Case report

Effects of Functional Proprioceptive Neuromuscular Facilitation with Mental Practice to Improve Physical Capacity, Functional Physical Status and Fatigue Tolerance and Functional Independences in Syringomyelia Patient - A Case Report.

ABSTARCT :

Background: Syringomyelia is a rare disorder in which a syrinx is formed in the spinal cord and it expands over the time, damaging the entire spinal cord. It shows low prevalence and is difficult to diagnose. **Objective:** The aim is to determine the effects of functional Proprioceptive Neuromuscular Facilitation with Mental Practice to improve physical capacity, functional status and fatigue tolerance in syringomyelia patient. **Case report:** We report the case of a 25 year old female presenting with history of fever and chills for a month followed by convulsions and loss of sensations and muscle power 1/5 in both lower limbs below the trunk. The condition was managed by functional PNF techniques with mental practice. **Conclusion:** PNF with Mental Practice is effective to improve physical capacity, functional status and fatigue tolerance in syringomyelia patient**.**

Key words: Syringomyelia; PNF; Mental Practice; Functional Status; Fatigue Tolerance.

Syringomyelia is a disorder in which a fluid-filled cyst forms within the spinal cord. This cyst, called a syrinx, expands and elongates over time, damaging the spinal cord.[1]the prevalence of syringomyeliais about 8.4 cases per 100,000 populations, common in men than women. It appears in third or fourth decade of life, with a mean onset age30 years.[2]Syringomyelia are of two types;1) primary type that includes its association with spinal cord injury, meningitis, arachnoiditis , tethered cord syndrome, a spinal tumour etc whereas secondary typeis likely to be associated with Arnold-Chiari malformation. The developed syrinx in cervical spine may result into arachnoiditis, hydrocephalus resulting in severe headache to lose consciousness.[1]

Oldfield's theory states that, downward movement of cerebellar tonsils during systolecreates a piston effect in the spinal subarachnoid space on spinal cord surface. This forces CSF pass between perivascular and interstitial spaces form a syrinx. This increases intramedullary pressure that compresseslong tracts, neurons, and microcirculation leading to neurological dysfunction. Symptoms may vary among individuals between the ages of 25 and 40.[a] depends on pressure exerted by syrinx on spinal cord that includes progressive weakness and pain over back, shoulders, arms, or legs, inability to feel hot or cold, a loss of pain sensation, difficulty walking, bowel and bladder function problems, facial pain and numbness, curvature of the spine or scoliosis.[4] The extend of syrinx cavity can be visualized in MRI scan [4]. At early stage, syrinx decompression can potentially reverse the symptoms due to raised intramedullary pressure.[3]Patient's functional status and physical capacity depends on underlying cause, magnitude of neurological dysfunction, and location and extension of syrinx.[2] Prognosis of symptoms associated with syrinx like numbness likely to get improve post-surgery whereas burning pain and weakness in extremities is most likely to be permanent and irreversible.[5]

Various physiotherapy interventions help to improve functional status and performance of patient. Mental practice is recently emerged technique that causes repetitive mental simulation to execution target movement in absences of bodily activity to improve functional movements. Proprioceptive Neuromuscular Facilitation (PNF) techniques involve functional diagonal patterns with repetitive resistance and stretch to facilitate normal movement. [7]There is lacunae in research about role of physiotherapy intervention in syringomyelia hence present case reports aim to determine the effects of functional Proprioceptive Neuromuscular Facilitation with Mental Practice to improve physical capacity, functional status and fatigue tolerance in syringomyelia patient.

Case Report:

