Investigation of The Effects of Pnf And Kinesiological Taping on Hand Function in Hemiplegic Stroke Patients Based on The ICF Framework

01.01.2025

INTRODUCTION

Stroke is the second leading cause of death and disability among adults over the age of 60 worldwide (Mackay & Mensah, 2004). Approximately 17 million people have a stroke each year in the world, and 140 thousand people in our country (Nazlıel & Akbaş Ilgaz, 2023). Data from all over the world also show that the incidence of stroke will increase in the coming years (Feigin et al., 2021; Wafa et al., 2020). By definition, stroke is a clinical condition that develops after focal infarction or hemorrhage in the cerebral cortex, cerebellum, and spinal cord, causes focal neurological dysfunction, can last 24 hours or longer, and can even result in death (Sacco et al., 2013). After a stroke, the surrounding brain tissue is deprived of oxygen and essential nutrients, and if left untreated, it can lead to permanent tissue damage, including neuronal cell death (Fifield et al., 2020). Damages after a stroke cause motor, sensory, and cognitive impairments in individuals; upper extremity dysfunction, balance, and walking difficulties, causing people to become dependent on various levels in their daily life activities (Doğan, 2023). Post-stroke disability reduces the quality of life of the individual and their relatives, affecting their lives. It also causes socioeconomic and social problems (Wei et al., 2024). Approximately 50-75% of those affected in the early post-stroke period experience upper extremity impairment (Raffin & Hummel, 2018; Simpson et al., 2021), and a large portion of them will live with long-term upper extremity impairment (Meyer et al., 2015; Nijland et al., 2010). Although most individuals regain walking function after a stroke, very few can use their upper extremities, especially their hands, at a fully functional level. Upper extremity function after stroke is among the leading causes of long-term disability. This is because the natural recovery of upper extremity function is generally more limited than that of the lower extremity (Alsubiheen et al., 2022). Impaired use of the upper extremity persists in approximately 60% of patients even 6 months after stroke (Triccas et al., 2019). Exercise interventions are necessary to improve upper extremity motor functions and activities of daily living (ADL) in stroke patients, because persistent upper extremity dysfunction is strongly associated with decreased activities of daily living and poor quality of life after stroke (Lindgren & Maguire, 2016; Y. Wang et al., 2022; Wen et al., 2022).

Abnormal synergies occur in the extremities of patients who have had a stroke. Literature has defined two main synergies for the upper extremity: Flexion or extension synergy pattern (Twitchell, 1951). These synergies in the upper extremity and hand lead to loss of movement, interfere with activities of daily living, including dressing and hygiene, may cause skin breakdown, and may cause pain. Over time, weakness in the hemiparetic hand, motor disorders caused by abnormal synergies and permanent spasticity begin to cause secondary changes in the musculoskeletal system that may limit the use of the arm and hand and affect functional mobility; soft tissue shortening and contracture formation may be observed (Namdari et al., 2012; Nelson et al., 2018). There is a wide range of treatments for upper extremity recovery following stroke. These methods recommend integrated treatments for both the hand and arm. Upper limb rehabilitation aims to provide all possible tools to restore lost function

and increase the autonomy of stroke patients, taking into account residual impairments and disabilities (Hatem et al., 2016). Carr and Shepherd (Carr & Shepherd, 2011) suggested that poor recovery in the upper limb may result from the direct effects of stroke as well as from inadequate, inappropriate, or incorrect therapeutic interventions. However, little information explains what best represents the "optimal treatment" (Ballinger et al., 1999). The chosen treatment modality may be directed at a specific impairment (e.g., muscle weakness) or functional movements (e.g., grasping and letting go activity). These treatment modalities may be used separately or combined to address the multifactorial impairments that may arise following stroke, i.e., primary problems and secondary complications. Therefore, it should be noted that upper extremity rehabilitation after stroke will involve a complex intervention that requires the cooperation of the patient, caregivers, and the rehabilitation team (Pollock et al., 2014).

