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RESEARCH PAPER

Hip joint torques in type II diabetes with and without neuropathy

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KEYWORDS
type II diabetes;
hip;
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torques;
peripheral neuropathy

Abstract *Background:* Patients with diabetes and peripheral neuropathy demonstrate significantly reduced peak torques at the peripheral joints.
Objectives: The aim of this study was to assess isometric and concentric peak torques of the hip joint in people with type II diabetes with and without peripheral neuropathy in comparison with healthy participants.
Methods: 27 patients with type II diabetes including 15 patients without peripheral neuropathy, 12 patients with diabetes and peripheral neuropathy and 15 healthy people participated. Isometric and concentric peak torques of hip flexion, extension, adduction and abduction of the non-dominant leg were measured by motorized dynamometer.
Results: Peak and average peak concentric torques of the hip extension and abduction in patients with diabetes and peripheral neuropathy were lower than those patients with diabetes and control group. Angle of extension peak torque was significantly greater in patients with diabetes and peripheral neuropathy compared with other groups. Angle of flexion peak torque was lower in the patients with diabetes and peripheral neuropathy.
Conclusions: Torque related parameters in patients with type II diabetes with or without peripheral neuropathy, are different from healthy subjects. As a result, patients with diabetes especially with peripheral neuropathy are more susceptible of injury and disability in lower limbs.

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Introduction

Diabetes is one of the causes of death and disability in the world with prevalence of approximately 366 million in the world. Among diabetic patients, 90% of them are diagnosed with type II diabetes and the rest with type I diabetes [1]. Inappropriate control of the disease may lead to various complications; including vascular and musculoskeletal disorder [2]. Progressive muscle weakness is usually considered as the most important musculoskeletal complications of the diabetes which mainly causes the disability [3]. It seems that 30–47% of patients with type II diabetes experience musculoskeletal complications in their life time [4]. Upper and lower weakness is evident in patients with long-term diabetes and there is a controversy that if lower extremity is more affected than upper extremity [3]. Based on magnetic resources imaging finding, patients with diabetes peripheral neuropathy had less muscle mass and cross-sectional area [4] and also double intramuscular fat (an important factor in skeletal muscle function) than the healthy individuals [5].

Proximal muscles of lower limbs play an important role in pelvic stability during walking, running, and standing on one leg or both [6]. During functional movements and sport activities, hip muscles provide stability, prevent falling, and have important roles in hip movements in frontal and horizontal planes [7,8]. Therefore, thigh muscles weakness and changes in the angle of maximum torque production of these muscles may alter functional abilities of the lower limbs [9,10]. However, current information regarding hip muscle strength in patients with type II diabetes is limited.

Patients with DPN experience weakness in skeletal muscles during their life time due to impaired nerve function and lack of physical activities [11]. Approximately, 30–50% decrement of power in ankle and knee muscle groups was evident in patients with DPN [12]. Muscle strength reduction is correlated with the duration of diabetes and severity of peripheral neuropathy [3,11–13]. As a result, ankle muscles (plantar and dorsi flexors) and knee extensors are more affected in patients with long-term type II DPN [3,12]. The extent of muscle power reduction was directly correlated with the severity of peripheral neuropathy [3,12]. On gait analysis, patients with type II diabetes have reduced ankle and knee joint torques and more joint work on walkway, thereby leading to less balance and potential increase in their risk of falling [14]. Furthermore, patients with peripheral neuropathy have less hip extension joints torques than the healthy individuals [14]. However, there is limited evidence about hip joint torques in patients with type II diabetes which are evaluated with isokinetic dynamometer, and this is the first time that hip joint torques have been evaluated in sagittal and frontal planes with isokinetic dynamometer.

Therefore, the aim of this study is to assess the isometric and concentric torques of the hip joint consisting the flexion, extension, abduction, and adduction in patients with DPN and diabetic patients without peripheral neuropathy (DWOPN) compared with healthy individuals. We hypothesised that patients with type II diabetes have less hip joint torques than the healthy individuals, and peripheral neuropathy is a contributing factor for torque reduction of hip joint in patients with type II diabetes.

Methods

Study population

In total, 27 patients with type II diabetes, including 15 DWOPN patients and 12 DPN patients (DPN), and 15 healthy individuals as control group (CG) participated in this study. This sample size was estimated based on the pilot study with 3 individuals in every study group, prior to the main study. In this study, isometric flexion average peak torque was 59.5 $\pm$ 18.02 newton meter (N.M) in CG, 49.04 $\pm$ 15.14 N.M in DWOPN, and 47.73 $\pm$ 12.03 N.M in DPN. Considering $\alpha = 0.05$, power $= 0.8$, and difference in between groups $= 10$, 13 participants were estimated for each study group. To increase the validity of the study, 15 participants were considered in each group. All sample size calculations were performed using the software power sample size calculation 3.1.2.2014 (by William D. Dupont and Walton D. Plummer, Jr.). Medical records of 2000 patients with type II diabetes were assessed in the clinic of internal medicine, and 70 of them were selected to participate in the study based on inclusion and exclusion criteria. Of 70 patients, 30 patients with type II diabetes, including 15 with DWOPN and 15 with DPN, accepted to participate in the study. Next, individually matched control individuals were identified and invited. The individuals in CG were selected among Tabriz University's clerks, and they were matched with DWOPN and DPN groups in terms of age, sex, and body mass index. The inclusion criteria were age of 40–55 years, lasting type II diabetes disease for 5–15 years, ability to follow simple commands, able to walk a distance of 6 m unaided, and full hip range of motion. The exclusion criteria were a history of severe or uncontrolled cardiac disease, other autonomic symptoms, intermittent claudication, central nervous system disorders, current or healed foot ulcers, musculoskeletal disorders, and rheumatoid arthritis in lower extremity. The individuals were also excluded if they showed any autonomic nervous system symptoms (e.g., heart and respiratory rate changes) during the test [13]. All inclusion criteria were considered for CG except that they were not diagnosed with type I and II diabetes. Fifteen DPN patients were diagnosed and referred by an internal physician based on the nerve conduction velocity findings of common peroneal and tibial nerves. Most of these patients were diagnosed by sensory and the others by motor and sensory peripheral neuropathy [15]. However, 3 patients in the DPN group were excluded due to no capability of learning test process, thereby leaving with 12 patients (Figure 1). Informed consent was obtained from all participants, and the protocol was approved by the Medical Ethical Committee of Tabriz University of Medical Sciences.

Testing procedures

HbA1c and fast blood glucose were recorded according to the last blood test. Radial pressure and finger blood glucose