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Deep Squating Posture will be Influenced by Intrinsic Factor apart from Passive Ankle Dorsiflexion Range of Motion

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ABSTRACT

A total of 50 subjects participated in the study. The study was conducted in the department of Physiotherapy, Uttaranchal (PG) College of biomedical sciences and Hospital, Dehradun. The subjects were recruited from Uttaranchal (PG) College of biomedical sciences and Hospital Dehradun. Subjects were chosen as per the inclusion and exclusion criteria and informed consent should be obtained from all of them. After explaining the procedure, the subjects were assessed and divided into two groups possible squatting group and impossible squatting group. The subjects were asked to sit in the deep squatting posture with their heel down and arm Crossed and maintain the posture for more than 5 second and they were divided into 2 groups. Two points to be kept in mind while squatting were as follows: (a) Both the knees and feet should be brought together to the maximum possible extent throughout the deep squat and (b) The thigh and calf should be in contact with each other. The subjects were divided into two groups possible squatting and impossible deep squatting groups. The possible deep squatting group can be described as those who can performed the squatting i.e, both the knee and feet should be brought together to maximum possible and the thigh and calf should be in contact with each other and maintain these posture more than 5 second whereas impossible deep squatting group can be described as those who cant performed to contact calf and thigh while squatting. shows the deep squatting posture. The following parameter were measure in two groups, *The straight leg raise (SLR), The Heel-buttock distance (HBD), The modified finger floor distance (MFFD), The modified Thomas tests, Ankle dorsiflexion flexibility*. To examine the possible differences between the two squatting groups regard to each test parameters the Mann-Whitney u test (if the distribution of the data is not normal) was used. The dependent variables for the deep squatting posture were analyzed by step wise linear discriminate analysis to determine their relative importance for differentiating between the two groups. The dependent variables for the deep squatting posture are hip flexibility, knee flexibility, trunk flexibility, flexibility of hip and pelvis and ankle dorsiflexion flexibility. The possible deep squatting group shows increase in ankle dorsiflexion flexibility than the impossible deep squatting posture. Thus deep squatting posture is easy and objective method to measure the ankle joint dorsiflexion flexibility.

Keywords: Heel-Buttock Distance; Straight Leg Raise (SLR); Modified-Finger Floor Distance; Modified Thomas Tests; Ankle Dorsiflexion Flexibility.