Neuromuscular therapies, one of the approaches used in treating stroke, include multiple methods. In recent years, activities related to the recovery of motor functions have become the focus of research by scientists dedicated to the development of the topic of brain plasticity, which allows a person to adapt to the environment through learning and self-repair after damage (Rejdak & Słowik, 2018; Zhang et al., 2021). A typical example of neural plasticity is the recovery process after ischemic stroke, which initiates the reorganization of the central nervous system and the assumption of some functions by undamaged parts of brain structures. Reorganization also involves expanding cortical areas that provide the neural substrate for recovering or adapting motor activities after damage (Segura et al., 2020). The results of studies on brain plasticity have revealed that the proprioceptive neuromuscular facilitation (PNF) technique, one of the neuromuscular treatments, provides the development of neurorehabilitation (Nguyen et al., 2022; J. S. Wang et al., 2016). Proprioceptive neuromuscular facilitation (PNF) is a therapeutic approach that provides input with cutaneous, proprioceptive, auditory, and visual stimuli to provide functional improvement in motor movement and can play a vital role in the rehabilitation of many injuries. PNF is a special manual technique that combines different planes of movement and is applied by physiotherapists to improve the patient's functional status. This method effectively supports the patient in achieving their goals by making movements more functional (Nguyen et al., 2022). Studies have shown that it is effective in pain management, increasing range of motion, developing muscle strength and endurance, improving balance and coordination, providing proximal stability, and supporting functional progress. Neuromuscular reeducation applications are widely preferred in the early rehabilitation processes of acute or subacute periods to improve paralyzed patients' motor functions (Guiu-Tula et al., 2017; Gunning & Uszynski, 2019). This method stimulates the proprioceptive organs in the muscles and tendons to improve muscle functions, promotes the emergence of postural reflexes, and regulates muscle contraction to increase strength, flexibility, balance, and coordination (C. S. Cayco et al., 2017; Gabriel et al., 2006; Shimura & Kasai, 2002). Many articles have revealed that a PNF-based program has the potential to produce positive results on motor function in

older adults with acute and chronic paralysis (C. Cayco et al., 2019; C. S. Cayco et al., 2017; Ribeiro et al., 2014). A 2018 study found that PNF was effective in improving upper extremity motor skills and function in acute and/or subacute stroke patients (Chaturvedi et al., 2018), while other studies found that it was effective in reducing spasticity, increasing joint range of motion, and improving self-care function in the chronic stage.

Another neuromuscular treatment method used in stroke patients is kinesiology taping. Kinesiology taping (KT) was introduced by Kenzo Kase in 1996 and is a practice that usually involves the combination of applying appropriate tension along the elastic therapeutic tape and placing the target muscle in a tense position, and is widely used as an interesting and relatively new method for various clinical treatments (Hu et al., 2019). KT is an elastic, cotton, adhesive bandage with a 140% elongation feature that can mimic the flexibility and tension of human skin, muscle, and fascia (Kase, 2003). Previous studies have shown that kinesiology taping can increase blood circulation, provide mechanical support and proprioceptive feedback, improve joint range of motion, and activate muscles. KT has gained popularity in clinical practice and has been used in clinical practice worldwide (Fandim et al., 2024). KT applications can promote functional use of the upper and lower extremities by supporting weak muscles, relaxing overstretched muscles, reducing pain, and improving balance (Jaraczewska & Long, 2006). Based on these observations, kinesiology taping is a potential treatment for spasticity, regulating motor control and tone, providing proprioceptive input, and enhancing functions (Bolognini et al., 2016).

The International Classification of Functioning, Disability and Health (ICF) is an international and standardized classification system developed by the World Health Organization (WHO) to be applied in many branches of health and to evaluate functionality, disability, and health holistically (Cieza et al., 2004). ICF can be used for many purposes; this classification system is a policy and planning tool for decision makers. In addition to categorizing health, ICF can be used to determine functional status, plan rehabilitation programs, and guide goal achievement (Björck-Åkesson et al., 2010). An interdisciplinary team approach in which different specialists work harmoniously and closely in stroke treatment has been defined as the basis for effective stroke rehabilitation programs (Teasell et al., 2016). Measuring, reporting, and comparing outcomes across each treatment approach is important to improve outcomes and make informed choices about optimizing healthcare and rationalizing costs (Teasell & Hussein, 2016).

Originality and innovative character of the study;

Research question 1: Do PNF applications with a conventional physiotherapy program in hemiplegic stroke patients have long-term effects on hand functions?

Research question 2: Do KT applications with a conventional physiotherapy program in hemiplegic stroke patients have long-term effects on hand functions?

Research question 3: Do PNF and KT applications with a conventional physiotherapy program in hemiplegic stroke patients have long-term effects on hand functions?

Research question 4: Does the effect of PNF applications applied together with a conventional physiotherapy program in hemiplegic stroke patients affect activity?

