RESEARCH PAPER

"Comparing the efficacy of Kinesio and Mc-connell Taping on knee hyperextension and gait parameters in individuals with stroke a Study Protocol"

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Abstract

Background: Stroke is a considered to be long-term disability globally and lead to gait abnormality. Genu recurvatum, characterized by knee Hyperextension during the stance phase of ambulation, is observed in about 65% of individuals after experiencing a stroke. This alteration in gait affects walking efficiency, raises energy expenditure, and may lead to knee discomfort and functional restrictions. In spite of its prevalence and clinical significance, there is a scarcity of evidence-based rehabilitation approaches aimed at addressing post-stroke knee Hyperextension..

Method: This comparative study will recruit 66 stroke participants that will be randomly allocated using block randomization with allocation concealment. Gait will be assessed pre-intervention and post-intervention using two-dimensional video analysis (Kinovea software) and the Wisconsin Gait Scale by a blinded assessor. Both groups will receive one month of Conventional rehabilitation, with prowling combined with either kinesiotaping or McConnell taping. Outcome measures that will be analysed will be knee Hyperextension angle, ankle dorsiflexion and spatiotemporal parameter of gait.

Outcome: For analysis of the knee Hyperextension and ankle dorsiflexion angle using Kinovea software and spatiotemporal gait parameter by Wisconsin gait scale.

Hypothesis: Kinesiotaping with prowling and McConnell taping with prowling will improve knee Hyperextension and gait parameters in stroke patients. Kinesiotaping with prowling or McConnell taping with prowling will be more effective than the other in improving knee Hyperextension and gait parameters in stroke patients.

Discussion: This study seeks to validate effectiveness of kinesiotaping with prowling and McConnell taping with prowling a rehabilitation framework for stroke patients with hyperextension of knee.The findings would contribute to evidence-based practice by establishing which taping technique along with prowling and conventional rehabilitation protocol provide optimal outcome for stroke patients with knee Hyperextension.

Keywords: Genu Recurvatum, Kinovea software ,Stroke

How to cite this article: Prachi RameBhanushali, Shilpa Khandare, Tushar J. Palekar. "Comparing the efficacy of Kinesio and Mc-connell Taping on knee hyperextension and gait parameters in individuals with stroke a Study Protocol". Int J Drug Deliv Technol. 2026;16(79s):712-716. DOI: 10.25258/ijddt.16.79s.134.CTRI No.: -CTRI/2025/08/092816

Introduction

Globally, stroke is considered as one of the major causes of disability.(1) Thirty percent of stroke survivors finds difficulty to ambulate independently due to unilateral sensorimotor impairments. Hemiparetic gait in stroke survivors results in a variety of unusual motions and aberrant muscle activity with different joint trajectories, even while walking without assistance (2-3). One of the main objectives of stroke rehabilitation is the restoration of safe and effective walking. Depending on the degree of paresis, spasticity, limited range of motion, impaired proprioception, impaired cognition, and the difference in time from stroke onset, patients with stroke exhibit a wide range of abnormalities in their gait. (4–6) Genu recurvatum, or hyperextension of the knee during the stance phase of the gait that extends beyond full knee extension (zero degrees), is common in patients with limb paresis that significantly impair walking speed, impair gait efficiency, increase energy expenditure during gait, and possibly cause knee pain. This can further result in gait asymmetry, which affects the appearance. (4,5) Hyperextension of the paretic knee during the stance phase of walking, with or without the assistance of an orthosis or walking aid, is known as genu recurvatum. (7) According to evidence knee Hyperextension affects about 65% of stroke patients.(8) Hip extensor weakness, knee extensor weakness or spasticity, limited ankle dorsiflexion due to spasticity or reduced range of motion, impaired proprioception, or a combination of these variables could be the contributing cause. (9) Okada et al. described knee Hyperextension patterns based on trunk motor function, ankle plantarflexor spasticity, and knee flexion strength. Long-term knee Hyperextension may cause the anterior cruciate ligament and posterior capsule to become lax, changing the length-tension relationship and increasing the risk of early degenerative changes of the knee joint that result in chronic knee pain (10,11), poor proprioception control of terminal knee extension, knee pain due to stress to the ligaments and tendons, and decrease in independence of daily activities.In addition above mentioned adverse consequences, knee Hyperextension increases circumduction and increases walking energy consumption by making knee flexion difficult for sufficient ground clearance during the swing phase (12, 9, 13) .