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INTRODUCTION

Squatting is one of the posture patterns under the influence of traditional lifestyle in Asian countries. Asian workers typically adopt their job in prolonged squatting postures in various fields to handle objects on the ground in furniture assembling, agriculture, metal we welding and trimming, shoe making, homemade food industries and Indian toileting etc.[8,23] The deep squatting posture can be described as a sitting posture with dorsiflexed ankles, deeply flexed knees and hips and a flexed torso with shoulder occasionally resting on the knee. The ability to perform the deep squat requires closed kinetic chain of dorsi-flexion of the ankles, flexion of the knee and hip, extension of thoracic spine as well as flexion and abduction of shoulder. Poor performance of the deep squat test can be the result of several factors such as limited mobility in the lower poor close kinetic chain dorsiflexion of the ankle, poor flexion of knee and hips.[8] Adequate flexibility in ankle dorsiflexion is necessary for normal performance of functional activities such as maintenance of gait, walking, running, stair climbing and rising from a chair and squatting.[23] Limitation of ankle dorsiflexion is associated with gait parameter and balance function. In addition, it is considered to be risk factors of falls for older people and sports injuries in healthy male. Restricted ankle dorsiflexion has also been implicated as a Contributing factors in overuse injuries of the lower limb and foot.[13] Limited ankle dorsiflexion produces significant shifts in the distribution of plantar pressure during gait. In particular, it was found that pressure was shifted laterally and dwelled for more time in the forefoot rather than the heel.[27] The ankle is the most injured joint of the musculoskeletal system, lateral sprains being the main dysfunction, affecting one in every 10,000 individuals in the entire World, corresponding to 80% of ankle joint dysfunctions.[24] The ankle dorsiflexion movement is necessary for functional performance, principally for gait. It is considered that about 10% of this movement is necessary during the medium support phase of gait.[12,24] During the normal gait, about 10 degree of dorsiflexion is needed during the stance phase and toe-off. The ankle dorsiflexion of more than 10 degree when going downstairs, kneeling and in many sports activity.[17] The ankle strategy has been shown to contribute to postural stability also. The ankle strategy works as an inverted pendulum action and is elicited by the activation, in a distal to proximal recruitment pattern of anterior muscle of lower limbs and trunk to overcome a posterior displacement of the body or activation of the posterior muscles of the lower limbs and trunk to over come an anterior perturbation limited ankle joint dorsiflexion has been associated with many overuse injuries of the lower extremity, including plantar fasciitis, Achilles tendinopathy, shin splints, iliotibial band syndrome, and patellofemoral pain syndrome.[14] A loss of ankle dorsiflexion has also been implicated as a risk factor for recurrent ankle sprain. Dorsiflexion range of motion can potentially be limited by tightness in the muscles that plantar flex the ankle, particularly the gastrocnemius and soleus, capsular and soft tissue restrictions, loss of normal posterior glide of the talus in the mortise, and loss of other accessory motions at the tibiofibular, subtalar, and midtarsa joints.[5] Recent studies also implicated that limited passive dorsiflexion (DF) range of motion (ROM) and increased passive ankle stiffness as key factors contributing to increased plantar loading. The degree of ankle joint dorsiflexion that is sufficient varies from individual to individual depending on factors such as type of daily activities, heel height of shoes, and structure of the forefoot.[25] Therefore maintenance of strength of the dorsiflexion muscle as well as adequate of movement is necessary to allow efficient force generation and balance strategy execution to prevent a fall. Functionally available dorsiflexion range of ankle range of movement motion is different depending on whether the knee is allowed to bend or kept straight.[9] In most instances of daily activity the knee is bend and the body weight is born through the feet or floor to contact is occurring when large range of dorsiflexion are required to enable activity. Two specific functional activities that rely on ankle dorsiflexion range being substantial include sitting down and standing up from a seat and ascending and descending stairs. During both these activities, stability can be lost if insufficient range of dorsiflexion is available and a fall might result. The measurement method described herein is expected to enable the production of risk factor, thus leading to the prevention of the risk of falls, sports injuries etc. However, it is necessary to clarify the influence of anthropometric characteristics and the flexibility of other joint on the ability to adopt the deep squatting posture. The anthropometric characteristics like body height, body weight and BMI were included.

METHODOLOGY

Sample: A total of 50 subjects participated in the

study. The study was conducted in the department of Physiotherapy, Uttaranchal (PG) College of biomedical sciences and Hospital, Dehradun. The subjects were recruited from Uttaranchal (PG) College of biomedical sciences and Hospital Dehradun.

Inclusion Criteria

- 50 normal healthy individual males.
- Age - 18 to 25 years.

Exclusion Criteria

- History of fracture of lower extremities in last 6 month.
- History of dislocation/subluxation hip, knee and ankle joints in last 6 months.
- History of any joint pathology of hip, knee and ankle joints in last 6 months.
- History of any soft tissues damage or tearing in the lower extremity in the last observational study.
- Any spasm/tightness in lower back muscle.

Study Design: Observational

Instrumentation

- Measurement tape/flexible metal tapes usein centimeter (cm)
- Universal Goniometer
- Half circle Goniometer
- Standard Weight Machine
- Use in Kilogram (kg)
- Staircase

Protocol

Subjects were chosen as per the inclusion and exclusion criteria and informed consent should be obtained from all of them. After explaining the procedure, the subjects were assessed and divided into two groups possible squatting group and impossible squatting group.

Procedure

The subjects were asked to sit in the deep squatting posture with their heel down and arm Crossed and maintain the posture for more than 5 second and they were divided into 2 groups. Two points to be kept in mind while squatting were as follows: (a) Both the knees and feet should be brought together to the maximum possible extent throughout the deep squat and (b) The thigh and calf should be in contact with each other. The subjects were divided into two groups possible squatting and impossible deep squatting groups.

