

Effects of Ankle Kinesio Taping on Postural Control in Stroke Patients

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Background: To investigate the effects of kinesio taping on postural control in stroke patients. *Materials and methods:* Forty stroke patients aged 30 to 60 years were randomly divided into an experimental and a control group. In the experimental group, kinesio tape (KT) was applied directly on the skin over the affected ankle in the direction of dorsiflexion and eversion to correct the equinovarus deformity. The tape was kept on the ankle for 1 day. The results were measured with the forward reach test, lateral reach test, Berg Balance Scale (BBS), and timed up and go test. Center of pressure (COP) displacement and velocity were also measured while the patients stood on a force plate. All variables were measured on the first day immediately after taping and 24 hours later in the KT group, and on the first day and also 24 hours later in the control group. *Results:* There was a statistically significant difference in BBS between the first day and 24 hours later in the KT group ($P = .01$). The forward reach test and mediolateral displacement of the COP differed significantly after taping in the experimental group compared to the control group ($P = .04$). Immediately after taping, BBS improved significantly in the KT group ($P = .02$). *Conclusions:* The application of KT improved forward reach test results and displacement of the COP in stroke patients. **Key Words:** Stroke—kinesio taping—postural control—Berg Balance Scale—equinovarus deformity.

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Postural instability is one of the important mobility problems after stroke.¹ It can result in reduced mobility, increased disability, and even mortality in stroke patients. These events have a great impact on patients' activities of daily independent living and gait ability.² One of the most common changes in the foot and ankle complex after a stroke is talipes equinovarus foot deformity (club foot), which can cause postural instability.³ This deformity leads to problems during quiet stance and walking.³⁻⁷ Equinovarus foot causes asymmetric weight-bearing, reduces the base of support, and further reduces equilibrium reactions during quiet stance and walking.³⁻¹⁴ In addition, the inability to dorsiflex and evert the ankle interferes with toe clearance during walking.¹⁵ As a result, abnormal gait, postural instability, and falling are frequently seen in these patients.

Recovery of the stroke patients from postural instability which is a major source of disability is essential. Kinesio taping is a prevalent method which is being used by physical therapists during rehabilitation programs.¹⁶ Kinesio tape (KT) is a thin, highly elastic material which may be used as a modality to relieve pain, correct joint

position, decrease swelling, increase proprioception, and increase or inhibit muscle recruitment.¹⁷ It has been shown that KT can improve postural control and gait ability by not only stimulating proprioceptive sense but also identifying the right position of the joint even in a comfortable posture with no weight-bearing.¹⁸ The equinovarus deformity consists of plantar flexion and inversion components. Therefore, concentrating on correction of its both components is important in restoring normal joint function.¹⁹ Previous studies have focused only on correcting the plantar flexion component.^{19,20} Ability of KT to stretch 120%-140% times its original length provides the opportunity to correct the deformed joint in both directions simultaneously.^{21,22} Other advantages of the KT include low cost and easy application.¹⁸

Despite the current use of KT as a part of clinical practice in physical therapy, its clinical effects on postural stability have not been extensively studied.^{16,18} To the best of our knowledge, no studies to date have investigated the effect of KT to correct equinovarus problems in postural control in stroke patients. There is also limited evidence of the effects of KT in neurologic patients^{16,23} and most of the previous studies involved non-neurologic patients.^{16,22,24-26} Therefore, the purpose of the present study was to determine the short-term effects of KT to correct the direction of ankle dorsiflexion and eversion in improving postural control during quiet standing in stroke patients.

Methods and Materials

Participants

Forty patients with stroke (26 men and 14 women) aged between 30 and 60 years participated in this study. The patients in the KT group and control group were matched by age, weight, height, and duration of the disease. All patients with the following criteria participated in the study: involvement of the anterior cerebral artery on computed tomography scan at least 1 year ago, score of 21-56 on the Berg Balance Scale (BBS), spasticity level of 2-3 according to the modified Ashworth scale, ability to stand for at least 30 seconds, ability to change walking direction, and ability to understand instructions.

Patients were excluded if they had hemiplegia due to traumatic brain injury, any history of lower limb surgery, fracture or joint dislocation in the lower limbs, low back pain, blindness or deafness, cerebellar disorders, middle ear problems, diabetes mellitus, neuropathy, or allergy to the KT. Patients were randomly divided into 2 groups: an experimental group with KT (14 men, 6 women) and a control group (11 men, 9 women) in which no KT was used.

The nature and purposes of the study were explained to all participants, and all signed an informed consent form. Ethical approval for the study was obtained from the Human Ethics Committee of Shiraz University of Medical Sciences.

Data Acquisition

The patients' characteristics such as age, gender, height, weight, and duration of disease were recorded. Level of spasticity was measured with the modified Ashworth scale. Postural control was evaluated by functional tests and force plate measurements. The order of measurements was randomized with a table of random numbers. Functional tests included the functional reach test (FRT), lateral reach test (LRT), and BBS. In the FRT and LRT, the maximum distance that patients could reach forward or laterally without losing balance or taking a step from quiet stance was recorded.^{27,28} These 2 tests measure a person's margin of stability and their ability to maintain balance during a functional task.^{27,29} The BBS is a standard clinical assessment tool for evaluating postural control in patients with senile disease and stroke patients, with a minimum score of zero and a maximum total score of 56. Higher scores in this scale indicate better postural control. The scale consists of 14 functional items which are similar to daily motor activities in adults.^{30,31} Each functional test was repeated 3 times, and the average of 3 trials was calculated for analysis. Gait ability was also assessed with the timed up and go test, which is the time a person needs to rise from a chair, walk 3 m, turn, and return to the chair.³² The average of 3 trials was recorded.

Force plate measurements included center of pressure (COP) displacement and velocity along the mediolateral (ML) and anteroposterior (AP) axes. The patients stood barefoot on the force plate (model 9286A, size 400 × 600, Kistler, Switzerland) for 30 seconds and were instructed to look at a spot in front of them. The distance of the spot from floor was determined according to each patient's eye level. The sampling frequency of the force plate was set at 50 Hz.²³ This measurement was repeated 3 times, and the average of 3 trials was calculated for further analysis. The patients were allowed a 2-minute rest period between trials. Raw data were exported to Visual 3D software (C-motion, Inc. Germantown, MD) and filtered using a fourth-order low-pass Butterworth filter with a cutoff frequency of 12 Hz.

After these measurements, taping was done for the KT group. Before KT application, the skin was cleaned and dried to remove all moisture and oil and then shaved if necessary. Standard 2-inch KT 3NSTEM (TS CO., LTD, Seoul, South Korea) was used. The patients were in supine position during taping, with their hip, knee, and ankle joints in neutral position. The kinesio I strip was applied with maximum tension (100%). Each strip simultaneously applied force in the directions of dorsiflexion and eversion. Three I strips, each covering approximately half the previous strip, were attached from 2-3 cm superior to the medial malleolus and passed around the ankle joint from the plantar surface of foot, then fixed at the top of the lateral malleolus. The strips were applied across the ankle joint from proximal to distal³³ (Fig. 1). The patients

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