CHAPTER 9

FUNCTIONAL ERGOTHERAPY IN PATIENTS WITH STROKE

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World Health Organization (WHO) describes the stroke as rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than that of vascular origin (1). Stroke is the most common cause of death in the world after heart disease and cancer and also the most important cause of disability in the adult population (2). Annually, millions of people worldwide suffer a stroke (3). Only in 2016, over 13 million new stroke cases has been identified worldwide (4). The effects of stroke may vary depending on the localization and size of the affected brain tissue. The vast majority of stroke survivors have sensory, motor, cognitive, and emotional disorders that lead to limitations in their performances in basic daily living activities (5). In addition to these, many different symptoms such as swallowing problems, incontinence, speech problems, balance problems, spasticity, and postural disorders may be seen after a stroke (6). It is known that stroke ranks 3rd in terms of length of hospital stay due to functional and neurological losses and is an important health problem that adversely affects the quality of life (7). 40% of stroke patients leave the hospital with moderate disability and 15-30% with severe disability (8). An effective rehabilitation program in the early period gains importance because of its positive effects on recovery and its relationship with minimal disability. Rehabilitation is very important in stroke patients who have such a degree of disability and have been shown to recover with appropriate treatment (9). Recovery most commonly occurs within the first 2-3 months following a stroke, and cases of chronic motor weakness often go beyond conventional rehabilitation treatment techniques (10).

The purpose of rehabilitation is to ensure the maximum level of independence that the person can reach physically, psychologically, socially, and professionally and to increase the quality of life of the individual (9,11). The main problems developing after stroke are disorders in motor and sensory functions and the com-

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plications that develop secondary to these. Motor disorders range from decreased abilities of limb movement, dexterity, and coordination to total loss of movement, whereas rehabilitative activities have been generally focused on the recovery of motor losses until recent years. However, the sensorimotor cortex, as a whole, must be intact for a normal movement pattern to develop. In clinical studies, even in patients with stroke who were found to be sensory intact as a result of routine neurological examination, sensory disturbances were identified during the quantitative evaluation. Therefore, the sensory evaluation must be carried out carefully and existing sensory disorders must be revealed (12,13). It has been observed that in stroke cases with both sensory and motor deficits, functional use of the extremity is significantly restricted, secondary complications are increased, and the length of hospital stay is prolonged, compared to those with isolated motor deficits. The most common sensory disorders in stroke cases include impaired sense of touch and proprioception, decreased sense of vibration and loss of two-point discrimination, astereognosis (loss of ability to recognize objects by touch), and akinesthesia (impaired ability to perceive body position and joint movements) (12,13).

Joint range of motion (ROM) exercises, which are started in the early period of conventional treatment maintain the flexibility of the joint and prevent contractures. Belts, weights, doughs, and machines are used for tone-up. There are strong pieces of evidence that tone-up increases grip strength (14). Stretching exercises are performed to prevent contractures while scapula mobilization activates the scapula, provides shoulder range of motion, and prevents shoulder pain. As motor function gets better, active exercises, coordination, tone-up, and skill exercises are added (15,16). However, although there is an improvement in muscle strength or joint range of motion as a result of conventional treatment, there may be no change in the daily life activities of the individual and the expected response from the treatment may be lacking. Such results brought ergotherapy (occupational therapy) to the fore, through which sensory disorders are treated as well as motor deficits in stroke rehabilitation, and goal-directed activities are planned according to the habitat and socio-cultural structure of the patient. Ergotherapy is a complementary medical rehabilitation element intended for the realization of significant and goal-directed activities throughout the individual's life (17,18). Studies and meta-analyses conducted have shown that occupational therapy reduces disability in stroke patients (19-21).

GENERAL PRINCIPLES OF ERGOTHERAPY

Ergotherapy is a type of treatment introduced in the treatment of many diseases, that aims for the individual to increase the quality of life, participate in social life,

and gain individual independence. It is to tonify or reduce the pathology in the patient, to protect and increase health, to increase, strengthen and restore the patient's performance in selected tasks, to facilitate the learning of the functions that are essential for adaptation and productivity, and to manage the participation of the person in this process (22). The word ergo is of Greek origin and means 'work'. Ergotherapy, or occupational therapy, aims to improve the health and well-being of patients by providing them with an occupation. The term 'occupation' here refers to the optimal use of time, energy, and interest in active participation in activities of daily living, task and productive capacity, games, and hobbies. Another key word in the definition of occupational therapy is 'participation in selected tasks'. Selected tasks are not just tasks for therapeutic purposes, but tasks in active environmental conditions that are essential for the patient's productivity. Ergotherapy includes many activities such as music, painting, handcrafts, physical activities, motor-function therapy, sensory perception exercises, and life-sustaining exercises.

