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To Compare the Effects of Posterior and Lateral Pelvic Tilt Taping Combined with Functional Exercises on Pelvic Asymmetry, Functional Mobility and Postural Sway in Patients with Chronic Stroke a Comparative Study

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Abstract

Introduction: Stroke is the sudden loss of neurological function caused by an interruption of the blood flow to the brain, and it causes various abnormalities in patients that affect their activities of daily living. The pelvic mal-alignment, which is excessive Lateral and Anterior Pelvic Tilt affecting the standing weight-bearing symmetry between feet, is often seen in patients with stroke. Due to a weak pelvis, they have more postural sway. Primary Objective: To compare the effects of posterior and lateral pelvic tilt taping combined with functional exercises on pelvic asymmetry, functional mobility, and postural sway in patients with chronic stroke. Methodology: the study included 30 patients randomly assigned into Experimental Group 1(n=10) with Posterior Pelvic Tilt taping and functional exercises, Experimental Group 2 (n=10) with Lateral Pelvic Tilt taping and functional exercises and Control Group (n=10) with only functional exercises performed for thirty minutes, five times a week, for six weeks. The outcome measures were Orthoking Pressure Plate SDP-610 and Pelvic Inclinometer. Results: The comparison shows that there was significant improvement in all the groups at the end of 6th week. However, the Experimental Group A showed greater improvements than Experimental Group B and Control Group at p value of 0.05. Conclusion: posterior pelvic tilt taping was superior to lateral pelvic tilt taping along with functional exercises in terms of improving postural sway, pelvic inclination, and functional mobility in patients with chronic stroke.

Keywords: Pelvic asymmetry, Postural sway, Pelvic tilt taping, Stroke

1. INTRODUCTION

A cerebrovascular accident (CVA), commonly referred to as a stroke, is a medical emergency that happens when the blood supply to a portion of the brain is cut off or diminished.[1] This lack of oxygen and nutrients causes brain cells to die within minutes. Hemorrhagic strokes are caused by the rupture of a blood vessel in the brain, while ischemic strokes are caused by a blockage (such a clot) in a cerebral artery. A transient

ischemic attack (TIA), sometimes known as a "mini-stroke.[2] One of the main causes of death and permanent disability in the world is stroke. Over 15 million individuals have a stroke every year, and over 5 million of them become permanently incapacitated, according to the World Health Organization.[3] Although younger adults are increasingly impacted by rising risk factors like obesity, diabetes, hypertension, and sedentary lifestyles, the prevalence is highest among those over 65. Depending on the location and degree of brain damage, stroke can have devastating effects.[4] Common impairments include hemiplegia or hemiparesis (paralysis or weakness on one side of the body), aphasia (difficulty speaking and expressing oneself), cognitive deficits, visual disturbances, and emotional or behavioural changes. These impairments can have a significant impact on an individual's independence and quality of life, which is why comprehensive rehabilitation is crucial.[5] Physiotherapy is essential for stroke rehabilitation and recovery. Restoring mobility and functional capacity, enhancing balance and coordination, and avoiding consequences like pressure ulcers and joint contractures are the main objectives of physical therapy.[6] Interventions include strength training, task-specific training, gait re-education, neurodevelopmental approaches (e.g., Bobath concept), and assistive gadgets. To maximize rehabilitation and encourage neuroplasticity—the brain's capacity to rearrange and make new connections—early mobilization and customized exercise regimens under the supervision of a qualified physiotherapist are essential.[7]

