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Original Research—CME

Effects of a Single Hand—Exercise Session on Manual Dexterity and Strength in Persons with Parkinson Disease: A Randomized Controlled Trial

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Abstract

Objective: To evaluate the effects on manual dexterity, hand grip, and pinch strength of a single intervention focused on hand exercises.
Design: Randomized, controlled, blinded study.
Patients: Sixty people with Parkinson disease (PD) were recruited; 30 participants were allocated to a brief exercise session and 30 to a control group.
Interventions: Participants randomized to the experimental group received a 15-minute exercise session focused on hand training using therapeutic putty. Participants allocated to the control group performed active upper limb exercises.
Main Outcome Measurements: Measures of manual dexterity (assessed by the Purdue Pegboard Test and the Chessington Occupational Therapy Neurologic Assessment Battery dexterity task) and strength (hand grip and pinch strength) were recorded at baseline and after the intervention.
Results: Participants had significantly improved manual dexterity values ($P < .05$) after the intervention. They also had increased hand grip ($P < .001$) and pinch strength ($P < .05$).
Conclusions: A single hand—exercise session showed an improvement in manual dexterity and strength in persons with PD.

Introduction

Persons with Parkinson disease (PD) frequently experience manual dexterity impairment [1] and muscle weakness [2], which has an impact on the performance of daily living activities, leading to a reduction in everyday activities and negative repercussion on quality of life. The major cause of disability in people with PD is the decrease of the quality of movement [3] affecting the performance of functional tasks because of bradykinesia, rigidity, and tremor [4].

Some studies have described difficulties in performing and maintaining repetitive and rhythmic voluntary movements [5,6]. These difficulties lead to manual dexterity impairments, with timing and force modulation affecting the quality of hand function progressively throughout the disease [3,7]. Different authors have shown alterations in the execution of fine manipulative hand activities (eg, buttoning, handwriting, and tying shoelaces) because of reduced finger torque control and decreased interdigit individualization [1,8].

People with PD retain the ability to anticipate and plan movements but have greater difficulty combining the movements of reach and grip during active mobility, especially when the grip is made with all fingers. This impairment affects the performance of functional activities [9-11]. Additionally, some studies have reported upper-limb deficits with bilateral asymmetric motor impairments, including a delayed onset of the opening of the hand, delayed movement initiation of the forearm, lack of coordination, loss of muscle control, and difficulties in the dissociation between the left and right arm [12-14].

Muscle weakness has also been described as an important impairment related to PD, with repercussions

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for functionality [15]. Reduction in muscle strength can compromise the ability of individuals to perform activities that require strength and is related to muscle activation and the speed with which movements are performed [16].

Different therapeutic strategies, including exercises and directed repetitions, have improved functionality and autonomy in patients with PD who achieve relevant motor improvements [1,3]. It has also been reported that imitation learning and motor control relearning have a positive effect in the motor training [17]. Most interventional studies have focused on the lower limbs, specifically on gait and stability [18,19]. We hypothesized that a brief therapeutic intervention focused on hand exercises would have beneficial effects on manual dexterity and strength in persons with PD. The effectiveness of a single session could provide an immediate therapeutic response that is important to improve the performance of daily activities. Therefore, the aim of this study was to evaluate the effects on manual dexterity and strength of a single intervention focused on hand exercises.

Methods

Subjects

After obtaining ethical approval from the University of Granada Ethics Committee, people with PD were recruited from a local Parkinson Association between March and July 2013. These persons received 2 sessions of physical therapy per week from the Association. Prior to participation, individuals gave informed consent in accordance with the Declaration of Helsinki. All the participants were clinically diagnosed with PD by a neurologist. Participants were eligible if they were older than 50 years and had stage II-III of disease progression as defined by the Hoehn and Yahr scale [20].

Persons were excluded if they had severe cognitive impairment (ie, a Mini-Mental State Examination score lower than 24) [21] or comprehension deficits that prevented them from following verbal commands, had visual or acoustic limitations defined as a total or partial loss of sight or hearing, were diagnosed with a neurologic condition other than PD, had musculoskeletal disorders defined as injuries or conditions affecting the musculoskeletal system including nerves, muscles, and tendons of the hand or fingers, and/or if they had previous trauma or fracture of the upper extremity.

Participants were randomly assigned 1:1 to an experimental group or a control group. The randomization sequence was drawn up and kept off-site by a statistician who was not aware of the study aims, using a random number generator in blocks of 8 with no stratification. The sequence of subjects included in the experimental or control groups were mailed from the statistician to the recruiter. A research assistant assigned the participants to the groups and contacted them by phone to obtain an appointment. The design of the study and participants' distribution between groups is shown in Figure 1.

After the allocation, baseline measures were taken. All of the data were collected by an independent researcher who was blinded to the allocation group of the patients. Anthropometric (height, weight, and body mass index) and sociodemographic (marital status and academic studies) data were obtained by self-report of each participant. The clinical records of participants were also reviewed, and the disease duration and the medication intake were obtained. The severity of PD was assessed across behaviors, activities of daily living, motor abilities, and other complications using the Movement Disorders Society-Unified Parkinson's Disease Rating Scale (MDS-UPDRS) [22].

Outcome Measures

Trained study personnel who were unaware of group assignment performed all the outcome assessments at the university laboratory. Manual dexterity and strength were evaluated on the "on" phase in the participants included in the study at baseline and immediately after the intervention.

Manual dexterity was assessed by the Purdue Pegboard Test [23]. Four subtests were included: dominant hand, nondominant hand, bimanual, and assembly task [24]. In the 3 first tasks, in 30 seconds, patients put as many pegs as possible in the holes of the board with one hand and bimanually. In the assembly task, patients have 60 seconds to manipulate pegs, collars, and washers onto the board. The score is the number of pegs and pieces placed on the board. The Purdue Pegboard Test reliably evaluates manual dexterity in patients with PD [25]. Manual coordination and speed movement is an important part of manual dexterity, and it was assessed using one component from the Chessington Occupational Therapy Neurologic Assessment Battery (COTNAB) [26]. This task consists of 3 subtests performed with dominant, nondominant, and both hands. In all the subtests, we registered the time in seconds that it took to move the blocks from one board to another. The COTNAB battery has previously shown good validity in patients with neurologic diseases [26].

Hand grip and pinch strength (lateral, distal, and tripod pinch) were measured using a dynamometer (Jamar dynamometer and pinch meter; Lafayette Instrument Company, Lafayette, IN) [27-29].

Procedures

For this double-blind, randomized, controlled clinical trial, 62 participants were initially screened for eligibility. Two patients were excluded because one declined to provide informed consent and one did not meet the inclusion criteria.