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Effect of Facilitatory and Inhibitory Kinesio Taping on Lower Limb Function for Foot Drop in Individuals with Chronic Stroke: A Literature Review

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Abstract

Foot drop is a common motor impairment following stroke that significantly affects gait, balance, and mobility. Kinesio taping (KT), a method involving elastic therapeutic tape, has gained attention as a potential intervention to enhance lower limb function in individuals with chronic stroke. This literature review evaluates the effectiveness of KT on lower limb function in stroke patients with foot drop, focusing on its impact on gait, balance, and mobility. A comprehensive search identified six studies that met the inclusion criteria, which examined gait parameters, balance, and mobility following KT application. The review found that KT, when applied correctly, improves gait parameters such as cadence, velocity, and step length. Additionally, KT was associated with enhanced balance and a reduced fall risk. However, the effectiveness varied across studies, likely due to differences in taping techniques and patient characteristics. While KT shows promise, further research is needed to fully understand its benefits compared to other interventions like ankle-foot orthoses (AFO) and dynamic taping. The review also highlights the importance of personalized application techniques and suggests that combining KT with other therapies may optimize outcomes for patients with foot drop.

Key Words: Kinesio taping, foot drop, stroke, lower limb function, gait, balance, mobility.

Introduction

In the world, stroke ranks as the second most common cause of death and disability. According to the Global Burden of Disease (GBD) study from 2019, the majority of fatalities worldwide (18.6 million [17.1–19.7]) in both sexes were projected to be caused by cardiovascular diseases (CVDs). With 3.33 million stroke deaths (3.04–3.62) in males and 3.22 million (2.86–3.54) in females among CVDs, stroke was the second most common cause of death.^[1] In India, cardiovascular disease is the primary cause of death (28.1 % [26.5–29.1]).^[2] In the category of cardiovascular illnesses, stroke ranked sixth in terms of mortality in 2016. Between 1990 and 2016, the mean percentage increase in the number of disability adjusted life years (DALYs) was 52.9% (40.4%–66.7%).^[3] The majority of strokes happened in people over 50, with a preponderance of men. The most frequent kind of stroke was an ischemic stroke, which occurred in between 67% and 74% of cases. It was also noted that older individuals accounted for about one-fifth of those admitted to hospitals after suffering their first stroke. These bolster the data showing that "young adults" in underdeveloped nations are far more vulnerable to stroke than those in developed nations.^[4] These studies, which were published between 2011 and 2020 and covered the entirety of India, demonstrate in particular localities that the estimates include indirect costs as well because the latter can have a significant impact. In India, out-of-pocket (OOP) expenses account for more than 80% of health spending.^[5] The most common intermediate illnesses linked to stroke were found to be hypertension (56.69%), obesity (36.61%), dyslipidemia (30.6%), and diabetes mellitus (23.8%). However, the observed behavioral risk factors for stroke in this context were alcohol consumption (28.15%), history of tobacco use (28.59%), and physical inactivity (29.9%). In the Asian population, hypertension continues to be the most prevalent vascular risk factor for stroke.^[6]

Stroke is a type of cerebrovascular illness that results in loss of brain function due to bleeding in the brain tissue or disruption of the blood flow to the brain. Stroke is a terrible illness that strikes every two seconds, taking a life globally every six seconds, and accounting for 15 million new cases each year.^[7] Devastating stroke deficits result in several emotional, cognitive, and physical problems. A stroke can have an impact on a person's general health, ability to lead an independent life, and overall well-being. A stroke is defined as a sudden start of focal or global impairments of brain function that continue longer than twenty-four hours or result in death and have no discernible cause other than vascular origin. Stroke survivors frequently experience cognitive and

motor deficits that impact their gait, muscular tone, strength, proprioception, balance, and coordination. ^[8]

