Title: Stability analysis in patients with neurological and musculoskeletal disorders using linear and non-linear approaches

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Abstract: Standing stability is controlled by musculoskeletal and neurological systems. Various methods have been used to evaluate the performance of subjects during standing including linear and non-linear methods. It is not clear which method has more sensitivity to represent the stability of subjects with various musculoskeletal disorders. Therefore, the aim of this study was to investigate the stability of the subjects with various musculoskeletal disorders by use of linear and non-linear methods. About 65 subjects including, normal and those with flatfoot, Parkinson and Perthes were recruited into this study. A Kistler forceplate was used to evaluate the stability. The difference between the linear (center of pressure excursion, velocity and path length) and non-linear (approximate entropy) parameters were evaluated using the independent t-test. The mean values of stability parameters (linear and non-linear) of flat arch subjects were more than that of normal subjects. Although there was no difference between linear stability parameters of normal and those with Parkinson disease, their mean value of non-linear parameter was less than that of normal subject ($p-< 0.05$). The results of stability analysis based on both linear and non-linear approaches showed that the subjects with Perthes disease were more unstable than normal subjects. It seems that non-linear method is more sensitive to represent the difference between stability of subjects with flatfoot, Parkinson and Perthes. However, if a combination of various parameters, based on linear method, is used to measure stability, the difference between stability can be enhanced. Depending on the disease condition increasing and decreasing the value of approximate entropy represent the unstability situations.