ASSESMENT OF PLANTAR PRESSURE POINT DISRTIBUTION IN NORMAL AND TYPE 2 DIABETICS USING F-SCANNER: A PRELIMINARY REPORT

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Abstract: ***Background:*** *Plantar ulcers produced by diabetic foot disease are devastating and costly. Better understanding of the ulcer-producing process is important to improve detection of feet that are at risk and to improve intervention. In clinical practice diabetic foot were normally screened for quantitative assessment through tuning fork and biothesiometer which uses vibration sense to asses the neuropathy. There are limited studies on the early assessment of plantar pressure distribution point in the diabetic population. Therefore, the objective of the present study is to find out the changes in plantar pressure in diabetic as compared to healthy individuals.*

Method: *Thirty Normal individuals with the mean age (28± 10) and twenty five diabetic individuals with mean age (43±4) were selected for the study. The plantar pressure distribution of both populations was recorded using I-Step foot scanner in erect standing position for 30 second on the foot scanning plate. The result analyzed using the t test. The result analysis of the present study showed there is an early change in plantar pressure distribution in type-II diabetic patients as compared to normal individuals.*

Conclusion: *The finding of the present study indicates that there is an early change in plantar pressure distribution in diabetic population as compared to healthy individuals.*

Key words: Plantar pressure, Type II Diabetes, Foot scanner.

Introduction

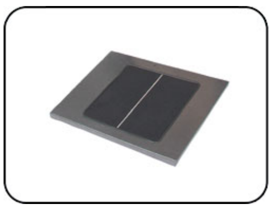
Foot problems remain a major cause of hospitalization amongst patients with diabetes and the lifetime risk for developing an ulcer for a person with diabetes was recently estimated to be as high as 25% [1]. The main contributory factors that result in foot ulceration include peripheral neuropathy (somatic and autonomic), peripheral vascular disease, trauma, foot deformity and limited joint mobility. Several of these factors combine to complete the causal pathway to ulceration. The commonest triad that results in 66% of ulcers is neuropathy, deformity and trauma.

Normally in clinical practice clinician screen the foot through quantitative assessment like tuning fork and biothesiometer which uses vibration sense to asses the neuropathy.[2, 3]. The key components in the management of diabetic foot are; foot care education, periodic screening for the foot complication by clinician and appropriate foot wear to prevent the foot complication like foot ulcer and deformity.

In healthy individuals normally they weight bear on following areas like metatarsal heads, calcaneum and to a little extent on the lateral border. There are three types of arches seen in normal individuals- low arch, medium arch, and high arch. However, In case of diabetic individuals, due to prone for developing peripheral neuropathy and due to intrinsic muscle weakness they are prone for altered foot loading. Due to intrinsic muscle weakness, collapse of arches and defective foot wear there is permanent changes in the foot structure. Several conditions such as bun unions, calluses, and flat foot are frequently seen with abnormal weight bearing areas. If not screened early they are prone for diabetic foot ulcer in the weight bearing points. There are very limited studies on the early assessment of plantar pressure point in the diabetic population and also to find the out the changes in planter pressure in diabetic as compared to normal individuals. There is a need to identify the changes in the weight bearing point in diabetic to prevent the complications like diabetic ulcer and foot deformity. Understanding the pressure bearing areas in diabetic individuals and comparing it with normal individuals will help us understand the areas prone to develop ulcers in diabetics. Early screening can help to stratify the population under threat of ulcer, so that effective care is initiated as early as possible.

Therefore, the aim of present study is to assess and compare the planter pressure point distribution in normal and type-II diabetes individual using F-scanner.

Materials and Method: I-step foot scanner (2005) was used for the study. I step F –scanner uses 1024 barometric sensors and measures the force exerted by foot every one cm. The Pressure information (force/ area) collected by the sensor is then analyzed by the high tech-I step software.



Method

Study design; Cross-sectional Observational study. Study centre, Department of physiotherapy, Manipal.

Sampling method: Convenience sampling

Procedure

Thirty Normal individuals with the mean age (28± 10) and Twenty five type-II diabetic patients mean age (43±4) were selected for the study. The diabetic individuals with existing foot deformity were excluded from the study. The procedure was explained to the patient before starting the foot scanning.

All the subjects were separately scanned through the foot scanner. The planter pressure point distribution on foot is being screened with help of F-Scanner. The subject is instructed to stand on the scanner bear foot for 30 seconds. The patients detailed are fed to the computer and then command is given to scan the foot. F-

Scanner has sensors which sense the weight bearing areas and transmits the impulse to the computer. The Pattern of weight bearing is studied in healthy and Type-II diabetic individuals, to see the variations in weight bearing areas. The scanning of the planter pressure point which is obtained is in form of blue, yellow and red dots. Red dots are the highest pressure bearing areas followed by yellow and blue. Along with the weight bearing areas it also analyses the arch type and other foot measurements such as –average kg weight per sensors, U max kg/sensor, L kg max/sensor and total area of foot.