Gait problems are addressed by neurophysiological approaches, knee Hyperextension in post-stroke gait has been treated with a number of methods, including orthotic therapy, surgery, functional electrostimulation (FES), electro goniometric feedback,(9) robotic devices and brain-computer interfaces in lower limb and gait training. (14) There is conflicting evidence about the impact of orthotic devices on paretic lower limb muscle activity, and the individuals expressed worries about

their look and application challenges. [15] Muscle fatigue, trouble placing electrodes, skin irritation, and soreness are all possible side effects of neuromuscular electrical stimulation. (16) In addition there are no any other technique proven to address quadriceps control, particularly eccentric control during loading response that is crucial in normal gait pattern.

Kinesiotaping and McConnell taping have emerged as promising non-invasive intervention in rehabilitation of various musculoskeletal conditions however their effectiveness in managing post stroke genu recurvatum remains unclear. Kinesiotaping (KT), an elastic adhesive tape applied to the body's surface, is used to enhance proprioception, reduce pain, increase lymphatic circulation, and offer mechanical support. As a cost-effective treatment, KT has long been utilized to strengthen weak muscles, regulate muscle tone, enhance active range of motion, balance, functional use, and gait ability (17). Structurally supportive McConnell tape is structurally supportive and rigid that can be worn for up to eighteen hours. The current study comprised stroke patients who were forced to walk with knee flexion and trunk retained slight forward flexion, similar to "prowling," or walking in a predatory fashion, which is based on a prior study finding by Noyes FR (18). By engaging the quadriceps and altering the direction of the quadriceps' moment arm, walking with both knees bent offers a dual benefit that increases mechanical advantage.(18) It reduces knee Hyperextension without the need for any external support devices and is easily adaptable by the subjects.

As there is no strong evidence for rehabilitation of knee Hyperextension in post stroke , the purpose of this study was to compare the effectiveness of the prowling with kinesiotaping and that of the McConnell taping with prowling in patients with hyperextended gait in stroke patients by using bi-dimensional tool that is kinovea software to provide quantative data. Kinovea is low-cost 2D technologies , one such low-cost solution that satisfies free 2D motion analysis software is Kinovea, which was developed in 2009 through a non-profit partnership of various researchers, athletes, trainers, and programmers from all over the world. Kinovea is licensed under GPLv2.The distance, angle, coordinates, and spatial temporal parameter are all evaluated by this instrument. (20) The Wisconsin Gait Scale (WGS), which measures the quality of gait and records the positions of key body parts at each stage of the gait cycle, is employed as a supplementary measure (21–22). The degree of ankle dorsiflexion, knee Hyperextension, and the amount of time needed to travel five meters. It is a helpful instrument for evaluating changes over time during rehabilitation training and for rating qualitative gait variations in hemiplegic post-stroke patients. (22)

Method

Methods

This study protocol describes a Randomized controlled trial reported according the SPIRIT 2025 guidelines 19 .

Trial design and setting

This is an prospective, open label, parallel group, randomized controlled trial. The study is planned to be conducted in NeuroPhysiotherapy OPD in Bharati Vidyapeeth Hospital Sangli district, Maharashtra, India. Eligible individuals will be randomly allocated into two groups with 1:1 ratio. Individuals in Group A will receive Kinesiotaping with prowling and conventional rehabilitation protocol whereas Group B will receive only MCconnell taping with prowling and conventional rehabilitation protocol rehabilitation. This superiority trial aims to demonstrate that individuals in Group A, receiving Kinesiotaping with prowling and conventional rehabilitation protocol compared to individuals in Group B, who will receive MCconell taping with prowling and conventional rehabilitation protocol rehabilitation.

Eligibility criteria and recruitment

Participants will be recruited from department of Physiotherapy in Bharati Vidyapeeth hospital, sangli (BVDU). Participants will be either self- referred and report at Neuro-Physiotherapy OPD or referred by diagnosis of qualified Medical Practitioner/ Neurologist or admitted in inpatient ward at BVDU. Inclusion criteria comprises of Individuals with hyperextended knee, both gender included ,first episode stroke subject referred by neurologist with presence of knee hyperextended, Montreal Cognitive Assessment greater than 26, ability to walk with or without support including assistive devices.Brunnstrom recovery stage of lower limb equal or greater than 3. Individuals with severe muscle contracture musculoskeletal disorders or cardiopulmonary or any other neurological deficits other than stroke that influence performance, allery to taping or uncooperative patients will be excluded from study.

