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CASE STUDY

Effects of proprioceptive neuromuscular facilitation on balance, strength, and mobility of an older adult with chronic stroke: A case report

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ABSTRACT

This study described the effects of a proprioceptive neuromuscular facilitation (PNF) program on balance, strength, and mobility in an older adult with chronic stroke. The patient was male, aged 69 years, with right hemiplegia for 17 years, and had diminished balance, balance confidence, lower extremity (LE) strength, and gait velocity. He received 1 h of PNF-based therapy thrice a week for six weeks. Outcome measures were: Mini-BESTest, limits of stability (LOS), Activities-Specific Balance Confidence Scale (ABC), Five Time Sit-to-Stand Test (FTSST), Upright Motor Control Test (UMCT), and 10 Meter Walk Test (10 MWT). The patient improved on the Mini-BESTest (25/28, from 21/28), FTSST (27.47 s, from 30.27 s), UMCT knee extension (moderate, from weak), and 10 MWT (0.82 m/s, from 0.67 m/s); and positive changes in LOS dimensions. PNF was effective in enhancing balance, strength, and mobility in an older adult with chronic stroke and may mitigate falls risk in this population. More research is needed to determine its impact in a larger sample of older people with chronic stroke.

1. Introduction

Falls are a common and serious problem in adults with stroke or cerebrovascular accident (CVA) and who belong in the older age groups (Weerdesteyn et al., 2008). Post-stroke falls are usually caused by residual impairments including balance and gait deficits, impaired sensory processing and decreased strength (Weerdesteyn et al., 2008). Balance and mobility deficits may persist years beyond discharge from inpatient rehabilitation (Lim et al., 2012) and account for high incidences of falls in chronic stroke (>6 months) (Harris et al., 2005). In people with chronic stroke, approximately 70% of fall incidents occur at home (Schmid et al., 2013) while 39–90% have been reported during walking (Weerdesteyn et al., 2008). Falls can lead to serious adverse outcomes including bone fractures, decreased physical activity, social deprivation, restrictions in activities of daily living and greater mobility deficits (Schmid et al., 2013; Weerdesteyn et al., 2008). Exercise and increased physical activity have been found to be effective in treating the impairments associated with an increased falls risk in adults with stroke and the older population (Sherrington et al., 2011).

Current evidence suggests that physical therapy (PT) is effective in improving mobility and functional outcomes even late after the onset of stroke (Ferrarello et al., 2011; Van Peppen et al., 2004). Given the diversity of patient needs and post-stroke disability, no single approach has been demonstrated to be superior in improving outcomes (Jette et al., 2005; Pollock et al., 2014; Veerbeek et al., 2014). Proprioceptive Neuromuscular Facilitation (PNF) is one approach that has been used conventionally in post-stroke rehabilitation. PNF is a form of neuromuscular re-education involving stimulation of the sensory receptors to provide information about body position and movement in order to facilitate a desired motion (Adler et al., 2008). Although originally underpinned by the reflex theory (Jette et al., 2005), PNF techniques have since evolved to incorporate contemporary principles of neuroplasticity. The philosophies of PNF share related concepts with principles of neuroplasticity (Kleim and Jones, 2008) (see Fig. 1). Concepts such as use of movement to promote improvement and avoid deterioration, task specificity, relevance of the task to the patient, and high

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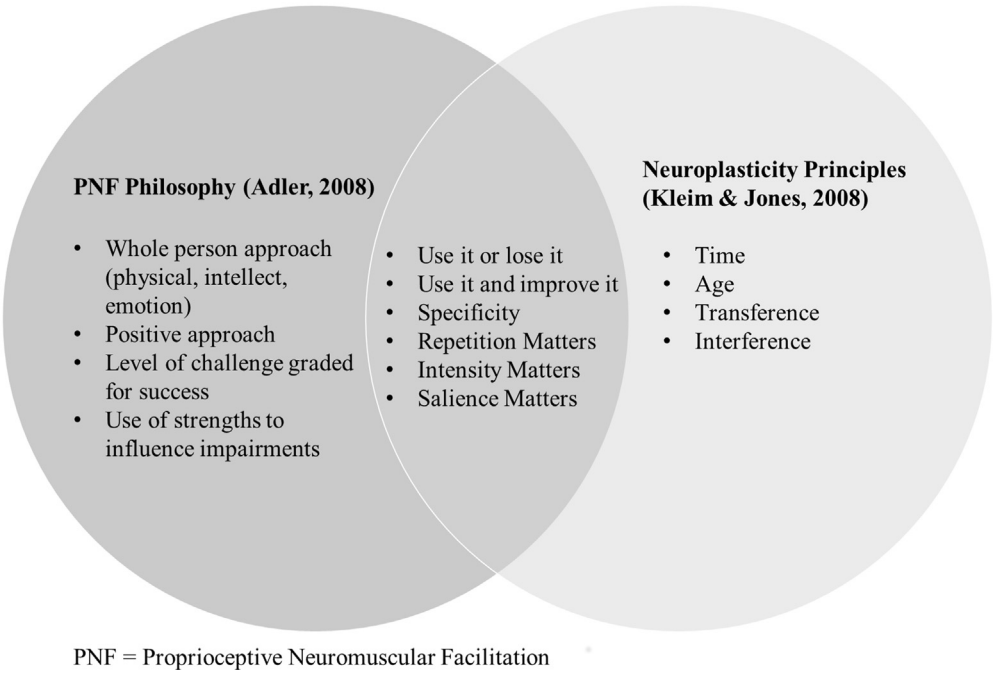

