Background:
Diabetic peripheral neuropathy (DPN) is one of the most common complications of diabetes that affects nerve functions and may occur in 25% of patients with 10 or more years of diabetes and up to 50% with 20 years of diabetes. Patients with DPN experience a high incidence of injuries while walking and have a low level of perceived safety. In certain cases the impaired judgment - mainly due to impaired proprioceptive feedback - can cause obstacle collision leading to falls and injuries. The subtle early findings that are indicative of postural instability are difficult to accurately assess from a clinical examination, and gait laboratory assessment is not currently available or practical. Thus, unfortunately, many patients that are "at risk for falls" are undiagnosed.

Objectives:
An innovative virtual obstacle crossing (VOC) paradigm using wearable sensors was developed in attempts to detect lower extremity nerve damage due to DPN.

Methods: Sixty-eight participants including diabetes with no, moderate and severe neuropathy and aged-matched healthy controls were recruited. Severity of neuropathy was quantified using vibratory perception threshold (VPT) values. The ability of perception of lower extremity was quantified by measuring the rate of obstacle crossing success (OCS), reaction time (TR), and foot position while crossing a series of virtual obstacles with various heights.

Results:
Results suggest VOC test allows separating between groups. All proposed parameters were significantly deteriorated by increasing neuropath severity (p<0.05). Results also suggest a significant correlation between TR and VPT values (r=0.5, p<10^-5). Finally, results suggest a significant deterioration in balance due to diabetes, irrespective of neuropath severity (p<0.05).

Conclusions:
The results proposed the benefit of virtual obstacle crossing as an objective method for detecting peripheral neuropathy at an early stage. This is based on the reasoning that lower extremity proprioception decreases with increasing nerve damage. The increased reaction time, decreased OCS, and increased sway of the DPN patients in this study suggests their decreased proprioception, and, therefore, increased peripheral nerve damage. Further studies should be addressed to compare VOC with other standard methods to confirm whether VOC can detect DPN earlier than current methods.