EFFECT OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION TECHNIQUE ON CORE STRENGTH IN PATIENTS WITH TYPE 2 DIABETES: AN EXPERIMENTAL STUDY

Jeba Chitra¹, Rohit Das²

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AUTHORS AFFILIATIONS
¹Professor, Department of Neurology Physiotherapy, KLE University Institute of Physiotherapy, Belagavi, India.
²Department of Neurology Physiotherapy, KLE University Institute of Physiotherapy, Belagavi, India.

Correspondence: Rohit Das
Email: rohit.jeet91@gmail.com

Abstract
Aim and Objective: To find the effect of proprioceptive neuromuscular facilitation technique on core strength in patient with type 2 diabetes.
Methods and material: Primary data collection was done from secondary and tertiary care hospitals in Belagavi using convenience sampling. 30 type II diabetic patients between the age group of 40-65 years were screened based on the selection criteria. Demographic data were recorded along with the scores of core strength using sphygmomanometer and active SLR test. Proprioceptive neuromuscular facilitation techniques were given to the participants with in a period of 4 weeks. Post intervention data were obtained and the data were analyzed.
Results: The result of the study showed a statistical significance in the core strength (p = <0.001) using aneroid sphygmomanometer and active SLR test. Proprioceptive neuromuscular facilitation techniques were given to the participants with in a period of 4 weeks. Post intervention data were obtained and the data were analyzed.
Conclusion: The study concludes that there is an effect of proprioceptive neuromuscular facilitation technique on core strength in patient with diabetes.

Introduction
Diabetes is classified as a group of chronic metabolic disorders which is characterized by elevated glucose levels in the blood. It occurs due to the insufficient production of insulin and/or peripheral insulin resistance¹. Diabetes is associated with long standing metabolic derangement which can lead to functional and structural changes in many organs and systems².

The prevalence of diabetes in the 20-79 year age group worldwide was estimated to be 6.6% in 2010 and 7.8% in 2030³. This global pandemic principally involves type 2 diabetes and is associated with greater longevity, obesity, unsatisfactory diet, sedentary life style and increasing urbanization².
According to world health organization (WHO) criteria prevalence of diabetes in India was 5.6% in urban areas and 2.7% in rural areas in 2010. It is estimated that the total number of people with diabetes in 2010 to be around 50.8 million, rising to 87.0 million by 2030⁴.
The clinical features of hyperglycaemia include thirst, polyuria, nocturia, generalized muscle weakness, weight loss, blurring of vision, nausea, headache, hyperphagia and irritability. In Type 2
Diabetes: The onset is insidious and may not be noticed, thus leading to a variety of complications in long-standing diabetes mellitus cases like retinopathy, nephropathy, peripheral neuropathy, autonomic neuropathy, foot ulcers, myocardial infarction, stroke, and peripheral claudication. The skeletal musculature is significantly involved in diabetic complications, such as contractile weakness, fiber-type changes, decreased oxidative activity and peripheral insulin resistance. Muscle is the most important insulin-dependent glucose sink in the body; therefore, impaired hormonal signalling has a deleterious effect on glucose uptake. The detailed biochemical characterization and proteomic establishment of distinct shifts in metabolic and signalling pathways in diabetic fibres might provide mechanistic insights into the underlying causes of abnormal glucose metabolism and peripheral insulin resistance. Diabetes is associated with loss of skeletal muscle mass and contractile strength, which is especially prevalent in aged patients, muscle mitochondrial dysfunction and the role of mitochondrial deficits in overall disease progression, and slow-to-fast muscle transitions and reduced oxidative enzyme activity in muscle of type 2 diabetic subjects. Diabetes is associated with excessive loss of skeletal muscle and trunk fat mass. The "core" is described as a box with the abdominals in the front, paraspinal and gluteal muscles in the back, the diaphragm as the roof and the pelvic floor and hip girdle musculature as the bottom. Within this box there are 29 pairs of muscles that help to stabilize the spine, pelvis, and kinetic chain during functional movements. When the system works efficiently, there is appropriate distribution of forces, optimal control and efficiency of movement, adequate absorption of ground impact forces and an absence of excessive shearing forces on the joints of the kinetic chain. Therefore, improving core muscle control, coordination, flexibility and strength will create a balance with the body in the patients with diabetes and if combined with developing proper techniques, the body will learn to move in a safer and more efficient pattern of motion.

