

Correlation between Foot and Ankle Characteristics with Functional Abilities and Balance among South Indian Geriatrics

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ABSTRACT

Objective: The aim of the study was to find the correlation between foot and ankle characteristics with functional abilities and balance among south Indian geriatrics.

Methodology: Sixty elderly people residing in an old age home were taken for test of Foot & Ankle characteristics, Balance and functional ability. Foot & Ankle characteristics were tested across five domains: Foot posture was tested by foot posture index, ankle flexibility was measured by modified version of Lunge test, foot deformity was tested by the grading exercised by the photographs, foot strength was measured by Paper grip test and foot sensation was tested by Semmens- weinsten aesthesiometer.. Balance and Functional ability were tested by standing balance test, sit to stand , 8foot and go test and walking speed.

Results: The correlation value between Foot posture with standing balance test, sit to stand test, 8-foot up and go test, gait speed are -0.027, -0.097, 0.048, 0.05 respectively. The correlation value between Ankle flexibility with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.023, -0.134, -0.169, -0.261 respectively. The correlation value between Hallux valgus deformity (HVD) with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.153, 0.011, -0.075, -0.099 respectively. The correlation value between Paper grip test1 (PGT1) with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are 0.735, -0.367, 1.374, 1.133 respectively. The correlation value between Foot sensation (FS) with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.007, 0.052, -0.272, -0.206 respectively.

Conclusion: This study proves that Foot and Ankle characteristics strongly correlate with the Balance and Functional ability in geriatric population.

Keywords: Characteristics, Impaired Balance, Functional Ability and Geriatrics

INTRODUCTION

Maintaining Balance and performing functional task depend on the interaction of multiple sensory, motor and integrative systems¹. Functioning of these factors decline with age.²As the age moves the ability of maintaining the balance decline in certain Age for elderly people may cause risk of falling, it is proven that the poor balance in the elderly people is due to

vestibular and cerebellar insufficiency³. However, There are number of factors for risk of falling of elderly people with impaired balance. In particular, it is like that the foot problem have a detrimental effect on mobility that is independent of these factor^(4, 5). Balancing requires concurrent processing of inputs from multiple senses, including equilibrioception (from the vestibular system), vision, and perception of pressure and proprioception (from the somatosensory system), while the motor system simultaneously controls muscle actions. The senses must detect changes of body position with respect to the base, regardless of whether the body moves or the base moves⁶. The study is to reveal the foot impairment based on the observation of foot lesion and structural deformities was significantly and independently

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associated with the performance on clinical tests of balance and functional ability⁷. There is an evidence that a significant association between ankle ROM and balance has been reported in older women⁸. Aging is associated with changes to the structure and the function of the foot and ankle. It is proved in the previous studies that the high risk of fall of old age people is due to impaired balance and functional ability. This study was to explore the relative contribution of several Foot & Ankle characteristics to performances on the range of Balance and Functional test. The study aimed to check the correlation between the foot and ankle characteristics associated with impaired balance and functional ability in elderly people

METHODOLOGY

Sixty people (30 male and 30 female) with mean age ranged from (64 to 85years) who were residing in an old age home , Chennai, Tamil Nadu, India. The subjects should satisfy the following Criteria: Age above 60 years, Sex, both male and female were oriented. Participants, who gave their informed consent to participate in the study, people who are having the history of frequent fall and independent ADL. Subjects who were disoriented , underwent Lower Limb Surgery and who had any recent injuries to lower limb were excluded from the study.

PROCEDURE

Foot and Ankle Characteristics

Foot and ankle characteristics were tested across five domains: foot posture, ankle flexibility, Foot deformity, foot strength and foot sensation. Foot posture was assessed by using the foot posture index⁹ Eight criterion rated from -2 to +2 (highly supinated to highly pronated).Navicular height was measured while the subject was fully weight bearing., the height of the navicular tuberosity from the ground was measured in millimeter using a steel ruler. Ankle flexibility was measured by modified version of Lunge test¹⁰. Subjects then stood with their one foot placed alongside a vertically aligned clear acrylic plate inscribed with 2° protractor marking .The position of the fibular head was marked on the clear acrylic plate, and the angle formed between the lateral malleolus and the fibular head was measured.1ST MTP JOINT ROM: by finger goniometer. Foot deformity included : Hallus valgus deformity was measured by the grading exercised by the photographs. Grades one to

four measured according to deviation of great toe in the photographs by compared that with the photograph which undergone research by many podiatrics. Lesser foot deformity: The similar photographic method was taken for other lesser toes.Foot strength was measured by Paper grip test¹¹:Two variants of the PGT were conducted, PGT1 to detect intrinsic muscle weakness of the great toe and PGT2 to detect weakness of the combined intrinsic muscles of the lesser toes (second, third, fourth and fifth toe) .Foot sensation was tested by Semmens-weinsten aesthesiometer in which colour coded monofilaments were used. Each color represent the force of the filament.

