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Research Article

Effect of Kinesio Taping on Spasticity and Postural Control in Stroke Patients with Hemiplegic Foot

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I N F O

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A B S T R A C T

Introduction: Post-stroke spasticity is a common complication of stroke and a key contributor to impaired Motor functions and functional independence. Patients with hemiplegic feet experience gait disturbances, impaired balances, and deviated posture control.

Aim: The purpose of the study is to analyse the effect of Kinesio tape to reduce spasticity and improve postural control.

Method: A comparative study with 60 subjects was conducted in Jaipur to analyse the effects of kinesio taping on spasticity and postural control. The subjects were divided into four groups, with Groups A and B focusing on spasticity and Groups C and D focusing on postural control. Statistical analysis was performed using the Modified Ashworth Scale and the Postural Assessment Scale for Stroke and Berg Balance Scale.

Results: In a comparison among groups A and B, Group B showed a significant reduction in spasticity MAS ($p = 0.001$), and a comparison among groups C and D showed a significant difference in the K-taping group in BBS score ($p = 0.001$) and PASS scores ($p = 0.001$).

Conclusion: According to the result, K-tape was effective in reducing spasticity and improving postural control, thus effectively promoting recovery in patients with hemiplegic feet after stroke.

Keywords: Hemiplegic Foot, Modified Ashworth Scale, Postural Assessment Scale for Stroke, Berg Balance Scale, Kinesio Tape

Introduction

Stroke is characterised as a focal neurological deficit which is seen worldwide and is a major concern regarding disability and death.[1] A stroke also known as cerebrovascular accident (CVA), occurs because of occlusion or burst of a blood vessel in the brain. Motor function deficits are the most obvious sign other symptoms include sensory or visual defects, aphasia and spatial disorders, and intellectual impairment which have a powerful impact on a patient's quality of life.[2] Indian stroke incidence rate is higher compared to other countries like the US, in which India is between 145 and 154 per 1,00,000 individuals a year and the US has an incidence rate of 107 per 1 lakh individuals, Australia has an incidence rate of 99 per 1 lakh individuals and Europe has an incidence rate of 61 to 111 per 1 lakh individuals. Stroke patients are found more in rural populations because of habits such as smoking, and poor health care system.[3]

Our main concern is knowledge about hemiplegic foot/ foot drop. Hemiplegic foot describes the inability to raise the front part of the foot due to weakness or paralysis

of ankle dorsiflexors which are the tibialis anterior, the extensor hallucis longus (EHL), and the extensor digitorum longus (EDL). These groups of muscles work together to clear the foot during the swing phase and during heel strike they control plantarflexion. Weakness of these muscles causes equinovarus deformity.[4] Walking dysfunction is the most reported limitation of the hemiplegic foot, leading to disbalance of lower extremities and the trunk these deformities trigger abnormality in gait patterns.[5] To prevent toe walking patients exaggeratedly flexes hip and knee during the swing phase referred to as steppage gait. Further hemiplegic foot leads to slow gait velocity and increased risk for falls attributed to foot drop and musculoskeletal system pain.[6] After a stroke, the individual shows abnormal hypertonicity that results in spasticity where there is intense and involuntary muscle contraction. This causes joint deformity, called equinovarus deformity in the foot. This furthermore creates balance issues, also creating difficulty in step clearance in the swing phase. Continuous increased pressure on the lateral border of the foot causes calluses and ulceration.[7] Patients with hemiplegiausually face many issues in fulfilling their Activity of Daily Livings (ADLs) because of motor, sensory, cognitive and language disorders; also with gait restrictions, there is activity limitation which decreases patients' functional independence.[8] Gait disorder causes major disability in stroke patients, slow gait cycle and speed, difference in stride length, increased time for swing phase and brief stance phase.[9] The ankle-foot complex absorbs the force from the ground and helps in walking, which are characterised as their primary role, but they also contribute to the ankle strategy to maintain balance. Movement disorder within the ankle joint is a crucial explanation for gait disorder.[10] Structural changes bring functional variations and therefore affect the balance of the lower extremities and the trunk; abnormality in the gait cycle and musculoskeletal system pain are triggered by these deformities.[11,12]

Postural Control

Postural control is the ability to maintain the centre of gravity within the base of support in various positions[13] which is important for all human activities, postural tone is the tension in the whole body's musculature.[14] Postural tone is kept high to prevent the body from collapsing towards gravity but also low to allow antigravity movement. Postural instability is one of the important mobility problems after a stroke.[15] Alterations in the ankle-foot complex after stroke are referred to as hemiplegic foot which is the main cause of postural instability.[16] Hemiplegic foot causes weight-bearing disturbances, and decreased base of support, and during stance/ walking equilibrium reactions are reduced.[17] The difficulty in pronating the ankle causes a hindrance in toe clearance while walking.[18] So, gait abnormality, postural deviations, and frequent falling are seen in stroke patients. In simple words, postural instability results in reduced mobility, increased disability, and even mortality in stroke patients.[19,20]

