Neuroscience Letters 589 (2015) 181–184

Contents lists available at ScienceDirect

Neuroscience Letters

journal homepage: www.elsevier.com/locate/neulet

Research article

Self-perceived and actual ability in the functional reach test in patients with Parkinson's disease

Gilles Ryckewaert[a,b], Marion Luyat[d], Melanie Rambour[a,b], Céline Tard[a,c], Myriam Noël[d], Luc Defebvre[a,b], Arnaud Delval[a,c,*]

[a] Université de Lille, U1171, F-59037 Lille cedex, France
[b] Department of Neurology, Lille University Medical Center, F-59037 Lille cedex, France
[c] Department of Clinical Neurophysiology, Lille University Medical Center, F-59037 Lille cedex, France
[d] Université de Lille, EA 4072, F-59650 Villeneuve d'Ascq, France

HIGHLIGHTS

- Differences between self-perceived and actual ability to reach an object could lead to falls in PD patients.
- Functional reach test performance was altered in PD patients.
- Antero-posterior CoP displacement was reduced in PD and elderly subjects.
- Ability to estimate self-performance was preserved in PD patients and was not linked to future falls.

ARTICLE INFO

Article history:
Received 19 November 2014
Received in revised form 2 January 2015
Accepted 15 January 2015
Available online 16 January 2015

Keywords:
Parkinson's disease
Posture
Falls
Functional reach test

ABSTRACT

Falls frequently occur during daily activities such as reaching for an object in patients with Parkinson's disease (PD). Misjudgment is also reported to be one of the circumstances that lead to falls. The functional reach test is an indicator of dynamic balance. The primary objective was to establish whether there is a difference between self-perceived and actual ability to perform the functional reach test in patients with PD who have never fallen. Three groups of participants (all with no history of falls) were studied: young adults, elderly adults and PD patients. The participants first estimated their maximum reaching distance (but without performing the action, i.e. as a motor imagery task) and then actually performed the functional reach test (i.e. as a motor task). No significant overestimation or underestimation was observed. The reaching distance was lower in PD than in the two other groups. There were no differences between PD patients and elderly adults in terms of the forward centre of pressure displacement. Seven PD patients reported a fall in the year following the experiment. The fallers had a longer history of disease. Finally, PD patients adequately estimated their ability in the functional reach test and did not adopt an "at risk" strategy and appeared to be quite conservative (as were healthy elderly adults) in their postural control behavior. Ability to estimate self-performance is preserved in PD patients with no clinical impairments of postural control although they are at risk of future falls.

1. Introduction

Patients with Parkinson's disease (PD) have difficulty maintaining their balance when performing tasks such as reaching for an object while standing [1]. Falls occur commonly during reaching activities in PD patients [2,3]. Moreover, misjudgment and distraction are involved in 12% of reported falls. Fallers frequently reported that misjudgment, lack of concentration, and loss of balance had caused them to fall [4–6]. Indeed, disrupted representation of the external space and the environment is a possible perceptual component of the motor disorders in PD [7]. The maintenance of balance in tasks such as reaching a book on a wall-mounted shelf often requires postural adjustment. The most efficient means of ensuring balance under such conditions is visual perception of the environmental properties at a distance, prospective modification of movement patterns and thus avoidance of perturbation altogether. Affordances (defined as actions that are possible within

* Corresponding author at: Clinical Neurophysiology Department, Hôpital Salengro, F-59037 Lille cedex, France. Tel.: +33 320 446 362; fax: +33 320 446 355.
E-mail address: arnaud.delval@chru-lille.fr (A. Delval).

http://dx.doi.org/10.1016/j.neulet.2015.01.039
0304-3940/

an environment and within the context of the individual's capacity) are prerequisites for prospective postural adjustments [8]. Some elderly adults fail to update internal models – prompting them to make over-optimistic predictions about upcoming actions [9]. In turn, this may favor "at risk" motor decision-making, and thus, promote falls [9]. This topic has not previously been investigated in patients with PD.

The functional reach test (FRT) is a valid, reliable, clinical measure of dynamic balance developed by Duncan et al. [11–13]. In the FRT, the individual is asked to elevate his or her arm to shoulder's height and then to perform a maximum forward reach. In elderly adults, a reaching distance (RD) of below 15 cm is associated with an increased risk of falls and frailty [11,13]. The FRT is also an indicator of dynamic balance: Duncan et al. [10] reported that the RD in the FRT is highly correlated with the centre of pressure (CoP) excursion [14]. The latter parameter (recorded on a force platform) is an indicator of dynamic balance and measures the limits of stability. Both CoP excursion and RD are inversely associated with recurrent falls and physical frailty [15,16]. However, young adults perform greater CoP displacements but also achieve a higher maximum forward RD while maintaining standing posture. The simple FRT has been found to be a reliable and precise estimate of postural instability. The functional RD can be analyzed separately or as an item in Berg's Balance score [17], which might represent an "at risk" strategy in patients with postural instability. The FRT has also been validated in a group of individuals with PD (with or without a history of falls); Behrman et al. [15] demonstrated that a cut-off RD of 254 mm accurately identifies individuals at a high risk of falls (specificity: 92%; positive predictive value: 90%). The FRT is also of particular interest in advanced PD patients who appear unstable when reaching who are at risk of further falls [18].

