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A COMPARATIVE STUDY BETWEEN THE MCKENZIE TECHNIQUE AND CORE-STRENGTHENING EXERCISES WITH CONVENTIONAL GAIT TRAINING IN PATIENTS WITH SPINAL CORD INJURY

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Abstract

Background: Spinal cord injury (SCI) is a disabling neurological condition that results in impaired gait, poor balance, reduced muscle strength, and decreased functional independence. Conventional ait training is commonly used in rehabilitation; however, interventions targeting trunk stability, such as the McKenzie Technique and core-strengthening exercises, may further improve functional outcomes.

Methodology & results: This experimental comparative study includes 60 patients with spinal cord injury aged 20–50 years. Participants are randomly allocated into two groups (30 participants each). Group A receives the McKenzie Technique with conventional gait training, while Group B receives core-strengthening exercises with conventional gait training. Both groups undergosupervised treatment for six weeks, five sessions per week. Outcome measures include the 10-Meter Walk Test (10MWT), Berg Balance Scale (BBS), Manual Muscle Testing (MMT), and Functional Independence Measure (FIM). Data are analyzed using paired and independent *t*-tests,with statistical significance set at $p < 0.05$. It is anticipated that both intervention groups will demonstrate improvements in gait performance, balance, muscle strength, and functional independence. The study aims to determine whether one intervention provides superior clinical outcomes when combined with conventional gait training.

Conclusion: This study is expected to provide evidence regarding the comparative effectiveness of the McKenzie Technique and core-strengthening exercises in the rehabilitation of individuals with spinal cord injury. The findings may assist physiotherapists in selecting evidence-based treatment strategies to enhance functional recovery and improve patients' quality of life.

Introduction

Spinal cord injury (SCI) is a serious neurological condition that results in partial or complete loss of motor, sensory, and autonomic functions below the level of injury. It commonly affects young and middle-aged adults and is mainly caused by road traffic accidents, falls, sports injuries, and other traumatic events. Despite advances in medical and surgical management, many individuals continue to experience long-term impairments such as muscle weakness, poor trunk control, impaired balance, reduced walking ability, and decreased functional independence. These limitations significantly affect daily activities, social participation, and overall quality of life. Among the various rehabilitation goals, restoration of walking ability is considered one of the most important because it enhances mobility, confidence, cardiovascular fitness, and independence.

Conventional gait training is widely used in the rehabilitation of individuals with SCI and includes progressive walking practice, lower-limb strengthening, balance training, weight-shifting activities, transfer training, and functional mobility exercises. Although effective, conventional gait training may not adequately address deficits in trunk stability, spinal alignment, and postural control, which are essential for efficient gait. The McKenzie Technique (Mechanical Diagnosis and Therapy) focuses on repeated spinal movements, posture correction, and patient education to improve spinal mobility and trunk control. In contrast, core-strengthening exercises aim to enhance the strength, endurance, and neuromuscular control of the trunk muscles, thereby providing a stable foundation for balance, posture, and coordinated lower-limb movement during walking. Both interventions have the potential to improve functional mobility through different therapeutic mechanisms.Although both the McKenzie Technique and core-strengthening exercises are widely used in physiotherapy practice, limited comparative evidence exists regarding their effectiveness inpatients with spinal cord injury when combined with conventional gait training. Therefore, the present study aims to compare the effectiveness of these two rehabilitation approaches in improving gait performance, balance, muscle strength, and functional independence in individuals with SCI. Treatment outcomes will be evaluated using standardized clinical measures, including the 10-Meter Walk Test (10MWT), Berg Balance Scale (BBS), Manual Muscle Testing (MMT), and Functional Independence Measure (FIM). The findings of this study are expected to provide evidence to guide physiotherapists in selecting the most effective intervention and contribute to the development of evidence-based rehabilitation protocols for patients with spinal cord injury.

