Chapter 7
The Role of Sensory Rhythmic Stimulation on Motor Rehabilitation in Parkinson's Disease (PD)

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ABSTRACT

In the last years the role of sensory rhythmic stimulation (SRS) on motor rehabilitation in PD has become a new line of interest for researches and therapists given the promising results reported in scientific literature. This kind of strategies present a whole range of features which make it very appealing for its daily use, namely, they are easy to use, they have not distorting side-effects, and, chiefly, their effectiveness have been reported either in presence as in absence of antiparkinsonian medication.

INTRODUCTION

From a technical point of view SRS can be applied through three different modalities, rhythmic auditory stimulation (RAS), visual stimulation (VS), and somatosensory stimulation (SSS); though the first two modalities have been the most frequently utilized. RAS is a technique by which a series of auditory stimuli are presented at a fixed rhythm, so that patients have to synchronize their movements to the rhythms (i.e. using a metronome). This kind of stimulation has been consistently reported to facilitate gait in PD (Thaut et al. 1996; McIntosh et al. 1997; Thaut 1997; Rochester et al. 2005; Willems et al. 2006; Arias and Cudeiro 2008), though some other motor tasks have also

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been evaluated (Kritikos et al. 1995; Byblow et al. 2002). Recent research efforts are focused on determining rhythm features (mainly frequency (Willems et al. 2006; Arias and Cudeiro 2008)) to better facilitate movement.

VS was firstly depicted as a way to facilitate the movement in PD by Martin in 1967. The author described how colour stripes laid on the floor can induce a better walking pattern in PD when they were asked to walk over them, putting their feet on the stripes. From this work it was clear that stripes should be placed in such a way that their orientation was perpendicular to the walking direction. Subsequently, some other works has reported different results with this kind of stimulation under different conditions and paradigms (Morris and Iansek 1994; Morris et al. 1996; Suteerawattananon et al. 2004; Morris et al. 2005). Several key elements, such as the distance to be set between lines, are still to be determined.

Recently it has been proposed another procedure of VS by means of flashing LEDs (light emitting diodes) integrated into the mount of clear glasses (Rochester et al. 2005; Arias and Cudeiro 2008). This allows administration of VS either in controlled as un-controlled environments, so that it can be use at home or at the clinic, but also in the street. Though VS has been used as a tool to improve gait in PD, some other movements have also been explored, for instance upper limb movements. Some of these studies offer valuable information on the neural mechanism involved in the motor facilitation in presence of sensory stimulation experienced by PD (Cunnington et al. 1999).

SSS has been much less investigated, probably as a consequence of first reports showing poor effects on motor facilitation (Enzensberger and Fischer 1996); however some research groups have re-opened the line recently (Novak and Novak 2006; van Wegen et al. 2006a) as a way of facilitating gait by mean of synchronizing the steps to the rhythm; also new form of SSS - whole body vibration - has been proposed as to ameliorate symptoms in PD (Schmidtbleicher et al. 2004; Haas et al. 2006; Arias et al. 2009)

THE ROLE OF RAS IN FACILITATING MOVEMENTS IN PD

Gait Facilitation in PD by means of RAS

Gait disturbances in PD are a major feature of the disease (Jankovic 2008). Parkinsonian walking is characterized by a series of well documented alterations, which are specific and dependent on the grade of development of the disease (Arias and Cudeiro 2008). Progressing along the disease course, parkinsonian gait develops a whole spectrum of clinical features; step length reduction and slowness in gait (reduction in velocity) are the most recognizable characteristics. However some others, no less important, are also displayed. Prominent among them are: Increase in stride duration variability (i.e. un-ability of maintaining a stable gait cycle from a temporal perspective (Hausdorff et al. 1998; Hausdorff et al. 2002; Hausdorff et al. 2003; Arias and Cudeiro 2008)) which is also related to disease progression (Arias and Cudeiro 2008) and is associated to the risk of falling (Schaafsma et al. 2003b) and to freezing of gait (FOG) (Schaafsma et al. 2003a), a paroxysmal phenomenon commonly seen in advanced Parkinson's disease defined as the inability to start or continue walking.

Different studies have been performed using RAS, either during ON as OFF periods (medicated or un-medicated). Those studies have shown that RAS induces larger steps, higher velocity, and a reduction in the temporal variability of the stride cycle in PD (McIntosh et al. 1997; Suteerawattananon et al. 2004; Rochester et al. 2005; Willems et al. 2006; Arias and Cudeiro 2008). The impact on variability has been described to be relevant, since it seems related to falling, both in PD and in the healthy elderly (Hausdorff et al. 1998;