Randomization, Assignment of interventions and Allocation concealment

All the eligible participants will be given informed consent and assigned into two groups , Group A and Group B using computerized random number generator. Sealed envelope will be used for group allocation which will be kept concealed from the rest of the research team. The other main researcher will be responsible for enrollment and assigning participants to the allocation group. Group A will receive Kinesiotaping with prowling and conventional rehabilitation and Group B will receive MCconell taping with prowling and conventional rehabilitation . The duration on treatment will be of 4 weeks every week , 5 sessions will be conducted.(Table 1)

Table 1: Schematic diagram of schedule of enrolment, interventions, and assessments (participant timeline)

TIMEPOINT	**Enrollment**	**0**	**4 weeks (Post intervention outcome)**
ENROLLMENT:			
Eligibility screen	X		
Informed consent	X		
Randomization		X	
INTERVENTION/			

COMPARATOR:			
Kinesio taping with prowling and conventional rehabilitation		X	X
MCconell taping with prowling and conventional rehabilitation		X	X
ASSESSMENTS:			
Kneehyperextension,Ankle dorsiflexion,WGS		X	X

Intervention

Group A will receive Kinesiotaping with prowling and conventional rehabilitation and Group B will receive will receive MCconell taping with prowling and conventional rehabilitation . The duration on treatment will be of 4 weeks ,the intervention is described following the TIDieR guidelines 20.

Taping Technique for hyperextended knee in Post stroke patients- Kinesiotaping will be applied for the Group A and MCconnell taping to the Group B

Why (Rationale, Theory, Goals)- to strengthen weak muscles, regulate muscle tone, enhance active range of motion, balance, functional use, and gait ability (17)

What (Materials)- Kinesiotaping and MConnell Taping , Spray for removal of adhesive tape.

Who will provide: Qualified physiotherapist

Modes of Delivery- Inperson face to face and supervised technique

Where (Setting)- NeuroPhysiotherapy OPD Bharati Vidyapeeth Hospital

Total DOSAGE: it will be given 5days/week for 4 week

Traditional Rehabilitation Protocol

Traditional Rehabilitation will be given to both the groups . (Table -2)

Table 2: Intervention for Group-A and Group-B for 4 week per week 5 sessions

GROUP A	GROUP B
Comprehensive training (40 min)-neuromuscular facilitation techniques, hip and knee joint control training, ankle dorsiflexion-induced training, affected lower limb support training, balance training (sitting, standing), and ambulation training.	Comprehensive training (40 min)-neuromuscular facilitation techniques, hip and knee joint control training, ankle dorsiflexion-induced training, affected lower limb support training, balance training (sitting, standing), and ambulation training.
Functional electrical stimulation, performed 20 min per session	Functional electrical stimulation, performed 20 min per session
Prowling along with kinesiotaping (10–15 min)	Prowling along with MC-connell taping (10–15 min)

Procedure

Eligible subjects will be screened according to the inclusion and exclusion criteria. Patients will be explained in detail about the study procedure and possible advantage of rehabilitation with regard to their condition. Patient will be provided with detailed information sheet which explains study procedure. Patients consent to participate in study will be sought using written informed consent duly signed by participant. The demographic details of each subject will be noted. Eligible subjects gait will be videoptaped using smartphone at resolution 1920× 1080 pixels at 60 fps mounted on tripod stand with the height corresponding to the patient hip kept at 4m perpendicular distance from midpoint of walkway. Markers will be placed on greater trochanter lateral condyle of femur and lateral malleolus of fibula and head of the 5 th metatarsal. Each subject will be made to ambulate 5m distance with or without support. Captured videos will be analysed on kinovea software (0.8.15) and degree of knee Hyperextension, degree of ankle dorsiflexion and total time taken to complete 5 m of walking distance will be analysed. For the spatiotemporal aspects of gait, the total score of WGS will be used. All the above mentioned parameters will be measured by an independent blinded assessor pre and post intervention. Both the groups will receive 1 month of treatment of routine Physiotherapy which will be lasted for 60–90 min including rest periods that include 20 sessions. One group will receive prowling with kinesio taping along with routine Physiotherapy .Subjects will be trained to prowl with bilateral knee flexion with trunk in mild forward flexion throughout the stance phase of the gait, the participants will be instructed to maintain a minimum of 15 ° to a maximum of 45 ° of bilateral knee flexion and avoid hyperextension. When required, the study participants will be given manual assistance during exercises. In addition to the above, the participants will also be instructed and encouraged to walk with knees bent for routine activities, just the way they will be trained during the therapy sessions.

While the other group will receive Mc-connell taping with prowling therapy for hyperextended knee along with routine Physiotherapy. Skin sensitivity test for taping will be done before the intervention. A piece of tape will be applied over flexor aspect of forearm for 6-8 hours with stretch of inhibitory technique (Suthar et.al).After sensitivity testing the tape will be applied to the posterior aspect of the knee. Tape will be anchor proximally and distally around the thigh and calf respectively. Then two strips will be overlapped, creating an x shape over the back of the knee. Taping will be removed every third day of intervention. After 1month of intervention post analysis using kinovea software and WGS will be done.

Adverse effects:

Any adverse events like allergic reactions to the skin itching or any discomfort will be documented and managed appropriately ,including immediate removal of tape.