The primary structure that supports and transfers body weight during a variety of functional activities is the pelvis, which joins the trunk and lower limbs. Before performing any functional actions, including sitting, standing, and walking, the injured limb must be able to shift weight to it.[8] In a normal gait pattern, the ipsilateral pelvis internally rotates during the initial foot contact because of the forward location of the foot. Kinesio taping, a method developed by Kenzo Kase, gives adhesive tape the suppleness of skin and is used in rehabilitation for a variety of purposes.[9] Additionally, studies have demonstrated that reducing pelvic inclination through posture modification using tape is beneficial. Taping is easy to apply and has no side effects. It can also be used to control muscle tone or alter joints, depending on how it is applied. Taping may increase muscle activity by activating proprioceptive receptors or increasing the excitability of motor neurons when applied to the skin.[10] It is also used to relax shortened muscles and strengthen weak ones in patients with stroke and musculoskeletal disorders to improve alignment. Additionally, in an evaluation that included functional training and pelvic posterior tilt tape, stroke patients' walking speed, hip extensor strength, and anterior pelvic tilt were significantly improved. Due to a subsequent decrease in proprioception, stroke patients exhibit a prolonged period of postural sway.[11] Postural sway can be lessened with the use of tape, functional exercises, proprioceptive training, biofeedback, local vibrator stimulation, and balance training. Functional exercises target the co-activity of the lower trunk abdominals and the proximal hip muscles, particularly the Gluteus Medius.[12] These workouts improve pelvic mobility and locomotor function. They provide core stability and aid in developing good lumbar and pelvic postures. They also affect stroke patients' lower limb circumduction gait pattern, balance, and asymmetric pelvis. Among other issues, the absence of a natural history group might have caused bias in how the findings of the previous studies were interpreted.[13] Furthermore, it was unclear whether weight distribution or gait symmetry changed after training because the trial was intended to be a short-term intervention, and no longer-term follow-up was conducted. The study just shows the preliminary tape results. The effects of long-term pelvic tilt taping on the anterior pelvic tilt angle need to be investigated in future studies. Due to pelvic asymmetry, stroke patients have poor postural control; however, there is no specialized exercise for this condition, and treating the patient is more difficult.[14]

2. Subjects and Methodology

2.1 Study design

The study was comparative and experimental. Convenient sampling was selected to determine the prevalence of chronic stroke in older adults of both genders aged between 45 and 75. A total of 30 patients from the outpatient department of DAVIPTR, Jalandhar, were taken for the study, which lasted for six weeks.

2.2 Procedure

The patients meeting the inclusion criteria were recruited for the study, and consent was obtained. Three groups were taken: Experimental Group 1 received taping for posterior pelvic tilt with the functional exercises, for Experimental Group 2 received taping for lateral pelvic tilt along with functional exercises, and the Control Group performed functional exercises only. The postural sway was measured on Ortho king Pressure Plate SDP-610. Firstly, the height, weight and Foot size of the patients were recorded. The Pelvic tilt or angle of Inclination was checked by the Pelvic inclinometer. Functional mobility was assessed by Time up and go test. Patients were examined and screened by using Assessment form and Mini Mental State Examination Scale.

2.3 Experimental Group 1

To provide mechanical correction for anterior pelvic tilt, Posterior Pelvic Tilt Taping (PPTT) was applied. It targets the two main muscles, the rectus abdominus and external oblique. To apply PPTT, an I- type 5cm wide tape strip was taken and it extended up to 75% of its length. For the external oblique muscle, the patient was in side- lying and therapist stood behind the patient. Pelvis was placed in posterior tilt position. Tape was placed from the inguinal region to the Spinous process of T12 vertebrae. While the patient is in the supine position, tape was applied to the Rectus Abdominus muscle from the pubic symphysis to the xiphoid process of the sternum in a hook-lying posture. To provide mechanical correction/ stability to the pelvis, one strip was attached from ASIS to PSIS in a posterior tilt fashion.

Fig. 1: Posterior pelvic tilt taping

2.4 Experimental Group 2

Lateral Pelvic Tilt Taping (LPTT) was used to mechanically correct the lateral pelvic tilt. It mainly targets

the gluteus Medius muscle. In this, the patient was in side- lying position and the therapist was behind the patient. The pelvis was in the neutral position. For LPTT, 3 I-type 5cm wide tape strip was taken, extended up to 75% of its length, and all three strips were applied from below the greater trochanter to the gluteal surface of the iliac crest in three directions, namely, Upward, kUpward and anterior, Upward and posterior.

Fig. 2: Lateral Pelvic tilt taping

2.5 Control Group

The exercises were performed commonly by all the groups for thirty minutes a day, 5 days a week, for six weeks. Ten Repetitions and two sets of each exercise were given, along with a break of one minute in between the exercises.

The functional exercises included Reach out, Pelvic bridging, Wall squats, Clamshell, and Stair climbing.