Methodology

This experimental comparative study was conducted in the Department of Physiotherapy, Pacific Medical College and Hospital, Udaipur, and included 60 patients with spinal cord injury aged 20–50 years who met the inclusion criteria and provided written informed consent. Participants were randomly allocated into two groups of 30 each using the lottery method. Group A received the McKenzie Technique combined with conventional gait training, while Group B received core-strengthening exercises combined with conventional gait training. Both groups underwent supervised treatment sessions for 45–60 minutes, five days per week, for six weeks. Outcome measures, including the 10-Meter Walk Test (10MWT), Berg Balance Scale (BBS), Manual Muscle Testing (MMT), and Functional Independence Measure (FIM), were assessed before and after the intervention. The collected data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Descriptive statistics were expressed as mean and standard deviation, while paired and independent *t*-tests were used for within-group and between-group comparisons, respectively. A *p*-value of less than 0.05 was considered statistically significant.

Results: A total of 60 participants with spinal cord injury completed the study, with 30 participants in each group. Baseline demographic and clinical characteristics were comparable between the groups. Following six weeks of intervention, both groups showed improvements in gait performance,

balance, muscle strength, and functional independence. Significant within-group improvements were observed in the McKenzie Technique group for the 10-Meter Walk Test (10MWT), Berg Balance Scale (BBS), Manual Muscle Testing (MMT), and Functional Independence Measure (FIM) ($p < 0.001$). The Core-Strengthening Exercise group also demonstrated significant improvements in the 10MWT, BBS, and FIM ($p < 0.001$), while the change in MMT was not statistically significant ($p = 0.32$). Between-group analysis showed greater improvement in the McKenzie Technique group, particularly in muscle strength and overall functional recovery. These findings indicate that both interventions were effective; however, the McKenzie Technique combined with conventional gait training produced superior clinical outcomes compared with core-strengthening exercises combined with conventional gait training.

STATISTICS

Table 1 Distribution of Age MK

Age	Number of Patients	Percentage
20-30	11	36.6%
30-40	11	36.6%
40-50	8	26.6%
Total	30	100%

The majority of patients were in the **20–30 years** and **30–40 years** age groups, with **11 patients (36.6%)** each. The **40–50 years** age group included **8 patients (26.6%).**

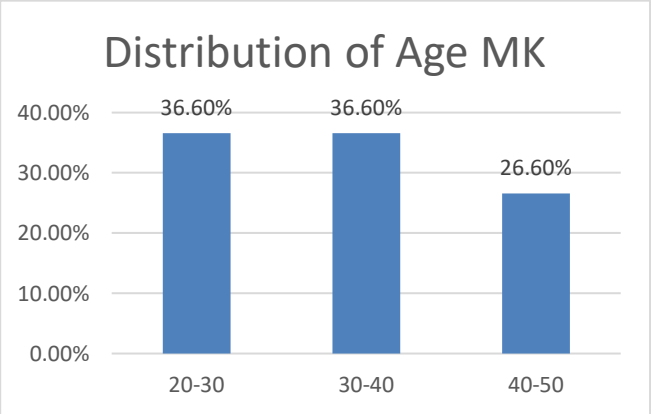

Table 2 Distribution of Gender MK

Gender	Number of Patients	Percentage
Male	15	50%
Female	15	50%
Total	30	100%

The study included an equal distribution of male and female patients, with **15 participants (50%)** in each group

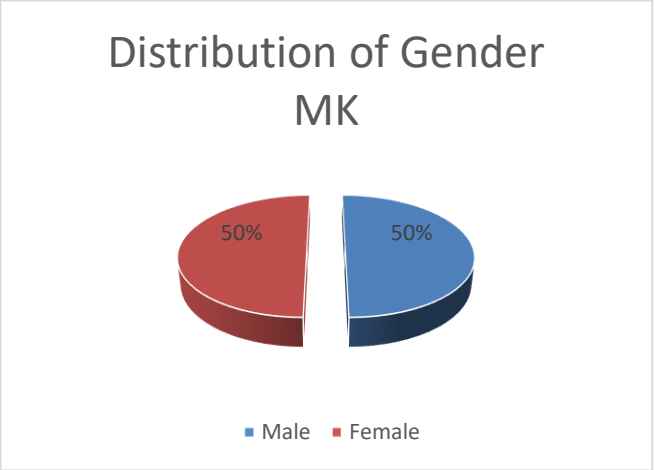

Table 3 Distribution of Occupation MK

Occupation	Number of Patients	Percentage
Housewife	5	16.6%
Businessman	7	23.3%
Unemployed	7	23.3%
Student	8	26.6%
Retd	0	00%
Farmer	3	10%
Total	30	100%

