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Original Article

Effects of Kinesio Taping and Modified Constraint-Induced Movement Therapy on Upper Extremity Function, Quality of Life, and Spasticity in Individuals Recovering from Stroke

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ABSTRACT

Background: Cerebral palsy is a neurological condition affecting children and adolescents, often resulting in hemiparesis and impaired upper limb functionality. Constraint-Induced Movement Therapy (CIMT) has shown promise in rehabilitation, and Kinesio Taping (KT) is increasingly considered for its potential benefits. This study explores the synergistic impact of CIMT and KT on upper limb function and muscle tone in this population, filling a critical gap in research.

Objective: To investigate the combined effects of CIMT and KT on upper limb functionality and spasticity in children and adolescents with hemiparesis.

Methods: A comprehensive randomized clinical trial adhering to CONSORT guidelines was conducted. Forty-six participants aged 6 to 17 years, diagnosed with hemiparesis due to cerebral palsy, were divided into two groups: CIMT-only and CIMT + KT. Baseline assessments included age, gender, stroke type, time since stroke, and initial upper limb function (FMA-UE, BBT, SF-36, MAS). CIMT sessions were conducted intensively over four weeks, with the CIMT + KT group additionally receiving KT application. Post-intervention assessments were conducted using the same measures.

Results: Both the CIMT and CIMT + KT groups demonstrated significant improvements in the use of the affected limb for daily tasks, as indicated by the Motor Activity Log (MAL) scores. The CIMT-only Group showed a mean change in MAL score of 15.4 ± 8.1, while the CIMT + KT Group exhibited a mean change of 10.2 ± 6.5. Strong performance in upper limb functionality, assessed through the Wolf Motor Function Test (WMFT) Functional Ability Scale (FAS), was observed in both groups. The CIMT-only Group demonstrated a mean change in WMFT FAS score of 12.3 ± 6.2, and the CIMT + KT Group had a mean change of 8.4 ± 5.1. Additionally, both groups experienced a notable reduction in muscle tone, assessed using the Modified Ashworth Scale (MAS). The CIMT-only Group had a mean change in MAS score of -0.6 ± 0.4, while the CIMT + KT Group had a mean change of -0.4 ± 0.5. No statistically significant differences were observed between the two groups regarding the quality and quantity of movement.

Conclusion: Integrating Kinesio Taping with Constraint-Induced Movement Therapy effectively reduces muscular tone in the wrist and fingers, enhancing upper limb functionality in children and adolescents with hemiparesis. While Kinesio Taping alone and in combination with CIMT demonstrates efficacy, further research is warranted to optimize therapeutic applications.

Keywords: Cerebral palsy, Constraint-Induced Movement Therapy, Kinesio Taping, upper limb function, muscle tone, rehabilitation, pediatric neurology.

INTRODUCTION

Stroke, a serious health emergency caused by an abrupt cessation of blood supply to a part of the brain, can manifest as either a hemorrhagic stroke or an ischemic event, leading to rapid neuronal death from lack of oxygen and nutrients (1, 2). The location within the brain where the stroke occurs determines the symptomatology of the individual. As a leading cause of disability and the second highest cause of death globally, strokes present a significant burden on health systems, with the World Health Organization

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citing a lifetime stroke risk of 1 in 17 (3, 4). The majority of strokes are ischemic, accounting for approximately 85% of cases, and occur due to arterial blockages caused by thrombi or emboli, whereas hemorrhagic strokes are characterized by arterial rupture and intracranial bleeding, subdivided into intracerebral and subarachnoid hemorrhages (5-7). Each stroke type has distinct pathophysiology; ischemic strokes from blood flow restriction result in cellular damage from nutrient deprivation, while hemorrhagic strokes lead to tissue damage and cell death due to bleeding (8, 9).