Spasticity

Spasticity is defined as "a motor disorder characterised by a velocitability-dependent increase in tonic stretch reflexes with exaggerated tendon jerks, as one component of the upper motor neuron syndrome". Spasticity (hypertonicity) develops on the contralateral side of the lesion and is typically strong in the hip and knee extensors, pelvic retractors, hip adductors and internal rotators, plantar flexors and supinators, and toe flexors in the lower extremities. Spasticity results in tight (stiff) muscles that restrict volitional/ voluntary movement as well as the involuntary adjustment of postural muscles, which typically takes place in preparation for and during a movement task. As a result, stroke patients may not be able to adequately stabilise and alter their trunks and proximal limbs during movement, which can lead to postural irregularities, balance problems, and an increased risk of falling. Contracture, aberrant posture and deformity, functional restrictions, and disability are linked to chronic spasticity. From little muscle stiffness to severe, painful, and uncontrollable muscle spasms, there are different degrees of spasticity.

Kinesio Taping

The Kinesio taping method is a world-renowned rehabilitative taping technique that is intended to support and stabilise muscles and joints without limiting the range of motion and to prolong the benefits of manual therapy administered in a clinical setting. It also provides extended soft tissue manipulation worn for days at a time without latex. Kinesio taping facilitates muscle action, provides support and proprioceptive sensation, and reduces pain after a stroke. Clinical applications of Kinesio tape can include pain relief, joint alignment correction, oedema reduction, increased proprioception, and stimulation or inhibition of muscle recruitment, depending on the application direction and tension of the tape. In individuals who have had a stroke, increasing proprioception and muscular activation may help reduce foot drop.[21]

Effect of Muscle Taping

Change in Tonus

In a tonus-decreasing muscle application, the Kinesio tape produces tension towards the direction of insertion, to the fixed base and shifts the skin in the ipsilateral direction. This leads to the inhibition of muscle contraction.

Support of Muscle Control

The ability to sense depths of perception helps the body find its place in space. Our mechanoreceptors allow us to perceive the position and motion of our joints.

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Mechanoreceptors' proprioceptive afferents regulate both directed motility (dynamic) and the postural motor system (static). The skin, tendons, muscles, and joints all contain sensors. With the aid of the tape, the skin's proprioceptors are accessed. This allows for the transmission of additional data regarding the position and effort of the extremities and, consequently, the body.[22]

The study aims to identify the effect of Kinesio taping to stimulate the proprioceptors to improve postural control as well as to reduce spasticity post-stroke. The rationale of the study is to find out the effect of K-taping in the early recovery of stroke patients.

Subjects and Method

A sample of 60 stroke patients from all age groups above 25 years, those who fulfilled the inclusion and exclusion criteria were taken for the RCT study, after obtaining ethical clearance from the Institutional Ethics Committee with reference number (MGMCH/IEC/JPR/2020/13) and informed consent from all participants. Fifteen patients were kept in each group (Group A: n = 15, Group B: n = 15, Group C: n = 15, and Group D: n = 15) who were referred to the Neurology Department of Mahatma Gandhi Hospital, Jaipur; with the diagnosis of stroke for 10 days. Each group was analysed using the statistical tool in an independent group as well as between the groups.

Patients with a hemiplegic foot either of ischaemic stroke/ haemorrhagic stroke were included. Minimal movement in the foot was required when recruited in the acute phase for spasticity, whereas patients' ability to stand for at least 30 seconds to check for postural control was matched before recruiting patients for the study. The exclusion criteria were if the patient had an MAS (Modified Ashworth Scale) score equal to or more than 3 and an individual with any musculoskeletal disorder; patients with recurrent stroke, aphasia, ataxia, visual impairment, severe cardiac illness, fractures, pregnancy, amputation, psychiatric illness, and chest complications; subjects with stroke secondary to traumatic brain injury; communication or language impairment leading to communication difficulty or any history of allergy to Kinesio tape.

Group A: Patients with hemiplegic foot receiving conventional treatment for spasticity

Group B: Patients with hemiplegic foot receiving conventional treatment adjunct Kinesio taping for spasticity

Group C: Patients with hemiplegic foot receiving conventional treatment for postural control improvement

Group D: Patients with hemiplegic foot receiving conventional treatment adjunct with Kinesio taping for postural control improvement

Procedure of Treatment for Groups A and B

In groups A & B the subjects were treated conventionally for hemiplegic foot spasticity. Conventional treatment involved exercises like TA stretching for 10 seconds, passive range of motion for dorsiflexion and inversion of the foot, positioning of the foot into dorsiflexion and basic limb exercises. Group B subjects received all the conventional exercises with k-taping. Kinesio tape was applied by the therapist on the patient's tibialis anterior muscle. The therapist cut the tape according to the length of the muscle then the tape was attached to the origin of the tibialis anterior i.e., the upper two-thirds of the tibia laterally. Kinesio tape was stretched to 50% and attached to its insertion at the base of the first metatarsal bone while keeping the foot into dorsiflexion. Another tape was applied on the peroneal longus muscle, the tape is attached at its origin i.e., the lateral side of the leg and stretched 50% to attach at the first metatarsal at the sole of the foot.

