

Combined Effect of Pelvic Proprioceptive Neuromuscular Facilitation with Core Strengthening on Trunk Control, Balance, and Gait in Paraplegia

Abstract

Spinal cord injury (SCI) has deleterious effects on quality of life and vocation. A partial or complete loss of sensory and motor functions below the site of injury is a potential clinical sign of SCI. Trunk and pelvic control are crucial for balance and gait to perform vocational tasks of daily living. In this case report, a 40-year-old male with traumatic incomplete paraplegia (AIS Grade C, neurological level T6) received 45 min of intervention per session, which included pelvic proprioceptive neuromuscular facilitation combined with core strengthening exercises 5 times a week for 4 weeks. Baseline and postassessments were done for trunk control with the trunk control test for SCI, balance with the Berg Balance Scale (BBS) and the SCI-functional ambulation inventory (SCI-FAI), and gait with the walking index for SCI II (WISCI). After 4 weeks of intervention, there were significant differences between baseline and postintervention scores on the trunk control test for SCI (16–18), WISCI (Level 1–2), SCI-FAI (03–06), and BBS (04–08). This is the first case report that enabled and promoted potentiate intervention to improve trunk control, balance, and gait in paraplegics. This outcome motivates additional research on its therapeutic potential and mechanism.

Keywords: *Gait, paraplegia, proprioceptive neuromuscular facilitation, spinal cord injuries, walking*

Introduction

Due to limitations in activities affected by inadequate or poor sitting balance and its maintenance, which is crucial to carrying out activities of daily living (ADL) and vocational responsibilities, paraplegic individuals' quality of life and functional independence are severely compromised.^[1] According to earlier predictive studies, spinal cord injury (SCI) sufferers largely lack the elements of seated balance.^[2] The physiotherapy interventions for people with spinal cord injuries that focus on trunk and pelvic control have been overlooked in earlier literature.

To maintain trunk control, balance, and gait, a novel technique called pelvic proprioceptive neuromuscular facilitation (PNF) is currently being employed in stroke patients to increase pelvic stability.^[3] However, in a study done by Sharma and Kaur in 2017, it was proven that gait, balance, and trunk control can be further improved by the addition of core strengthening to pelvic PNF. The muscles of the trunk and pelvis form the

core musculature that helps in maintaining the stability of the spine and pelvis, which includes abdominal muscles anteriorly, paraspinal muscles posteriorly, and the diaphragm which acts as a roof, whereas the musculature of the pelvis and hip girdle act as the base of the core musculature.^[4] It is also proven that core training improves static and dynamic balance in paraplegic individuals.^[5] Hence, in this case report, we intend to discuss the combined effect of pelvic PNF and core strengthening to improve trunk control, balance, and gait in patients suffering from incomplete paraplegia.

Case Report

A 40-year-old male with a history of falls from height reported to the neurological physiotherapy department of our institute with complaints of an inability to walk and sit independently for 3 months and was treated surgically by the neurosurgery department. His complaints were initially limited to loss of sensation and motor weakness in bilateral lower limbs, loss of bowel and bladder control, and being unable to walk after the injury with no

**Adarsh Sharma,
Akanksha Saxena**

*Department of Physiotherapy,
Maharishi Markandeshwar
Institute of Physiotherapy
and Rehabilitation, Maharishi
Markandeshwar (Deemed to be
University), Mullana, Ambala,
Haryana, India*

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Address for correspondence:

*Dr. Adarsh Sharma,
Flat No. 61, D-Block, Maharishi
Markandeshwar (Deemed
to be University), Mullana,
Ambala -133 207,
Haryana, India.
E-mail: adarshsharma476@
gmail.com*

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family history. The patient underwent surgery after 4 days of injury, where ORIF of the vertebral column between T4 and T8 levels was performed and was diagnosed with a vertebral compression fracture at T6 level.

