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Improving Upper Limb Function in a Person with Stroke Using Proprioceptive Neuromuscular Facilitation Approach: A Case Study

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Abstract

A sixty-six-year-old male presented with right upper limb weakness of three years duration. Radiological studies identified an acute infarct with haemorrhagic component and absence of flow in the left middle cerebral artery. This case report discusses his presentation and effect of proprioceptive neuromuscular facilitation (PNF) approach in stroke to improve upper limb function

Keywords: *Stroke, proprioceptive neuromuscular facilitation, upper limb*

Introduction

The World Health Organisation (WHO) defines stroke as rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin.[1] It is one of the leading causes of death and disability in India. The estimated adjusted prevalence rate of stroke range, 84-262/100,000 in rural and 334-424/100,000 in urban areas.[2]Some people recover completely from strokes, but more than 2/3rd of survivors will have some type of disability.

Rehabilitation is a common route taken by individuals who have survived a stroke in order to regain function and independence, which can take place in acute, sub-acute, inpatient and outpatient setups. There are several different approaches to physiotherapy treatment after stroke. Proprioceptive Neuromuscular Facilitation (PNF) is a neurophysiological approach in which impulses from the periphery are facilitated to the central nervous system through the stimulation of sensory receptors present in muscles and around the joints by stretch, resistance, traction, approximation and audio-visual command to the patient.

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PNF provides the therapist with an efficient means for evaluating and treating neuromuscular and structural dysfunctions.[3-7] The goal of the PNF techniques is to promote functional movement through facilitation, inhibition, strengthening, and relaxation of muscle groups by using concentric, eccentric, and static muscle contraction[s.8-9] Thus, the purpose of this case study is to provide clinicians with a perspective on physical therapy management of patients that present with a stroke using PNF approach to improve the function of upper limb.

Case Report

A 66-year-old male who was a known case of hypertension and diabetic mellitus experienced a sudden onset of weakness in his right upper limb and deviation of his mouth towards the right side on 12th July 2016. He was taken to the local hospital, where MRI of brain was done which was diagnosed as acute infarct with haemorrhagic component at left basal ganglia, internal capsule and corona radiata causing mass effect and also absence of flow in the left middle cerebral artery. Medical management was started immediately for pain, hyperlipidaemia, congestive heart failure, hypertension, as well as medications for spasticity, and anxiety. Physiotherapy treatment was started in 2017.

Following the subjective history, it was hypothesized that the patient would present with right hemiparesis,

impaired range of motion, balance and muscle spasticity secondary to a middle cerebral artery(MCA) embolic cerebrovascular accident (CVA). In addition, the Fugl Meyer Scale was used to objectively assess stroke specific disability and the Barthel Index was used to measure functional ability. He was a good candidate for a case report due to limited publication on the interventions that were implemented, including specific PNF techniques for upper limb interventions.

A standardized physiotherapy (PT) examination was performed with tests and measures as described by the Bickerstaff's Neurological Examination in Clinical Practice.[10] These included muscle performance, neuromotor development and sensory integration, range of motion, and reflex integrity. Voluntary Muscle control was graded using Brunnstrom stages of motor recovery as described by O'Sullivan.[11]

Reflex integrity and muscular tone is commonly impaired following a CVA, and the patient presented exaggeration in these categories on initial examination. The patient's reflex integrity was measured using reflex hammer, while his muscular tone was assessed using the Modified Ashworth Scale(MAS). Tham L. K. et al. have demonstrated the validity and reliability of using deep tendon reflexes as an assessment of neurological or neuromuscular disorders through motion analysis.[12]

The patient's symptoms from his MCA stroke included impaired muscle performance which led to impairments of range of motion, muscle spasticity and exaggerated reflexes. The patient's muscular weakness led to impairments of motor function; his left upper and lower extremity presented with hemi-paresis. The patient's functional assessment score on the Fugl- Meyer Scale was 34 out 78 at the first week indicating severe physical disability and Barthel index 10/20 indicating moderate disability. The patient's functional mobility deficits were secondary to a central nervous system insult, which made him a good candidate for PNF-based interventions.

