MUSCLE STRENGTH BUT NOT BALANCE ABILITY IS ASSOCIATED WITH DYNAMIC STABILITY PERFORMANCE IN PARKINSON'S DISEASE

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Introduction

Postural instability is one of the greatest problems of patients with Parkinson´s disease (PD). The falling rate of PD patients is five times higher than the one of age-matched controls [Bloem, 2001] and cannot be reduced significantly by treatment with dopaminergic medication [Bloem, 2004]. Identifying the reasons responsible for the deficits in postural stability in PD patients at a young age would contribute to the development of adequate training interventions aiming to reduce the risk of falls. Therefore, the purpose of this study was to investigate the effect of muscle strength and balance ability on the dynamic stability control after simulated disturbances in young faller and non-faller PD patients.

Methods

Twenty-five young PD patients (12 fallers, 13 non-fallers, 48 ± 5 yrs, stage I–III H&Y scale) and 14 matched healthy controls participated in the study. Dynamic stability performance was determined after sudden simulated forward falls. The participants were instructed to restore balance by taking a single step after the forward fall was initiated. Kinematic data were recorded with 12 Vicon cameras operating at 120 Hz. Dynamic stability was examined using the "extrapolated center of mass" concept [Hof, 2005]. To assess the muscle strength of the leg extensors, the participants performed isometric maximal voluntary ankle plantar flexion and knee extension contractions on a dynamometer. Balance ability was evaluated by measuring the limits of stability (LoS) in the anterior as well as in the posterior direction using a force plate.

Results

The faller PD patients showed a lower ($p<0.05$) stability performance (i.e. they were able to recover from a less unstable position) compared to the healthy controls. The non-faller patients and the healthy group did not differ in the stability performance. The lower ability to increase the base of support (BoS) after a forward fall was the main deficit responsible for the impaired stability performance in the PD fallers. Further, the PD fallers showed lower ($p<0.05$) plantar flexion and knee extension moments during the maximal isometric contractions indicating lower muscle strength compared to the control group. A significant ($p<0.05$) relationship was found between stability performance and muscle strength (i.e. maximal resultant knee extension and plantar flexion moments, $r=0.57$ and $r=0.54$ respectively). The three groups did not show any significant ($p>0.05$) differences in the anterior and posterior LoS indicating similar balance ability.

Discussion

Our findings showed that recovery performance after a sudden perturbation is reduced in young PD fallers and the underlying responsible mechanism from a biomechanical point of view is an insufficient increase of the BoS in relation to the extrapolated center of mass. This deficit in dynamic stability may contribute to the higher frequency of falls in this group. The absence of significant differences in static balance ability between the three groups demonstrates that quasi-static tests are not adequate to predict stability performance during dynamic activities for young PD patients. We could confirm that strength of the lower extremity muscles partly explain recovery performance in young PD patients. Therefore, we can argue that PD patients with an increased risk of falls may benefit, already at early stages of the disease, from leg-extensor strengthening programs as well as from interventions exercising the mechanisms responsible for dynamic stability.

References

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