The build of the patient was mesomorphic, and the attitudes of the lower limbs were bilateral ankle in plantar flexion and bilateral hip joint in external rotation, followed by extension at the bilateral knee joint. The neurological examination was performed with the ISNCSCI-ASIA impairment scale, and an AIS Grade C, NLI (T6) with sacral sparing was observed. The tone of both lower limbs was normal, i.e., Grade 0, according to the Modified Ashworth Scale. Spinal fixation at levels T4 and T8, as well as a compression fracture at level T6, were detected on magnetic resonance imaging findings. The pre- and postintervention assessments were done for trunk control by the trunk control test for SCI, balance by the Berg Balance Scale and SCI-functional ambulation inventory, and gait by the walking index for SCI II. The physiotherapy management for this patient was primarily focused on improving trunk and pelvic control, which will further help maintain balance and gait in paraplegic individuals. For this, participants with incomplete paraplegia received pelvic PNF with core strengthening, which consists of an anterior elevation-posterior depression pattern of movement for pelvic PNF with quadruped tummy tuck-in and medicine ball rotations for core strengthening, followed by the prevention of secondary complications [Figure 1].

To improve trunk and pelvic control, in each session, pelvic PNF with anterior elevation-posterior depression pattern of movement was given followed by rhythmic

initiation, slow reversal, and agonistic reversals for 10 min each with 2 min of rest between each technique for 30 min per session 5 times per week for 4 weeks. To improve the strength of core musculature, in each session, we instructed the patient to perform tummy tuck in quadruped position for 10 repetitions × 2 sets with 30 s hold. Medicine ball rotation was given for 3–5 min. Intervention was performed for 15 min per session 5 times per week for 4 weeks making a total of 45 min of intervention per session. Finally, passive range of motion exercises and ankle-toe movements for bilateral lower limbs, including positional changes every two hours, were administered to prevent secondary complications such as pressure sores, deep vein thrombosis, etc.

Discussion

This is the first study demonstrating the effectiveness of pelvic PNF combined with core strengthening on trunk control, balance, and gait in individuals with paraplegia. The patient was suffering from incomplete paraplegia with a neurological level of injury at T6 according to the ASIA impairment scale. In a previous study, the same intervention was given for 4 weeks, i.e., pelvic PNF combined with core strengthening, to chronic stroke patients, where significant improvements were seen in trunk control, balance, and gait.^[6] In our study, we found improvement in trunk control, balance, and gait in paraplegic patients after pelvic PNF and core strengthening were administered for 4 weeks [Table 1]. The effect on pelvic control could be due to the insertion of trunk musculature on the pelvis, as it provides a base of support for core musculature.^[6]

Core muscles such as the transverse abdominis, internal abdominal oblique, quadratus lumborum, rectus abdominis, and pyramidalis include the musculature of the trunk and pelvis that are essential for the maintenance of spinal and pelvic stability and help in the transfer and generation of energy from large to small body segments during ADLs.^[6] This intervention is crucial for patients suffering from paraplegia who have poor trunk and pelvic control, causing a decline in daily living tasks. The intervention was provided with conventional physiotherapy to avoid secondary complications. This protocol can be used locally to observe better results. Early participation by SCI patients has higher chances of recovery. This study also suggests that



Figure 1: (a) Anterior Elevation, (b) Posterior Depression, (c) Quadruped Tummy Tuck-In, (d) Medicine Ball Rotations. *Arrows depict the direction of force applied during movement

Table 1: Pre-and postintervention scores of outcome measures

Outcome measure	Preintervention	Postintervention
Trunk control test for SCI	16	18
WISCI	Level 1	Level 2
SCI-FAI	3	6
BBS	4	8

SCI: Spinal cord injury; WISCI: Walking index for SCI; SCI-FAI: SCI functional ambulatory inventory; BBS: Berg Balance Scale

if intervention is followed for 5 days a week for 4 weeks, it will be helpful for the patients to gain early recovery.

Conclusion

Pelvic PNF combined with core strengthening could be used as a potentiate intervention to improve trunk control, balance, and gait in individuals with paraplegia. Pelvic PNF and core strengthening exercises are easier to use, cost-effective, and short-term interventions with no side effects that can also be used for home-based physiotherapy by prescribing active-assisted strengthening exercises.

Clinical trial registration

Clinical Trials Registry-India (CTRI/2022/09/045965).

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initials will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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