The possible deep squatting group can be described as those who can performed the squatting i.e, both the knee and feet should be brought together to maximum possible and the thigh and calf should be in contact with each other and maintain these posture more than 5 second where as impossible deep squatting group can be described as those who can't performed to contact calf and thigh while squatting shows the deep squatting posture. The anthropometric characteristic of the subject and girth of thigh and calf and the flexibility and movement range of the lower extremities of subjects were tested. The anthropometric characteristic includes body height, body weight and BMI. It is necessary to measure the flexibility of each joint of the lower extremities in deep squatting posture. Therefore items reflecting the flexibility of each joint were measured by specific tests.

The straight leg raise (SLR) tests were used to measured *hip flexibility.* In the SLR test, the subjects leg with the knee held straight were raised parallel to the edge of the table with the subject in supineposition and hip flexion angle were measured. The goniometer was placed with the stationary arm parallel to the edge of the table, the moving arm along the lateral midline of the thigh and the axis over the superior half of the greater trochanter.

The Heel-Buttock Distance (HBD) tests were measured as an indicator of *knee flexibility.* The HBD is the distance between the heel and buttock. The subjects were placed in the prone position and HBD was measured using a tape measure with subjects knee passively bent.

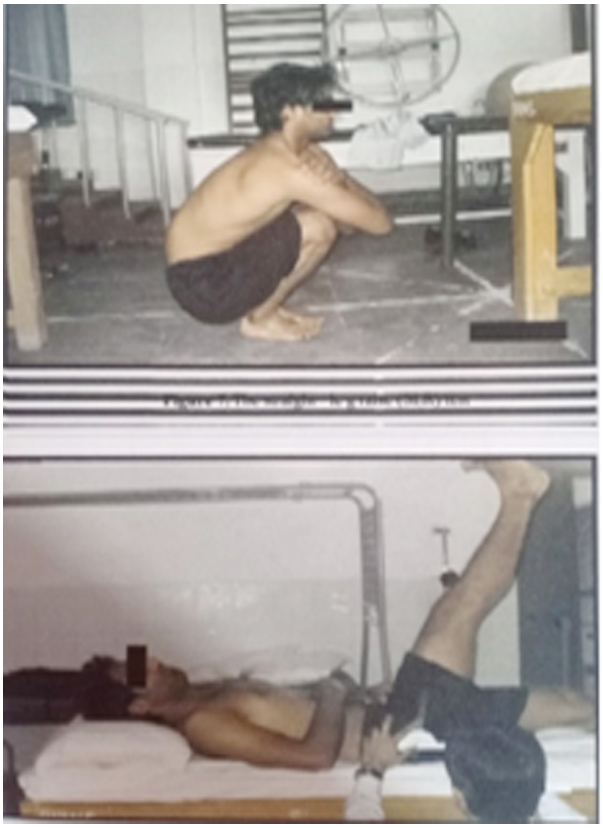
The Modified-Finger Floor Distance (MFFD) were measured as an indicator of *trunk flexibility.* The MFFD is the distance between the fingertips and the top of stool when the subjects bend in an upright standing position and extends his figures toward the floor while standing on a stool.

The Modified Thomas Tests were used to measure the *flexibility of hip and pelvis.* In modified Thomas test, the subjects were sitting at the end of the plinth and held both knees to the Chest. The subject held one leg in maximal hip flexion with his arms, while the tested limb was lowered toward the floor. Flexibility was determined by measuring hip flexion angle.