The largest proportion of patients were **students (8, 26.6%),** followed by **businessmen** and **unemployed individuals** with **7 patients (23.3%)** each. **Housewives (16.6%)** and **farmers (10%)** were less represented, while **no retired participants**

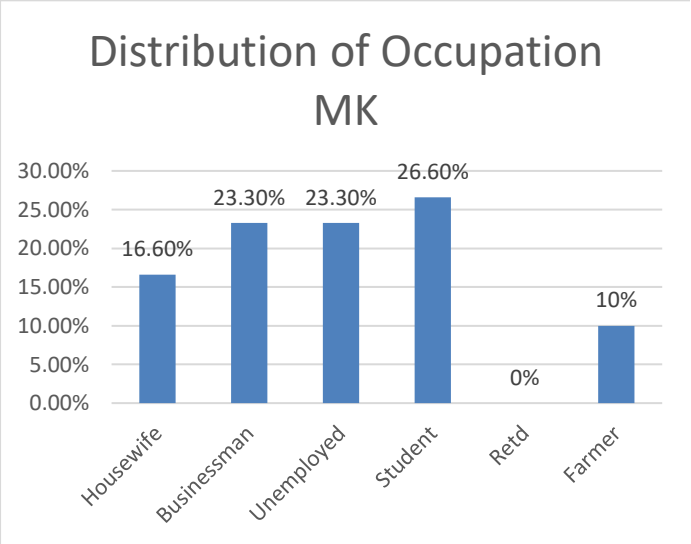

Table 4 Distribution of Area MK

Area	Number of Patients	Percentage
Urban	13	43.3%
Rural	17	56.6%
Total	30	100%

The majority of patients belonged to **rural areas (17, 56.6%)**, while **13 patients (43.3%)** were from urban areas

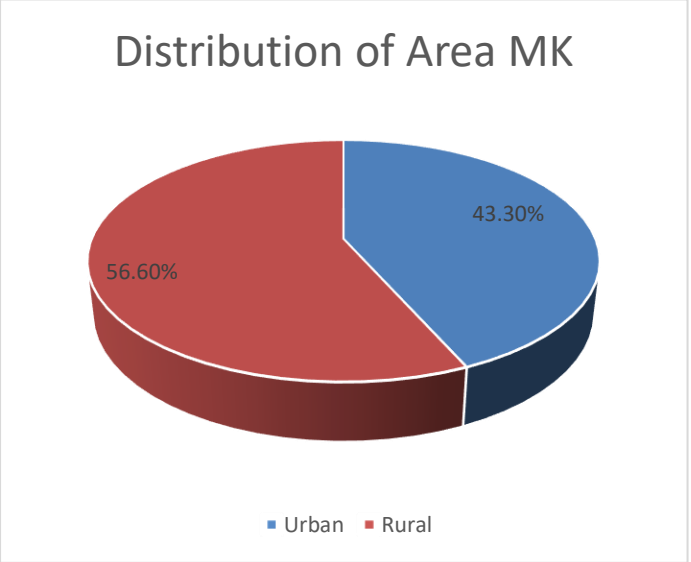

Table 5 Distribution of 10MWT MK

10MWT	Mean ± SD (n=30)	Range	Maximum	Minimum
Pre 10MWT	0.7 ± 0.08	0.30	0.88	0.58
Post 10MWT	0.8± 0.08	0.30	1.0	0.7

The mean **10-Meter Walk Test (10MWT)** score increased from **0.70 ± 0.08** before treatment to **0.80 ± 0.08** after treatment.