Outcome measures

Parameters to be studied (Study variables): knee Hyperextension angle ,ankle dorsiflexion angle and spatiotemporal gait parameters will be assessed .All

study variables will be assessed at the following timelines (Table 3)

Table 3: Timelines at which outcome measures will be assessed

Timeline	Description
T1	Baseline,Pre intervention assessment
T2	Post intervention assessment; 4 weeks

1. Bi-dimensional tool kinovea software - To measure dorsiflexion of ankle and hyperextension of knee. It will be videoptaped using smartphone at resolution 1920 × 1080 pixels at 60 fps mounted on tripod stand with the height corresponding to the patient hip kept at 4m perpendicular distance from midpoint of walkway. Markers will be placed on greater trochanter lateral condyle of femur and lateral malleolus of fibula and head of the 5 th metatarsal. Each subject will be made to ambulate 5m distance with or without support. Captured videos will be analysed on kinovea software (0.8.15) and degree of knee Hyperextension, degree of ankle dorsiflexion and total time taken to complete 5 m of walking distance will be analysed. (20)

2. Wisconsin Gait Scale – to measure spatiotemporal parameters of gait.minimum score: 13.35 maximum score is 42 .The higher the score the more seriously affected the gait. (21,22)

Sample Size : Calculated by using prevalence of 44 per 100000 (kamalakannan et.al)

N=Z2P(1-P)/e2

Z=1.96 (CI-95%)

P=0.044 e=0.05

N (sample size) =65

Blinding, Data collection and management

This is a double blinded study as the assessor and statistician will be blinded. Paper based data collection will be done and intervention will be given by primary investigator. The outcomes will be assessed by the co-investigator and will be blinded as he will be unaware of group allocation. The data will be fed into and tabulated in an Excel spreadsheet, ensuring anonymity. These records will be stored securely with access only to the principal investigator. The intervention groups will be named by unlabelled data table to keep the statistician blinded. (Figure-1)

Figure 1: Consort Flow Diagram

Statistical Analysis

Data will be analyzed using SPSS version 28.0. All analyses will follow intention-to-treat principle. Statistical significance will be set at α=0.05 (two-sided), Effect sizes (Cohen's d for parametric, r for non-parametric) and 95% confidence intervals will be reported for outcomes.

1. Descriptive Statistics

Continuous Variables: Baseline demographic characteristics (Age, gender, side of involvement and brunstrom stage) and outcome measures (knee Hyperextension angle,ankle dorsiflexion angle,WGS scores) will be summarized using Mean and Standard Deviation (SD) for normally distributed data, or Median and Interquartile Range (IQR) for non-normally distributed data.

2. Normality Testing

The Shapiro-Wilk test will be used to assess the normality of the distribution for all continuous variables

3. Inferential Statistics

Baseline Comparability: An Independent t-test (or Mann-Whitney U test) will be performed to compare baseline demographic and clinical characteristics between the Group A and Group B to ensure successful randomization.

Intra-Group Analysis (Within-Group Changes):

- To evaluate the effect of the intervention within each group (comparing Pre-test vs. Post-test values), a Paired t-test will be used for normally distributed data.
- If data deviates from normality, the Wilcoxon Signed-Rank test will be used.

Inter-Group Analysis (Between-Group Differences):

- To compare the effectiveness between the two groups (Group A vs. Group B) at post-intervention, an Independent t-test will be used for normally distributed data.
- If data is non-normal, the Mann-Whitney U test will be applied.

Data Monitoring

No independent data monitoring committee is established due to the low-risk nature of Physiotherapy interventions. Any adverse events like allergic reactions to the skin,itching or any discomfort pain during or after exercise will be managed after immediate removal of tape Trial will be monitored by Institutional Ethical committee at 6 monthly interval until the completion of trial.

Ethical Consideration

Ethical Approval has been obtained by Dr.D.Y Patil Vidyapeeth,Pune (Deemed to be University) Ref no:-DPU/Ph.D./483(24)/2025. The study will conform to the Declaration of Helsinki, and participant privacy and autonomy will be protected throughout the trial. All participants will receive detailed written and verbal information about the study's purpose, procedures, benefits, risks, and data confidentiality. Written informed consent will be obtained from each participant before enrollment, confirming their voluntary participation and right to withdraw at any time without penalty. All personal and medical data will remain confidential. Data will be anonymized, securely stored, and accessed only by authorized researchers. At the end of 4 weeks, that is post trial, all the participant will be advised to continue with the home program or will be referred to further rehabilitation, if required. This study will be reported in accordance with the Consolidated Standards of Reporting Trials 2010 statement. Trial results of the main trial will be submitted for publication in a peer-reviewed journal.

Funding Declaration

The study will be conducted through self funding by the research team, with no external grants or sponsorships involved.

Conflicts Of Interest: No conflict of interest

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