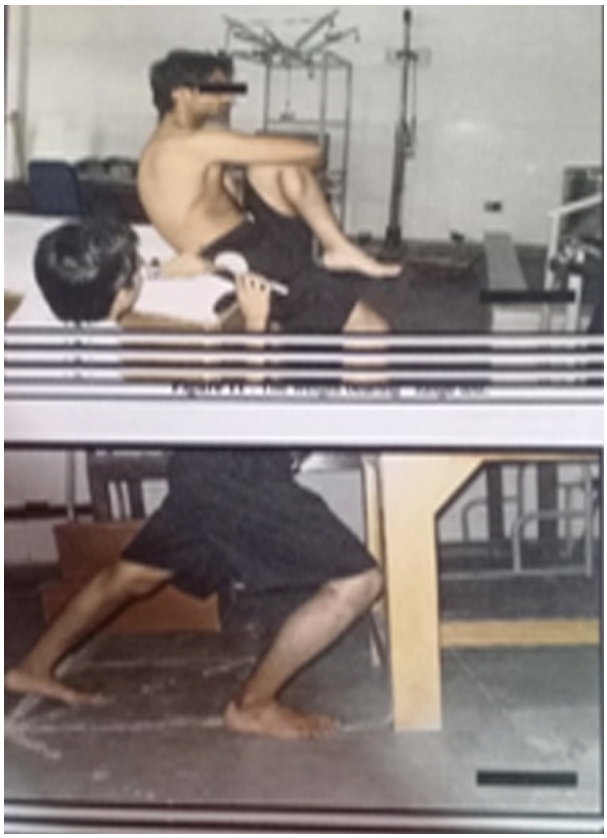
Ankle dorsiflexion flexibility were measured using the weight bearing lunge test. A weight bearing lunge is the distance between the tip of the big toe and wall when the subject lunges toward the wall. It was measured with tape measure placed on the floor. Physiotherapists commonly use aweight bearing lunge test to assess DF at the ankle. For this test, the patient is required to place their foot perpendicular to a wall and to lunge their knee toward the wall. The foot is progressively moved away from the wall until the maximum range of ankle dorsiflexion is reached without the heel lifting. The most frequent measurements taken at this point arethe distance from the foot to the wall. The benefits of the DF lunge test are that it is cost and time efficient, requires minimal equipment and is performed in weight bearing. The latter is particular advantage as the torque applied to the ankle is many times greater than that applied by non weight bearing methods and hence the resulting measurement may be more indicative of the range available for functional tasks. On the negative side, the test cannot be performed on patients for whom weight bearing is contraindicated.[13]

To examine the possible differences between the two squatting groups regard to each test parameters the Mann-Whitney u test (if the distribution ofthe data is not normal) was used. The dependent variables for the deep squatting posture were analyzed by step wise linear discriminate analysis to determine their relative importance for differentiating between the two groups. The dependent variables for the deep squatting posture are hip flexibility, knee flexibility, trunk flexibility, flexibility of hip and pelvis and ankle dorsiflexion flexibility.

The Deep Squatting posture



The Heel to buttock distance test and The Modified finger floor Distance (MFFD) test



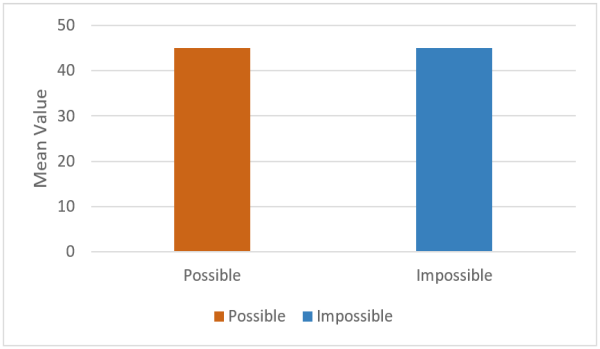
The modified Thomas test and The weight bearing lunge test

RESULT

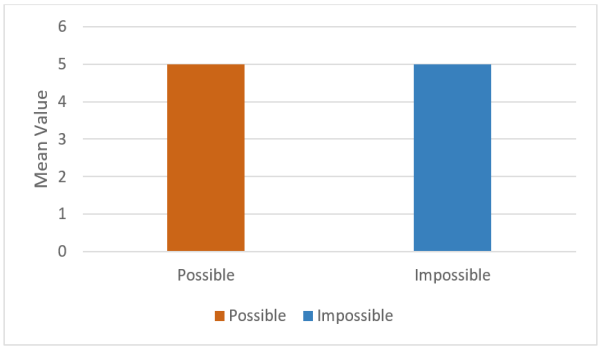
The data was analyzed for the 50 participants, 25 were belongs to the possible squatting groups, and there maining 25, to the impossible group.

Possible squatting groups had mean and SD value and impossible squatting groups had mean and SD value. Both groups had U value and Significance.

