

A Study to Determine the Correlation of Ankle Dorsiflexion Range of Motion with Dynamic Balance in Young Males and Females

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ABSTRACT

Background: Posture and balance play a important role in the overall health of the body. Dynamic posture could depends on leg strength muscle, core strength muscle, proprioceptive abilities, age, sex, body height, body mass etc and of course, dorsiflexion range of motion (DROM) as a measure of flexibility of the ankle joint is one of them.

Objective: The purpose of the study was to examine the correlation of ankle dorsiflexion range of motion and dynamic balance in young males and females.

Methodology: 60 healthy young adults (both male and females) fulfilling the inclusion criteria were selected randomly. Ankle dorsiflexion and dynamic balance were assessed by performance based measures. The Pearson's correlation test was used to examine the correlation of Ankle dorsiflexion Range of motion with dynamic balance.

Results: There is significant correlation of Ankle dorsiflexion range of motion and dynamic balance in young males in medial direction (+0.25,+0.38) and females in anterior and posterolateral direction(+0.05,+0.15 and +0.12,+0.24). But there is weak correlation in Anterolateral(L), Lateral(L), Posterior(L), Medial (L) and Anteromedial(L) in Females and in lateral(L), posterolateral(L), posterior(L), Anteromedial(L) in males.

Conclusion: It can be concluded from the study that Ankle dorsiflexion range of motion is associated with dynamic balance in young adults.

Key Words: Ankle Dorsiflexion ROM, Balance, Posture.

INTRODUCTION

Balance is defined as "a state in which a body or object remains reasonably steady in a particular position while resting on a base that is narrow or small relative to its other dimensions".^[1] Posture and balance play a important role in the overall health of the body. A centered and balanced skeletal position allows for the ease of movement and optimum functioning of the joints and structure of the body.^[2]

Balance is greatest when Body's center of mass (COM) or Center of gravity (COG) is maintained over its Base of support(BOS).^[3] Postural control is often described as being either static or dynamic.

Static postural control is commonly quantified through instrumented measurements of ground reaction forces or less sophisticated non-instrumented means. Various tests for static balance includes Romberg's test, tandem stance, single leg stance. Dynamic postural control often involves completion of a functional task without compromising one's base of support. The advantage of assessing dynamic postural control is that additional demands of proprioception, range of motion (ROM), and strength are required along with the ability to remain upright and steady.^[4]

The Star Excursion Balance Test (SEBT) is one test that provides a significant challenge to the postural control system. The SEBT involves having a participant maintain a base of support with one leg while maximally reaching in different directions with the opposite leg, without compromising the base of support of the stance leg. The weight-bearing ankle lunge test (WBLT) is probably the most widely used measurement method to assess ankle dorsiflexion ROM. The WBLT is based on the “knee-to-wall” principle and requires patients or athletes to perform, in front of a wall, a forward displacement of the pelvis and trunk with knee flexed while a lunge position is adopted (Bennell et al., 1998). [5-15] The goal of the WBLT is to determine the maximum distance in centimetres between the big toe and the wall without the heel lifting from the ground while the knee is able to touch the wall.

The ankle is a hinge joint that allows the foot to move in the sagittal plane. Within this plane, there are two specific movements; dorsiflexion and plantar flexion. Ankle dorsiflexion plays an important role in dynamic balance. It influences the anterior reach distance in healthy adults in the balance test.

METHODOLOGY

STUDY DESIGN- Correlational study
NUMBER OF SUBJECTS- 60 subjects (30 males and 30 females) were included in this study.

INCLUSION CRITERIA -Normal healthy young Males and Females having age group 18-25 years. -Individuals having normal BMI.

EXCLUSION CRITERIA- Any previous surgery of lateral ankle ligament complex or ankle joint. - Previous injury within one month of the test of the lower limbs (to avoid influence of acute symptoms) - Any Neurological, systemic or psychiatric conditions and Ear infection present at the time of study.

INSTRUMENTATION USED- Measuring tape, Marker, Micropore.