The majority of stroke cases are divided into two categories. Both ischemic strokes and hemorrhagic strokes result in local hypoxia that damages brain tissue. Ischemic strokes are triggered by the rupture of an internal blood vessel in the brain. Ischemic strokes are more common, yet both are dangerous and common. The most common cause of blockages in ischemic strokes is blood clots that become stuck in one of the brain's arteries. ^[9]

Hemiplegia is a common symptom of stroke patients and is caused by rigidity on the contralateral side of the injured brain. When upper motor neuron lesions cause spasticity, convulsions, hypertonia, and deep tendon hyperreflexes, the condition is referred to as spasticity, or elevated muscle tone above normal. Patients who have had a stroke have impaired balance because of decreased mobility of the ipsilateral upper and lower extremity joints, including the trunk, sensory impairment, abnormal postural response, muscle weakness, and changes in muscle tone. ^[10]

Damage to the brain and subcortical areas in stroke patients results in an asymmetrical posture, left-right body imbalance, and difficulty maintaining the center of the body. Patients who have had a stroke experience twice as much postural sway as healthy individuals do. Additionally, the unaffected leg bears an inordinate amount of weight, resulting in an uneven posture. ^[9, 10]

One of the main objectives of post-stroke therapy is to address post-stroke gait dysfunction, which is one of the neurological gait abnormalities that is being studied the most. Compared to the healthy patients, stroke survivors walk more slowly and have less selective motor control. During a walk, they employ the affected lower leg's synergistic mass patterns as opposed to separate joint movements. Stiff-legged stride (limited range of motion in the knee) and drop foot (absence of ankle dorsiflexion during swing) resulting in elevated hip during swing are characteristics of stroke gait. After a stroke, the spinal cord's function is retained while the cerebral cortex's gets damaged. To remodel the cortex for walking, certain training techniques that act on the distal physical level and influence the neural system can be applied. Ankle movement training is said to help with brain restructuring. Dobkin et al. demonstrated that the supraspinal sensorimotor network for the neural control of walking can be assessed indirectly by ankle dorsiflexion. ^[11, 12]

Ankle injuries are more common than other lower extremity injuries in patients with chronic stroke; these include limited ankle range of motion from gait asymmetry, ankle stiffness, and ankle

weakness. These factors can interfere with balance, gait, and daily living activities over an extended period of time. ^[13]

Following a stroke, foot drop is a common disability. High levels of motor impairment, increased plantar flexor spasticity, and weakness or loss of voluntary control of the ankle dorsi flexors are associated with this disorder. Foot drop impairs ankle dorsiflexion during the swing phase of gait and interferes with the first foot contact at the start of the stance phase. As a result, foot drop raises the risk of falling and impairs walking efficiency, speed, and gait stability. It also disrupts weight acceptance and transfer. ^[14]

Stroke survivors' ankles can be treated in a variety of ways to increase their capacity to walk; two such examples are robotic rehabilitation and plastic ankle orthoses. Following gait training, these therapies enhance walking speed and ability while also increasing weight-bearing capacity. ^[15, 16] Ankle foot orthoses (AFOs), functional electrical stimulation, robot-assisted walking therapy, partly weight-supported treadmill training, and virtual reality walking training have all been used to improve foot drop gait in previous research. ^[17, 18]

After a stroke, as seen that it can be hard to walk because of weak or paralysed muscles, poor motor control, and tightened soft tissues. The decreased activation of a number of muscles like the anterior tibial muscles, quadriceps, and hip extensor muscles has been frequently cited in many works of literature ^[11, 19]

Because of its distinct elastic qualities, kinesio taping—also known as elastic sports taping or elastic therapeutic tape—differs from other kinds of strapping tapes. The kinesio taping technique has gained popularity in recent years for treating a variety of medical ailments. For example, research has demonstrated that, when used in conjunction with other therapy approaches, the kinesio taping method may either promote or inhibit muscle function and maintain joint structure for the upper extremity in hemiplegia. Moreover, Kinesio taping can enhance the asymmetry gait and walking speed of stroke victims' paralyzed limbs. ^[20, 21] This method causes the muscles to contract instantly while also stabilizing the joints. It has been observed that applying Kinesio tape to stroke patients' lower extremities improves their capacity to walk by lowering pain and stiffness, increasing muscular activation, and improved balance. ^[22]

Thus, the aim of this review is to evaluate the use and effect of Kinesio taping on lower limb function for foot drop in individuals with chronic stroke.