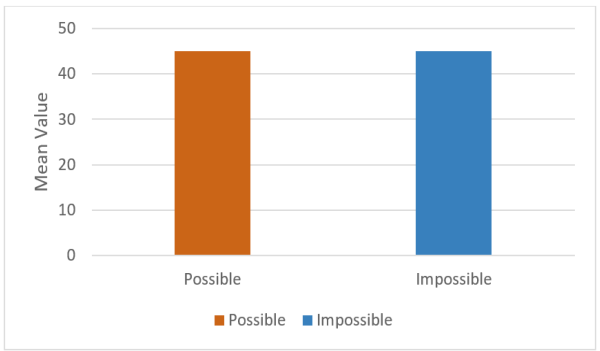
Comparison of all the variable between possible and impossible squatting groups.



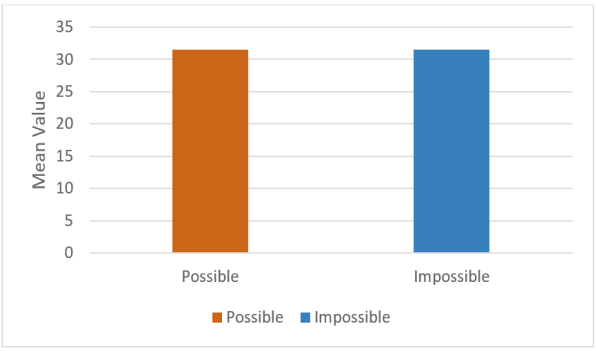
Graph 1: Comparison of mean values for RGT between Possible and Impossible Group



Graph 2: Comparison of mean values for FFDT between Possible and Impossible Group



Graph 3: Comparison of mean values for LGT between Possible and Impossible Group



Graph 4: Comparison of mean values for LGC between Possible and Impossible Group

Age: 22.4 1.6922.00 1.65 -.076 P>0.05.

Height: 163.91 5.45 164.0 4.80 -2.04 P>0.05.

Right modified thomas test left modified thomas test finger to floor distance test right weight bearing lunge test left weight bearing lunge test impossible deep squatting groups U value Significanc SD.

Weight 53.71 3.88 57.20 3.84 -3.043 P>0.05.

BMI 20.50 1.26 21.25 1.37 -2.156 P>0.05.

Right girth of thigh 44.6 4.06 44.76 3.19P>0.05.

Left girth of thigh 44.41 4.04 44.49 3.07- .398 P>0.05.

Right girth of calf 31.67 1.84 31.74 1.82- .495 P>0.05.

Left girth of calf 31.52 1.90 31.61 1.79 - 233 P>0.05.

Right SLR 72.61 4.48 72.60 5.49 - 136 P>0.05.

Left SLR 72.53 4.2272.40 5.64.126 P>0.05.

Right heel buttock distance 4.70 0.98 7.72 0.90 -5.972 P>0.05.

Left heel buttock distance 4.61 1.09 7.61 1.09 -5.834 4.80 .204 P>0.05.

Right modified thomas test 10.87 1.50 11.32 1.53 -1.090 P>0.05.

Left modified thomas test 1010.77 1.20 11.20 1.36 -942 P>0.05.

Finger to floor distance test 4.98 2.44 4.81 2.15 -.058 P>0.05.

Right weight bearing lunge test 13.5. 1.11 8.99 0.68 -6.073P>0.05.

Left weight bearing lunge test 12.81 1.07 8.87 0.64 -6.067 P>0.05.