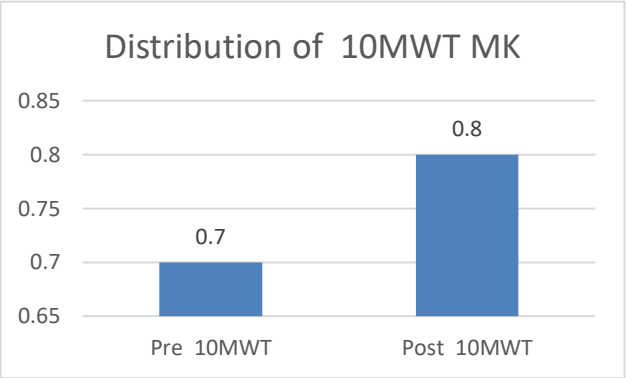

Table 6 Distribution of BBS MK

BBS	Mean ± SD (n=30)	Range	Maximum	Minimum
Pre BBS	34.8±4.25	15	43	28
Post BBS	42.0±4.0	14	50	36

The mean **Berg Balance Scale (BBS)** score increased from **34.8 ± 4.25** before treatment to **42.0 ± 4.0** after treatment.

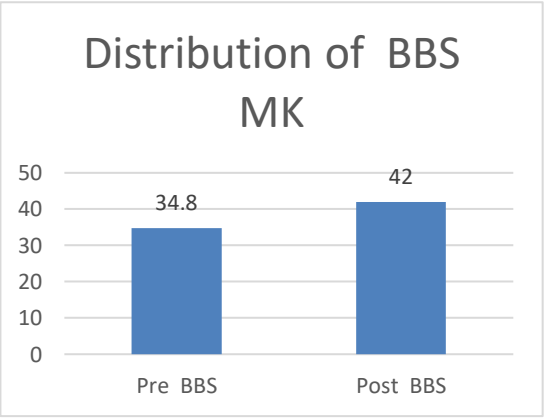

Table 7 Distribution of MMT MK

MMT	Mean ± SD (n=30)	Range	Maximum	Minimum
Pre MMT	3.6±0.6	2	5	3
Post MMT	4.6±0.4	1	5	4

The mean **Manual Muscle Testing (MMT)** score improved from **3.6 ± 0.6** before treatment to **4.6 ± 0.4** after treatment.

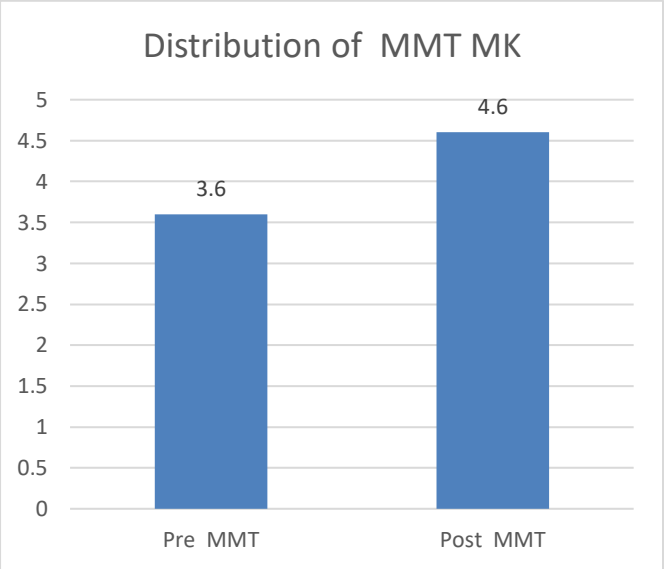

Table 8 Distribution of FIM MK

FIM	Mean ± SD (n=30)	Range	Maximum	Minimum
Pre FIM	84.7±6.1	22	96	74
Post FIM	97.6±5.8	21	109	88

The mean **Functional Independence Measure (FIM)** score increased from **84.7 ± 6.1** before treatment to **97.6 ± 5.8** after treatment.

