



## Loading character of diabetic foot in young patients during normal speed walking

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### ABSTRACT

*This study aims to investigate and compare the influence of plantar loading variables during gait of patients with diabetic in young ages. Subjects were divided into the following two groups: diabetic foot, 56 subjects; control group, 52 subjects. Plantar pressure distribution was measured during barefoot gait using the Novel emed platform. Both midfoot and lateral forefoot regions' peak pressure in the diabetic foot was higher than the normal foot. Also, diabetic foot group experienced significantly higher in pressure-time integral and contact time. Those variables provided an indication of plantar loading behavior over time, and other kinesiological factors like joint deformities and mobility can be investigated in further study.*

**Keywords:** Plantar pressure, Diabetic foot, Gait.

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### INTRODUCTION

Foot problems in diabetes can develop from a lot of component causes. The main contributing factors include sensorimotor and autonomic neuropathy, peripheral vascular disease, and limited joint mobility [1]. The existence of other long-term complications of diabetes also influence the development of foot ulceration [2]. So diabetologists pay particular attention to the feet of older patients to prevent significant avoidable morbidity and mortality in this vulnerable group. However, biomechanical study of diabetes foot on young ages is quite limited. Understanding of how the foot functions in relationship between foot and ground allows to target therapy towards controlling or changing that function in addition to treating tissue disease. A great majority of the problems that lead to diabetic amputations start off as problems related to the structure of the foot and how it relates to the ground and to the shoe worn above. The purpose of this study is to investigate the plantar pressure character of the young patients with diabetic foot providing useful information to podiatrist for maintenance, protection and active treatment of diabetic foot problems that do develop.

### EXPERIMENTAL SECTION

Fifty-six young diabetic patients (age range between 20-40) were participated in this study. Patients with previous amputation, active foot ulcers or who were unable to walk normally without aid for any reason were excluded from this study. Fifty-two non-diabetic subjects (age range between 20-40) selected as control subjects group. All control subjects were able to walk normally and none had a history of foot problems. The subjects details were listed in Table 1.

Table.1 Subjects details

	Diabetic group	Control group
Number of subjects	56	52
Age [years]	31±5.5	29±6.2
Body mass index [kg/m <sup>2</sup> ]	21.6±3.5	22.3±3.6

Plantar pressures were measured through the Novel emed system (Novel GMBH, Munich, Germany), which is an automated, digitized pressure platform that analyzes pressure, force, and area data along the contact surface during static or dynamic movement. The resolution of this system is 0.25 sensors/cm<sup>2</sup>, and the sensor area of the platform measures 475mm×320 mm, with a total of 6080 sensors, and a pressure range of 10–1270 KPa. Walking speed was under the subject's own selected pace, and the subjects were asked to walk in a straight line for about 20 meters for habituate before the tests. During each walk, data was collected from one step in the middle of the walking to avoid the starting and ending bias. Gait analysis was performed in the barefoot condition to avoid the influence of compounding factors such as shoe structure on plantar pressure.

## RESULTS

Peak pressure value during walking were shown in Fig.1, both midfoot and lateral forefoot region were significantly different between two groups, in which the diabetic foot was higher than the normal foot.