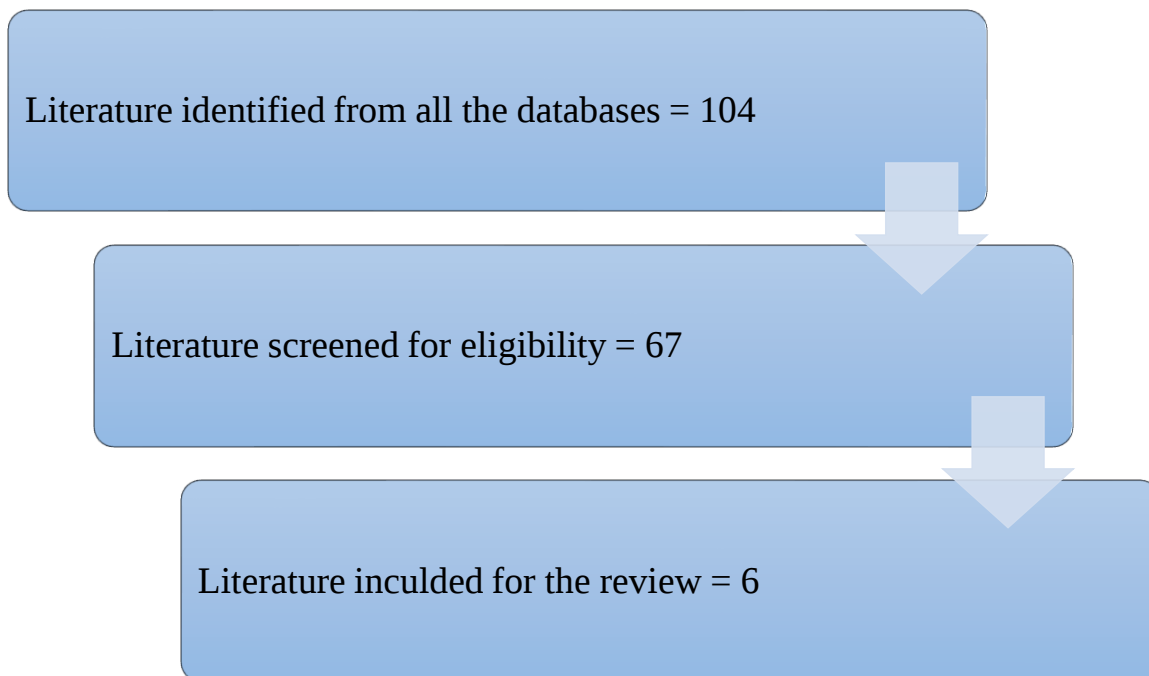
Method

A bibliographic search was done by using keywords ‘facilitatory taping for foot drop’ AND ‘inhibitory taping for foot drop’ AND ‘foot drop post-stroke’ AND ‘taping for foot drop post-stroke’. Following databases were used to run the search for the literature – PubMed, the Cochrane Library, Science Direct, Trip and Pedro.

Studies underwent a screening process as per the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) protocol. Each literature was screened for the methodology, participants and results and those which met the inclusion criteria were included for the review.