OUTCOME MEASURES- Weight Bearing Lunge Test and Star Excursion Balance Test

PROCEDURE

The purpose of the study was explained to the subject and a verbal description of all procedures and tests was given to them. Once the inclusion criteria was met, measures of Ankle dorsiflexion Range of motion and Dynamic Balance during the test were obtained bilaterally with the subjects barefoot. The following tests were performed. -The Weight bearing lunge test (WBLT) was done to measure Ankle dorsiflexion ROM. Subjects performed 3 trials of the WBLT on both limb. Subjects were in a standing position facing a wall with the test foot parallel with a tape measure secured to the floor with the second toe, center of the heel, and knee perpendicular to a wall. To provide upright balance, the other leg was placed approximately 1 foot length behind the test foot in a tandem stance and subjects placed their hands on the wall. While maintaining this position, subjects were instructed to perform a lunge in which the knee was flexed in such a way that it makes contact between the anterior knee and the wall. When subjects were able to maintain heel and knee contact, the test foot was progressed away from the wall and the subjects repeat the lunge. Maximum lunge distance was measured. Maximum lunge distance is defined as the distance of the great toe from the wall to the farthest distance where the foot is able to make contact with the ground without lifting the heel while the knee is able to touch the wall. The same procedure was administered across all the subjects. The 3 trials for each limb was included for statistical analysis.

Another test is the Star Excursion Balance test that was performed for assessing the dynamic balance. The goal of the SEBT is to maintain single leg stance on one leg while reaching as far as possible with the contralateral leg. The Subject performed the test by standing in the middle of the grid and maintaining

their balance on one leg, while using the other leg to reach as far as possible in 8 different directions. The person must reach in 8 different positions, once in each of the following directions: anterior, anteromedial, medial, posteromedial, posterior, posterolateral, lateral and anterolateral. Each reach distance was recorded with a mark on the tape as the distance from the center of the grid to point of maximum excursion by the reach leg. -Data was collected and was recorded in data collection form.

RESULT

A sample of Sixty young adults in age group eighteen years to twenty five years was taken. Out of which, thirty were female and thirty were male young adults. The mean age of young adults was 21.9 years and standard deviation was 0.97 years. Linear regression was used to determine the relationship between ankle dorsiflexion ROM and measures of dynamic balance. Mean of WBLT and SEBT left and right side has been taken. SEBT was measured in anterior, anterolateral, lateral, posterolateral, posterior, posteromedial, medial and posteromedial directions.

The Mean and Standard Deviation of Ankle Dorsiflexion ROM in female young adults was 11.632±1.762 for Right side and 12.055±1.734 for left side. The Mean and Standard Deviation of Ankle Dorsiflexion ROM in Male young adults was 11.97±1.259 for Right side and 13.042±1.201 for left side.

Weight bearing lunge test and Star excursion balance test: As per data analysis, the values of correlation(r) in Females are as follows: **RIGHT SIDE:** Lunge test + Anterior Reach = +0.05, Lunge test + Anterolateral = -0.11, Lunge test + Lateral = -0.22, Lunge test + Posterolateral = +0.22, Lunge test + Posterior = -0.08, Lunge test + Posteromedial = -0.46, Lunge test + Medial = -0.08, Lunge test + Anteromedial = -0.23 **LEFT SIDE:** Lunge test + Anterior Reach = +0.15, Lunge test + Anterolateral = +0.02, Lunge test + Lateral = +0.145, Lunge test +

posterolateral = +0.24, Lunge test + Posterior = +0.29, Lunge test + Posteromedial = -0.02, Lunge test + Medial = +0.16, Lunge test + Anteromedial = +0.19 As per data analysis, the values of correlation(r) in Males are as follows: **RIGHT SIDE:** Lunge test + Anterior Reach = -0.21, Lunge test + Anterolateral = -0.19, Lunge test + Lateral = -0.07, Lunge test + Posterolateral = -0.12, Lunge test + Posterior = -0.02, Lunge test + Posteromedial = -0.05, Lunge test + Medial = +0.25, Lunge test + Anteromedial = -0.21 **LEFT SIDE:** Lunge test + Anterior Reach = -0.13, Lunge test + Anterolateral = -0.10, Lunge test + Lateral = +0.14, Lunge test + posterolateral = +0.26, Lunge test + Posterior = +0.29, Lunge test + Posteromedial = +0.45, Lunge test + Medial = +0.38, Lunge test + Anteromedial = +0.21.