Fig. 1. Similarities between the PNF philosophy and principles of neuroplasticity showing an overlap in concepts applied such as use of movement to prevent deterioration in movement and improve movement; focus of therapy on the specific task to be improved; and sufficient repetition, intensity, and highlighting of salient features of activities and exercises to elicit positive changes in movement.

repetitions and practice intensity to foster change in movement are common to both PNF and neuroplasticity principles. The use of PNF patterns and positions suggests a stronger sensory excitation at the cortical level leading to increased number and improved threshold of motor neurons (Westwater-Wood et al., 2010) which could result in improved range of motion, strength and balance reactions. The concept of irradiation, in which muscular activity spreads across different muscle groups during certain patterns, can be used to improve function, strength and motor learning (Adler et al., 2008).

Few studies have demonstrated how a PNF program might improve multiple falls risk factors such as impaired balance, lower extremity (LE) strength, and mobility in older adults with chronic stroke. Generally positive treatment outcomes in chronic stroke have been attributed to PNF such as improved gait (Akosile et al., 2012; Kim et al., 2015a, 2015b; Ribeiro et al., 2013; Wang, 1994) and balance (Kim et al., 2015a, 2015b; Seo et al., 2015; Seo and Kim, 2015). However, published studies have been limited in that: (1) the focus of outcome measurement had been restricted to either balance or ambulation/gait only (Akosile et al., 2012; Kim et al., 2015a, 2015b; Ribeiro et al., 2013, 2014; Seo et al., 2015; Seo and Kim, 2015; Wang, 1994); and/or (2) the interventions were carried out in non-weight bearing positions or aquatic environments only and not oriented to the demands of upright posture and walking during which most falls have been reported to occur (Akosile et al., 2012; Kim et al., 2015a, 2015b; Wang, 1994). This study therefore aimed to describe the effects of a PNF program on the balance, strength, and mobility of an older adult with chronic stroke.

2. Methods

The University of the Philippines Manila's Research Ethics Board approved the study protocol. The participant was part of a larger study that investigated the effects of PNF in improving selected impairments and activity limitations in older people. The participant provided written informed consent.

2.1. Participant

The participant was recruited from a university-based pro-bono outpatient PT clinic. He was selected using purposive sampling and met the following inclusion criteria: aged 60 years or older; diagnosed with CVA of longer than six months duration; cleared by a physician to undergo outpatient PT; co-morbidities controlled by medication; had impaired balance and ambulation, whether or not dependent on an assistive device; and able to follow simple commands and instructions.

The participant was a 69-year-old male who sustained a left-sided CVA 17 years ago resulting in right hemiplegia. He received conventional PT comprising electrotherapy and therapeutic exercises for one year immediately after the stroke. After the episode of care, he was able to take steps without physical assistance but had impaired balance and required supervision because his walking was unsafe. He resumed outpatient PT one year ago when he joined a stroke support group that facilitated his referral to PT for impaired balance and restricted ambulation. Since then, he had been receiving 1 h of outpatient PT consisting of task-oriented training for only once a week because of financial constraints. His other forms of physical activity included joining a student-led exercise group once a week and going to the public pool with assistance from another person.

During initial examination, he required supervision when walking on both even and uneven surfaces, stairs, and crowded areas. He had no known history of falls but he substantially limited his activities and participation. He took maintenance medication for hypertension and prevention of prostate enlargement, and required the use of prescription eyewear. He had no other known co-morbid conditions and had no significant problems related to muscle tone or sensation. However, he walked with decreased foot clearance on the hemiparetic side and limited trunk movement, and compensated for short step length by shuffling his steps to increase cadence. He was able to respond appropriately to