



Effect of Kinesio Taping on Muscle Spasticity in Post-Stroke Patients Receiving Infrared Therapy and Stretching Exercise : A Quasi-Experimental Study

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Abstract

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Background : Spasticity is one of the symptoms of a stroke. One of the muscles with increased tone is the plantar flexor (66%). Spasticity is commonly treated with infrared therapy and stretching exercises. Kinesio Taping is a skin-based therapeutic procedure that uses elastic tape and can be used with infrared therapy and stretching exercises. Kinesio Taping is predicted to reduce spasticity in the plantar flexor muscle as determined by the Tardieu scale, improving functional walking. The objectives of this study was to demonstrate the efficacy of adding Kinesio Taping on lower extremity muscular spasticity in post-stroke patients who had previously received infrared and stretching exercises.

Methods : This study is a controlled group design with a quasi experimental pre and post test. Post-stroke patients were divided into two groups: the control group (16 patients) and the treatment group (16 patients) who received the addition of Kinesio Taping. Before and after 6 weeks of treatment, the Tardieu scale was measured.

Results : Before and after treatment, there was a significant difference in Tardieu scale (both on quality and angle of resistance) in each group ($p < 0.05$), and there was a significant difference in Tardieu scale in the two groups ($p < 0.05$).

Conclusion : Kinesio Taping has been demonstrated to significantly reduce plantar flexor muscle spasticity in stroke survivors.

Keywords : post-stroke, spasticity, stretching, Kinesio Taping

INTRODUCTION

Stroke is the leading cause of disability worldwide and the second leading cause of death after coronary heart disease.¹ Damage to the higher motor neurons occurs in stroke, resulting in symptoms such as spasticity, clonus, hyper reflexes from deep tendon reflexes, muscle weakness, functional difficulties in walking and daily activities. Spasticity, a component of upper motor neuron syndrome, is caused by a lesion in the descending motor pathway caused by a pathological condition such as stroke or brain injury and is defined as a velocity-dependent increase in muscle tone with increased tendon reflexes.² According to reports, the prevalence of post-stroke spasticity ranges from 30% to 80%, with disability rates ranging from 2% to 13%.³ This is caused by limb muscle weakness and poor coordination between the agonist and antagonist muscles.⁴ Spasticity is more prevalent in the lower leg extensor muscles (knee and ankle) and upper limb flexor muscles (fingers, wrist, and elbow). Spasticity most frequently occurred at the elbows (79%), wrists (66%), ankles (66%), and shoulders (58%) according to Wissel *et al.*³ Increased tone, particularly in the plantar flexor muscle, can lead to spastic equinus, which is the primary cause of walking problems caused by decreased ankle dorsiflexion during stance and circumduction during swing.⁵

Heating and stretching are prominent therapy strategies utilized in spasticity management since they are simple to execute and generally inexpensive. Infrared heating is the most commonly utilized and virtually always available in medical rehabilitation services. However, because infrared heating has a short duration, it must be paired with stretching exercises to achieve the best benefits in reducing spasticity.⁶ Stretching is currently used to treat spasticity.⁷ Dr. Kenzo Kase developed Kinesio Taping, a form of skin therapy that uses an elastic tape, in Japan. Studies have shown that it is effective at providing afferent stimulation in weaker muscles, causing contractions with increased motor unit recruitment, and inducing neuroplasticity. Kinesio Taping has recently emerged as a treatment option for hemiplegic stroke patients. Kinesio taping can help enhance limb function in daily activities. According to Jaraczewska in the journal Yu Chi Huang *et al*, Kinesio Taping when used with other interventions can improve muscle function, joint support, and minimize post-stroke discomfort. According to Yu Chi Huang *et al.* (2019), the inclusion of Kinesio Taping can reduce spasticity and improve hand function.⁴ Kinesio Taping, according to Cavalcante J *et al* (2018), is beneficial for relieving spasticity in post-stroke patients.⁸ According to the findings of Koseoglu *et al.* (2017), the use of Kinesio Taping on the tibialis anterior muscle may enhance the recovery of lower extremity motor function and can be utilized as an ankle training method for stroke patients.⁹