Balance and Functional ability

Standing balance test: standing balance test scale designed to quantify independent standing balance performance, based on timed measurements.Sit to stand: the participant is instructed to rise to a full stand and return back to a fully seated position after the signal "go" is given.8-Foot and go test: subject is instructed that on the signal "go," they are to rise from the chair (pushing off of thighs or chair is permitted), walk "as quickly as possible" around the cone exactly 8 feet away and return to a seated position in the chair. The participant is told that they will be timed and should therefore walk as quickly as possible but not to run.Walking speed: Subjects are asked to walk across the course at their "usual, comfortable speed." Time is started when the subject's foot crosses the black tape line indicating the end of the course. One practice trial is performed prior to testing to ensure patient understanding of the task. Two timed walks are performed with the fastest of both trials recorded on the sheet.



Fig. 1. Acrylic Plate With Protractor

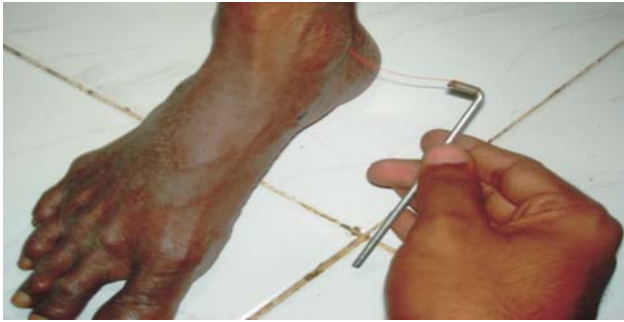


Fig. 2. Semmens Asthesiometer Testing Foot Sensation

RESULTS

Table 1: Mean values of Balance and Functional abilities

Balance and Functional abilities	Mean	SD
Standing Balance Test	3.10	1.16
Sit to Stand	8.93	3.62
8-foot & Go Test	12.93	4.18
Gait Speed	17.04	5.38

TABLE 2 : Correlation values of Foot and Ankle characteristics with Balance and Functional abilities

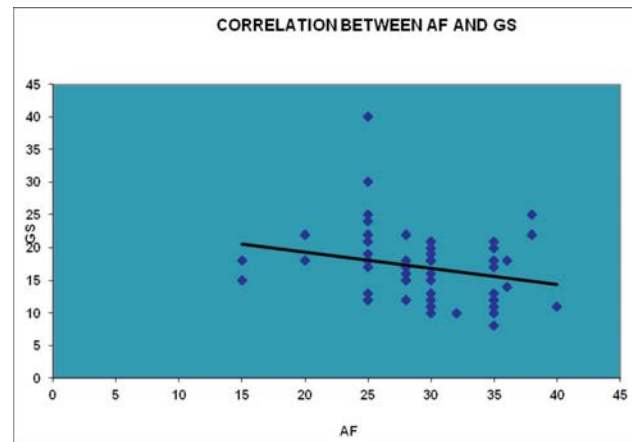
	Foot Posture Index	Navicular Height	Ankle Flexibility	1 st MTP ROM	Hallux valgus	Lesser toe deformity	Paper grip test-i	Paper grip test-ii	Foot sensation	Navicular Height
Standing balance test	-0.0270.789(NS)	0.0750.569	-0.0230.823	0.2010.123	0.151 0.249	-0.153 0.243	0.735 0.465	-0.347 0.730	-0.007 0.957	0.0750.569
Sit to Stand	-0.0970.309(NS)	0.2030.121	-0.1340.175	0.110.397	0.0830.529	0.0110.934	-0.367 0.713	0.223 0.824	0.052 0.691	0.2030.121
8-foot & Go test	0.0480.606(NS)	-0.060.646	-0.1690.079	-0.120.362	0.132 0.316	-0.0740.575	1.374 0.175	0.803 0.426	-0.272 0.036	-0.060.646
Gait speed	0.0050.959(NS)	-0.08 0.5	-0.2150.026	-0.260.044	0.0520.695	-0.0990.450	1.133 0.262	1.299 0.199	-0.206 0.115	-0.08 0.5

The mean value of foot posture index, Navicular height, ankle flexibility, 1st MTP joint ROM, Hallux valgus deformity, Lesser toe deformity and Foot sensation are -1.45, 4.59, 29.25, 52.48, 11.75, 1.5, 1.33, 3.22, 3.05 and 2.22 respectively.