Research question 5: Does the effect of KT applications with a conventional physiotherapy program in hemiplegic stroke patients affect hand functions?

Research question 6: Does the effect of PNF and KT applications with a conventional physiotherapy program on hand functions in hemiplegic stroke patients affect activity?

Research question 7: Does the effect of PNF applications and a conventional physiotherapy program on hand functions in hemiplegic stroke patients affect participation?

Research question 8: Does the effect of KT applications with a conventional physiotherapy program on hand functions in hemiplegic stroke patients affect participation?

Research question 9: Does the effect of PNF and KT applications with a conventional physiotherapy program on hand functions in hemiplegic stroke patients affect participation?

Original value of the study:

The original value of the study 1: This is the first study to evaluate hand functions in hemiplegic stroke patients using PNF and KT applications with a conventional physiotherapy program.

The original value of the study 2: This study is conducted to compare the effects of PNF, KT, and PNF+KT applications applied in addition to the conventional physiotherapy program on hand functions in hemiplegic stroke patients

The original value of the study 3: While investigating the effects of PNF, KT, and PNF+KT applications applied in addition to the conventional physiotherapy program on hand functions in hemiplegic stroke patients, this project will report for the first time how these treatments affect the patient's body structure, activity, and participation level.

The original value of the study 4: Determining the effects of PNF, KT, and PNF+KT applications applied in addition to the conventional physiotherapy program on hand functions in hemiplegic stroke patients on motor activation, social adaptation, and activities will be a guide for physiotherapists, occupational therapists, and mental health specialists.

In the literature, PNF applications in hemiplegic patients are a frequently studied topic (Nguyen et al., 2022; Kaminska & Sargsjane, 2024). Although kinesiology taping applications are less common than PNF applications, studies have generally compared acute effects (Tan et al., 2022). In the literature, there are meta-analyses examining the effects of PNF and kinesiology taping on shoulder pain and upper

extremity functions in stroke (Tan et al., 2022) and examining the effects of PNF application on upper extremity functions (Guiu-Tula et al., 2017). However, no study has been found investigating kinesiology taping and PNF applications together and separately in a study, comparing their long-term effects and examining their effects on hand function. In addition, activity and participation levels will be examined within the scope of the ICF as a result of these applications. In this context, the study is intended to be a guide for physiotherapists, occupational therapists, and mental health specialists:

Hypotheses of this research:

H1: PNF applications affect hand functions in hemiplegic stroke patients.

H2: KT applications affect hand functions in hemiplegic stroke patients.

H3: PNF+ KT applications affect hand functions in hemiplegic stroke patients.

H4: PNF+ KT applications affect activity in hemiplegic stroke patients.

H5: PNF+ KT applications affect participation in hemiplegic stroke patients.

METHOD

SELECTION AND DETERMINATION OF THE TARGET GROUP

The research and applications will be conducted at Ondokuz Mayıs University, SUVAM Havza Physical Therapy and Rehabilitation Center, and İstinye University Hospitals. Patients who meet the inclusion criteria will be informed by İlker İlhanlı, Mahmut Yaran, and Berrak Varhan and included in the study.

Place of the research: Ondokuz Mayıs University, SUVAM Havza Physical Therapy and Rehabilitation Center, İstinye University Hospital (Bahçeşehir Liv Hospital).

Time of the research: Ethical approval was obtained from Ondokuz Mayıs University Clinical Research Ethics Committee (DECISION NO: 2024/565). The project will start after the materials are supplied.

The universe, sample, and research group of the study: This study, which was conducted to examine the effects of PNF and KT applications applied in addition to conventional treatment on hand functions in hemiplegic stroke patients, will include hemiplegic stroke patients who apply to On Dokuz Mayıs University, SUVAM Havza Physical Therapy and Rehabilitation Center, İstinye University Hospital (Bahçeşehir Liv Hospital), and are receiving treatment, who volunteer to participate in the study, and who meet the inclusion criteria.

Study Design: It was designed as a prospective, randomized, controlled, single-blind (the evaluator is blinded) clinical study.