Procedure of Treatment for Groups C and D

Subjects were treated conventionally to improve postural control in hemiplegic foot patients after stroke. Group C received Conventional treatment which involved AROM movements of hip, knee and ankle, Quadriceps exercises, sit-to-stand, single leg stance and tandem stance with GAIT training and squatting exercises. Group D subjects received conventional treatment with K tape. Kinesio tape was applied by the therapist on the peroneus longus muscle by attaching its one end to the lateral part of the leg at the muscle's origin and giving 50% stretch and attaching the other end of tape on muscle insertion i.e., first metatarsal on the sole, to provide support to the peroneal tape another tape was applied from 2 cm ahead the medial malleolus with 50% stretch and attach to the foot 3 cm ahead lateral malleolus.

Another tape was applied to the extensor digitorum longus. The first part of the tape was attached to the origin of the muscle at the front of the leg and with 50% stretch it was split into 4 strips; all attached to the distal phalanges of lateral four digits. To provide support to the tape another tape is applied from lateral malleolus to medial malleolus around the ankle mortise.

A total of 10 days of treatment was given in all four groups.

Results

In this study a total of 60 subjects were randomly selected and allotted into 4 groups A, B, C and D. Group A and B were compared together for spasticity reduction there were 17 males and 13 females with a mean age of 63 years, a minimum age of 52 years, and a maximum age of 78 years. Groups C and D were compared together to improve postural control. There were 21 males and 9 females with a mean age of 56 years, a minimum age of 35 years, and a maximum age of 76 years.

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Table 1.MAS Scores of Groups A and B

Groups	Pre- and Post-MAS Score	Mean	SD	p Value	Variance
Group A	Pre	2.1	0.67	0.343	0.544
	Post	2.2	0.51		0.844
Group B	Pre	2.6	0.31	0.001*	0.266
	Post	1.7	0.73		0.455

MAS: Modified Ashworth Scale, *Significant

Table 2.BBS and PASS Scores of Groups C and D

Groups	Pre and Post Score	Mean	SD	p Value	Variance
Group C (Conventional group)					
BBS score	Pre	23.7	8.70	0.343	75.78
	Post	23.9	8.25		69.10
PASS score	Pre	19.2	5.05	0.141	25.51
	Post	20.9	5.42		29.43
Group D (Kinesio taping)					
BBS score	Pre	18.8	6.33	0.001	40.17
	Post	35.6	6.00		36.04
PASS score	Pre	20.2	2.98	0.001	8.93
	Post	28.0	5.27		27.77

BBS: Berg Balance Scale, PASS: Postural Assessment Scale for Stroke

Discussion

The results showed a significant difference in the improvement of postural control in patients who received Kinesio taping adjunct to conventional treatment. The results showed a significant difference in the K-taping group in BBS score (p = 0.001) and PASS scores (p = 0.001); This was consistent with the results of the study of Rojhani-Shirazi et al. in November 2015. They took 40 stroke patients belonging to the age group of 30 to 60 years and divided them into an experimental and a control group. The experimental group subjects received K taping and were measured with the forward reach test, lateral reach test, Berg Balance Scale (BBS), and timed up and go test. The result showed a significant difference in BBS between the first day and 24 hours later in the Kinesio tape group (p = 0.01). The forward reach test and mediolateral displacement of the COP differed significantly after taping in the experimental group compared to the control group (p = 0.04). Immediately after taping, BBS improved significantly in the Kinesio tape group (p = 0.02).[23]

The results also show a decrease in the spasticity in the sub-acute phase of stroke in the foot because of the application of Kinesio taping showing a significant difference in the K taping Group in the MAS score (p = 0.001); which was consistent with the study done by Huang et al. on hemiplegic hand in post-stroke spasticity on 31 participants, who were enrolled and divided into Kinesio tape group and control group they gave 5 days a week for 3 weeks regular treatment. The Kinesio tape group received K taping in adjunct to regular treatment and was measured by the MAS scale. In the Kinesio tape group, significant differences were noted in the MAS in the third and fifth week (p = 0.001–0.035),[24] which speculated that K-taping was effective in reducing spasticity. So, our study showed that conventional treatment was able to reduce spasticity but adjunct to Kinesio tape the recovery was speedy and effective. Conventional treatment to improve postural control was effective but Kinesio tape with conventional treatment promoted speedy recovery and can be used as part of a physiotherapy regime in stroke rehabilitation.

Conclusion

From this study, we concluded that conventional treatment and conventional treatment with Kinesio taping both can reduce spasticity in hemiplegic foot patients after stroke, as well as we also concluded that conventional treatment and conventional treatment with Kinesio tape can improve postural control. But as we compare both groups, the group with Kinesio tape adjunct to conventional treatment was more effective in reducing spasticity in the hemiplegic foot. Comparing the two groups for postural control showed that the group with Kinesio tape with conventional treatment was more effective in improving postural control in hemiplegic foot patients.

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Conflict of Interest: None

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