According to a study conducted in Indonesia (at Kandou Hospital/Manado) by Gloria *et al* (2020), Kinesio Taping on the anterior tibialis muscle can be used as a supplement to walking exercise. Walking mobility function improves in post-stroke subjects following 30 minutes of Kinesio Taping's application on the paretic anterior tibialis muscle.¹⁰ Kinesio Taping is a simple, non-invasive, cost-effective therapy that can be used to treat post-stroke patients who have extremity muscle stiffness. The addition of Kinesio Taping to the spasticity of the ankle plantar flexor muscles in post-stroke patients has never been studied before, according to the researchers. As a result, researchers aim to see how adding Kinesio Taping to basic infrared therapy and stretching exercises affects lower extremity muscle spasticity in post-stroke patients, specifically the ankle plantar flexor muscles.

METHODS

The study design was a quasi experimental pre and post test controlled group design in stroke patients at K.R.M.T. Wongsonegoro Hospital Semarang. The study was approved by the Ethics Commission of the Faculty of Medicine, Diponegoro University Semarang, Number 48/EC/KEPK/FK-UNDIP/XII/2022, as well as the Ethics Commission of K.R.M.T Wongsonegoro Hospital Semarang, Number B/3280/070/IV/2022. The research was carried out between April 4 and August 19, 2022. The approach used to collect subjects was consecutive sampling.

The study's inclusion criteria included post-stroke patients with first attack hemiparesis, stroke duration > 6 months - 12 months, 50 to 60 years old, able to stand and walk on their own with or without assistance, no cognitive impairment (MoCA-Ina, score > 26), spasticity in the plantar flexor muscles based on the Tardieu scale has a quality degree of 1-3, and muscle strength (MMT) of the ankle dorso flexor 3-4.

Uncontrolled hypertension (blood pressure >180/110 mmHg), contractures in the ankle joint, pain when walking with a VAS > 3, abnormalities in the lower limbs such as a history of fracture or history of bone surgery in the lower leg, an open wound or non-specific skin disease in the Kinesio Taping installation area, hypersensitivity to Kinesio Taping materials, no history of diabetes mellitus, had medical rehabilitation therapies (thermal modality, stretching exercises) on the lower limbs less than 3 days before the trial, taking medications antispasticity during the past 2 weeks, received botulinum injections and surgical intervention for management of lower extremities spasticity were all exclusion criteria. While the criteria for dropping out included not finishing the study, not participating in stretching exercises >4 times, and not attending the research's introductory and final assessments, and Kinesio Taping was not installed for more than two days

over the study's duration.

The individuals were allocated into two groups after giving their informed consent, and each group's lower extremity spasticity was measured using the tardieu scale (degree of quality of resistance and angle of resistance). Stretching exercises, infrared therapy, and Kinesio Taping interventions were offered to the treatment group. The Kinesio Taping utilized is BSN Medical Kinesio Tape with a width of 5 cm. An allergy test is performed prior to installing Kinesio Taping by placing a piece of Kinesio Taping (± 1 cm) on the skin for 24 hours.

Installation with facilitation technique on the tibialis anterior muscle with a 50% of available tension followed by Kinesio Taping inhibition technique on the gastrocnemius muscle with a 25% of available tension (according to the research protocol), provided Kinesio Taping is applied for 4 days then removed for 24 hours before re-application. Kinesio Taping was applied for 6 weeks (Kinesio Taping was applied at least 30 minutes before activity, removal was performed by the patient's family, and installation was performed by the researcher).