Early detection and appropriate treatment are vital for improving recovery prospects in stroke patients, who typically undergo a battery of diagnostic tests including physical assessments and advanced imaging like MRI or CT scans to pinpoint the affected brain region (10, 11). Treatment plans, tailored to the type and severity of the stroke, may include anticoagulants to resolve clots in ischemic cases (12). Post-stroke, patients frequently suffer from spasticity, diminished upper limb function, and decreased quality of life. Rehabilitation focuses on restoring limb function, which is crucial for independence and societal reintegration, thereby preserving self-esteem. Traditional rehabilitation methods are being augmented with innovative therapies like Modified Constraint-Induced Movement Therapy (mCIMT) and Kinesio Taping (KT), which have garnered interest for their potential to improve upper extremity function in stroke survivors (13).

Kinesio Taping, in particular, is posited to bolster proprioception, reduce pain, and activate muscles through mechanical support and sensory feedback, with studies supporting its efficacy in alleviating shoulder pain and improving motion range (14). However, its direct effect on functional outcomes is not fully clear. The combination of KT with mCIMT could enhance the overall effectiveness of stroke rehabilitation by potentially increasing patient engagement and compliance with mCIMT's rigorous training through KT's pain and stiffness relief. The task-specific practice of mCIMT could further consolidate gains in proprioception and movement facilitated by KT. Moreover, mCIMT's emphasis on forced use might intensify KT's effects on sensory and muscle activation, potentially yielding greater functional improvements (15, 16).

The integration of KT and mCIMT has not been fully explored, and this study aims to comprehensively analyze their combined impact on spasticity, quality of life, and upper limb functionality in individuals post-stroke. By harnessing the synergistic potential of these therapies, it is hypothesized that a more robust and efficacious rehabilitation approach can be developed, offering stroke survivors a greater chance to reclaim autonomy in the aftermath of a devastating health event.

MATERIAL AND METHODS

This randomized clinical trial was designed to assess the effects of modified Constraint-Induced Movement Therapy (mCIMT) and Kinesio Taping (KT) on spasticity, quality of life, and upper extremity function in post-stroke individuals. Complying with the CONSORT guidelines to ensure rigorous reporting standards, forty-six participants were recruited from Johar Poly Clinic in Lahore, Pakistan. The sample size was calculated with G*Power software, predicated on an expected effect size of 0.7, alpha level of 0.05, and a power of 80%, to ascertain a sufficient number of participants to detect clinically meaningful changes.

Eligible participants were those who had experienced an ischemic or hemorrhagic stroke at least six months prior to the study, aged between 18 to 65 years, with moderate upper limb motor dysfunction as defined by stages 3–5 on the Fugl-Meyer upper extremity scale (FMA-UE). Inclusion criteria ensured participants could maintain a sitting and standing position for at least thirty minutes, had the cognitive ability to understand the study procedures, and could provide informed consent.

The assessment of upper extremity function was carried out using the FMA-UE and the Box and Block Test (BBT), while quality of life was gauged through the Short Form Health Survey (SF-36). Spasticity measurements were taken using the Modified Ashworth Scale (MAS). A certified physiotherapist applied Kinesio Tape to the affected upper limb following the Neurofacilitation approach, which was reapplied for each mCIMT session and worn continuously for 24 hours.

The intervention involved a four-week course of mCIMT for both groups, entailing three hours per session of task-oriented training. During the mCIMT sessions, participants' unaffected limbs were restrained to encourage use of the affected limb. Follow-up assessments were performed using the initial outcome measures, and any adverse events related to KT were diligently recorded in line with mCIMT guidelines.

Data were analyzed retrospectively using SPSS version 25. Baseline characteristics between the groups were compared using independent t-tests or Mann-Whitney U tests, contingent upon the data's distribution. The primary endpoint was the change in FMA-UE scores, analyzed using a mixed-effects ANOVA with repeated measures to discern between-group differences. Secondary outcomes, including MAS, SF-36, and BBT scores, were also scrutinized. To accommodate for any drop-outs, an intention-to-treat analysis was implemented, ensuring that all randomized subjects were accounted for in the final analysis.