Fig. 3: Reaching exercises and stair climbing

3. Results

This study aimed to compare the effects of posterior and lateral pelvic tilt taping, combined with functional exercises, on pelvic asymmetry, functional mobility, and postural sway in patients with chronic stroke. The findings have shown significant improvement in Pelvic asymmetry, Functional mobility and Postural sway at the end of the intervention (6 weeks). At baseline, there were no significant differences in the outcome measures between the experimental groups (A and B) and the control group. At 3rd week post-intervention, there was a significant difference between the experimental groups A (posterior tilt taping and functional exercises), B (lateral tilt taping and functional exercises), and the control group(functional exercises) in terms of Pelvic inclination but not in terms of Functional mobility and postural sway. At the 6th week post-intervention, there was a significant difference between all three groups in terms of pelvic inclination, functional mobility, and postural sway. The statistical difference between the groups was ascertained at the p-value of 0.05.

In this study, significant improvements in pelvic inclination were observed at both the 3rd and 6th weeks, particularly in Groups A and B, with a significant difference in mean pelvic inclination between Group A and B as compared to the Control group. This suggests that the intervention applied to Groups A and B, that is, Posterior and lateral pelvic tilt taping techniques combined with functional exercises, had a more pronounced effect on pelvic alignment in Experimental groups A and B than in the control group.

Group A had equal gender distribution (5 males, 5 females), Group B had 6 males and 4 females, and Group C had 4 males and 6 females. Mean ages were 100.0 ± 0.0 years for Group A, 27.27 ± 0.0 for Group B, and 25.0 ± 0.0 for Group C, with no significant age difference between groups (p = 0.321) shown in

Table 1: Demographic characteristics of the patients

	GA(n-10)	GB(n-10)	GC(n-10)	p value
Gender(M/F)	5/5	6/4	4/6	
Age(year)	100.00±0.00	27.27±0.00	25.00±0.00	0.321

Values represented as Mean±SD, GA: Group A, GB: Group B, GC: Group C. p< 0.05.

The collected data was analysed using SPSS version 18.0. Repeated measure ANOVA and one-way ANOVA were used for within and between-group analysis, respectively. The results of the study showed that there was significant difference in Experimental Group A (posterior pelvic tilt taping and functional exercise), Experimental Group B(lateral pelvic tilt taping with functional exercises) and Control Group (functional exercises) in terms of Pelvic Inclination as the p values of Group A, B and C were 0.000, 0.000 and 0.061 respectively. Secondly there was significant difference in Experimental Group A, B and control group in terms of functional mobility and the p values for the respective groups were 0.000, 0.000 and 0.022. Similarly, in case of Postural Sway there was significant difference in Group A, B and C and the p values were 0.000, 0.000 and 0.122 respectively. The final comparison shows that there was significant improvement in all the groups at the end of 6th week. However, the Experimental Group A showed greater improvements than Experimental Group B and Control Group and p value was 0.05 as shown in Table 2.

Table 2: The comparison of outcome measures on Baseline, POST 3rd WEEK and 6th WEEK in Intra-group for GA and GB

	Group	Baseline	3rd WEEK	6th WEEK	F-test	T-Value	p Value
Pelvic Inclination	GA	16.02±0.505	15.52±0.520	14.90±0.873	25.790	3.555	0.000
	GB	16.48±0.807	15.80±0.966	15.21±1.176	51.610	3.555	0.000
	GC	16.63±0.897	16.57±0.912	16.52±0.898	3.290	3.555	0.061
Functional Mobility (Sec.)	GA	65.90±23.601	52.90±19.536	40.80±14.281	30.050	3.555	0.000
	GB	68.60±33.553	53.90±25.792	44.40±19.574	22.820	3.555	0.000
	GC	65.90±26.768	64.80±27.247	64.30±26.850	4.770	3.555	0.022
Postural Sway	GA	3.25±0.952	2.26±0.799	1.11±0.390	55.020	3.555	0.000
	GB	6.39±5.321	4.53±5.026	2.87±3.051	13.510	3.555	0.000
	GC	3.63±1.779	3.51±1.619	3.43±1.578	2.370	3.555	0.122

The Mean and SD value of Pelvic Inclination for experimental group A increased from 16.02±0.505 at baseline to 14.90±0.873 at 6th week, in experimental group B the Mean and SD values increased from 16.48±0.807 at baseline to 15.21±1.176 at 6th week whereas in control group the Mean and SD at baseline was 16.63±0.897 and 16.52±0.898 at 6th week respectively. Although all the groups showed improvement in Pelvic inclination over time, the statistically significant difference (p= 0.003) was achieved at the 6th week. The one-way ANOVA test values at Baseline and 3rd week assessments (p= 0.189 and p= 0.023 respectively) showed statistically significant improvement. Similarly, the values for one- way ANOVA test for 3rd and 6th week assessments (p=0.023 and p= 0.003) showed statistically significant improvements. As per the mean difference between the experimental group A, B and C, group A showed greater improvements than groups B and C in terms of pelvic inclination.