Both groups received infrared therapy twice a week for six weeks, with the intensity determined by the patient's tolerance. The type used an infrared that was given perpendicular to the area being treated, with a distance of 50 cm in the treatment area. Stretching

exercises are also given to the lower extremities twice a week for six weeks in a row, with the severity of the stretch in the stiff area, the stretch holding time are 10–30 seconds, 2–4 repetitions, and the type is passive static flexibility. Hip, knee, and ankle stretching exercises are performed. For 6 weeks, both groups were given a home regimen of stretching exercises every day with guidebooks overseen via video calls.

Data was obtained using data collection sheets, which were then coded, tabulated, and placed into a computer application. Data analysis includes descriptive analysis as well as hypothesis testing. The data distribution normality test, using the Shapiro Wilk test, revealed that age, gender, BMI, stroke duration, type of stroke, and amount of physical activity were all normally distributed. The paired t-test is used to examine the hypothesis of differences before and after treatment. Because the delta data from both groups was normally distributed, an unpaired t-test was used. All data is processed on a computer using the SPSS® 23.0 software version. In this study, significance was determined by obtaining a p value < 0.05 with a 95% confidence interval.

RESULTS

The study's inclusion and exclusion criteria were met by 33 subjects. The study lasted six weeks. The assessment of

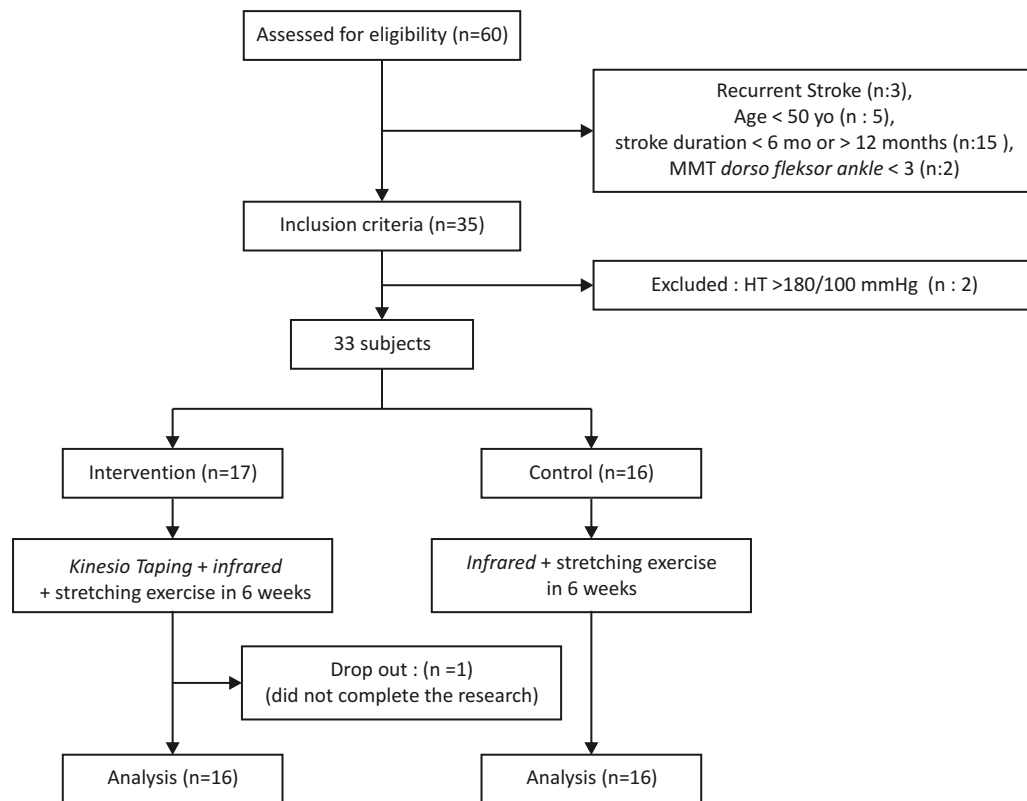


Figure 1. Consort Flow Diagram

TABLE 1
Characteristic of subjects

Variable	Group		p
	Control (16)	Intervention (16)	
Age (years)	59.25 ± 6.49	54.88 ± 7.06	0.078 [§]
Sex	Men	11 (64.7%)	0.156 [¥]
	Women	5 (33.3%)	
Physical activity	Mild	7 (35%)	0.068 [¥]
	Moderate	9 (75%)	
Stroke	SNH	15 (48.4%)	0.500 [£]
	SH	1 (100%)	
Stroke duration	7 (6–12)	8 (6–12)	0.439 [‡]
Degree of quality of plantar fleksor muscle spasticity	1 (1–2)	2 (1–3)	0.483 [‡]
Hemiparesis	Dekstra	5 (45.5%)	1.000 [¥]
	Sinistra	11 (52.4%)	

Explanation : [§]Independent t; [¥]Yates Correction; [£]Fisher's exact; [‡]Mann Whitney
MoCA-INA : *Montreal Cognitive Assessment* Indonesian version; SNH : Stroke Non Hemoragik; SH : Stroke Hemoragik, MMT : *Manual Muscle Testing*

TABLE 2
Degree of quality of muscle resistance

Degree of quality of muscle resistance	Group		p
	Control (16)	Intervention (16)	
Pre treatment	1.50 ± 0.52	1.75 ± 0.68	0.252 [‡]