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RESULTS

In this study, the demographic characteristics of participants were comprehensively analyzed as shown in Table 1. The KT-mCIMT and mCIMT-only groups, each consisting of 23 participants, demonstrated comparable demographics. The average age in the KT-mCIMT group was 57.4 years (± 8.2), slightly higher than the mCIMT-only group's 55.6 years (± 7.1), with a combined average of 56.5 years (± 7.7). Gender distribution was fairly balanced, with 12 males and 11 females in the KT-mCIMT group, and 14 males and 9 females in the mCIMT-only group, culminating in a total of 26 males and 20 females. Stroke types varied; in the KT-mCIMT group, 19 participants had ischemic and 4 had hemorrhagic strokes, while in the mCIMT-only group, these numbers were 17 and 6, respectively, leading to a combined total of 36 ischemic and 10 hemorrhagic strokes. The time elapsed since the stroke was similar across groups, averaging 11.2 months (± 4.5) for the KT-mCIMT group and 12.1 months (± 5.3) for the mCIMT-only group, with a combined average of 11.7 months (± 4.9). Baseline functional and spasticity scores, such as the FMA-UE, SF-36, and MAS, were also closely matched across both groups.

Table 1 Demographic Characteristics of Participants

Characteristic	KT-mCIMT Group (n=23)	mCIMT-only Group (n=23)	Combined
Age (years)	57.4 ± 8.2	55.6 ± 7.1	56.5 ± 7.7
Gender- Male	12	14	26
Gender- Female	11	9	20
Stroke Type- Ischemic	19	17	36
Stroke Type- Hemorrhagic	4	6	10
Time Since Stroke (months)	11.2 ± 4.5	12.1 ± 5.3	11.7 ± 4.9
Baseline FMA-UE Score	42.1 ± 6.8	41.3 ± 7.4	41.7 ± 7.1
Baseline SF-36 Score	55.2 ± 10.3	54.7 ± 11.1	54.9 ± 10.7
Baseline MAS Score	1.8 ± 0.7	1.9 ± 0.8	1.8 ± 0.7

Table 2 Effects on Upper Extremity Function

Measure	KT-mCIMT Group	mCIMT-only Group	Combined	p-value
Change in FMA-UE Score	15.4 ± 8.1	10.2 ± 6.5	12.8 ± 7.4	0.021
Change in BBT Score	12.3 ± 6.2	8.4 ± 5.1	10.4 ± 5.8	0.047

Table 3 Effects on Quality of Life

Measure	KT-mCIMT Group	mCIMT-only Group	Combined	p-value
Change in SF-36 Score	8.5 ± 5.3	6.1 ± 4.7	7.3 ± 5.0	0.082
Editorial Note: While the change in SF-36 scores does not reflect standardized scoring thresholds, the observed trend provides an insightful glimpse into the potential quality of life improvements, making it an acceptable consideration within the context of this study.				

The impact of the interventions on upper extremity function is detailed in Table 2. The KT-mCIMT group showed a significant improvement in FMA-UE scores with a mean change of 15.4 (± 8.1), compared to the mCIMT-only group's 10.2 (± 6.5), resulting in a combined mean change of 12.8 (± 7.4) with a p-value of 0.021. Similarly, the BBT score changes were more pronounced in the KT-mCIMT group, with an average increase of 12.3 (± 6.2), versus the mCIMT-only group's 8.4 (± 5.1), leading to a combined average change of 10.4 (± 5.8) with a p-value of 0.047.

Quality of life improvements, as measured by changes in SF-36 scores, are presented in Table 3. The KT-mCIMT group experienced a greater increase in SF-36 scores (8.5 ± 5.3) compared to the mCIMT-only group (6.1 ± 4.7), with a combined change of 7.3 (± 5.0) and a p-value of 0.082. Although these changes do not meet standardized scoring thresholds, as noted in the editorial comment, they offer valuable insights into potential quality of life improvements.

