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A Combination Effect of Sensory Motor Training and Proprioceptive Neuromuscular Facilitation in A Case of Peripheral Polyneuropathy Manifested by Foot Drop in Type II Diabetes Mellitus – A Case Study

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Abstract

Peripheral neuropathy is one of the common complications in patients with diabetes Mellitus (DM) which leads to disrupting the peripheral nervous system resulting in reduce sensory inputs and motor outputs. Patients with foot drop (FD) will have weakness in dorsiflexor muscles of ankle and toe and sensory loss due to disruption of small myelinated and unmyelinated nerve fibers. Sensory motor training (SMT) will facilitate sensory inputs, correcting muscle imbalance, and ensuring correct program at the level of central nervous system whereas Proprioceptive Neuromuscular facilitation techniques (PNF) not only helps facilitating the weaker group of muscles also improve strength . Hence the purpose of the study to combine the effect on use of SMT along with PNF in a case of peripheral polyneuropathy manifested by foot drop in patient with type II DM. The case report study of 72 year old male patient diagnosed with diabetic polyneuropathy manifested by foot drop in type II diabetes mellitus on medication. Intervention of patient received Sensory motor training and Proprioceptive Neuromuscular Facilitation in foot drop for 5 days a week for 4 weeks and outcome measures used were Stanmore Assessment Questionnaire (SAQ) , Diabetic Neuropathy Examination (DNE) score for diabetic neuropathy which were taken on day one and after 4 weeks of intervention and results shown improved on both the outcome measures which concluded that on combination of SMT and PNF techniques have shown efficacy on improving ankle range of motion and strength , sensory discrimination , thereby implementing these combination techniques, will reduce functional dependence and improve quality of life.

Keywords: Foot drop (FD), Diabetes Mellitus (DM), Sensory Motor Training (SMT), Proprioceptive Neuromuscular facilitation techniques (PNF), Stanmore Assessment Questionnaire (SAQ), Diabetic Neuropathy Examination (DNE) score.

Introduction

Diabetes mellitus (DM) is a metabolic disease depicted by hyperglycemia that results from deficiencies in insulin secretion, insulin action on target tissue, or both. The long-standing of chronic hyperglycemia may result in damage and failure of various organs, namely the kidneys, heart, eyes, blood vessels, and nerves [1,2,3].According to the WHO, the diabetic population of developing countries around Asia wereestimated about 60% by 2025.Currently, around the globe the second highest number of cases of type 2 DM were in India.Some of the important complications include coronary artery disease, nephropathy, retinopathy, microalbuminuria, and neuropathy.[1,2] One of the most common complications of DM were diabetic peripheral neuropathy (DPN) and is seen in 50% of all patients with diabetes. The main characteristic feature of diabetic neuropathy is the continuing destruction of the nerves which results in reduced sensory inputs and motor outputs. Most of the polyneuropathies result in length – related, distal greater than proximal i.e. foot, sensory loss, weakness and hyporeflexia. This classic description is appropriate for the common distal symmetric polyneuropathy (DSP), but a variety of other patterns are also encountered. Patients with DSP usually report sensory disturbances involving the feet as the presenting symptom. These disturbances may be "negative" in nature, involving loss of sensations described as numbness or deadness and "positive" like dysesthetic sensory symptoms are common as well. These are often described as tingling or "pins and needles", and can range from mild to very severe. Clinically important weakness usually only develops late in progression of the neuropathy, though signs of motor involvement such as weakness in dorsiflexor muscles of ankle and toe and wasting of intrinsic foot muscles are present much earlier and may lead to foot drop which interferes with the initial foot contact at the beginning of the stance phase and hinders ankle dorsiflexion during the swing phase of gait. Consequently, foot drop contributes to disruption in weight acceptance and weight transfer; reduces walking speed, efficiency and stability of gait and increases the risk of falling [3,4-5].The individuals having all these symptoms will affect activities of daily living and consequently reduce the quality of life.Previous studies on foot drop which were performed aimed at individually improving range of motion, strength, gait and balance in lower limbs but not on overall augmentation in the performance of the lower limbs in individuals with foot drop. Various interventions have been used to improve the function of the patients with foot drop in the form of stretching, strength training (ST), endurance training (ET), resistance training, functional electrical stimulation (FES), transcutaneous electrical nerve stimulation (TENS), orthosis, balance training, Swiss ball exercises, etc., have been used[6,7]. Sensory motor training (SMT) is a global approach and emphasizes the sensorimotor system function as one unit, and works on enhancing sensory inputs and proper recruitment patterns of various muscles in maintaining joint stability, range of motion, strength, motor learning and sensory loss by regulating movement through Central Nervous System. Proprioceptive Neuromuscular Facilitation (PNF) techniques such as , Slow reversal technique helps to strengthen and build up endurance of weaker muscles or of two antagonistic patterns and to develop co-ordination whereas Rhythmic initiation helps to improve the ability to initiate movement[8,9] .It's says that sensory and motor functions of Lower Limb (LL) has an important role for a person's ability to explore and interact with the surroundings in many daily activities. It is also described that lack of sensory and proprioceptive