In order to ensure that the number of patients in the groups is equal, as well as similar in terms of factors such as age, gender, and Brunnstrom stages, a stratified randomization method will be used. An equal number of patients will be selected by a simple random method with a computer-generated randomization program ('www.randomizer.org') in a ratio of 1:1:1, stratified according to age, gender, and Brunnstrom stages. Thus, a homogeneous distribution will be provided in each group according to gender, age, and Brunnstrom stages. The researchers who will make the evaluations and outcome measurements will not know the distribution of the groups throughout the study and will be blind. The group to which the participants will be assigned will be determined by a researcher not involved in the data collection process using sealed and sequentially numbered opaque envelopes. The group will be determined by checking the sequence number in the envelope chosen by the participant from the randomization table. The participant will know the sequence number but not know which group this sequence number belongs to. Similarly, the researcher who will make the evaluations and the researcher who will make the data statistics will not know which group the patients are included in. The participants will be trained in different groups in different environments. The physician will evaluate whether there is an obstacle to including the individuals in the study. The procedures will be explained to the patients verbally before the evaluation.

Inclusion criteria for the study (Junior et al., 2019; Kim & Kim, 2015; Saklecha et al., 2023)

- Stroke diagnosed by MRI or CT, regardless of ischemic or hemorrhagic origin,
- Hemiplegia caused by stroke alone,
- At least 6 and at most 24 months have passed since the stroke was diagnosed
- Being over 18 years of age,
- Volunteering to participate in the study
- Scoring 24 or more on the Standardized Mini Mental State Examination (if illiterate, scoring 18 or more is sufficient)
- Cooperating with the evaluation, tests, and treatment
- Understanding and speaking Turkish
- Being at least stage 4 according to Brunnstrom staging

Exclusion Criteria (Junior et al., 2019; Kim & Kim, 2015; Saklecha et al., 2023)

- Bilateral Individuals with hemiplegia
- Individuals with unstable vital signs
- Individuals with any open wound in the upper extremity
- Pathological conditions affecting the upper extremity sensation (undergoing surgery after fracture, etc.)
- Individuals with a BMI value of more than 29.9 kg/m2

- Individuals with a Standardized Mini Mental Test score below 24 points (18 points)
- Individuals with major neurological or rheumatological disorders affecting the musculoskeletal system other than stroke (Polyneuropathy, Parkinson's, Multiple Sclerosis, Rheumatoid Arthritis, etc.)
- Presence of upper extremity amputation
- Being at less than stage 4 according to Brunnstrom staging

Calculation was performed with the G*Power program, version 3.1, to determine the sample size. The effect size obtained as 95% confidence (1-α), 90% test power (1-β), f=0.2526456 was analyzed by taking 0.06 as the medium effect size when Cohen's Effect size was considered. According to the repeated measures ANOVA power analysis result, 54 cases should be taken in 3 groups (Cohen, 1988). The patients included in the study will be divided into the PNF group, the KT group, and the PNF+KT application group using the stratified randomization technique. Thus, the groups will be distributed homogeneously. The procedures will be explained to the patients verbally before the evaluation.

The patients to be included in the study will be divided into three groups. As a result of the randomization, PNF will be applied to the first group, KT will be applied to the second group, and KT and PNF will be applied together to the third group. The treatment frequency is planned as 8 weeks, 3 days a week. All participants will continue to receive conventional treatment during the same period. The evaluation of the cases will be done twice, before and after the treatment. In evaluating the cases, body structure and functions, activity and participation status, and their relationship with the environment will be investigated together with tests for hand function.

ASSESSMENTS AND MEASUREMENTS BEFORE AND AFTER THE TREATMENT PROGRAM

The members of the multidisciplinary team working in the field of physiotherapy and rehabilitation who took part in the study are as follows.

· Prof. Dr. İlker İlhanlı, an expert physiatrist experienced in stroke

· Physical therapist faculty members were blind to the treatment who made the pre-treatment evaluation of the cases (Advisors). Assoc. Prof. Dr. Mahmut Yaran, Assoc. Prof. Berrak Varhan

· The first researcher who performed the treatment, Physiotherapist, Spec. Physiotherapist Elif Önder

Evaluation Methods to be Used

1. Demographic Information Form:

The sociodemographic information of the participant and information about his/her disease will be questioned. Gender, age, height, weight, education status, marital status, dominant side, affected side, additional morbidities and mortalities, smoking, alcohol habits, profession and working status, date of stroke, how long physiotherapy has been received, and how many days per week it has been received. According to the Bamford classification, the etiology of stroke will be questioned.

2. Brunnstrom Motor Staging:

According to the Brunnstrom motor staging upper extremity scale, the Brunnstrom stage will be determined for the hand and fingers.

Stage 1: The hand is flaccid. There is no voluntary motor activity.

