Robot-assisted gait training versus treadmill training in patients with Parkinson's disease: a kinematic evaluation with gait profile score

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Summary

The purpose of this study was to quantitatively compare the effects, on walking performance, of end-effector robotic rehabilitation locomotor training versus intensive training with a treadmill in Parkinson's disease (PD). Fifty patients with PD were randomly divided into two groups: 25 were assigned to the robot-assisted therapy group (RG) and 25 to the intensive treadmill therapy group (IG). They were evaluated with clinical examination and 3D quantitative gait analysis [gait profile score (GPS) and its constituent gait variable scores (GVSs) were calculated from gait analysis data] at the beginning (T0) and at the end (T1) of the treatment. In the RG no differences were found in the GPS, but there were significant improvements in some GVSs (Pelvic Obl and Hip Ab-Add). The IG showed no statistically significant changes in either GPS or GVSs. The end-effector robotic rehabilitation locomotor training improved gait kinematics and seems to be effective for rehabilitation in patients with mild PD.

KEY WORDS: gait analysis, gait profile score, Parkinson's disease, rehabilitation, robotic rehabilitation, treadmill

Introduction

Gait disorders are among the most common and most disabling symptoms of Parkinson's disease (PD) (Tan et al., 2012; Kwakkel et al., 2007; Smania et al., 2010; Toole et al., 2005), and they can manifest themselves as different types of clinical involvement of various body segments: shuffling of the feet, ankle and knee stiffness, flexion of the pelvis and trunk, slowness of movement of the entire lower limbs, and reduction of associated movements (e.g. arm swinging), together with difficulty changing direction or modulating velocity.

Thus, recovery of walking is a crucial aspect of PD rehabilitation, serving to improve the patient's quality of life and level of independence. Pharmacological therapy, with levodopa as the "gold standard", is commonly used to manage the motor symptoms of PD. Many studies have demonstrated the ability of levodopa to increase stride length and walking speed (Morris et al., 2001). However, as the disease progresses, chronic levodopa treatment is associated with the development of motor complications, including wearing-off episodes and dyskinesia (Stocchi et al., 2014; Warren Olanov et al., 2013). Motor complications are the primary reason for surgical interventions in PD (deSouza et al., 2013). It is therefore important to use rehabilitation treatment approaches designed to help patients manage motor complications, and rehabilitation is, indeed, playing an increasingly important role in the treatment and care of subjects with PD. Non-pharmacological treatments, such as exercises (Goodwin et al., 2008) and physiotherapy (Davey et al., 2004; Comella et al., 1994; de Goede et al., 2001), have been shown to be effective on gait impairment in PD. In recent years, electromechanical devices such as treadmill training systems have also been used in patients with PD, and shown to improve cognitive and motor features in these patients (Mehrholz et al., 2010; Picelli et al., 2016). Recently, robotic assistive devices have been used for gait training in neurological disorders such as stroke, spinal cord injury and multiple sclerosis, giving good results in terms of gait recovery (Sale et al., 2012; Semprini et al., 2009; Mehrholz and Pohl, 2012; Spenko et al., 2006; Lee et al., 2011a,b; Roy et al., 2011; Forrester et al., 2011). The literature now also reports interesting results of the application of robotic assistive devices in PD (Lo et al., 2010; Picelli et al., 2012, 2013; Ustinova et al., 2011; Sale et al., 2013): gait was