et al 2013).

Foot posture has historically been viewed as affecting the mechanical alignment and dynamic operation of the lower limb, potentially linking it to the onset of musculoskeletal issues in that region (Levinger, Menz et al 2010). Numerous studies indicated that particular combinations of abnormal structures and mechanics in the foot, like reduced arch height and pronation, could elevate the risk of soft tissue injuries on the medial aspect of the lower extremity and the knee.(B Vicenzino,G skardoon et al 2005). Structural deformation of feet leads to lesion in ankle joint andfeet in lower limbs joints results in early fatigue and pain due to excessivecompensatory actions of intrinsic and the extrinsic muscle cause problems in stability and balance of feet during the gaits (DA, 2009). In pronated foot the head of talus displace medially and plantarward from navicular. This displacement stretches thespring ligament and tendon of tibialis posterior muscles, resulting in loss of Medial longitudinal arch. Because of this medial displacement of the talar head, a callus may developwherethe prominenttalarheadpressesagainstthemedialcounterofthe shoe.Whenviewedfromtheposterioraspectofthefoot,thecalcaneuswillbe everted.Thepersonwhosecalcaneusisinvalguswillhavearelativelyflatarched footbecauseofuntiwistingof theinterconnectingligamentsofthe forefootandthe hind foot. The flattening of Medial longitudinal arch disturbs the normal process of weightbearingandcausesfunctionalchangesinthefoot.Symptomsinclude shortening of the evertor muscles (peroneal muscles), tenderness of plantar fascia,laxity of supporting structure of medial side of the foot and tibialis posterior (Franco 1987).

Limitationsofthestudy

- Smallsamplesize.
- Therewasunequalratioofmaleandfemale.
- Physicalactivitylevelofcollegiatestudentswasnotassessed.
- Only two components- congruence of medial longitudinal arch and calcaneal frontal plane position of Foot posture index-6 (FPI-6) were included in this study.

Futurescope ofthestudy

- Samplesizecanbelarger.
- Usewideragegroup.
- Further studycan bedone by maintaining homogeneityamong maleand female.
- OthercomponentsofFootpostureindex-6(FPI-6)canbetakenwhichwere not included inthisstudy apartfrom congruence of medial longitudinalarch and calcaneal frontal plane positions.

Conclusion

Theconclusionofthestudythatthereishaving12 %everted and 13%pronated.Thus shows that Group A (hamstring tightness) show more pronated and everted foot as compared to group B (Without hamstring tightness). Hence awareness of hamstring stretching is important to prevent musculoskeletal conditions.

Conflict Of Interest: NONE

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