Stage 2: Slight flexion movement has started in the fingers.

Stage 3: Rough and hook grip has started in the hand. However, there is no voluntary finger extension and relaxation, and the object held cannot be released. Reflex extension movement can be seen in the fingers occasionally, and the objects in the hand may fall.

Stage 4: He can make a lateral grip and release objects with thumb movement. Finger extension that can be considered partially voluntary is seen at small angles.

Stage 5: Palmar grasp, cylindrical or spherical finger grasps have begun, although not entirely voluntary and controlled. Voluntary gross finger extension is observed at different angles.

Stage 6: Control is gained in all grasps, isolated flexion and full extension can be done in the fingers, and skills may be limited compared to the normal hand.

3. Standardized Mini Mental Test (SMMT)

Folstein and his colleagues first published the Standardized Mini Mental Test (SMMT). The SMMT is a test that evaluates cognitive functions. The maximum score that can be obtained is 30. The total test score is between 24 and 30 points if the patient's cognitive functions are intact, and 24 points or below if there is cognitive impairment. It is stated that the SMMT, one of the most widely used scales in the world, is widely accepted in Turkey (Güngen et al., 2002; Patel et al., 2002). MMT shows 80% sensitivity and 98% specificity for detecting cognitive problems (Blake et al., 2002). The test has five main titles: orientation, recording memory, attention and calculation, recall, and language. In each subparameter, a correct answer will be scored 1 point, and an incorrect answer will be scored 0 points (Güngen et al., 2002). 4. Fugl Meyer Upper Extremity Motor Assessment Scale

The Fugl Meyer assessment scale is a stroke-specific, performance-based scale, and each parameter is scored as 0, unsuccessful; 1, partially successful; and 2, completely successful performance (Fugl-Meyer et al., 1975; Gladstone et al., 2002). In the shoulder, elbow, and forearm, reflex activity,

voluntary movements performed with dynamic flexor and/or extensor synergies, voluntary movements performed with the combined use of dynamic flexor and extensor synergies, voluntary movements performed without or with little dependence on synergies, and normal reflex activity parameters are evaluated. Three different functions of the wrist muscles are evaluated when evaluating the wrist. The hemiplegia hand evaluation evaluates 7 movements (flexion, extension, and five grasping functions). In the coordination/speed evaluation, the finger-nose test is performed for the upper extremity. During this test, tremor, dysmetria, and movement speed are evaluated. The maximum motor performance score for the upper extremity is 66 points (Fugl-Meyer et al., 1975).

5. Action Research Arm Test (ARAT)

ARAT observes arm and hand movements during various reaching and grasping tasks (Zhao et al., 2019). It measures the ability to qualitatively use and carry large or small objects, including manual dexterity and proximal strength for the upper extremity (Nomikos et al., 2018). The ARAT rates the upper extremity on a 4-point scale (maximum 57 points for each upper extremity): 3 points if the task is performed normally; 2 points if the task is completed but takes an abnormally long time; 2 points if performed with great difficulty or poorly coordinated movements; 1 point if the task is only partially completed; and 0 points if the task is not performed at all (Rabadi & Rabadi, 2006). Studies have reported high reliability and validity of the ARAT (Nomikos et al., 2018). The main advantage of the test is its ability to assess a wide range of upper extremity functions after stroke (Rabadi & Rabadi, 2006).

6. Box and Block Test

The Box and Block Test measures unilateral manual dexterity. It is a fast, simple, and inexpensive test. It can be used in a wide variety of diseases, including stroke patients. It consists of a box divided into two sections and 150 blocks. The wooden blocks are cubes measuring 2.5 cm x 2.5 cm x 2.5 cm. The barrier in the middle of the box is 15.2 cm. Patients are asked to throw the blocks from one section to the other, one by one, within 60 seconds, and the number of blocks is recorded (Mathiowetz et al., 1985).

7. Nine-Hole Peg Test

It is a fast and straightforward test used to evaluate changes in hand function. The participant is asked to place nine rods suitable for a wooden block with nine holes as quickly as possible and remove them. The test is repeated twice, and the score is determined as the average of the two attempts. The participant is expected to perform the test with the hand on the affected side of the body (Temporiti et al., 2023).

8. Upper Extremity Physiological Profile Assessment (PPA)

The test battery called the Upper Extremity Physiological Profile Assessment (PPA) consists of 13 separate tests (17 total outcome measures) classified into different areas: muscle strength, unilateral movement and dexterity, position sense, skin sense, bimanual coordination, arm stability, and functional tasks (Ingram et al., 2019).

