

The Center of Pressure in Peripheral Diabetic Neuropathy



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Introduction

Human upright posture is inherently unstable and requires control of the central integration of information from the three sensory systems: vestibular, visual and somatosensory. Humans seem to depend mainly on the sensory signals obtained from the lower limbs to maintain body stability [1]. In people with Peripheral Diabetic Neuropathy (NDP), peripheral sensory and motor function is affected with consequences of the alteration of the deterioration of the balance, decreased ability to optimally control stability, which is essential for mobility and reducing the independence of these people.

When a person is standing upright, the body shows small displacements of the Pressure Center (COP), this small deviation results in a torque due to gravity accelerates the body beyond the initial vertical position, but in order to maintain the vertical position, the destabilizing torque (due to gravity) it must be countered by a corrective torque exerted by the feet against the support surface. The result of these torques causes a continuous oscillation of the body around the vertical position, and it is achieved through feedback mechanisms detected by visual, vestibular and proprioceptive sensory systems [2].

COP measurement is recorded to study the body stability parameter, which is the result of force vertical ground reaction forces and product torques ankle to keep the COP on stability limits [3]. For registration a force or pressure platform is used and it can be analyzed as a time series in the anterior-posterior or medial-lateral direction or through a map where the two signals are observed on the same graph. Similarly, for recording various tests are used in order to remove or alter the sensory systems that maintain the balance, as they are, closed-open eyes (visual input is removed), straight-back head (vestibular input is altered) and rigid-foam surface (proprioceptive input is altered).

Regarding the analysis of the COP in NDP, in the scientific literature are several studies focused on a linear analysis (time and frequency domain), but very few have performed a non-linear analysis [4]. With many parameters available, the challenge is to be able to identify which would be the most suitable for

quantifying body stability. The selection of a parameter is a controversial issue in the literature, since there are conflicting opinions as to which measures are most sensitive to the changes that occur while in an upright posture. NDP has been found to oscillate more in both anteroposterior and medial-lateral directions (in greater proportion in the anterior-posterior direction) compared to type 2 diabetics without NDP and healthy controls. Indicating an unstable body posture, the above may be because these individuals demonstrated a significant change in the dependence of ankle to hip strategies when performing static balancing tasks [5]. Regardless of the parameter obtained in the linear analysis COP (excursion, average amplitude, range, RMS value, average speed, area, among others) people with NDP always show higher value relative to the comparison group. People with NDP presented between 40-50% greater sway than control subjects during static bipedal position on a rigid surface with open and closed eyes [6]. As for the non-linear analysis is still emerging, but found using approximate entropy differences between type 2 diabetics and healthy controls [7]. In contrast, using the Lyapunov Exponent did not find among diabetics without NDP with respect to those with NDP [8]

Physiologically, it is because progression NDP follows a distal to proximal gradient, therefore, the effects of DPN on the strength and balance are more evident in the ankles and feet, because there are large distal ends of motor and sensory fibers. Loss of nerve function has a negative impact on standing and walking activities exhibiting increased postural movement and slower walking speed with greater variability of walking time, respectively. Its impact is further amplified when the task becomes more difficult, such as walking or standing on uneven surfaces [9]. Similarly, visual and vestibular functions cannot fully compensate for the reduction of somatosensory input experienced by individuals with NDP [10].

According to the above, further research is proposed to study the COP in NDP with a linear and non-linear analysis to understand the mechanisms used by this population to maintain balance and compensate for physiological deficiencies.

References

1. Winter DA (1995) Human balance and posture control during standing and walking. *Gait and Posture* 3: 193-214.
2. Peterka RJ (2002) Sensorimotor integration in human postural control. *J Neurophysiol* 88(3): 1097-1118.
3. Ruhe A, Fejer R, Walker B (2010) The test-retest reliability of centre of pressure measures in bipedal static task conditions - A systematic review of the literature. *Gait Posture* 32(4): 436-445.
4. Toloza D, Zequera M (2017) Linear and non-linear methods for analysis Center Pressure and its application in Diabetic Peripheral Neuropathy: A systematic review. In: Torres I, Bustamante J, Sierra D (Eds.), VII Latin American Congress on Biomedical Engineering CLAIB 2016, Bucaramanga, Santander, Colombia, October 26th-28th, 2016. IFMBE Proceedings, Singapore, 60: 713-716.
5. Meyer PF, Oddsson LI, De Luca CJ (2004) Reduced plantar sensitivity alters postural responses to lateral perturbations of balance. *Exp Brain Res* 157(4): 526-536.
6. Horak FB, Dickstein R, Peterka RJ (2002) Diabetic neuropathy and surface sway-referencing disrupt somatosensory information for postural stability in stance. *Somatosens Mot Res* 19(4): 316-326.
7. Morrison S, Colberg SR, Parson HK, Vinik AI (2012) Relation between risk of falling and postural sway complexity in diabetes. *Gait Posture* 35(4): 662-668.
8. Fioretti S, Scocco M, Ladislao L, Ghetti G, Rabini RA (2010) Identification of peripheral neuropathy in type-2 diabetic subjects by static posturography and linear discriminant analysis. *Gait Posture* 32(3): 317-320.
9. Stergiou N, Decker LM (2011) Human movement variability, nonlinear dynamics, and pathology: Is there a connection? *Hum Mov Sci* 30(5): 869-888.
10. Lord SR, Clark RD, Webster IW (1991) Postural stability and associated physiological factors in a population of aged persons. *J Gerontol* 46(3): 69-76.



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