Functional mobility is often compromised in patients with chronic stroke. Our study showed significant effects in Functional mobility at the 6th week post-intervention in all the three groups. However, Experimental groups A and B showed more improvement as compared to the control group. The functional mobility was assessed using the Time Up and Go (TUG) test as shown in table 2.

Table 3a: The comparison of changes for Pelvic inclination between GA, GB and GC

	Group	Baseline	3rd WEEK	6th WEEK
Pelvic Inclination	GA	16.02±0.505	15.52±0.520	14.90±0.873
	GB	16.48±0.807	15.80±0.966	15.21±1.176
	GC	16.63±0.897	16.57±0.912	16.52±0.898
F-test		1.772	4.358	7.515
T-value		3.354	3.354	3.354
P-value		0.189	0.023	0.003

Table 3b: The comparison of changes for functional mobility between GA, GB and GC

	Group	Baseline	3rd WEEK	6th WEEK
Functional Mobility (Sec.)	GA	65.90±23.601	52.90±19.536	40.80±14.281
	GB	68.60±33.553	53.90±25.792	44.40±19.574
	GC	65.90±26.768	64.80±27.247	64.30±26.850
F-test		0.030	0.731	3.674
T-value		3.354	3.354	3.354
P-value		0.970	0.491	0.039

Table 3c: The comparison of changes for postural sway between GA, GB and GC

	Group	Baseline	3rd WEEK	6th WEEK
Postural Sway	GA	3.25±0.952	2.26±0.779	1.11±0.390
	GB	6.39±5.321	4.53±5.026	2.87±3.051
	GC	3.63±1.779	3.51±1.619	3.43±1.578
F-test		2.721	1.360	3.678
T-value		3.354	3.354	3.354
P-value		0.084	0.274	0.039

Values represented as Mean±SD; Pelvic Inclination, Functional Mobility (Sec.), Postural Sway
GA: Group A, GB: Group B and GC: Group

The Mean and SD values for the TUG test in experimental group A varied from 65.90+23.601 to 40.80±14.281 at Baseline and 6th week respectively. Similarly, for experimental group B, the Mean and SD value improved from 68.60±33.553 at baseline to 44.40±19.574 at 6th week, while the control group showed variations, at baseline, the mean and SD values were 65.90 ± 26.768; in the sixth week, they were 64.30±26.850. The significant difference (p=0.039) was only reached at the sixth week, despite the fact that all of the groups had significantly improved by then. There was no discernible improvement, according to the baseline and third-week one-way ANOVA results (p=0.970 and p=0.491). However, the one-way ANOVA test results for the third and sixth weeks showed a significant improvement (p=0.491 and p=0.039). The mean difference between all the groups showed that group A had greater improvements as compared to group B.

According to the results, both experimental groups A and B showed improvement by the end of the treatment period; however, the control group did not show significant improvement. The postural sway was measured using the orthoking pressure platform SDP-610. The mean and SD values of postural sway for experimental group A progressed from 3.25±0.952 to 1.11±0.390 at baseline and 6th week, respectively. In contrast, for experimental group B, the mean and SD values ranged from 6.39±5.321 to 2.87±3.051 at baseline and the 6th week. The postural sway values for the control group, however, ranged from 3.63±1.779 at baseline to 3.43 ±1.5780 at week six. By the end of the therapy period, experimental groups A and B had improved. At sixth week, the significant difference (p=0.039) was attained. Although there was no discernible change in the one-way ANOVA values at baseline and the third week (p=0.084 and p=0.274), there was a significant improvement in the one-way ANOVA test values for the third and

sixth weeks (p=0.274 and p=0.039). Group A has significantly better performance than Group B, based on the difference in mean values for the three groups shown in Table 3a, 3b and 3c.