The first area consists of two tests measuring muscle strength, the isometric elbow flexion test and the pinch grip test.

The second area measures unilateral movement and manual dexterity, finger reaction test, finger touch test, loop and wire test, and nine-hole peg test.

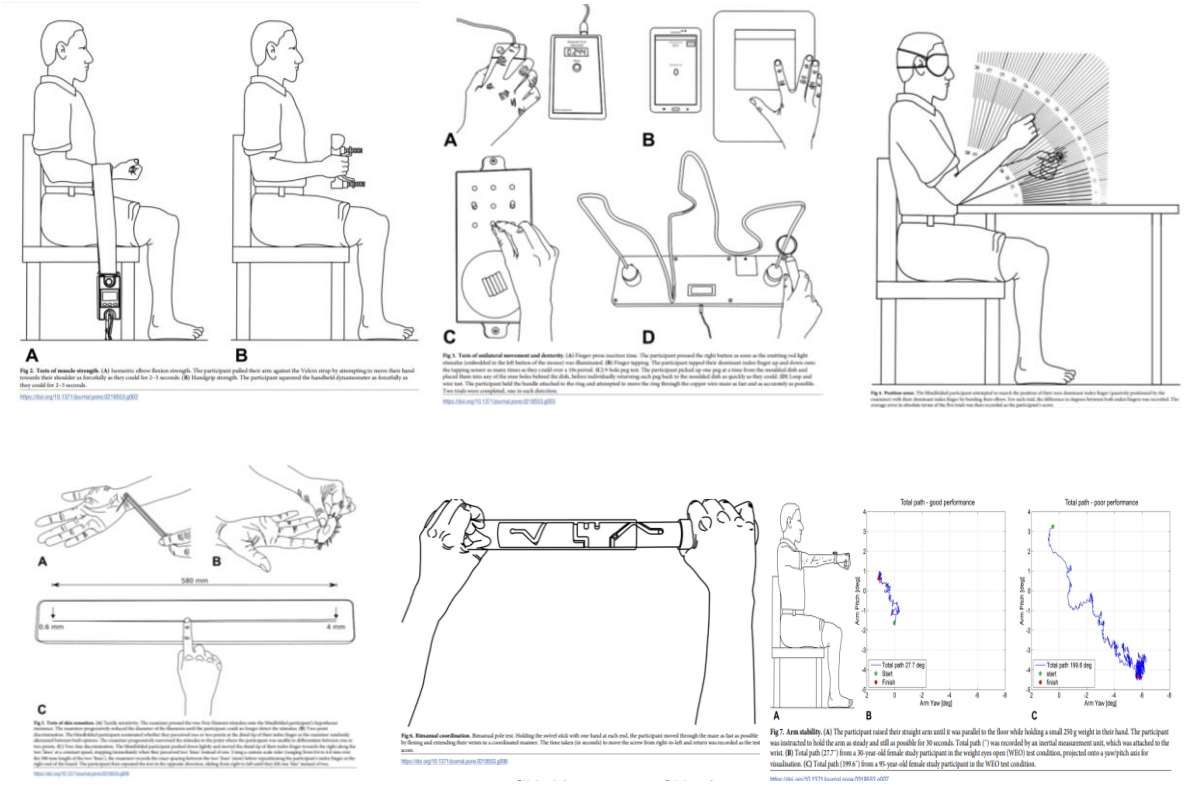
The third area consists of a position test that evaluates position sense.

The fourth area consists of tests that evaluate skin sensitivity. Tactile sensitivity, two-point discrimination, and two-line discrimination.

The fifth area will be used to test the bimanual coordination and the pole test.

The sixth area is the arm stability test, which measures arm stability. Here, the IMU-Accelerometer accelerometer will be used.

The seventh and last area is the shirt task test that measures functional performance.



9. Environmental Quality Scale

The scale evaluates the impact of the environment on the individual's abilities and limitations while performing daily activities. The short form consists of 26 questions in total. Each question includes two options: facilitating and complicating. The scale's scoring ranges from -3 to 3. The facilitating option includes a score of 1 to 3, and the complicating option includes a score of -1 to -3. A score between 1 and 3 indicates that environmental factors facilitate the individual's daily life and social roles, and a score of zero indicates that they do not affect social interaction. A score between -1 and -3 is considered harmful. All positive and negative results are collected separately. The application takes approximately 10 minutes.