Proprioceptive neuromuscular facilitation (PNF) is the therapeutic intervention used in rehabilitation which was originally developed to facilitate performance in patients with movement deficits. Proprioceptive neuromuscular facilitation (PNF) exercises are designed to enhance the response of neuromuscular mechanisms by stimulating the proprioceptors. The patterns of PNF exercises are performed in spiral and diagonal directions, and the performance of these patterns is in line with the topographic arrangement of the muscles being used. There are different forms of PNF exercises. Two commonly used forms are rhythmic stabilization training (RST) and combination of isotonic exercises (COI). The RST technique uses isometric contraction of antagonistic patterns and results in co-contraction of the antagonists if the isometric contraction is not broken by the physical therapist. The COI technique is another form of PNF exercise used to evaluate and develop the ability to perform controlled purposeful movements. It involves the performance of alternating concentric, eccentric, and isometric contractions and is used to treat deficiencies in strength and range of motion. There are many interventions given for strengthening of the core muscles of which proprioceptive neuromuscular facilitation techniques shows great effectiveness and is one of the beneficial techniques. But, there are very few studies proving the effect of this technique to improve core muscle strength in patients with type 2 diabetes. Hence the aim of the study is to find the effect of PNF technique on core strength in patient with diabetes.

Materials and methods

30 male and female participants suffering from diabetes mellitus were recruited from Secondary and Tertiary Care Hospitals in Belagavi for the study. Prior to the commencement of the study, approval was obtained from the ethical committee of the institution review board. The participants were screened based on the inclusion and exclusion criteria and those willing to receive intervention for a minimum of 20 sessions for 4 weeks duration were recruited, briefed about the nature of the study and informed consent was taken. The inclusion criteria included participants with type II diabetes mellitus, age between 40-65 years and active SLR test score between 5-10. The exclusion criteria were central nervous system dysfunction (hemiparesis, myelopathy, cerebellar ataxia) and severe prolapsed intervertebral disc (PIVD).

Outcome measures

The outcome measures of core strength using aneroid sphygmomanometer and active SLR test score was collected pre and post 4 weeks. Core strength using aneroid sphygmomanometer: An aneroid sphygmomanometer and a stopwatch was used to obtain the pressure readings. The aneroid sphygmomanometer was calibrated with pressure biofeedback unit prior to the study. The aneroid sphygmomanometer consists of an inflation bulb, air release valve, cuff, bladder hose (or tube) and aneroid manometer gauge. It registers changing pressure in an air filled pressure cell allowing body movement, especially spinal movement, detected during exercises. The pressure cell measures from 0-300 mmHg, with a precision of 2 mmHg. Participants were in prone lying, cuff was placed horizontally under the abdomen with the lower edge just below the anterior superior iliac spine (ASIS) and naval at centre of the cuff. Inflate to 70 mmHg and participants were instructed to perform drawing-in manoeuvre. If done properly, the pressure drops to 6-10 mmHg and participants were asked to maintain the pressure drop for up to 10 seconds.
Active SLR test- Participants were positioned in supine lying with the knees extended and feet 20cm apart. Participants were asked to raise their legs, one leg after the other, above the plinth 20cm without bending the knee and hold for approximately 10 seconds. Each participant was instructed to grade self-perceived impairment according to a 6-point scale from 0-5. The total score was computed by adding the scores of both sides, which ranges from 0 (normal stability) to 10 (core instability) 24.