Selection Criteria

Inclusion Criteria	Exclusion Criteria
➤ Type of literatures included : Randomized Control trials, Case controlled studies, pilot studies, review reports, meta-analysis, clinical commentaries, narrative reviews, scooping reviews, editorials ➤ Publication time limit : 2014-2024 ➤ Population Characteristics : Individuals with foot drop under the influence of chronic stroke ➤ Intervention Strategies : Kinesio Taping for lower limb ➤ Outcome Measures : Any outcome measures used to rate the functionality of lower limb	➤ Studies on the individuals with acute stroke ➤ Intervention strategies other than Kinesio Taping ➤ Intervention applied to upper limb



Results

A total of 104 articles were found from all the databases, after removing duplicates, 67 articles were screened for title and abstract review and 61 of them didn't meet the inclusion criteria. After a full text review, 6 articles meeting the inclusion criteria were finalized for the review.

Literature Found:

Title	Aim	Method	Results/Conclusion
Choi JB et al. [23]	This study aimed to compare outcomes of	The study recruited 18 patients exhibiting	This study demonstrated that

	Ankle-Foot Orthosis treatment with those of Kinesio Taping to investigate the effect on gait ability in patients with foot drop after stroke.	foot drop from stroke. Gait ability was assessed under 2 conditions: treatment with Kinesio Taping and that with Ankle-Foot Orthosis using the GAITRite system according to the following parameters: cadence, velocity, swing time, stance time, step length, and stride length.	Kinesio Taping and Ankle-Foot Orthosis use have similar effects on gait function in patients with foot drop after stroke. Thus, treatment of foot drop with Kinesio Taping may be an alternative in patients for whom Ankle-Foot Orthosis use is contraindicated.
Shin YJ et al. [24]	This study aims evaluates the immediate effect of ankle eversion taping on dynamic and static balance of chronic stroke patients with foot drop.	9 subjects recruited performed three interventions in a random order. Subjects were randomly assigned to an ankle eversion taping, placebo taping, and no taping. For dynamic and static balance, ability was measured using BIO Rescue. Limit of stability, sway length and sway speed for one minute were measured	The Limit of Stability, Sway length and Sway speed differed significantly among the different taping methods. It was concluded that ankle eversion taping that uses kinesiology tape instantly increases the dynamic and static balance ability of chronic stroke patients with foot drop

Lee D et al. [25]	The aim of this study is to identify the effectiveness of proprioceptive neuromuscular facilitation (PNF) leg Kinesio taping (KT) on gait parameters and dynamic balance in chronic stroke patients with foot drop.	A total 22 chronic stroke patients were randomly assigned to experimental (n = 11) and control groups (n = 11). The primary outcome measures that the gait parameter are gait velocity, cadence, step length, and stride length. Dynamic balance was measured by the timed up-and-go test (TUG) time and activity-specific balance confidence scale (ABC) as the secondary outcomes. All of the measurements were performed baseline and 24 h after intervention.	Results showed that the experimental group showed significant improvements in gait velocity, cadence, step length, stride length and TUG, and ABC score compared with the control group. We conclude that the short term effect of application of lower-leg KT according to the PNF pattern increased the gait ability and dynamic balance of chronic stroke patients with foot drop.
Shin YJ et al. [26]	The purpose of this study is to assess the immediate effects of applying ankle eversion taping using kinesiology tape in	Subjects were randomly initially assigned to an ankle balance taping, placebo taping, and no taping each group. Gait ability was	It was concluded that the application of ankle eversion taping that uses kinesiology tape instantly increased the gait ability of chronic

	patients with foot drop after stroke.	assessed by the GAITRite System. The measured gait variables are gait velocity, step length, stride length, H-H base support, and cadence. All of the measurements were performed immediately after intervention..	stroke patients with foot drop.
Kim KH et al. [27]	The purpose of this cross-sectional single-blind study was to evaluate the immediate effects of Kinesio taping of tibialis anterior and quadriceps on the mobility and balance ability in individuals with chronic hemi-paretic stroke.	Participants were divided into 3 groups: Ankle Kinesio taping (AKT) group, a placebo (PKT) group, and a control (NKT) group. All participants were assessed before and after taping training using timed up and go test (TUG), timed up and down stairs test (TUDS), and balance ability.	This study suggested Kinesio taping as an effective intervention to increase the mobility and balance abilities of patients with chronic hemi-paretic stroke.
Im JG et al. [28]	The purpose of this study was to investigate the immediate effects of dynamic taping,	The patients were randomly assigned to the experimental group (n = 17), wherein dynamic	The results indicate that compared with kinesiology taping, dynamic taping used in chronic stroke patients