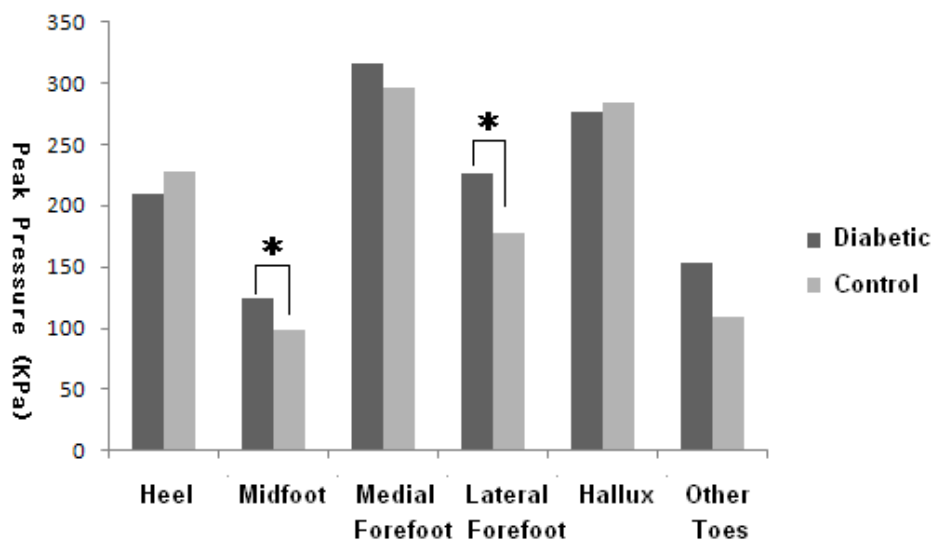


Fig.1 Peak pressure value of different parts of foot during walking (\* P&lt;0.05)

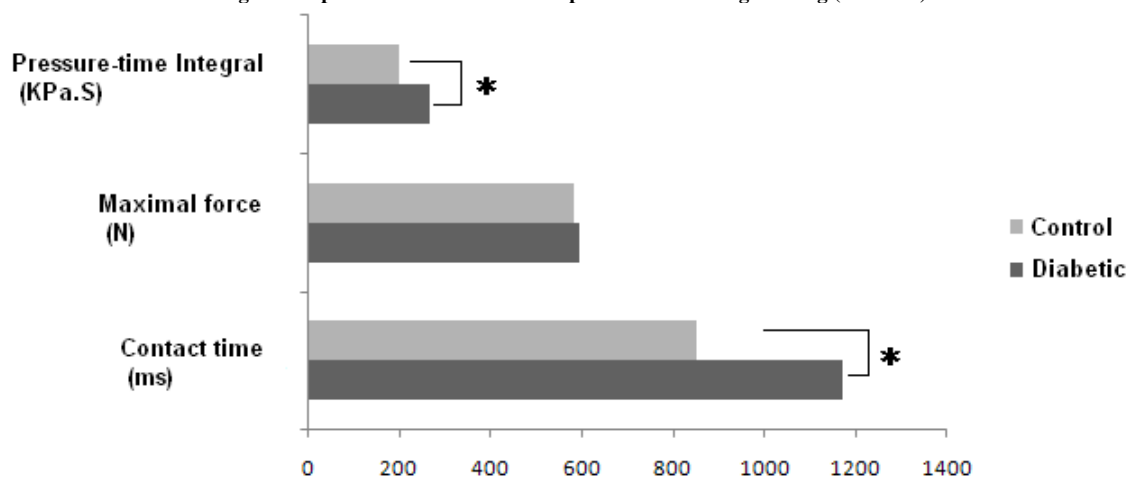


Fig.2 Comparison of difference in whole foot contact time, maximal force and pressure-time integral (\* P&lt;0.05)

Regarding to the value of pressure-time integral, maximal force and contact time of whole foot (Fig.2), diabetic foot group experienced significantly higher in pressure-time integral and contact time. The value of maximal force shows no significant difference.

#### DISCUSSION

This study investigated plantar loading character during gait between two different groups in young ages. It was interesting to discover that the higher pressure value in the midfoot and lateral forefoot in diabetic group comparing to the normal control group. Although the value was not considered to be a risk for foot ulceration based on the thresholds described in the literature [3, 4]. However, diabetic patients can develop ulceration even under normal plantar pressure values [5, 6]. Notably, the pressure-time integral and contact time were also elevated in the diabetic foot group. Those variables provided an indication of plantar loading behavior over time, which may more relating to the ulcer formation [7, 8]. The presence of elevated plantar pressure could also be associated with other kinesiological factors like joint deformities and mobility, which can be further investigated.

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