Data Analysis

The data were analyzed using the independent t test to find the differences in loading, between the healthy and diabetic individuals.

Result analysis

In the present study we found that depends upon the dominance of the person the loading is more on the that side as compared to non-dominant side in both healthy and diabetic individuals. The entire diabetic individuals showed low arch bilaterally as compared to healthy individuals. In healthy individuals, six of then are high arch, nineteen of them are medium arch and five of them are having low arch. Even through there is change in the architecture of the foot in diabetes clinically all of them were asymptomatic with their foot findings.

Table-I
Comparison of Base of 2nd Metarsal loading in Healthy and Diabetes individuals

Group	N	Right		Left		p
		Mean	SD	Mean	SD	
Normal	30	1.04	0.48	1.01	0.35	≤0.05
Diabetes	25	1.89	0.89	1.79	0.68	

Table-II
Comparison of Heel weight loading in Healthy and Diabetes individuals

Group	N	Right		Left		p
		Mean	SD	Mean	SD	
Normal	30	1.04	0.48	0.98	0.35	0.68
Diabetes	25	1.05	0.49	1.02	0.68	

Discussion

Plantar ulcers produced by diabetic foot disease are devastating and costly. Better understanding of the ulcer-producing process is important to improve detection of feet that are at risk and to improve intervention. The foot has two important functions: weight bearing and propulsion. These functions require a high degree of stability. In addition, the foot must be flexible, so it can adapt to uneven surfaces. The multiple bones and joints of the foot give it flexibility, but these multiple bones must form an arch to support any weight. The foot has three arches. The medial longitudinal arch is the highest and most important of the three arches. It is composed of the calcaneus, talus, navicular, cuneiforms, and the first three metatarsals. The lateral longitudinal arch is lower and flatter than the medial arch. It is composed of the calcaneus, cuboid, and the fourth and fifth metatarsals. The transverse arch is composed of the cuneiforms, the cuboid, and the five metatarsal bases. The arches of the foot are maintained not only by the shapes of the bones as well as by ligaments. In addition, muscles and tendons play an important role in supporting the arches.

During normal locomotion the human foot cushions the musculoskeletal system during impact, supports the body during ground contact, transmits forces between the ground and the leg, adapts to uneven surfaces, keeps the body in balance, and serves as a system for sensory input [4-6]. The supporting and force transferring functions of the foot are evident and are well discussed in the literature. Less research has been published on the influence of sensory input on the pressure distribution at the plantar surface of the foot. It has been proposed that the sensory feedback control system plays a role in human locomotion [5,7]. Interference with any sensory input due to disease, anaesthesia, or stimulation from outside may cause a disturbance of posture and influence the kinematics and kinetics of locomotion[5], producing a redistribution of the pressure at the plantar surface of the foot[8']. Studies analysing the pressure distribution in the diabetic foot have found that insensitive feet had abnormally high pressures under the forefoot and mid foot. A decrease in toe loading was found with increasing neuropathic involvement [9-13].

In the present study we have screened both healthy individuals and diabetes for the plantar pressure distribution. The result analysis of the present study indicates that there is early change in the foot arch of all diabetic patients as compared to normal individuals. Normally the medial longitudinal arch the most important arch and it equally distributes the weight to fore foot and hind foot. If medial arch starts getting changed due to age and other associated pathology then there will be an abnormal foot loading and due to continuous friction and also most importantly in diabetes due to peripheral neuropathy the patients start getting early foot ulcer.

In the present study, one of the most important observations we got is that in all diabetes patients the loading is increased in base of the second metatarsal (forefoot) as compared to normal individuals (Table-I). This is also supported by previous study[8]. This change is very important because, in diabetes patients most commonly we observe the ulcer in the first web space or the base of the second metatarsal in the plantar aspect. Therefore, with this finding of the present study we can definitely recommend that appropriate foot wear modification is required in these populations to prevent the abnormal loading on base of the Meta tarsal to prevent further complications like diabetic ulcer. In the present study we have found there is an increase in fore foot loading in all diabetic as compared to healthy individuals and it is statistically significant in diabetes as compared to normal individuals (Table-I), However, loading on the heel does not show any statistical significance between the diabetes and normal individuals. (Table-II)

In the present study, one the limitation is, we have not compared the same age group population with normal and diabetic patients and therefore we do not know these changes in the foot of diabetes patients is mainly due to diabetes or due to aging. Therefore, future study with randomized controlled trail is recommended to know the exact mechanism of foot architecture in normal and diabetic population.

Conclusion

From the present study we conclude that there is change in the plantar pressure distribution in diabetes as compared to normal individuals.

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