	which facilitates the dorsiflexor muscle, on static and dynamic balance and gait speed in stroke patients with foot drop.	taping was used to facilitate the dorsiflexor muscle, or the control group (n = 17), wherein kinesiology taping was used. Before the taping application, velocity average, path-length average, Berg balance scale, and timed up and go test (TUG) were recorded to measure static and dynamic balance, whereas the 10-meter walk test (10MWT) was used to measure gait speed. After the taping application, these parameters were re-evaluated in both groups	with foot drop had a more significant effect on dynamic balance and gait speed.
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Discussion

One of the most popular adhesive therapeutic tapes for preventing injuries, promoting recovery, and improving performance is kinesio tape (KT). It has been demonstrated to be clinically beneficial in promoting joint mobility, raising muscle activity, causing an earlier occurrence of muscular peak torque, and improving functional performance. ^[29] It has been proposed that the interaction between motor unit firing in the peripheral and central nervous systems and cutaneous

afferent stimulation may be the cause of KT's therapeutic benefits. It has been demonstrated that increasing peripheral nerve stimulation increases the motor cortex's excitability. Cutaneous stimulation has the potential to reduce motor neuron threshold, which would facilitate the recruitment of motor units and enhance functional performance. KT has been demonstrated to be useful in pain management by suppression of muscle activation in addition to muscle facilitation. It is believed that stretching the Golgi tendon organ at the muscle's distal end can block the muscle. [30-33]

With the potential benefits of kinesio taping, this literature review aims to investigate the effect of facilitatory and inhibitory Kinesio Taping on lower limb function for foot drop in individuals with chronic stroke.

Choi JB et al. investigated the effect of Kinesio Taping on the gait ability of patients with foot drop after stroke using an objective quantitative assessment method. This study applied KT and AFO to 18 patients with hemiplegia after stroke and found no significant difference in all parameters, namely cadence, velocity, swing time, stance time, step length, and stride length. These results suggest that AFO and KT have similar effects on walking ability. [23] AFO use alleviates foot drop symptoms of the ankle during walking through the principle of three point pressure. Conversely, KT prevents foot drop symptoms based on a different principle. Since KT is characterized by adhesion and elasticity, it can partially limit the range of motion of the joint due to the attachment of the tape to the skin and while at it KT is known to facilitate or activate a small but immediate increase in muscle strength by producing a concentric pull on the fascia, which may stimulate an increase in muscle contraction. [23, 34]

The purpose of the study by Shin YJ et al was to assess the short-term effects of kinesiology tape-assisted ankle eversion on the dynamic and static balance of chronic stroke patients who had foot drop. Patients with chronic stroke showed significant improvements in both their dynamic and static balance abilities following the application of ankle eversion tape. Furthermore, as compared to the other two therapies (placebo taping and no taping), sway length, sway speed, and limits of stability (LOS), which are indicators of dynamic balance, were all statistically significantly improved. It is explained that ankle eversion taping is not the same as applying kinesiology tape to muscles; rather, it is a mechanical taping technique used to improve alignment. Many studies have documented the effectiveness of kinesiology taping in correcting this posture. [24, 35-37]