The primary objective of the present study was to establish whether there is a difference between self-perceived and actual ability to perform the FRT in patients with PD who have never fallen. The secondary objective was to assess the participants' limits of stability during the FRT and identify possible "at risk" strategies induced by the task. To this end, we studied CoP excursion during the FRT. One year after the experiment, a "phone survey" (notified to the participants in advance) provided information on whether or not the participants in the three groups had fallen during that period.

2. Material

Two force platforms (OR6 from AMTI, Watertown, MA, USA, each measuring 46.5 cm × 51 cm) were used to assess the participant's kinetic parameters (e.g. the CoP trajectory) during the FRT. The force platform signal was sampled at 250 Hz. Kinematic measurements were recorded by means of a video motion system (VICON Video System, Oxford Metrics, Oxford, UK) with eight infrared cameras and a sampling frequency of 50 Hz. Thirty spherical, retroreflective markers were placed on different body segments (Plug-In-Gait, Full-body model). The system's measurement precision for movement was 2 mm.

3. Methods

Three groups were studied: young adults (between 18 and 30 years of age), elderly adults (over 65 years of age) and PD patients with no history of falls. Patients with PD were only included if their Hoehn and Yahr scale score was below 2.5 [19]. This criterion means that the included PD patients had mild bilateral disease but no clinical impairments of postural control. The PD patients performed the experiment while on their usual antiparkinsonian medication. Participants were excluded if they had any neurological conditions (other than PD for the patient group), signs of dementia (according to the DSM IV criteria), musculoskeletal disorders, vestibular disorders, recurrent dizziness, or known hip- or ankle-related disease or injury or if they were taking medications that could have affected posture. All the subjects gave their informed consent and the study was approved by the local ethics committee.

In the experiment, the participant stood barefoot with one foot on each force plate and with the feet parallel and set a comfortable distance apart. The participant first had to estimate his/her maximum RD (but without performing the action, i.e. as a motor imagery task) and then actually perform the FRT (i.e. as a motor task). In the motor imagery task, the investigator placed a vertical bar (height: 1600 mm) at the participant's index finger (arm extended) and asked the participant not to move. The bar was then sequentially moved away from and towards the participant by random amounts (in multiples of 50 mm steps, for example: 500, 350, 1000, 50, 550, 800, 150, 450, 950, 650, 200, 750, 100, 900, 700, 300, 600, 850, 400, 250 mm). After each placement of the bar,

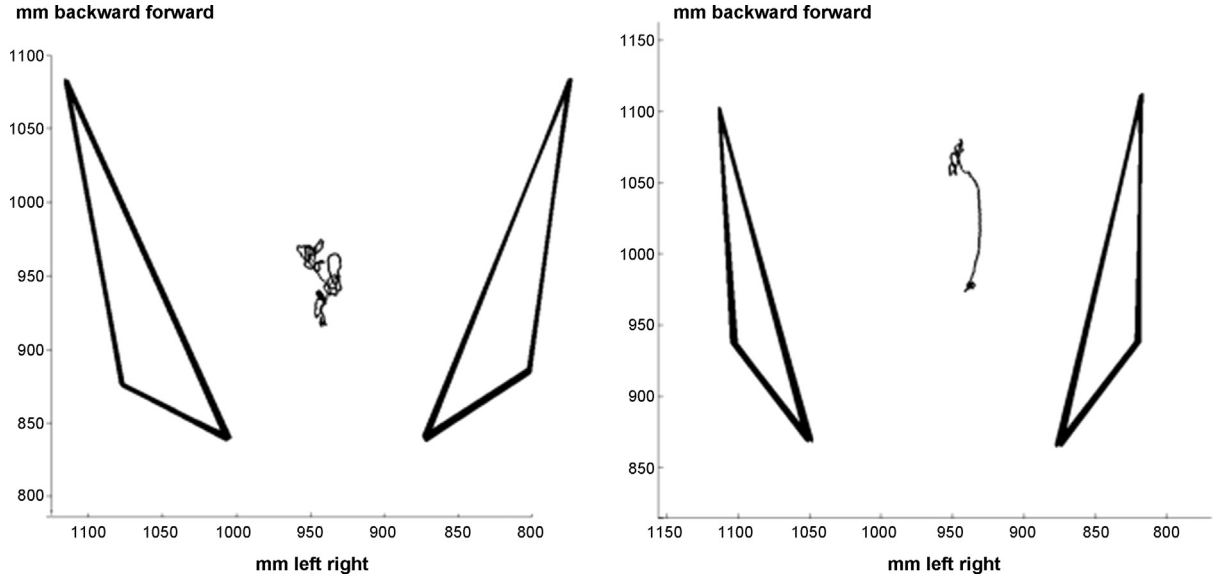

Fig. 1. The CoP trajectory in a PD patient (A) and in a young adult (B) during the FRT. Note the differences in the anteroposterior axis. Foot placement was determined by heel, ankle and toe markers on each foot.