Post treatment	1.19 ± 0.54	0.88 ± 0.72	0.0177 ^{‡*}
P	0.019 ^{†*}	0.0004 ^{¥*}	
Delta	0.31 ± 0.49	0.88 ± 0.50	0.0042 ^{‡*}

Explanation : *Signifikan (p < 0,05); [‡]Independent t test; [†]Paired t test; [¥]Wilcoxon; [‡]Mann Whitney

spasticity was then repeated at the end of the sixth week of the research. One patient from the treatment group dropped out because he did not complete the study. Subject research did not start on the same day, hence the results were not the same for all subjects at the end of the study. The two research groups were given a stretching exercise home program with videos supplied for stretching exercises and were observed using logbooks and video calls. The total number of participants analyzed until the end of the study was 32. There were no adverse effects reported by the patients or identified during the study's evaluation during or after the study.

Data on the characteristic subject baseline evaluation of all the factors described above (Table 1) obtained a p value >0.05, indicating that there was no significant difference between the treatment and control groups in the demographic data.

Table 2 shows that there were significant differences in the pre-treatment and post-treatment degrees of quality of ankle plantar flexor muscle resistance from the paired t-test in the control (value of p = 0.019) and intervention groups (value of p = 0.0004). There was no significant difference in the unpaired t-test during the pre-treatment (value of p = 0.252), but there were significant differences in the post-treatment (value of p = 0.0177) and delta degrees of quality of muscle resistance (value of p = 0.0042).

Table 3 shows that there was a significant difference in the pre-treatment and post-treatment average angle of dorsi flexor ankle muscle from the paired t-test in the control (value of p = 0.025) and intervention groups (value of p = 0.001). There was no significant change in the unpaired t-test during pre-treatment (value of p = 0.794), but there were significant

TABLE 3
The mean angle of muscle resistance

Angle of muscle resistance	Group		p
	Control (16)	Intervention (16)	
Pre treatment	5.94 ± 2.02	6.25 ± 4.28	0.794 [‡]
Post treatment	4.38 ± 3.10	1.88 ± 2.50	0.022 ^{†*}
P	0.025 ^{†*}	0.001 ^{†*}	
Delta	-1.56 ± 2.39	-4.38 ± 3.59	0.012 ^{‡*}

Explanation : *Signifikan ($p < 0.05$); [‡]Mann Whitney; [†]Independent t test; *Paired t test

differences in the post-treatment (value of $p = 0.022$) and delta mean angle of muscle resistance (value of $p = 0.012$).

