



Original Article

Evaluation of Ankle Joint Proprioception and Balance in Patients with Type 2 Diabetes and Healthy Subjects

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ABSTRACT

Background: Joint proprioception plays an important role in limb movement and awareness of position sense. Diabetes has a lot of complications such as loss of sensory function, which can lead to impaired balance, thus the aim of this study to evaluate joint proprioception and balance in diabetic patients.

Methods: Twenty type II diabetic patients and 20 healthy controls participated in this case-controlled study. Standing balance in various positions and ankle joint proprioception were measured. The data were analyzed using Mann-Whitney and chi-square test.

Results: It was observed that the ankle joint proprioception and balance in diabetic patients were significantly less than control groups. ($P < 0.05$)

Conclusion: Joint proprioception and balance functions impair in diabetic patients. Thus improvement of joint proprioception for prevention of fall is important.

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Introduction

Diabetes is a group of metabolic disease which is manifested by high levels for blood sugar for prolonged periods. The disease has been reported in 15% of the population over 65 years [1]. The disease is accompanied by many complications which develop over years. One such complication is diabetic neuropathy which affects about 50% of diabetic patients. The neuropathy causes sensory disturbances in distal parts of the extremities, numbness, pain and weakness [2, 3]. As such, movement and balance can be affected due to the impairment of proprioceptive afferents originating from muscle spindles and tendon organs.

[4]. Proprioceptive afferent fibers which originate from the lower limbs, especially around the ankles, are main

sources of information to maintain and control the body's sensory system.

The position control disorder increases the risk of ankle sprain and falling [5]. In people with diabetes, injuries in major sensory fibers reduce sensitivity of light touch and position sense, while, small fiber damage reduces sensitivity to pain and thermal sense. In fact, both types of fiber neuropathy in these patients may be involved [6].

Examining the ankle joint proprioception and balance in people with diabetes seem necessary, to prevent complications, such as ankle sprains and falling.

The aim of this study was to determine ankle proprioception and balance in diabetic patients.

Methods

This study is a cross-sectional case-control. Twenty type II diabetic patients and 20 healthy controls were investigated in this study. The two groups were matched

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in terms of sex, age, height and weight. Patients who had active wounds [8] or were using assistive devices for walking or had any other musculoskeletal disorders, history of fractures or deformity were excluded from the study [7].

All participants read and signed the consent form approved by the Ethics Committee of SUMS. A questionnaire was used to obtain demographic from each subject. Two goniometer were used to measure dorsiflexion/plantar flexion and inversion/eversion of the ankle. To properly align the goniometers, subjects were asked to sit on a chair in a quiet and comfortable manner. The task for the subjects was to reconstruct ankle angle. Subject's foot were placed on a movable foot plate. With closed eyes, the foot was positioned by the examiner. Subsequently, the foot was moved to a random angle and the subject was asked to move it back to the original angle. This procedure was repeated three times for each movement and the mean difference between desired angle and the reconstructed angle was determined. Standing balance was examined by single leg standing with eyes open and closed. The duration that the subject was able to stand without a significant disturbance of balance was measured. Finally, subjects were asked to do tandem gait. Again, the distance of sturdy walking was measure. Data were analyzed in SPSS16.

Kolmogorov-Smirnov tests were used to assess normal distribution of all variables. The Mann Whitney test was used for between groups comparisons of the variables. Significant differences were set at $P \leq 0.05$.

Results

The mean duration of diabetes, at this study was (8.2 ± 12.5) years). Table 1 shows the biographical characteristics of healthy subjects and diabetic patients.

The difference between the desired and reconstructed ankle angel was calculated for all the directions. It was shown that diabetic patients had a significantly higher reconstruction error compared to the healthy group ($P < 0.001$). The results are summarized in Figure 1.

The balance of the two groups in single leg and double leg standing with eyes open and closed were examined. The results showed that in diabetic patients the ability to hold standing balance with closed eyes was significantly less than that of healthy individuals ($P > 0.001$) (Figure 2). However, there was no difference while they stood with eyes open. Tandem gait distance also was significantly lower in diabetic patients than in controls (53.2 ± 1.11 vs. 96.00 ± 26.11).

Discussion

The results of this study showed people with diabetes had more errors in the reconstruction of the right ankle joint angle. That may be due to the effect of diabetes on the nervous system including the nerves related to the sensation of the proprioception. This research confirms Andersen and Mugensen [9] who reported that knee and ankle proprioception reduced in diabetic patients [9].