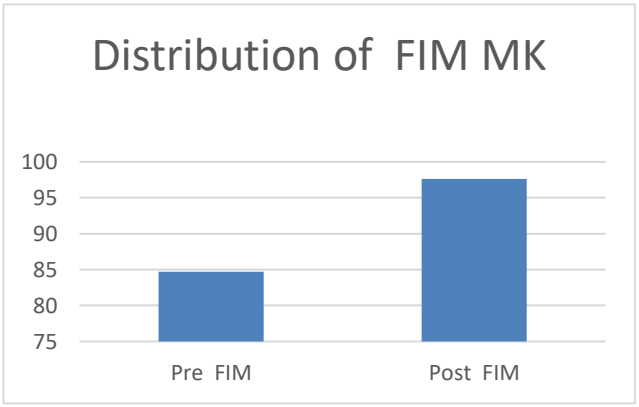

Table 9 Comparison of Pre and Post 10MWT MK

10MWT	Mean ± SD (n=30)	Statistical T value	P Value
Pre 10MWT	0.7 ± 0.08	-89.4	0.0001(S)
Post 10MWT	0.8± 0.08		

The mean **10MWT** score increased from **0.70 ± 0.08** before treatment to **0.80 ± 0.08** after treatment. The difference was **statistically highly significant** (**t = -89.4, p = 0.0001**).

Table 10 Comparison of Pre and Post BBS MK

BBS	Mean ± SD (n=30)	Statistical T value	P Value
Pre BBS	34.8±4.25	-78.6	0.0001(S)
Post BBS	42.0±4.0		

The mean **Berg Balance Scale (BBS)** score increased from **34.8 ± 4.25** before treatment to **42.0 ± 4.0** after treatment. The improvement was **statistically highly significant** (**t = -78.6, p = 0.0001**)

Table 11 Comparison of Pre and Post MMT MK

MMT	Mean ± SD (n=30)	Statistical T value	P Value

Pre MMT	84.7±6.1	-20.1	0.0001(S)
Post MMT	97.6±5.8		

he mean score increased from **84.7 ± 6.1** before treatment to **97.6 ± 5.8** after treatment. The improvement was **statistically highly significant (t = -20.1, p = 0.0001)**.

RESULTS

The present study was conducted to compare the effectiveness of McKenzie Technique with Conventional Gait Training and Core Strengthening Exercises with Conventional Gait Training in patients with Spinal Cord Injury. A total of 60 participants were included in the study, with 30 participants in each group. The participants were assessed using the 10-Meter Walk Test (10MWT), Berg Balance Scale (BBS), Manual Muscle Testing (MMT), and Functional Independence Measure (FIM) before and after the intervention.

Demographic Characteristics

The age distribution showed that most participants were between 20 and 40 years of age, while fewer participants belonged to the 40–50 years age group. Male and female participants were equally represented in the study. Most participants were from rural areas, and the majority were businessmen, students, or unemployed individuals. The demographic characteristics of both groups were similar before treatment.

Group A (McKenzie Technique with Conventional Gait Training)

The mean 10-Meter Walk Test (10MWT) score increased after treatment, indicating an improvement in walking ability. The difference between the pre- and post-treatment scores was statistically highly significant ($p < 0.001$).

The Berg Balance Scale (BBS) score increased after the intervention, showing improvement in balance performance. The improvement was statistically highly significant ($p < 0.001$).

The Manual Muscle Testing (MMT) score also increased after treatment, indicating improved muscle strength. This improvement was statistically highly significant ($p < 0.001$).

The Functional Independence Measure (FIM) score increased after the intervention, demonstrating improvement in functional independence. The improvement was statistically highly significant ($p < 0.001$).

Group B (Core Strengthening Exercises with Conventional Gait Training)

The 10-Meter Walk Test (10MWT) showed only a slight improvement after treatment. However, the difference between pre- and post-treatment scores was statistically highly significant ($p < 0.001$).

The Berg Balance Scale (BBS) score increased after treatment, indicating improvement in balance. This improvement was statistically highly significant ($p < 0.001$).