information from lower extremities in distal sensorimotor polyneuropathy patients has resulted in postural instability[10,11]. The activity limitations may in turn lead to restriction in social roles and perceived participation. Despite these problems, little attention is paid to the sensory impairment in diabetic polyneuropathy rehabilitation of the LL[12] . Hence there is a need of study to combine the effect on use of Sensory Motor training and PNF in foot drop patients in type II DM. And consequently there is a great need to develop more efficient rehabilitation interventions for the LL in persons with sensorimotor impairments after diabetic polyneuropathy.

METHODOLOGY

HISTORY

A 72 years old male patient of endomorphic in built came to Rural Hospital, with chief complaints of difficulty in walking and altered sensations on foot and ankle. The patient had history of diabetes since 1 year back since then patient on regular medications. On Physiotherapy assessment a) muscle tone: bilateral upper limb and lower limb: normal +2; b) sensations: superficial altered on L4-S1 dermatome level whereas deep and cortical were intact; c) reflex examination: superficial present and deep tendon bilateral upper limb normal +2 whereas bilateral lower limb altered +1 d) MMT of bilateral upper limb 4/5 and left lower limb 4/5 whereas right lower limb, hip and knee 4/5 , ankle 1/5; e) ROM : bilateral upper limb having full range and lower limb bilateral hip , knee and left ankle full range whereas right ankle limited active range. f) NCV studies concluded that nerve conduction for bilateral common peroneal nerve and posterior tibial nerve shows generalized sensory motor polyneuropathy. Based on examination and electro diagnostic findings patient is case of type II Diabetes Mellitus diagnosed with right side foot drop manifested by polyneuropathy.

OUTCOME MEASURES

1. Stanmore Assessment Questionnaire (SAQ): total score 100, lower the score shows impairment and higher the score indicates improvement seen in outcome measure[13].
2. Diabetic Neuropathy Examination (DNE) score: total score 16 , higher the score indicated impairment and lower the score indicates improvement seen in outcome measure[14]

Table 1:INTERVENTION (sensory-motor training & PNF) [9,15]

INTERVENTION	DOSE/ DURATION
SENSORY TRAINING	
1. TO IMPROVE SENSORY DISCRIMINATION • Use of sponge, hard cloth, soft cloth, • Velcro, paper • Place foot into box filled with grass, mud, stones. • Localization- Touch subject on digit and foot and have subject put finger on spot where touched. • Stereognosis- Interpret information about an object through exploration and touch with digit and sole of foot (e.g. pins, keys, pen, marbles, balls) • Kinesthesia - Using great toe for pointing, move patients lower limb from a starting place to a new place and have patient replicate the movement on own.	Begin with eyes closed to eyes open. Each exercise 10 reps and practiced for about 10-15 min up to 4 weeks.

2. Reinforce learning with mental rehearsal • Put unaffected foot in front of mirror and put your affected foot behind the mirror, look at mirror image and imagine it is your affected foot. Feel different objects with both feet and make them feel the same (eg. Roller, theraputty, towel roll)	Each exercise for 10 min upto 4 weeks.
3. Quiet the nervous system • Facilitate normal motor movements following light sensory stimuli (eg. Light touch) • Put on a socks without putting ankle, keep both ankle close together, wrap up in a blanket and rock in a rocker.	Each exercise for 10 min upto 4 Weeks
MOTOR TRAINING	
• Flexibility • ROM exercise, toe Curls) • Strengthening • Fine motor task- chess board, peg board • Aerobic	Flexibility- ≥ 2- 3 days/week, stretch to a point of tightness, hold stretch for 10-30 sec, 2-4 reps. 5 reps for 10 min upto 4 weeks. Resistance- 3 days/ week , Moderate (50-69% of 1RM and progress to vigorous 70-85%), 1-3 sets of 8-10 reps (weight cuff, TheraBand) 5 reps for 10 min upto 4 weeks. Aerobic- 3-5 days/ week, moderate (11-12 RPE) and progress to (14-17 RPE), 150 min/week (Cycling)
PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION	
• Rhythmic initiation • Slow reversal	1st week 10 reps 2nd week 2 sets of 10 reps 3rd and 4th week 3 sets of 10 reps