TABLE NO. 1 SHOWING MEAN AND STANDARD DEVIATION OF WEIGHT BEARING LUNGE TEST IN FEMALES

PARAMETERS	NO. OF SAMPLES	MEAN	STANDARD DEVIATION
RIGHT	30	11.632	1.762
LEFT	30	12.055	1.734

TABLE NO.2 SHOWING MEAN AND STANDARD DEVIATION OF WEIGHT BEARING LUNGE TEST IN MALES

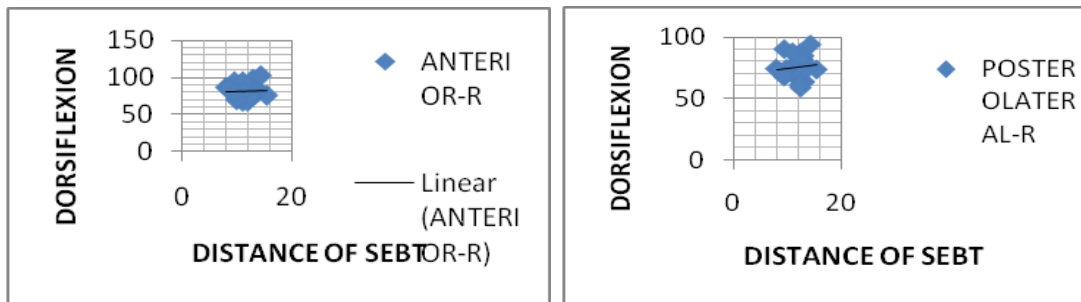
PARAMETERS	NO. OF SAMPLES	MEAN	STANDARD DEVIATION
RIGHT	30	11.97	1.259
LEFT	30	13.042	1.201

TABLE NO. 3 SHOWING MEAN OF STAR EXCURSION BALANCE TEST IN FEMALES

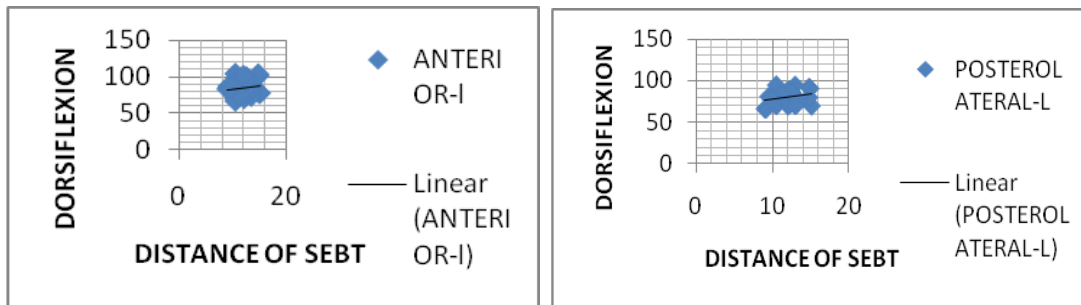
PARAMETERS	RIGHT	LEFT
ANTERIOR	81.65	84.80
ANTEROLATERAL	84.84	84.41
LATERAL	82.26	82.57
POSTEROLATERAL	67.95	69.99
POSTERIOR	69.63	72.73
POSTEROMEDIAL	67.95	69.99
MEDIAL	62.41	66.26
ANTEROMEDIAL	70.00	80.51

TABLE NO. 4 SHOWING MEAN OF STAR EXCURSION BALANCE TEST IN MALES

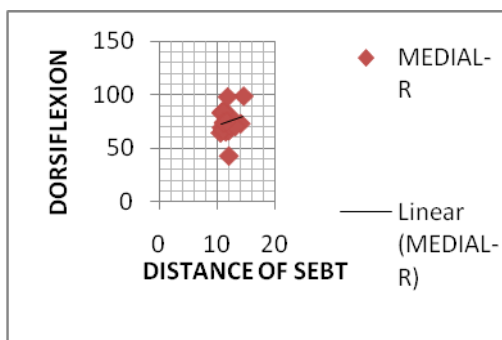
PARAMETERS	RIGHT	LEFT
ANTERIOR	89.46	93.71
ANTEROLATERAL	93.34	99.12
LATERAL	91.11	95.35
POSTEROLATERAL	89.92	93.97
POSTERIOR	80.33	90.01
POSTEROMEDIAL	80.62	89.92
MEDIAL	76.08	82.70
ANTEROMEDIAL	86.63	92.69