The Manual Muscle Testing (MMT) score showed only a slight increase after treatment. However, this improvement was not statistically significant ($p = 0.32$).

The Functional Independence Measure (FIM) score increased after treatment, indicating improvement in functional independence. The difference between pre- and post-treatment scores was statistically highly significant ($p < 0.001$).

Overall Results

Both intervention groups showed improvement following treatment. Improvement was observed in walking ability, balance, and functional independence in both groups. Muscle strength improved markedly in the McKenzie Technique group, whereas only minimal improvement was observed in the Core Strengthening Exercise group. The statistical analysis demonstrated significant improvement in most outcome measures following the intervention.

DISCUSSION

The present study was conducted to compare the effects of McKenzie Technique with Conventional Gait Training and Core Strengthening Exercises with Conventional Gait Training in patients with Spinal Cord Injury (SCI). Spinal cord injury commonly affects muscle strength, balance, gait, and functional independence, making rehabilitation an important component of patient recovery. The present study evaluated changes in walking ability, balance, muscle strength, and functional independence using the 10-Meter Walk Test (10MWT), Berg Balance Scale (BBS), Manual Muscle Testing (MMT), and Functional

Independence Measure (FIM). The results demonstrated improvements in both intervention groups following the rehabilitation programme.

Walking ability was assessed using the 10-Meter Walk Test (10MWT). Improvement in walking performance observed after the intervention may be attributed to repeated gait practice, improved lower-limb muscle activation, better postural alignment, and enhanced neuromuscular coordination developed during rehabilitation. Conventional gait training provides repeated opportunities for weight shifting, stepping, and gait correction, while McKenzie exercises focus on restoring spinal mobility and maintaining proper posture. Similarly, core strengthening exercises improve trunk stability, which is essential for efficient gait. The combined effect of these rehabilitation strategies may have contributed to improved walking performance. Similar findings have been reported by McKinley et al. (2007), who observed that comprehensive physiotherapy programmes improve walking ability and mobility in individuals with spinal cord injury. Harvey et al. (2009) also reported that repetitive gait training and therapeutic exercises enhance locomotor function and walking capacity in neurological rehabilitation.

Balance was evaluated using the Berg Balance Scale (BBS). Balance is often impaired in patients with spinal cord injury because of reduced muscle strength, impaired proprioception, and decreased trunk control. Improvement in balance following treatment may be associated with better postural stability, increased trunk control, improved sensory feedback, and repeated practice of functional activities during rehabilitation. McKenzie exercises encourage proper spinal alignment and movement, whereas core strengthening exercises improve activation of the abdominal and back muscles that support the trunk during standing and walking. Conventional gait training further reinforces balance by promoting controlled weight transfer and postural adjustments during ambulation. Similar observations were reported by Wirz and Dietz (2015), who stated that rehabilitation programmes emphasizing postural control and task-specific training improve balance and functional mobility in individuals with spinal cord injury. These findings suggest that rehabilitation targeting trunk stability and functional movement can positively influence balance performance.

Muscle strength was assessed using Manual Muscle Testing (MMT). Improvement in muscle strength observed after treatment may be explained by repeated muscle activation, progressive therapeutic exercise, and neuromuscular adaptation that occur during rehabilitation. Regular exercise stimulates motor unit recruitment and improves muscle performance, allowing patients to perform functional tasks more effectively. McKenzie exercises involve repeated active spinal movements that may facilitate muscle activation around the trunk and lower limbs, while core strengthening exercises specifically target the stabilizing muscles of the trunk. Conventional gait training further promotes activation of the lower-limb muscles during walking practice. Similar findings were reported by Hicks et al. (2011), who concluded that exercise-based rehabilitation programmes contribute to improvements in muscle strength, endurance, and physical function in patients with spinal cord injury. These findings support the role of structured physiotherapy in improving muscle performance during rehabilitation.