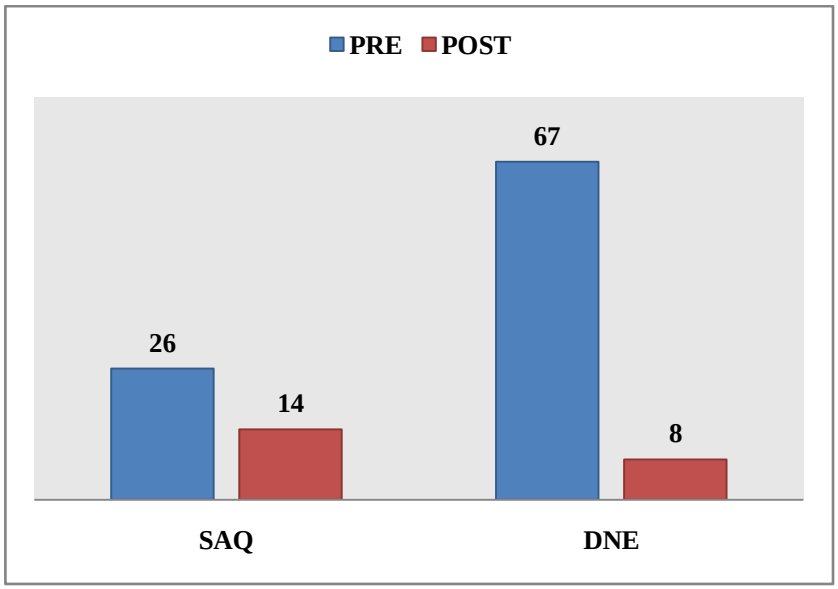
RESULTS

Table 2: Assessment of Pre and Post of Stanmore Assessment Questionnaire (SAQ), Diabetic Neuropathy Examination (DNE) score.

OUTCOME MEASURES	PRE- TEST	POST- TEST

Stanmore Assessment Questionnaire (SAQ)	26/100	67/100
Diabetic Neuropathy Examination (DNE)	14/16	8/16

Figure 1: comparison of pre and postof Stanmore Assessment Questionnaire (SAQ), Diabetic Neuropathy Examination (DNE) score.



DISCUSSION

The current case study report on the combine effects of Sensory Motor training and PNF in foot drop patients in type II DM manifested by peripheral polyneuropathy with 4 weeks of intervention with pre and post outcomes i.e. Stanmore Assessment Questionnaire and Diabetic Neuropathy Examination, have shown improved after intervention. The changes within one section of the sensorimotor system are reflected by adaptations made elsewhere in the system thus, the sensori motor system works as one unit[13,14]. The new coordinated movement pattern is programmed in the sub-cortical region becoming more "automatic" and requiring less conscious thought processing, thus becoming much quicker. This explains the possible mechanism of improvement on sensory motor training. At this point, ''feed-forward'' mechanisms become important. Feed-forward mechanisms are important in preparing the body for movement by contracting stabilizing muscles prior to initiating the movement which occurs unconsciously. The joints are protected for dynamic functional stability throughout the body due to this automatic level of processing. SMT is to increase proprioceptive input in order to stimulate subcortical pathways and facilitate automatic coordinated movement pattern [6,9,17,18] . Whereas PNF techniques increases the stimulation of mechanoreceptors present in muscle spindle, golgi tendon organs and joint capsule responsible for enhancing proprioception inputs from foot and ankle. Use of PNF techniques suggests a stronger sensory excitation at cortical level leading to increased number and improved threshold of motor neurons which result in improved strength, balance and range of motion, enhances proprioception firing, sensory-motor function, and muscle stabilization[9,16-20]. Ontop of that, the manual

contact and the tailor- made resistance offered by the therapist also played their role by inducing tactile feedback and making the treatment more subject-specific. In this study we assessed the patient on Stanmore Assessment Questionnaire which showed improvement in degree of active dorsiflexion of ankle and ability to wear normal shoes, whereas Diabetic Neuropathy Examination (DNE) showed improvement in muscle strength of quadriceps femoris, tibialis anterior and improved sensitivity to touch and pin prick.

CONCLUSION

In present case study, from the results of this study, it can be concluded that combination of Sensory Motor Training and Proprioceptive Neuromuscular Facilitation techniques have shown improvement effectively on improving ankle range of motion and strength, sensory discrimination have reduce functional dependence and improve quality of life.

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