Journal of Bodywork & Movement Therapies (2014) 18, 526—532

Available online at www.sciencedirect.com

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journal homepage: www.elsevier.com/jbmt

STROKE REHABILITATION: PRELIMINARY STUDY

Effects of a training program based on the Proprioceptive Neuromuscular Facilitation method on post-stroke motor recovery: A preliminary study

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Received 27 July 2013; received in revised form 23 November 2013; accepted 3 December 2013

KEYWORDS
Stroke;
Rehabilitation;
Recovery of function;
Gait

Summary This preliminary study sought to analyze the effects of a training program based on the Proprioceptive Neuromuscular Facilitation (PNF) method on motor recovery of individuals with chronic post-stroke hemiparesis. Eleven individuals with chronic hemiparesis (mean lesion time of 19.64 months) after unilateral and non-recurrent stroke underwent training based on PNF method for twelve sessions, being evaluated for motor function - using the Stroke Rehabilitation Assessment of Movement (STREAM) instrument; functionality, by the Functional Independence Measure (FIM); and gait kinematic (using the Qualisys Motion Capture System), at baseline and post-training. Significant changes in FIM (from median 67 to median 68;

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http://dx.doi.org/10.1016/j.jbmt.2013.12.004

$P = .043$) and STREAM scores (from median 47 to median 55; $P = .003$) were observed. Data showed significant changes in motor function and functionality after training, suggesting that this program can be useful for rehabilitation of chronic stroke survivors.

Introduction

Stroke survivors commonly exhibit uni or bilateral sensory-motor impairments, loss of coordination, visual field disorders as well as cognitive, perceptive and language deficits (World Health Organization, 2006). In physical therapy, the main goals of treatment after stroke are to restore motor control in gait and gait-related activities and to improve upper limb function, as well as to learn to cope with existing deficits in activities of daily living (ADL) and to enhance participation in general (Van Peppen et al., 2004).

Although there are currently several rehabilitation treatments for stroke, traditional approaches — such as the Neurodevelopmental method (Bobath) and Proprioceptive Neuromuscular Facilitation (PNF) - continue to be used in clinical practice, showing good results (Pollock et al., 2007). The PNF method was originally developed to facilitate motor performance in individuals with impaired movements. It involves maximum resistance to movement, which must be executed in a spiral and diagonal direction, promoting a larger neuromuscular response in proprioceptors, thereby facilitating biarticular muscle activation (Kofotolis et al., 2005). It also involves exploring postural reflexes (primarily the stretch reflex) and the use of eccentric contractions to facilitate agonist muscle activity (Shimura and Kasai, 2002).

Despite the theoretical basis and its clinical use, there are scant scientific publications based on this method on post-stroke rehabilitation (Dickstein et al., 1986; Ozdemir et al., 2001; Trueblood et al., 1989). In addition, the differing forms of the application of PNF method hinder the comparison between studies, and, especially, the reproduction of the protocol. This significantly reduces the evidence about the method. Two systematic reviews (Pollock et al., 2007; Van Peppen et al., 2004) found the effects of neurophysiological approaches, including PNF, in individuals with hemiparesis and did not find enough evidence to generalize results regarding the potential clinical impact of these treatments. Finally, no studies indicate a program or the best mode of PNF application to improve motor function in these patients.

Thus, we developed a training program based on the PNF method, designed to improve the functionality, motor function and gait in individuals with chronic hemiparesis post-stroke. To verify if this protocol is reproducible and if is able to promote the wanted effects, we decided to conduct a feasibility study (a preliminary study) prior to the implementation of this program in larger scale.

Methods

Participants

Eleven individuals (six men and five women), aged between 40 and 70 years, with chronic hemiparesis (mean lesion time of 19.64 ± 9.81 months) after unilateral and non-recurrent stroke were recruited by convenience sampling from clinics and hospitals in the city of Natal-RN. Subjects should had spasticity classified between levels 0 and 2 on the Modified Ashworth Scale (MAS) of muscle spasticity for the lower limb affected (Biering-Sørensen et al., 2006) and ambulatory capacity classified between levels 3 and 5 on the Functional Ambulatory Category — FAC (Mehrholz et al., 2007). Furthermore, subjects had to be able to walk 10 meters on a flat surface without personal assistance and/or assistive devices/orthesis, no clinical signs of cardiac alterations (New York Heart Association, degree I), capable of obeying simple commands and not exhibit any other orthopedic and/or neurological impairment that could alter gait. Exclusion criteria were individuals whose heart rate (immediately after exercise) exceeded 75% of age-adjusted maximum heart rate, according to the formula proposed by Tanaka et al. (Tanaka et al., 2001). The study was approved by the local ethics research committee.

Measuring instruments

The FAC was used to determine walking capacity. Scores range from 0 to 5, where 0 represents walking incapacity or needing help from two therapists, and 5 indicates locomotion independence, including climbing stairs (Mehrholz et al., 2007).

The National Institute of Health Stroke Scale (NIHSS) was used to categorize neurological status, from minimal impairment (scores 0—1) to severe impairment - scores over 20 (Montaner and Alvarez-Sabin, 2006).

The MAS was applied to assess muscle tone in the paretic lower limb (Biering-Sørensen et al., 2006). The following muscle groups were tested: quadriceps, hamstrings, triceps surae and ankle muscle dorsiflexors.

The Stroke Rehabilitation Assessment of Movement (STREAM) protocol evaluated motor function. STREAM analyzes voluntary limb movement and basic mobility with a maximum score of 70 points (higher scores indicate better function) (Daley et al., 1999).

Functional Independence Measure (FIM) assesses the level of assistance required to perform activities such as self-care, mobility, locomotion, sphincter control, communication and social cognition (Riberto et al., 2001, 2004). In this study, we only used the motor domain of the FIM (motor FIM), which excludes communication and social cognition items. Higher scores demonstrating greater independence.

Gait analysis was obtained using the Qualisys system (Qualisys Motion Capture System — Qualisys Medical AB 411 13, Gothenburg, Sweden). Three cameras (Qualisys Oqus 300) that emit and capture infrared light reflected by spherical passive markers were used. Data were captured at a frequency of 120 Hz, using Qualisys Track Manager 2.3 (QTM) acquisition software, and exported to Visual 3D processing software (Visual3D Standard, 4.75.33 — C-