DISCUSSION

The effect of infrared therapy and stretching exercises on spasticity

Upper motor neuron lesions occur in stroke patients, causing symptoms such as spasticity. Spasticity can develop in the ankle (66% of the incidence).³ This can result in a drop foot condition. This syndrome is caused by a weakness of the dorsi flexor ankle muscles, which is followed by an increase in tone of the plantar flexor muscles (gastrocnemius muscles). This causes the feet to be in an unfavorable position, resulting in a reduction in the contact area with the floor surface on the soles of the feet, resulting in a decrease in sensory input received by the plantar mechanoreceptors for posture adjustment.⁵ This abnormal gait pattern is caused mostly by difficulty moving the body by supporting the affected side, resulting in a hemiplegic walking pattern.¹¹

The Tardieu scale is used for measuring spasticity, and its components measure the degree of quality and the angle of resistance. Because it is assessed subjectively and objectively, this measurement is more valid. The results of this study revealed a reduction in plantar flexor muscle spasticity in the control group who underwent infrared therapy and stretching exercises, as well as a reduction in the degree of resistance quality and the angle of resistance before and after treatment.

These findings support the idea that infrared, as a heat modality with a peak intensity of 1000 nm, can raise the temperature of surface tissue over 40 degrees Celsius. An increase in tissue temperature of up to 42 degrees Celsius reduces the excitation rate of the muscle spindles while increasing the excitation rate of the Golgi tendon organ. Furthermore, heating enhances connective tissue extensibility, with a peak at 40°C to 45°C for 5 to 10 minutes. The process described above shows how heat works to reduce spasticity. The loss of influence on activation of muscle spindles and golgi tendon organs, as well as decreased extensibility of connective tissue, leads

in a drop in muscle tone that cannot be maintained optimally by just heating. Continuous stretching exercises promote changes in the organization of collagen fibers as well as changes in the viscoelasticity of collagen fibers, resulting in a decrease in muscle tone.⁶

This is also consistent with the findings of Ghasemi *et al.*, who provided stretching exercises 3 times a week for 4 weeks in spastic stroke patients and found a reduction in spasticity as measured by the modified Ashworth scale until two months after the program ended.¹² Ergul *et al.* discovered that stretching exercises performed 3 times a week for 4 weeks on the hamstring, quadriceps, hip adductor, and plantar flexor muscles in patients with multiple sclerosis may reduce spasticity in the lower extremities.¹³

The effect of adding Kinesio Taping on spasticity

The application of Kinesio Taping to the muscles will facilitate the tibialis anterior muscles while inhibiting the plantar flexor muscles, resulting in reduced plantar flexor muscle spasticity. Reducing spasticity improves joint range of motion, resulting in more functional walking in stroke patients. Kinesio Taping is applied with 50% tension to the tibialis anterior muscle and 25% tension to the plantar flexor muscles. In this study, the treatment group that received the addition of Kinesio Taping experienced a reduction in ankle plantar flexor muscle spasticity. However, when compared to the control group, the delta of reduction in resistance quality and the resulting angle of resistance was significantly greater.

This is consistent with the hypothesis that using Kinesio Taping with facilitation techniques, from origin to insertion, can improve muscle performance and increase motor unit recruitment, hence increasing muscular strength. This mechanism is hypothesized to be caused by the elastic rebound qualities of Kinesio Taping influencing the length-to-tone relationship. Taping from the origin to the insertion improves reflex contraction of the muscle spindles and promotes muscular contraction. The concept is based on cutaneous afferent impulses that are hypothesized to influence the excitability of the motor unit as well as the proprioceptive reflex arc. Through

pressure and tension, Kinesio Taping will stimulate skin mechanoreceptors, resulting in physiological changes such as increased muscle activity and recruitment of firing motor units.¹⁴