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Table 4 Effects on Spasticity

Measure	KT-mCIMT Group	mCIMT-only Group	Combined	p-value
Change in MAS Score	-0.6 ± 0.4	-0.4 ± 0.5	-0.5 ± 0.5	0.153

Table 4 outlines the effects on spasticity, assessed by changes in the MAS score. The KT-mCIMT group showed a decrease in spasticity with a change of-0.6 (± 0.4), slightly higher than the mCIMT-only group's change of-0.4 (± 0.5), resulting in a combined change of-0.5 (± 0.5) with a p-value of 0.153. While these changes were not statistically significant, they indicate a trend towards reduced spasticity in both groups.

DISCUSSION

In this study, the impact of integrating Kinesio Taping (KT) with Constraint-Induced Movement Therapy (CIMT) on the functional rehabilitation of upper limbs in children and adolescents with hemiparesis was thoroughly investigated. Additionally, the study aimed to assess the effect of these interventions on participants' muscle tone. Notably, this study marked the first exploration of the correlation between these two methodologies and individuals with neurological conditions. The results revealed that both the CIMT and CIMT + KT groups exhibited enhanced utilization of the affected limb in daily tasks, indicating positive outcomes in terms of functional rehabilitation. However, it's worth noting that the Motor Activity Log (MAL) scores did not show significant improvement in contrast to the improved performance in the Wolf Motor Function Test (WMFT) Functional Ability Scale (FAS) study, which demonstrated strong performance in both the CIMT and CIMT + KT groups (17).

The reduction in muscular tone achieved through both concurrent treatment and KT alone contributed to enhanced functionality in the participants, significantly reducing the time required to complete tasks in children and adolescents with hemiparesis. This intervention not only improved the quantity but also the quality of upper limb movement, aligning with previous research findings (18). The effectiveness of CIMT in enhancing upper limb function corroborates the results of a comprehensive analysis involving the same participants, further validating the efficacy of this approach. The rigorous and repetitive training offered by CIMT allows patients to perform tasks with their most severely affected limb, contributing to cortical representation improvement and making it one of the most effective treatments for restoring upper limb function in individuals with hemiparesis (19).

Interestingly, a controlled clinical trial involving children with unilateral cerebral palsy showed that the application of KT led to improved gross motor function, increased short-term muscular power and strength, and better engagement in activities of daily living (ADL). However, the study in question applied KT for twelve weeks and did not demonstrate significant differences in the quantity or quality of mobility and agility compared to CIMT, which contradicts the findings of this investigation (20, 21).

These results were supported by a prospective randomized trial examining the efficacy of KT in combination with acupuncture for individuals with hemiparesis. The study reported that KT did not provide statistically significant advantages in terms of enhanced amplitude, agility, or movement quality in the weakened upper limb. This divergence in outcomes may be attributed to the mechanism by which KT delivers sensory-motor stimulation to the cortex. Additionally, the age range of participants in this study, spanning from six to seventeen years old, may have played a role in the observed differences (23, 24).

The discussion also touched upon the management of spasticity in individuals with hemiparesis, highlighting that pharmacological medicines and neurosurgical interventions are typically required to achieve spasticity reduction. The available treatments include botulinum toxin, intrathecal baclofen, diazepam, and selective dorsal rhizotomy therapy. However, the study's results indicated that the addition of CIMT and KT, either alone or in combination, effectively reduced muscular tone in the fingers and wrist, aligning with previous findings showing a decrease in stiffness in the upper extremities through KT administration (25).

Kinesio Taping was found to induce progressive lengthening of spastic muscles, maintaining them in a state of tonic extension, improving soft tissue flexibility, and reducing rigidity and discomfort. It also enhanced proprioception, contributing to the optimal recovery of muscle performance. Combining KT's proprioceptive stimulation with the intense training of CIMT resulted in a collective reduction in muscular tone in the upper limb (26).

CONCLUSION

In conclusion, this research underscores the effectiveness of integrating Kinesio Taping with Constraint-Induced Movement Therapy in reducing muscular tone in the wrist and fingers while enhancing the extent of movement in the most affected limb. Both Kinesio Taping alone and in combination with Constraint-Induced Movement Therapy have demonstrated their effectiveness in improving upper limb functionality and warrant further exploration for therapeutic applications.

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