4. Discussion

Numerous studies in the literature support the idea that taping can improve postural alignment and reduce pelvic asymmetry. A study by Jung KS, et al; (2022)[18] found that pelvic taping improved pelvic symmetry in patients' post-stroke (6 weeks). This study demonstrated that the application of pelvic corrective tape over the muscles such as the Rectus abdominus, external oblique, and gluteal muscles, which enhances the likelihood of cross-bridges by expanding the muscle belly and increasing the overlap of actin and myosin filaments, greatly strengthened the treatment effect. Consequently, when the length-tension curve is moved to the left, a greater contraction force can be produced. Similarly, In TS et al; (2021)[16] observed improvements in pelvic tilt, muscle strength, and gait ability in individuals with chronic stroke when tape interventions targeting the core muscles (rectus abdominus and external oblique) were included alongside functional exercises (6 weeks). The elasticity of taping applied to the pelvis is greater than its initial length, which promotes distortion of the skin, complete joint mobility, and activation of epidermal mechanoreceptors. Applying tape to the Rectus Abdominis and External Oblique muscles decreased the anterior pelvic tilt. According to their findings, the anterior pelvic tilt decreases as the strength of the abdominal muscles rises in response to mechanoreceptor stimulation, which triggers nerve impulses. However, while pelvic inclination improved significantly by the 6th week in this study, Group A and Group B showed relatively modest changes, with no significant differences between these two groups. These findings indicate that none of the taping methods was superior to one another in improving pelvic inclination. The findings are consistent with the literature suggesting that taping is effective in producing long-term improvements in pelvic tilt. For instance, Wu YT et al; (2017)[15] demonstrated that immediate effects of taping alone led to improvements in pelvic inclination, balance, and gait in stroke patients. When kinesiology tape was used over the (Rectus abdominis, external obliques) muscles were stimulated, somatosensory information was enhanced, sensory input increased, and balancing function improved. Additionally, their research demonstrated that kinesiology tape led to tactile stimulation, which helped reduce muscle weakness brought on by decreased IA afferent fibres.

These findings align with the study by In TS et al; (2021)[16], where patients undergoing combined posterior and lateral pelvic tilt taping and rehabilitation exercises for 6 weeks exhibited enhanced mobility measures, including walking speed and balance. The improvements in mobility are likely a result of the postural alignment corrections provided by pelvic taping, which can reduce asymmetry and improve the base of support. Furthermore, A study by Mehta M et al; (2020)[17] highlighted that the immediate effects of pelvic taping along with functional exercises targeting the core muscles (external oblique, abdominals) were particularly beneficial for post-stroke patients in restoring balance and reducing the loss of functional mobility. This study's results align with those of Jung KS et al. (2018)[18], who found that pelvic Kinesio taping contributed to reduced postural sway in stroke survivors, likely due to improved alignment and muscle control. The 6-week significant findings in this study suggest that the long-term effect of the intervention may continue to contribute to better postural stability. Essentially, maintaining functional stability is the reason for the muscle control needed around the lumbar spine. Patients who have had strokes exhibit weakness in their bilateral rotatory muscles, trunk flexors, and extensors. To increase trunk stability, Kinesio Taping was administered to the Rectus Abdominus, External Oblique, and additional muscles such the erector spinae and Internal Oblique, because stability is greatly aided by these

muscles. KT improves the taped area's sensory feedback via the skin. Consequently, the neuromuscular system's capacity to regulate movements will also improve as joint position sense does.

5. Future Scope

The larger samples should be used in order to demonstrate the feasibility of pelvic tilt taping. The intervention can be used for the rehabilitation of stroke, However, the treatment applied in the study can also be used for other neurological conditions in which gait and balance will be affected. The study can be performed in Acute and Sub- acute stages of stroke. The same criteria can also be used to evaluate the trunk and pelvis separately, focusing on other muscles used for postural control.

6. Clinical Implications

The study showed that in chronic stroke patients with hemiplegia, there was an improvement in pelvic inclination, functional mobility, and postural sway (in the ML direction). Therefore, in clinical practice, all stroke patients should have their postural sway, functional mobility, and pelvic inclination evaluated for early rehabilitation. Appropriate intervention measures can also be used to prevent the emergence of severity and, consequently, stroke-related deformity.

7. Conclusion

From the findings of our study, it can be concluded that the application of posterior pelvic tilt taping was more effective in improving the pelvic inclination, functional mobility and postural sway, as compared to lateral pelvic tilt taping combined with functional exercises in patients with chronic stroke. Therefore, in future studies, it is necessary to examine the effects of the pelvic taping on a larger sample size.

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