DISCUSSION

In the present study 50% of the subjects could

not maintained the deep squatting posture. G. Katherisan *et al.* reported that approximately 22.5% of their Malaysian healthy individual male could not maintain the deep squatting postture. Various researches state that the ability to adopt the deep squatting posturerelated to the ankle dorsiflexion flexibility.[23] However, since the deep squatting posture has also been shown to relate to the anthropometric characteristics and flexibilities of the other joints. It was necessary to determine the factors that influence the deep squatting posture. Therefore, we aimed to determine the intrinsic factors that influence the deep squatting posture on the measurements of ankle dorsiflexion. The discreminent analysis conceptually revealed that the deep squatting posture is significantly correlated with ankle dorsiflexion, knee flexibility, body weight and BMI but ankle dorsiflexion is most significantly correlated with the deep squatting posture than the other dependent variables, the increase in the ankle plantar flexion moment with increase in the anteversion angle of the shank (i,e ankle dorsiflexion) is the most influential factors for the deep squatting posture. The ankle plantar flexion moment causes frontrotation of the shank and help to stabilize the center of gravity, thus enabling the maintenance of balance. In particular, ankle dorsiflexion flexibility is significantly correlated with maintenance of a stable deep squatting posture. Ankle dorsiflexion is also significantly correlated with the maintenance of the squatting knee flexion. Furthermore, body mass index (BMI) was found to be correlated to the maximal knee flexion during squatting[23] In the present study, we instructed the subjects on the positioning of the foot, and only movement in the sagittal plane was allowed. We think that lowering the degree of freedom of the lower extremities lead to the moderate discrimination percentage obtained by this evaluation method. In order to maintain balance in the case of the limitation of the ankle dorsiflexion, it is necessary to move the center of gravity forward by compensating with trunk and hip joint flexion. However, in this posture, it is impossible to keep the thigh in contact with the calf. Thus, limitation of ankle dorsiflexion makes it impossible to adopt the deep squatting posture. The hypomobility of the ankle dorsiflexion can be observed during the deep squatting posture if the heel of the foot rises while descending from the neutral starting position, the subject may have weak, tight lateral gastrocnemius, hamstring, weak inner thighs, and is at risk for achilles tendonitislf the knee drift inward shows the subject has weak glutes, tight inner thighs and is prone to knee and low back problem. lf the patients back bend into flexion while performing the deep squat, it may mean they have tight hip flexors, a weak core and poor posture. The lumbar spine may be more flexible relative to the hips in flexion due to lengthene derector spinae and short hamstring, this can lead to a hamstring straighten lack of mobility in the thoracic spine during the deep squat, the patient may inability to get the dowel directly over the feet and the armway out in the front of the feet. Body weight is associated with the deep squatting posture only to sligh textent. BMI (body mass index) was found to be correlated to the maximal knee flexion during the squatting. A smaller BMI indicates less soft tissue to restrict motion in deep knee flexion. Body weight and BMI are strongly related. We think that increase of body weight also influences the knee flexion, thus making it impossible to keep the thigh in contact with the calf and to adopt the deep squatting posture.Limitation of ankle dorsiflexion is associated with gait parameters during heel strike and balance adopts function. In addition, it is considered to be a risk factor of falls for the elderly and sports injuries in healthy malès Therefore, the measurement method described above is expected to enable the prediction of the risk factor, thus leading to the prevention of falls, sports injuries, etc. Restricted ankle dorsiflexion has also been implicated as a Contributing factors in overuse injuries of the lower limb and foot the method does not require any specific instrument, meaning that the skill level and the experience of the evaluator were not significant for the measurements. This studydescribed an easy and objective measurement of ankle dorsiflexion for physical therapy practices and coaches and assessment of the deep squat provides analysis of stability and mobility[11] and flexibility of lower extremities.

CONCLUSION

The possible deep squatting group shows increase in ankle dorsiflexion flexibility than the impossible deep squatting posture. Thus deep squatting posture is easy and objective method to measure the ankle joint dorsiflexion flexibility.

Clinical Significance

Since we found that there is significant difference in ankle dorsiflexion flexibility between the possible and impossible deep squatting posture. So there is increased in ankle dorsiflexion flexibility in possible deep squatting posture than the impossible deep squatting posture.

Limitations

The subjects recruited in our study consisted of normal healthy individuals males that were considered normal. Factors such as the subjects who have restricted range of motion and musculoskeletal disorder in lower extremities in last 6 months may affect the reliability of the measurements there fore the results of our study can be applied only to the normal healthy individual males and the test cannot be performed on the subjects for whom weight bearing is contraindicated.

Future Research

The study can be done on people of both sexes belonging to the different races the study can be done on old ages groups. The study can be done on the certain condition after the physical therapy. The study can be done on the people with diabetes mellitus.

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