Kinesio Taping with inhibited techniques used from insertion to origin through receptors on the skin's surface can provide stimulation to the neuromuscular system by facilitating in the activation of nerve and muscle performance when performing a functional movement. Kinesio Taping can improve muscle and tendon function by stimulating mechanical receptors, namely the Golgi tendon organ in the muscle tendon junction. During movement, the Golgi tendon organ regulates the muscle spindles. Kinesio Taping applied in an inhibitory approach to the ankle plantar flexor muscle through the Achilles tendon will inhibit the Golgi tendon organ, consequently helping to regulate the tone of the ankle plantar flexor muscle. As a result, the ankle plantar flexor muscles' spasticity is decreased. The insertion and origin of Kinesio Taping, as well as the muscle fibers, fascia, and skin above it, are moved away from the center of mass using this inhibitory technique, which inhibits muscle contraction.^{15,16} The muscles work better when muscle tone is reduced with Kinesio Taping stretch inhibition of the ankle plantar flexor muscles.

The findings of this study coincide with the findings of Razti *et al* and Roy *et al*. Razti stated that Kinesio Taping with 35% tension will help the wrist extensor muscles due to the effect of skin mechanoreceptors through pressure and stretch, causing physiological changes such as increased muscle recruitment. Furthermore, Kinesio Taping enhances the flow of blood arteries and lymph, which affects muscle function.¹⁷ Furthermore, Yam *et al*. and others who studied the influence of Kinesio Taping on muscle activation reported that 50% Kinesio Taping resulted in significant outcomes.¹⁸ According to Koseoglu *et al*, applying Kinesio Taping with facilitation techniques to the ankle dorso flexor muscles can enhance muscle contractions in stroke patients.⁹ The research by Cavalcante *et al*, which demonstrates a reduction in spasticity in the wrist flexor muscles following 6 weeks of Kinesio Taping treatment in post-stroke patients as measured by the modified ashworth scale (MAS).⁸

Kinesio Taping applied to spastic muscles after infrared therapy and stretching exercises will result in optimum tissue extensibility. Subjectively, the subjects reported a reduction in the sensation of being pulled and tight, which is typically felt on the side of pain, after getting Kinesio Taping. This provides weight to the study's objective findings. All of this contributes to a lower delta degree of quality and a greater angle of resistance in the group who received Kinesio Taping. The findings of this study support the research hypothesis, namely that there is a significant difference in a reduction in the average degree of quality and the angle of

resistance between the intervention and control groups at the end of the study.

The use of Kinesio Taping was also determined to be safe for post-stroke patients in this study. There was no mention of any potential pain or adverse effects in the literature. Kinesio Taping's strong effectiveness and lack of side effects may be reasons for considering it as a complement in the treatment of stroke spasticity.

CONCLUSION

In post-stroke patients who received Kinesio Taping in conjunction with infrared therapy and stretching exercises, there was a significant difference in improvement in spasticity of the ankle plantar flexor muscles, which was greater than in those who was infrared and stretching exercises alone. Kinesio taping can be applied as a complementary treatment to relieve spasticity in stroke patients who are receiving other treatments. The findings of this study can be used to guide future studies into the long-term effect of Kinesio Taping on spasticity. Following the Kinesio Taping treatment, a follow-up study can be performed to assess the effectiveness of the addition of Kinesio Taping in post-stroke rehabilitation that receives infrared and stretching exercises against spasticity while taking neuroplasticity and the drugs given into consideration.