A 25year old female was apparently alright 6 years back when she encountered with repeated episodes of fever and chills a month. She neglected her condition and self administered paracetamol 650mg. After a month, there were 3 episodes of convulsion that lasted for 2hours. Patient was immediately taken to tertiary health care hospital and admitted to Intensive Care Unit. Patient regained consciousness after an hour and complained for loss of sensations in both her lower limbs. Patient was scheduled for radiological investigation where brain MRI scan revealed mild grade of hydrocephalus likely to be associated with basal meningitis and spine.MRI scan showed diffused and extensive meningeal enhancement involving almost entire spinal canal. A Cerebrospinal Fluid (CSF) test showed lymphocytosis with raised ADA level to 119U/L. Elevated ADA along with MRI impression and sign and symptoms, patient was diagnosed with tuberculous myelitis with arachnoiditis. Following medication were started C-Rcinex, T-Moxi 400 and T ethambutol tuberculosis drugs, T-Levipil for convulsions, T-Lioresal for muscle spasms, T Domsal and T-pan to prevent abnormal GI reflux and T-Wysolone for infection**.** Preventive Physiotherapy intervention was beginned. After a week patient was shifted to medicine wards, in this duration patient gradually regained altered sensation in both lower limb and flicker contraction of left lower limb. On Manual Muscle Testing (MMT): 1/5 and right side remains same MMT: 0/5.Repeated CSF examination showed elevated protein level to 208mg/dl and reduced glucose level to 29mg/dl. Patient was discharged after a month and was recommended to continue physiotherapy and advised to undergo MRI scan every 6months. Patient underwent regular physiotherapy sessions for 2 years. Since 2 years patient was asymptomatic, she decided to discontinue her medicines. Sixth monthly MRI brain scan in October 2015 revealed extensive meningeal enhancement and mark reduction ventricular size and MRI dorsal spine scan showed ill-defined patchy T1 hyposensitivity extending from D1 to D10 and patient was diagnosed with syringomyelia level D1-10. No medical management was initiated due poor financial status of the patient and eventually patient discontinues her physiotherapy sessions. In 2017, Patient experienced increased burning sensation, numbness and no movements in both lower limbs. Immediately MRI spine was advised by neurophysician and scan revealed long segment cavitations of cervicodorsal cord that extended from C1 to upper margin of D12. Patient was started on her previous medication and was strictly advised for intense physiotherapy.

On day 1at our neuro-rehabilitation centre, patient complained of inability to walk, stair climbing, outdoor and indoor transfer and maximum dependency for activities of daily living. On physical examination, Active Range of Motion (AROM) of hip, knee and ankle muscles were on possible. Passive ROM, there was mark increased in lower limb muscle tone. On Modified Ashworth Scale (MAS) hip movements were ¾ knee extensor ¾ and ankle planter flexors ¾ both lower limb. Manual Muscle Testing of both lower limbs was 0/5. On observational gait analysis, patient used manual 4 point mode of walker walking pattern. She leans on upper body to make her lower limb weight free and propel forward by drags feet. Also there was an anatomical lock of knee joint causing hyperextension and frequent buckling on weight bearing. On sensory examination, there was altered touch and pain sensation till level L1 on both limbs and absent from level L2-S1. On Environmental examination, patient has western toilet with 4 feet wide door of entry. She uses walker for mandatory ambulation and remains on bed or wheelchair other time. She needed assistance for transfer activities from 2 feet height bed to wheelchair, toilet seat etc. There was a presence of cemented ramp at entrance of residence and elevator facility which made outdoor wheelchair mobility easier. To travel to hospital and rehabilitation centre, patient uses Auto rickshaw as mode of transport which is at a distance of 5 kilometres. Patient needs complete assistance to transfer from wheelchair to vehicle seat. The average vehicle entry passage is 1.5 feet and height from ground level is more than around 1 feet.

Physiotherapy intervention since day 1 included general warm up exercises like passive movements, stretching of lower limb muscles with active mobility of upper limb and trunk for 15 repetitions x 2 sets, Modified cobra pose and push up hold for 10 counts 15 repetitions, 2 sets. Mat PNF technique like bridging, quadruped position, bed mobility training, quadruped supported walk, kneeling position, supported kneel walk, diagonal reach outs, functional training for sit to stand using walker support and passive fixation of knee for10 seconds hold for 15 repetition 2 sets. Functional PNF diagonal lower limb pattern were given includes symmetrical bilateral D1 flexion-extension and D2 flexion extension along with pelvic and scapular PNF pattern for 20 repetition 2 sets. Endurance training was given using static ergo meter by fixing the foot over peddle using strap and strapping over mid tibia level on paddle bar to prevent knee joint failing. It started with passive cycling to active assisted for 30 minutes. Gait PNF training was used to gain passive stability on standing which was progressed to segmental walking phase training using parallel bars for 30 minutes. Throughout each segment of treatment, mental practice was carried out. Patient was asked to visualise and perform all the movements in their mind with high level concentration and repeat the given task multiple times approximately 180 seconds prior to actual physical performance of the task. Patient was given planned monthly home programme with specified goals in order to motivate her for monthly physical target.

Table1: Pre-post intervention score of Manual muscle test scores, Trunk impairment score, Functional Independence Measure Scale, Fatigue severity score and 6 minute walk test.