GRAPH 1 SHOWING RELATION BETWEEN WBLT AND SEBT IN FEMALES- RIGHT SIDE



GRAPH 2 SHOWING RELATION BETWEEN WBLT AND SEBT IN FEMALES- LEFT SIDE



GRAPH 3 SHOWING RELATION BETWEEN WBLT AND SEBT IN MALES- RIGHT SIDE

DISCUSSION

The objective of the study was to examine the correlation between Ankle Dorsiflexion Range of Motion and Dynamic Balance in young males and females.

We have examined the Weight Bearing lunge test and Star excursion balance test in both Males and Females, and we found that there is Significant positive correlation of ankle dorsiflexion and dynamic balance in Anterior and Posterolateral direction in females whereas Medial direction in Males.

While examining we also found that there is weak positive correlation between dorsiflexion and dynamic balance in Anterolateral, Lateral, posterior, medial and anteromedial reaches of left side in females whereas Lateral, Posterolateral, posterior,

posteromedial, and anteromedial of left side in Males.

Individuals with chronic ankle instability often have impairments in ankle range of motion and balance, therefore they were excluded from the study.

S. Karger, stated that Deterioration in balance function clearly starts at relatively young ages and further accelerates from at about 60 years upwards. Due to systematic differences between males and females, separate normative values for both sexes are needed.

Older adults also have more difficulty balancing when sensory inputs are reduced experimentally or pathologically. Ankle dorsiflexor muscle weakness is also a factor in balance dysfunction in the older adult. Therefore, both young Males and females of age group 18-25 were included in the study.

We also examined that Weight-bearing ankle DF was greater on the nondominant side compared with the dominant side. Ankle dorsiflexion plays an important role in dynamic balance. It influences the anterior reach distance in healthy adults in the balance test.

Matthew C. Hoch stated that Ankle Dorsiflexion was measure using Weight bearing lunge test as it is functional and

reliable method to indirectly assess dorsiflexion by measuring the maximal advancement of tibia over the rearfoot in a weight bearing position.

In our study we found that the correlation of anterior and posterolateral reaches in females was +0.05(R), +0.152(L) and +0.12(R) , +0.24(L) whereas in males medial reach was +0.252(R), +0.387(L).

Pranali Suryavanshi et.al. 2015^[4] did a study on 60 females by convenient sampling and found that there was significant positive correlation in between dorsiflexion range of motion and star excursion balance test in anterior and posterolateral direction.

Phillip A. Gribble & Jay Hertel^[16] found that Using raw excursion measures, males were found to have significantly greater excursion distances than females, however, after normalizing excursion distances to leg length, there were no significant differences related to gender. Therefore, when using the SEBT for experimental or clinical purposes, participants' excursion distances should be normalized to leg length to allow for a more accurate comparison of performance among participants.

Dr. Atul Mahajan found that The SEBT is a promising test of postural control that may be useful in assessing dynamic balance.

Matthew C.Hoch et.al.^[13] suggested that the WBLT explain a significant proportion of the variance within the anterior reach distance signifying this direction of the SEBT may be a good clinical test to assess the effects of dorsiflexion range of motion restrictions on dynamic balance as Only the anterior direction (mean: $79.0 \pm 5.8\%$) of the SEBT was significantly related to the WBLT (mean: 11.9 ± 2.7 cm), $r = 0.53$ ($p = 0.001$). The r^2 for this simple linear regression was 0.28, indicating that the WBLT explained 28% of the variance in the anterior normalized reach distance.

CONCLUSION

It can be concluded from the study that there is significant positive correlation between Ankle Dorsiflexion Range of motion and Star excursion balance test in anterior and posterolateral direction in females and medial direction in males.

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