Functional independence was evaluated using the Functional Independence Measure (FIM). Functional independence reflects the ability of an individual to perform activities of daily living with minimal assistance. Improvement in FIM scores following the intervention may be related to improvements in walking ability, balance, muscle strength, and confidence during functional activities. As patients become more stable and mobile, they are better able to perform transfers, walking, self-care activities, and routine daily tasks independently. Rehabilitation programmes combining therapeutic exercise with gait training provide opportunities for repetitive practice of functional activities, which may improve overall independence. Similar findings were reported by Kirshblum et al. (2011), who emphasized that comprehensive rehabilitation improves functional outcomes and quality of life in individuals with spinal cord injury.

The findings of the present study are generally consistent with previous research demonstrating the importance of physiotherapy rehabilitation in spinal cord injury. Improvement in functional outcomes is likely to result from multiple factors, including repeated therapeutic exercise, improved neuromuscular coordination, enhanced trunk

stability, postural correction, and task-specific gait practice. Both McKenzie Technique and Core Strengthening Exercises were administered along with conventional gait training, and each intervention may contribute differently to the rehabilitation process. While McKenzie exercises primarily focus on spinal movement and posture, core strengthening exercises emphasize trunk muscle stability. Conventional gait training complements both approaches by improving walking practice and functional mobility. Therefore, the observed improvements are likely to reflect the combined effects of these rehabilitation strategies rather than a single treatment component.

Overall, the present study supports the role of structured physiotherapy rehabilitation in improving walking ability, balance, muscle strength, and functional independence in patients with spinal cord injury. The findings are in agreement with earlier studies suggesting that rehabilitation programmes incorporating postural training, strengthening exercises, trunk control, and gait training contribute to functional recovery. Further studies with larger sample sizes, longer follow-up periods, and advanced outcome measures may provide additional evidence regarding the long-term effects of different rehabilitation approaches in patients with spinal cord injury.

CONCLUSION

The present study was conducted to compare the effects of McKenzie Technique with Conventional Gait Training and Core Strengthening Exercises with Conventional Gait Training in patients with Spinal Cord Injury (SCI). The primary objective was to evaluate the effectiveness of these rehabilitation approaches in improving walking ability, balance, muscle strength, and functional independence using the 10-Meter Walk Test (10MWT), Berg Balance Scale (BBS), Manual Muscle Testing (MMT), and Functional Independence Measure (FIM).

The findings of the study demonstrated that both intervention programmes resulted in improvements in the measured outcome variables following the rehabilitation period. Participants in both groups showed better walking performance, improved balance, enhanced muscle strength, and increased functional independence after receiving the respective treatment protocols. These findings highlight the importance of structured physiotherapy rehabilitation in improving functional recovery among individuals with spinal cord injury.

Comparison between the two intervention groups indicated that participants who received McKenzie Technique with Conventional Gait Training demonstrated greater improvement in the assessed outcome measures than those who received Core Strengthening Exercises with Conventional Gait Training. The greater improvements observed in walking ability, balance, muscle strength, and functional independence suggest that the McKenzie Technique may provide additional benefits when incorporated into a conventional gait rehabilitation programme for patients with spinal cord injury.

The findings of this study support the role of physiotherapy interventions that focus on spinal mobility, postural control, gait training, and functional exercise in the rehabilitation of patients with spinal cord injury. Rehabilitation programmes that combine therapeutic exercises with conventional gait training can contribute to improved mobility, better postural stability, enhanced muscle performance, and greater independence in activities of daily living. These improvements may ultimately help patients achieve better functional outcomes and participate more effectively in everyday life.

Although both rehabilitation approaches were found to be beneficial, the results of the present study suggest that the McKenzie Technique combined with Conventional Gait Training may be a more effective physiotherapy intervention for improving functional outcomes in patients with spinal cord injury. However, treatment selection should always be individualized according to the patient's clinical presentation, functional status, rehabilitation goals, and overall condition.