In a similar study done by Lee D et al., the results showed that improving gait function and dynamic balance requires extra application of the KT in accordance with the PNF pattern prior to conventional therapy and gait training. As suggested by a prior study, KT improves blood flow, increases subcutaneous space, and provides tactile stimulation to improve muscle activation and re-education, individuals who received four weeks of Kinesio Taping on the tibialis anterior muscle report a significant improvement in their gait velocity and step length. In a previous research, it was showed that applying KT for more than four weeks significantly enhanced step length and gait velocity. [25, 38-40]

The purpose of this study by Shin YJ et al. was to assess on how applying ankle eversion taping affected stroke patients' walking capacity right away after they experienced foot drop. After applying ankle eversion taping, stroke patients with foot drop showed a considerable improvement in their gait. Numerous studies claim that because of a mechanical effect, tape can improve posture. Using kinesiology taping, ankle eversion taping could reduce ankle discomfort, increase ankle flexibility, and improve dynamic balance in patients with ankle sprain from inversion. Postural awareness and proprioception are enhanced with kinesiology taping. Kinesiology taping has been shown by Long et al. to improve sensory stimulation by raising proprioception at the ankle and foot. [26, 40-42]

This study by Kim KH et al. set out to assess the immediate effects of KT application to the ankle on individuals with chronic cerebral infarction's mobility and balance. In this study, KT was administered to the ankle joint, and its effects on balance and mobility were examined. This study applied taping to correct the position of equinus. The application is thought to have improved the movement and function of the foot, increased sensory input through the sole of the foot, and positioned the ankle joint in the normal position. Both forward and backward movement are influenced by the function of the gastrocnemius and the tibialis anterior. The tibialis anterior serves to draw the ground during the swing phase and to maintain stability when the feet make contact with it during the support phase. Even while walking on uneven ground, the tibialis anterior helps the leg stay vertical to the ground by balancing the opposing ankle and leg while the foot is on the ground. For this reason, ankle stability and proprioception greatly depend on the tibialis anterior muscle being activated. The use of taping permits useful movements since it protects and supports the joint. Another benefit of taping is that the external support strengthens the ligaments and limits mobility to increase joint stability. [27, 43, 44]

Im JG et al carried out a study with the purpose to investigate the immediate effects of dynamic taping, which facilitates the dorsiflexor muscle, on static and dynamic balance and gait speed in stroke patients with foot drop and reported that when compared with kinesiology taping, dynamic taping used in chronic stroke patients with foot drop had a more significant effect on dynamic balance and gait speed. When stroke patients' ankles were taped with kinesio taping, a study by Choi et al. showed a significant impact on TUG results. According to a study by McNeill and Pedersen, dynamic taping has the ability to stretch both vertically and horizontally, which sets it apart from kinesio taping. This characteristic allows the ankle to be supported when performing three-dimensional movements like walking, which preserves the stability of the foot and neck. [28, 45, 46]

The placebo effect is a psychological phenomenon that has been linked to altered conditions and performance because it occurs when an individual's expectations affect their beliefs and conduct, which produces a more favorable result. Prior research has indicated that a placebo may have analgesic properties and improve motor performance. [29]

The two main categories of KT are elastic and inelastic types. Tensile strength is an attribute of an elastic tape. That is, tension can be provided differently by increasing the length as desired by the user. Notwithstanding its comparatively low elasticity, non-stretchable tape is useful for stabilizing or supporting the structure. Therefore, it is important to consider each of these features appropriately when applying KT for swallowing rehabilitation. Therefore, it is clinically necessary to consider various factors such as KT type, application strength, and design for gait rehabilitation of patients with foot drop after stroke. [47]

Conclusion

With the number of literature available and standing true to the purpose of the review, it can be said that kinesio taping can be an effective method for foot drop seen in individuals post stroke of a chronic duration. With the lack of solid evidence on the mechanism of kinesio taping still in research, it is difficult to give an adamant statement over the problem of the review. Variety is seen in the way kinesio taping has been addressed across the available literature, some say that it can be used as an alternatives treatment option while some think of it to be incorporated as a daily practice for effective results.

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