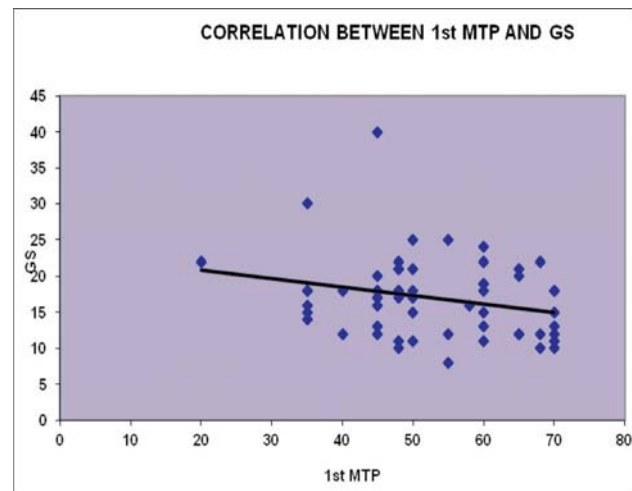
According to table 2, The correlation value between Foot posture index(FPI) with standing balance test, sit to stand test, 8-foot up and go test, gait speed are -0.027, -0.097, 0.048, 0.05 respectively. The correlation value between Navicular height(NH) with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are 0.075, 0.203, -0.06, -0.08 respectively. The correlation value between Ankle flexibility(AF) with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.023, -0.134, -0.169, -0.261 respectively. The correlation value between 1st MPT joint ROM with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are 0.201, 0.111, -0.12, -0.261 respectively. The correlation value between Hallux valgus deformity (HVD)with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.083, 0.132 , 0.052 respectively. The correlation value between Lesser toe deformity with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.153, 0.011, -0.075, -0.099 respectively. The correlation value between Paper grip test1 (PGT1)with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are 0.735, -0.367, 1.374, 1.133 respectively. The correlation value between Paper grip test2 (PGT2)with Standing balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.347, 0.223, 0.803, 1.299 respectively. The correlation value between Foot sensation(FS)with Standing

balance test, Sit to stand test, 8-foot up and go test, Gait speed are -0.007, 0.052, -0.272, -0.206 respectively.

GRAPH - I



GRAPH-2



DISCUSSION

The study conducted proved that there is a strong correlation between the ankle flexibility and first metacarpal joint range of motion with balance and functional ability. The significant correlation exists between Ankle flexibility and Gait speed with the value of ($P < 0.026$). There is a significant correlation between first metatarsophalangeal joint range of motion with gait speed had P-value of ($P < 0.044$). Hyton et al.,¹² proved that foot and ankle characteristics particularly Ankle flexibility, Tactile Sensibility and Toe strength are important determinants of Balance and Functional ability in old age people. The scientific rationale behind the relation of Ankle flexibility and Gait speed are proved by Adam Graf, James O Judge MD.,⁶ The reduced momentum in gait indicated by the relationship of the ankle with vertical axis of the body during stepping, ankle plantar flexor generate the significant power during normal gait (Power of ankle plantar flexor decline with age causes reduction in ankle flexibility) such that, Impairment to these muscle could induce change in speed of walking. The above study stated that there is a strong correlation between 1st Metatarsophalangeal joint ROM with Gait speed, Which is also proved by Howard J, Dananberg DPM.,¹³ The 1st Metatarsophalangeal joint permits sagittal plane motion to occur while the forefoot remain in contact with the ground. It has the ability to efficiently transfer the body weight that allows for the proper use of the kinetic energy created by the swing limb activity. Metatarsophalangeal joint extension, however begin to occur before the heel can be seen leaving the support surface, this occur after initial shock of impact is reduced. The value measured between Foot posture index and Balance Functional ability are not significantly correlated which is also stated by Karen P Cote, Micheal E Brunet.,¹⁴ that there is no significance in balance and foot type. The stability index was greater in pronators than in supinators. Foot posture had less relation with both static and dynamic balance. The result of the study proved that there is no significant correlation between the Foot sensation and Balance Functional ability which is explained by Ducic, Short K W.,¹⁵ that there is Intuitive relationship between increasing loss of Foot sensibility and increasing loss of Balance. In which the tools used for measuring balance is Sway meter, but in this study the tools used for measuring Balance have not much correlation with Foot sensation. The result of the study proved that there is no significant correlation between Hallux valgus deformity & Lesser toe deformity and Balance Functional ability. Mickle K J, Munro B J.,¹⁶ stated that

Hallux valgus deformity and Lesser toe deformity were highly prevalent Foot problem in older people and the presence of toe deformities increase the risk of falling in older people. In this present study tools used for measuring for balance may not had significance with Hallux valgus and lesser toe deformity. The intrinsic muscle weakness without any deformity has no correlation with Balance.

CONCLUSION

This study proves that Foot and Ankle characteristics strongly correlate with the Balance and Functional ability in geriatric population. Foot and ankle characteristics particularly Ankle flexibility and 1st Metatarsophalangeal Range of Motion are important determinants of Balance and Functional Ability in Older people.

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ETHICAL CONSIDERATION

All the ethical consideration has been taken care of for conduction of this study. The author had obtained the official acceptance from the Old age home for the conduction of the study. A informed consent in the local language (Tamil) and in English was obtained from the elderly who participated in the study.

Conflict of Interest & Source of Funding

We further state that no financial gain or aid has been taken from any Government and Non Government agency for conducting the study. All the ethical consideration has been taken care of for conduction of this study.

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