**Intervention**

Treatment session consisted of PNF techniques for trunk which includes Rhythmic Initiation, Rhythmic Stabilization and Combination of Isotonic exercises. In Rhythmic Initiation there is rhythmic motion of the limb or body through the desired range, starting with passive motion and progressing to active resisted movement. Rhythmic Stabilization includes alternating trunk flexion-extension isometric contractions against resistance for 10 seconds. Combination of Isotonic exercises includes alternating concentric and eccentric contractions of agonists without relaxation. Resisted active concentric contraction for 5 seconds and resisted maintained contraction for 5 seconds (trunk flexion-extension) 25. Each treatment session lasts for 30-45 minutes, with a total of 20 treatment sessions within 4 weeks. Participants performed 3 sets of 10 repetitions at maximal resistance for each technique and 30 seconds rest was given after each set and 60 seconds rest was given after each technique26. After 4 weeks of intervention, core strength using sphygmomanometer and active SLR test score was measured and the results were analyzed.

**Results**

The mean age of male and female with diabetic neuropathy was 57.61 ± 6.38 and 61.35 ± 5.56 respectively. The mean BMI of females was 27.57 ± 3.82 and that of the males was 25.14 ± 4.67. Female were suffering from diabetes for 12.29 ± 2.99 years and the males for 11.84 ± 2.30 years (Table 1). The pre test mean of core strength using aneroid sphygmomanometer was 6.33±1.75 and post test was 9.73±2.20 which was statistically significant (p <0.001) (t=11.885). The pre test mean of Active SLR test was 6.27±1.4 and post test was 3.37±1.16 which was statistically significant (p <0.001) (t=10.173) (Table 2).

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<th>Parameters</th>
<th>Gender</th>
<th>Mean</th>
<th>SD</th>
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<table>
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<tr>
<th>Duration of Diabetes (Years)</th>
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<tr>
<td></td>
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<td>Male</td>
<td>11.84</td>
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Female n = 17 and Male n = 13

<table>
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<tr>
<th>Characteristics</th>
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<th>Post</th>
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<td>Core-strength</td>
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<td>Active SLR test</td>
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<td>3.37±1.16</td>
<td>10.173</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Discussion**

Diabetes is associated with excessive loss of skeletal muscle and trunk fat mass23. The findings of the present study shows that 4 weeks of PNF exercises significantly increase the core strength in people with type 2 diabetes. There is dearth in literature proving that PNF exercises improves core strength in patients with type 2 diabetes but these results are in support with other studies which concluded that PNF training improves trunk muscle endurance in chronic low back pain. Nikolaos D (2008) showed gain in muscle endurance with 4 weeks of PNF exercises in patients with chronic low back pain. It was concluded in a study that 4 weeks of intensive PNF training for the chronic low back patients is very effective in improving trunk muscle endurance. The researchers attributed these findings to the dynamic nature of the PNF exercises26.

In patients with type 2 diabetes, a single bout of exercise triggers a substantial increase in whole- body glucose disposal, mediated by the translocation of the crucial glucose transporter GLUT4 to the surface membrane system in contracting skeletal muscles. Therefore, exercise training plays a key role in the
prevention and treatment of diabetes\textsuperscript{27-31}. In the present study the increased core strength in patients with type 2 diabetes may be due to the inclusion of the PNF exercises (Rhythmic initiation, Rhythmic stabilization and combination of isotonic), which used all muscle action types (eccentric, concentric, and isometric) through a progressively increased range of motion.

In the present study there is significant improvement in the core strength using aneroid sphygmomanometer; the technique used to measure the core strength is abdominal ‘drawing-in’ manoeuvre, designed to recruit the deep abdominal muscles and hence PNF exercises which involve significant muscle work results in muscle strength and endurance improvement. There is significant improvement in the active SLR test score, which indicates that there is increased lumbar stability after 4 weeks of PNF exercises. This may be due to the dynamic nature of the PNF exercises which improves the lumbar stability.

**Conclusion:** The present study concludes that proprioceptive neuromuscular facilitation (PNF) technique improves core strength in patients with diabetes.

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**References:**

23. Saliba V, Johnson GS, Wardlaw C. Proprioceptive neuromuscular facilitation. In: Basmajian JV, Nyberg RE,