Manual Muscle Testing (MMT)	**DAY 1**		**DAY 540**	
	Right	**Left**	**Right**	**Left**
Hip flexor	0/5	0/5	2/5	3/5
Hip extensors	0/5	0/5	3/5	3/5
Hip abductors	0/5	0/5	2/5	3/5
Hip adductors	0/5	0/5	2/5	3/5

Hip internal rotators	0/5	0/5	3/5	3/5
Hip external rotators	0/5	0/5	3/5	3/5
Knee flexors	0/5	0/5	3/5	3/5
Knee extensors	0/5	0/5	3/5	3/5
Ankle dorsiflexors	0/5	0/5	1/5	3/5
Ankle plantar flexors	0/5	0/5	1/5	3/5
Trunk muscles (F/E)	2/5 and 2/5		3/5 and 3/5	
Trunk Impairment Score	8		15	
Functional Independence Measure Scale	87		118	
Fatigue Severity Score	8		3.8	
6 Minute Walk Test Predicted Distance Covered=750m				
Distance Covered	16.8m		67.2m	
Energy Expenditure	10000		2333	

Discussion: Young individual with chronic disease are physically inactive and psychologically severely stressed about multiple factors. This increases their lifetime dependency for activities of daily living and putting patient at high risk to develop secondary complication and deformities. Trunk function majorly has three components stability, dynamic balance and coordination. There was an improvement in trunk impairment scale score, indicating pelvis PNF pattern along with resistance would have added up more trunk stability and dynamic coordination with limb movements. Manual trunkal perturbations within base of support limit and rhythmic Pelvic and scapular stabilization would have increased more rigidity and stability to trunk muscles. Studies have shown that manual perturbation improves static balance in stroke patients[8] and stepping strategy in older individuals [9, 29.] An exercise program that involves PNF diagonal limb movement patterns that are parallel to muscular topography, resemble functional activities helps in improving balance and activities of daily living of an individual.

PNF diagonal pattern technique that works on repeated stretch and resistance helps in attaining functional range of motion and improving muscle strength of limb. It works on Sherrington principal of autogenic inhibition that is over contracted or stretched muscles decrease its excitability due to inhibitory signals sent from the Golgi tendon organ of the same muscle [13] The developed tension in the muscle activates Ib afferent fibres in Golgi tendon organ that send signals to spinal cord and causes activation of inhibitory inter-neurons that in turn decreases nerve excitability and the efferent motor drive of the muscle leading to activation of active group of limb muscles [13]. This chain reaction causes the target muscle to relax and is one of the driving theories behind increased elongation of muscle fibres during PNF techniques like contract-relax, contract-relax and antagonistic contract methods[12] This could be reason to show improvement in Motor component of ASIA scale score. Studies have shown progressive resistance training for non-paralysed muscles increases strength as well as increases quality of life in spinal cord injury patients and individual with partial paralysis following Spinal cord injury get stronger with time.[14, 15]

Individual with SCI have higher energy expenditure and easy fatigability than healthy individuals. Functional PNF with mental practise helped in reducing energy expenditure by 3 times that early stage and improved six minute walk functional capacity by 4 times with no pacing. This could be because mental practise prepares the patients to set a proper goal mentally and training of functional PNF task like static supported cycling with stretch and resistance might have improved cardiovascular and muscle endurance also helped in functional task energy conservation[28] leading to decrease in fatigue level and more distance covered. PNF techniques including repetitive concentric, eccentric and static muscle contraction that helped in achieving functional goals and improved muscle coordination and endurance to accompanist functional set goal.[7] this could be the reason for decrease in fatigue severity score. Studies have shown that increase in muscle strength, endurance and learning of energy conserving techniques helps in reducing the fatigue levels in SCI individual [26,27,28]

A recent evidence stated that in neurologic condition, patients is unable to produce movements, the rehearsing of a skill with motor imagery is believed to help keep the motor program active, thus priming and facilitating the future execution of specific movements.[18] mental practice is expected to act on declarative knowledge at non-conscious levels of learning by improving retention level of movements pattern and rehearsing neuronal network involved in the skill performance. [19]

Studies shows high levels of pain and spasticity has direct association with lower quality of life in SCI individuals. [20,21,22,23] All three major components of functional independence measure components were choose for mental practise with functional PNF, showed drastic improvement in sphincter control, transfers and Mobility. Mental practice along with physical assistance to functional diagonal pattern task helps in attaining proper execution and improves accuracy of task this might have resulted in improved Functional Independence score. This suggests that combination of diagonal motion patterns on functional task and mental practise, facilitate motor reorganization and motor regeneration of brain circuit and that evidence neuro plasticity principles. By adding our patients functional prognosis in International classification of Function ICF conceptual model showed improvement in mobility, improved functional activity level and opened more opportunities for social participation in turn reduces perceived participation restrictions and life satisfaction.[24,25]

Conclusion: we concluded that Proprioceptive Neuromuscular Facilitation with Mental Practice does help to improve physical capacity, functional physical status and fatigue and exercise tolerance and functional independences in Syringomyelia patient.

Conflict of Interest: None

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