The Environmental Quality Scale was developed by Fougeyrollas (Fougeyrollas et al., 2002), and its Turkish validity and reliability were examined by Akyürek (Akyürek, 2011) in 2011. The Cronbach Alpha coefficient measuring the internal consistency of the questionnaire is 0.84 and 0.83. The questionnaire was found to be moderately reliable regarding test-retest reliability ($p<0.05$). 10. Upper Extremity Motor Activity Diary-28

This scale, which aims to evaluate the function of the hemiparetic upper extremity, was developed by Uswatte et al. in 2006. 30 upper extremity functions are evaluated and scored with 2 different scales as "level of use" and "quality of use". The scores for each scale are calculated by adding them together and dividing them by the number of marked items (Uswatte et al., 2005). The validity and reliability of the scale in Turkish have been examined (Ersöz Hüseyinsinoğlu et al., 2011).

11. Stroke Impact Scale 3.0 (SES 3.0)

The stroke impact scale was created in 1999 based on patient and caregiver data. SES 3.0 was developed by the Mapi Research Trust in 2003 (Nichols-Larsen et al., 2005). Its Turkish validity and reliability were performed by Hantal and colleagues in 2013 (Hantal et al., 2014). It is a stroke-specific health status scale that allows patients and their caregivers to evaluate the patient's general condition, the quality of life, and functional dependency status of individuals with the disease after a stroke. SES 3.0 consists of 8 subsections and a total of 59 questions. All questions are used to evaluate the difficulties experienced by the patient in the last week. The evaluation is scored with a 5-point Likert scale.

12. Social Adaptation Scale

The social adaptation scale consists of 10 items (McColl et al., 2001). The survey focused on personal experiences regarding the level of integration with society rather than objective and observable aspects of social integration. The internal consistency of the survey was found to be Cronbach's alpha = 0.955, and the test-retest reliability ICC = 0.99 (Yaran et al., 2024).

IMPLEMENTATION AND FOLLOW-UP OF THE TREATMENT PROGRAM

Specialist Physician Elif Önder will participate in the treatment's implementation phase.

Treatment Method: Treatment will be given to patients who continue the rehabilitation program due to hemiplegic stroke and meet the inclusion criteria. The treatment will be applied in addition to the conventional physiotherapy program in 24 sessions, 3 days a week for 8 weeks.

Group 1: PNF application Group (n: 18): Conventional Physiotherapy + PNF application

Group 2: KT application Group (n: 18): Conventional Physiotherapy + KT application

Group 3: PNF+KT application Group (n: 18): Conventional Physiotherapy +PNF + KT application

PNF Application: In the application method, the subjects will be in a sitting position. The application will be made to the fingers, wrist, and forearm in both D1 and D2 directions in flexion and extension patterns. The techniques will start using rhythmic initiation, and then the combination of isotonics, dynamic-opposite, rhythmic stabilization, and muscle relaxation will be determined. The movements will be made in 10 repetitions with rest in between (Saklecha et al., 2023).

KT Application: In the taping treatment, taping will be applied from the fingers to the elbow with kinesiology taping (Huang et al., 2019). Taping will be done 3 days a week, and the tape will remain on the patient for 2 days.

PNF+ KT Application: PNF and taping will be applied to this application.

After each application, conventional treatment will be applied to all three groups at the end of each session. When all treatments are completed, re-evaluations will be made by the Physiotherapist who is blind to the treatment.

STATISTICAL ANALYSES AND INTERPRETATION OF RESULTS

The conductor Elif Önder, the researcher İlker İlhanlı, and Berrak Varhan will take part in the process of performing and interpreting the statistical analyses.

SPSS 21.0 for Mac program will be used for statistical analyses. In this study, the data will be analyzed using SPSS for Mac. The normality of continuous variables will be determined by the Shapiro-Wilk test. If the data exhibits a normal distribution, parametric tests such as ANOVA will be used to compare groups. In that case, the T-test will be used in pairwise comparisons, and the Pearson Correlation tests will be used in relationship analysis. Suppose the data does not have a normal distribution. In that case, Kruskal-Wallis-H will be used in comparisons between groups, Man-Whitney U will be used in pairwise comparisons, and Spearman Correlation will be used in relationship analysis. The relationship between categorical variables will be tested with the chi-squared test. The significance level will be accepted as $p<0.05$.

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