Comparison of the balance duration between the two

Table 1: Demographic characteristics of healthy subjects and patients with diabetes

Variables Group	Age	Height(m)	Weight(kg)
Healthy	58.25±9.40	1.57±8.54	63.16±10.97
Diabetic	58.66±9.25	1.58±11.6	69.16±9.79

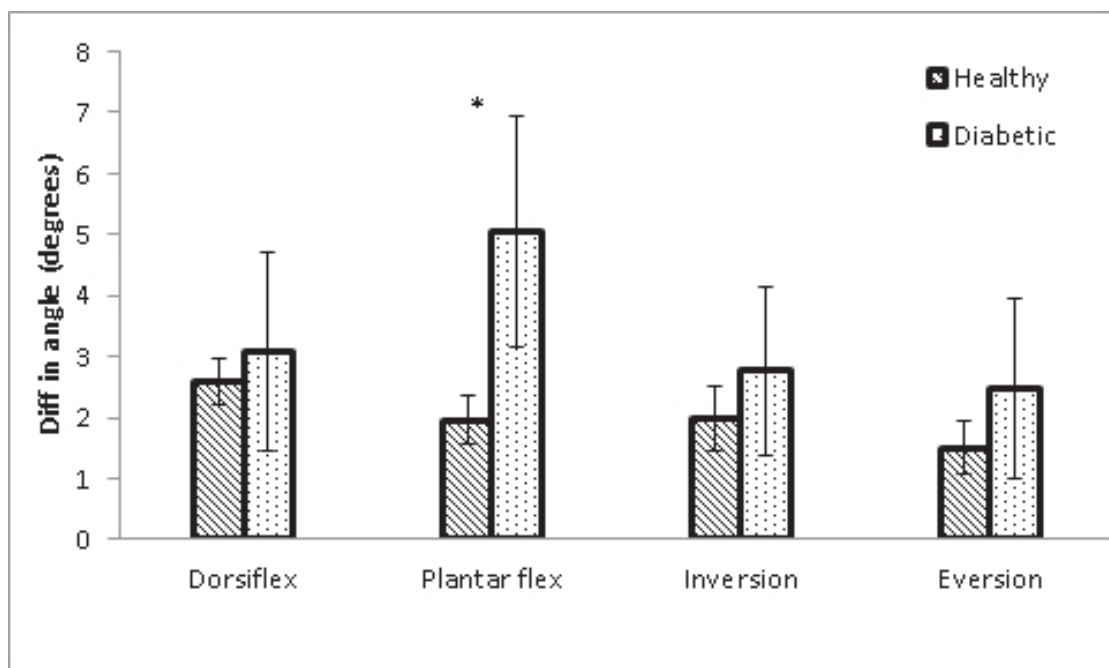


Figure 1: Comparison of error rate in right ankle joint angles repositioning in healthy subjects and patients with diabetes

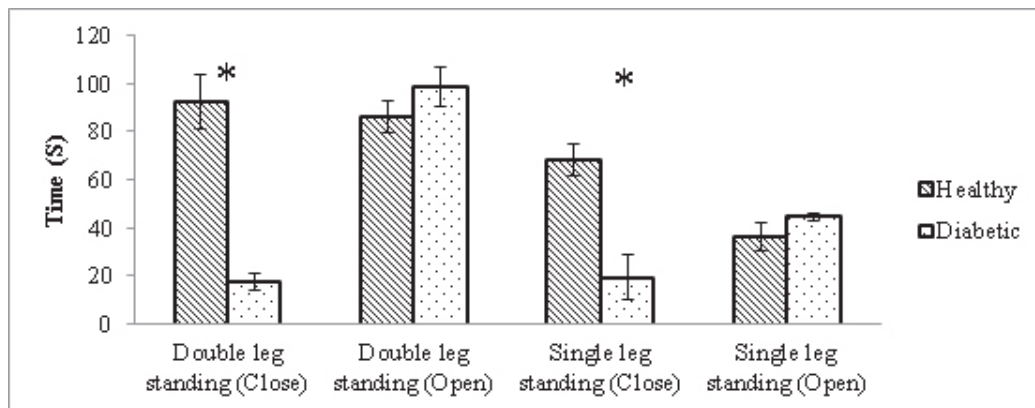


Figure 2: Standing time (seconds) and tandem walking distance (meters) in healthy subjects and diabetic patients.

groups showed that diabetic patients have less balance than healthy subjects. These results were similar to the study of Vaz and coworkers and Deursen and coworkers [10, 11]. Van Deursen [8] stated that, diabetic neuropathy reduces the function of peripheral sense receptors includes muscle spindles and leads to impaired balance and gait instability. Diabetics showed the delay of reflex responses to postural perturbation, following reduction of nerve conduction velocity. This leads to impaired balance and increases the risk of falls [6]. Beloem [12] and its coworkers also established that the equilibrium reactions in tibialis anterior muscle in diabetic patients is associated with a delay. in patients with diabetic neuropathy progressive destruction of sensory and motor nerves of lower extremity has seen. It seems that reduction of Proprioceptive of lower limb Leads to reduced accuracy and efficiency of equilibrium reactions like ankle Strategies, hip and stepping and finally causes imbalance and increased risk of falls in this population [13-15].

Conclusion

The results of this study showed that diabetes can disrupt the balance and proprioception of the ankle joint. That this can put a person at risk of damage. Therefore, strengthening the sense of proprioception, you can prevent the consequences of reduction of proprioception like falling repeatedly.

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Conflict of Interest: None declared.

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