Interventions, outcome measures, and changes in impairments, functional limitations, and disabilities were documented on a daily basis. The patient was scheduled for physiotherapy daily for 1-hour sessions on weekdays during his rehabilitation. The patient attended the session for 6 weeks. The basic principle of motor learning is to repeatedly practice a particular task in order to relearn. In a study carried out by Chaturvedi et al in which PNF intervention was given to upper extremity for two weeks to the patients of acute stroke, there was significant improvement in the upper extremity function. [13] In the PNF approach, there are two pairs of diagonal patterns for the upper and lower extremities: diagonal 1 (D1) and diagonal 2 (D2). Each of these patterns can be performed in either flexion or extension. Hence, the terminology used is D1Flexion(D1F) or D1Extension(D1E) and D2Flexion(D2F) or D2Extension(D2E) of the upper or lower extremities. The upper limb was exercised in the D1F and D1E patterns, first passively then in an active assisted manner and then active manner. A PNF D1 thrust pattern was practiced (reverse thrust was contraindicated as the limb is moving into a flexion synergy pattern) and along with it hold and relax technique was used simultaneously. The hold and relax technique was performed in a position of comfort and below an amount that caused pain. Strong isometric contraction from the restricting muscles (antagonists) was resisted and then voluntary relaxation, and passive movement in to the newly gained selection of the agonist pattern.

Fig 1.(a). D1 EXTENSION

Fig 1.(b).D1 FLEXION

On first week the patient's Barthel Index score was 10/20 that is a low score. By sixth week his Barthel Index score was increased by 15/20 which showed a

moderate disability. In a previous study which compared the muscle tone and stiffness on the affected side and the non-affected side of the upper extremity (UE) in stroke patients at Brunnstrom stage III or above for the UE, and at MAS grade 2 or lower and it was found that the flexor carpi radialis of the affected side showed significantly lower muscle tension and stiffness than that on the non-affected side. Additionally, it was also found that the non-affected side of the extensor digitorum and flexor carpi ulnaris showed slightly less muscle tone and stiffness than those on the affected side.

In the present case, it was noticed that the patient's spasticity in first week according to Modified Ashworth Scale was 1+ i.e. slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM. In sixth week it was seen that according to Modified Ashworth Scale it was improved to 1 i.e. slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion when the affected part/s is/are moved in flexion or extension. The physical performance according to Fugl Meyer Test in first week was 34/78 which when tested on sixth week was seen to be 40/78 which considered as a slight improvement in the physical performance. See Fig 2.for progression of Barthel index and Fugl Meyer test from first week to sixth week.

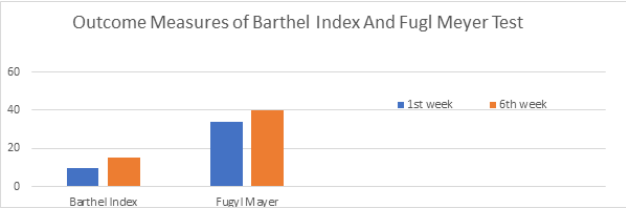

Fig 2. Progression of Barthel Index and Fugl Meyer Test

Discussion

The patient made a good progress in six weeks outpatient rehabilitation. There was a good improvement seen in the upper limb, grip strength being the only weakness. More importantly, the patient was pleased to see the progress that was made. Factors that may have positively influenced the patient's outcome include PNF based rehabilitation, patient motivation and consistent emotional support from family. The scientific literature on CVA provided beneficial information regarding the pathological condition and expected clinical signs and symptoms, providing background information that enhanced the physiotherapist's understanding of the patient's conditions. This information also provided a basis upon which hypotheses could be formed regarding the underlying causes of the patient's problems, emphasizing the need for a plan of care that maximized the patient's functional independence.

A study done by Morreale et al. in ischemic stroke patients of early versus late stage found that patients who received early PNF treatment showed better improvement than patients who received late PNF treatment after 12 months.[14] A study conducted by Kraft et al. based on techniques to improve arm and hand function using PNF and EMG stimulation concluded that chronic stroke patients would achieve arm function by combining both stimulation and PNF.[15] The studies regarding the PNF intervention in stroke are both conflicting and supportive, but they not been tried in acute stroke. Our results show that PNF is efficient in improving functional outcome after stroke. Continuous application of the PNF intervention could decrease abnormally increased muscle tone and stiffness while increasing the muscle activity of the UE muscles.

Patients with strokes might benefit from longer rehabilitation, allowing for a greater breadth of treatments and progression in their programs, as well as maintaining an intensive therapy schedule. Moreover, the breakdown of PNF-based interventions into intervention sequencing and outcomes would be helpful to further explore the effectiveness of PNF-based therapy in rehabilitation of strokes.

Conclusion

Residual upper limb disability is a common occurrence in patients with chronic stroke. PNF treatments can be useful in motor function, reducing musculoskeletal and neurological complication and most, importantly increasing levels of functional independence in subjects with residual upper limb disability.

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