REFERENCES

1. Kuriakose D, Xiao Z. Pathophysiology and Treatment of Stroke: Present Status and Future Perspectives. 2020;21(20):7609.
2. Bavikatte G, Subramanian G, Ashford S, Allison R, Hicklin D. Early Identification, Intervention and Management of Post-stroke Spasticity: Expert Consensus Recommendations. 2021;13:11795735211036576.
3. Kuo C-L, Hu G-C. Post-stroke Spasticity: A Review of Epidemiology, Pathophysiology, and Treatments. International Journal of Gerontology 2018;12(4):280-4.
4. Huang YC, Chen PC, Tso HH, Yang YC, Ho TL, Leong CP. Effects of kinesio taping on hemiplegic hand in patients with upper limb post-stroke spasticity: a randomized controlled pilot study. European journal of physical and rehabilitation medicine 2019;55(5):551-7.
5. Son J, Rymer WZ. Effects of Changes in Ankle Joint Angle on the Relation Between Plantarflexion Torque and EMG Magnitude in Major Plantar Flexors of Male Chronic Stroke Survivors. 2020;11.
6. Cameron MH. Thermal Agents. Physical Agents in Rehabilitation : An Evidence-Based Approach to Practice. Fifth ed. St Louis, MO: Saunders Elsevier; 2018. p. 509-13.
7. Lecharte T, Gross R, Nordez A, Le Sant G. Effect of chronic stretching interventions on the mechanical properties of muscles in patients with stroke: A systematic review. Ann Phys Rehabil Med 2020;63(3):222-9.
8. Cavalcante J, Silva M, Silva J, Anjos C, Soutinho R. Effect of Kinesio Taping on Hand Function in Hemiparetic Patients. World Journal of Neuroscience 2018;08:293-302.
9. Koseoglu BF, Dogan A, Tatli HU, Sezgin Ozcan D, Polat CS.

- Can kinesio tape be used as an ankle training method in the rehabilitation of the stroke patients? *Complement Ther Clin Pract* 2017;27:46-51.
10. Gloria E Rondonuwu , Lidwina S Sengkey, Marpaung. E. Pengaruh Kinesio Taping Terhadap Fungsi Mobilitas Berjalan pada Pasca Stroke *Jurnal Medik dan Rehabilitasi (JMR)* 2020;2:1-9.
 11. Timmermans C, Roerdink M, Meskers CGM, Beek PJ, Janssen TWJ. Walking-adaptability therapy after stroke: results of a randomized controlled trial. *Trials* 2021;22(1):923.
 12. Ghasemi E, Khademi-Kalantari K, Khalkhali-Zavieh M, Rezasoltani A, Ghasemi M, Baghban AA, *et al.* The effect of functional stretching exercises on functional outcomes in spastic stroke patients: A randomized controlled clinical trial. *Journal of bodywork and movement therapies* 2018;22(4):1004-12.
 13. Ergul M. NMA, Biglarian A. Effects of Static and Functional Stretching Exercises on Lower Limb Spasticity and Function in People with Multiple Sclerosis: A Randomized Controlled Trial. *Turk J Physiother Rehabil* 2021;32(3):43-51.
 14. Denizoglu Külli H, Karabulut D, Arslan YZ. The prolonged effect of Kinesio Taping on joint torque and muscle activity. *Somatosensory & Motor Research* 2022;40:1-7.
 15. Sheng Y, Kan S, Wen Z, Chen W, Qi Q, Qu Q, *et al.* Effect of Kinesio Taping on the Walking Ability of Patients with Foot Drop after Stroke. *Evidence-based complementary and alternative medicine : eCAM* 2019;2019:2459852.
 16. Park SJ, Kim T-H, Oh S. Immediate Effects of Tibialis Anterior and Calf Muscle Taping on Center of Pressure Excursion in Chronic Stroke Patients: A Cross-Over Study. 2020;17(11):4109.
 17. Roy S, Dixit J, Kumar A, Singh O, editors. *The Effect of Kinesiotaping in Improving Fine Motor Skills In Children With Spastic Diplegic Cerebral Palsy* 2018.
 18. Yam TTT, Or PPL, Ma AWW, Fong SSM, Wong MS. Effect of Kinesio taping on Y-balance test performance and the associated leg muscle activation patterns in children with developmental coordination disorder: A randomized controlled trial. *Gait & posture* 2019;68:388-96.