In conclusion, the present study indicates that both McKenzie Technique with Conventional Gait Training and Core Strengthening Exercises with Conventional Gait Training are effective rehabilitation approaches for patients with spinal cord injury. However, within the scope and limitations of this study, the McKenzie Technique combined with Conventional Gait Training demonstrated greater improvement in walking ability, balance, muscle strength, and functional

independence. These findings may assist physiotherapists in planning evidence-based rehabilitation programmes aimed at maximizing functional recovery and improving the quality of life of individuals with spinal cord injury.

REFRENCES

1. Keith RA, Granger CV, Hamilton BB, Sherwin FS. The Functional Independence Measure: a new tool for rehabilitation. Arch Phys Med Rehabil. 1987;68(6):350–356. PMID: 3503663.
2. Berg K, Wood-Dauphinee SL, Williams JI, Gayton D. Measuring balance in the elderly: preliminary development of an instrument. Physiother Can. 1989;41(6):304–311.
3. Wade DT, Wood VA, Heller A, Maggs J, Hewer RL. Walking after stroke. Measurement and recovery over the first 3 months. Scand J Rehabil Med. 1987;19(1):25–30.
4. Dobkin B, Apple D, Barbeau H, Basso M, Behrman A, Deforge D, et al. Weight-supported treadmill vs over-ground training for walking after acute incomplete SCI. Neurology. 2006;66(4):484–493.
5. Field-Fote EC, Roach KE. Influence of locomotor training approach on walking speed and distance in chronic incomplete spinal cord injury. J Neurol Phys Ther. 2011;35(2):82–90.
6. Behrman AL, Harkema SJ. Locomotor training after human spinal cord injury: a series of case studies. Phys Ther. 2000;80(7):688–700.
7. Behrman AL, Harkema SJ. Physical rehabilitation as an agent for recovery after spinal cord injury. Phys Med Rehabil Clin N Am. 2007;18(2):183–202.
8. Dietz V. Behavior of spinal neurons deprived of supraspinal input. Nat Rev Neurol. 2011;7(3):167–174.
9. Wirz M, van Hedel HJ, Rupp R, Curt A, Dietz V. Muscle force and gait performance in spinal cord injury. Spinal Cord. 2006;44(2):81–88.
10. Harvey LA, Glinsky JV, Bowden JL. The effectiveness of physiotherapy interventions for people with spinal cord injuries: a systematic review. Spinal Cord. 2016;54(9):682–695.
11. Harvey L. Management of Spinal Cord Injuries: A Guide for Physiotherapists. London: Elsevier; 2008.
12. Kirshblum SC, Biering-Sørensen F, Betz R, Burns S, Donovan W, Graves DE, et al. International Standards for Neurological Classification of Spinal Cord Injury: cases and clinical application. J Spinal Cord Med. 2014;37(2):115–126.
13. Fehlings MG, Tetreault LA, Wilson JR, Aarabi B, Anderson P, Arnold PM, et al. A clinical practice guideline for the management of acute spinal cord injury. Global Spine J. 2017;7(3 Suppl):195S–202S.
14. Hicks AL, Martin KA, Ditor DS, Latimer AE, Craven C, Bugaresti J, et al. Long-term exercise training in persons with spinal cord injury. Arch Phys Med Rehabil. 2003;84(10):1489–1497.
15. Wernig A. Body weight-supported locomotor training after spinal cord injury. Spinal Cord. 2012;50(9):687–688.
16. Dobkin BH, Duncan PW. Should body weight-supported treadmill training and robotic-assisted step training be routine neurorehabilitation? Neurology. 2012;78(9):684–685.
17. Panjabi MM. Clinical spinal instability and low back pain. J Electromyogr Kinesiol. 2003;13(4):371–379.
18. Richardson C, Jull G, Hodges P, Hides J. Therapeutic Exercise for Spinal Segmental Stabilization in Low Back Pain. Edinburgh: Churchill Livingstone; 1999.
19. Hodges PW, Richardson CA. Feedforward contraction of transversus abdominis is not influenced by direction of arm movement. Exp Brain Res. 1997;114(2):362–370.
20. Akuthota V, Nadler SF. Core strengthening. Arch Phys Med Rehabil. 2004;85(3 Suppl 1):S86–S92.