With ergotherapy, it is aimed to ensure that patients regain their competencies, return to their activities, develop a positive activity identity or reach their maximum capacity (23,24). The basic strategy is to teach the necessary skills to patients and others around them to identify or compensate for the situations that prevent, or restrict the activity performance, to model this into their lives, and to make necessary interventions for the environmental conditions (25). Activity performance is the ability to choose, organize, and perform meaningful tasks that are culturally defined and age-appropriate. Activity performance is shaped by the interaction between the individual's environment and the activity, and by basic personal skills.

The main focus of rehabilitation is the goals of individuals (26). Each patient must be the center of the rehabilitation process individually, and the information that cannot be obtained from objective data must be complemented by the subjective perceptions of the individuals (27). Pollock et al. noted that the active participation of individuals in rehabilitation processes increases in case the rehabilitation process is individual-centered (28). Individual-centered approaches are self-defined rehabilitation goals and collaborative methods between the individual and the therapist. Individual-centered approaches have been studied extensively in the ergotherapy literature for a long time (29,30). Goal-directed activities provide continuity of interest and are keys to motivation. Goal-directed activities in ergotherapy facilitate the adaptive process and thus help to ensure maximum adaptation of the patient and to regulate the dysfunction. To determine appropriate therapeutic activities, an overall analysis of the activity components must be

carried out and the relationship between the activity components and the treatment goals must be identified. The best way to analyze an activity is to examine all the chains of activity and its effects on muscles, joints, and sub-systems.

Ergotherapy is the task of a rehabilitation team. One of the most important members of the team is the patient. The role of the physiatrist in this treatment is to measure and evaluate the patient's performance, to identify short-term and long-term goals of therapy, to create a treatment plan, to evaluate response to therapy, and to evaluate the patient periodically to determine whether the target modification and treatment change are needed.

EVALUATION OF PATIENT

The initial assessment must be in the form of identifying the damages that prevent the individual from achieving functional independence and identifying the competencies and restrictions in self-care and other activities at work, school, play, and hobby area, and at home. Re-evaluations throughout the treatment include determining the effectiveness of the chosen method, modifying partially or fully achieved goals, eliminating goals that seem impossible to achieve, and adding new goals according to additional problems or progress that arise. The evaluation must include the status of the patient's goals, functional abilities, and deficits in performance areas.

Activity Performance Areas include ADLs, task and productive activities, hobbies, and leisure activities.

- ADL includes the ability to perform the performance tasks required for self-care. Some of such activities include dressing, hygiene, eating, mobilization, socialization, communication, and sexual functions.
- Task and productive activities consist of housework, childcare, educational activities, and vocational activities.
- Hobby and leisure activities include the performance in age-appropriate games and hobbies.

Performance Components; The basis of performance areas is performance components. Performance components are learning the developmental behavior patterns that form the basis and infrastructure of the individual's performance.

1. Sensorimotor component: It includes 3 function types.

- Sensory function comprises the processes of being aware of the senses and perceiving. In this component, the ability to receive sensory information, process this information, and produce an appropriate response is crucial.

- Neuromusculoskeletal component comprises structural areas such as reflex responses, range of motion, muscle strength, muscle tone, postural control, and endurance.
- Motor component comprises gross coordination, motor control, fine coordination and skills, and oral motor control.

2. Cognitive component: This term refers to the ability to use higher brain functions. It comprises the functions of alertness, orientation, recognition, attention, initiation of activity, interruption of activity, memory, categorization, formation, problem-solving, learning, and generalization.

3. Psychosocial/psychological component: This is social communication skills. This category comprises interests, hobbies, social communication, interpersonal tasks, self-expression, copying, and self-control (31,32).

In the neurodevelopmental treatment approach, the evaluation of the patient's somatosensory system (SS) and motor control in detail plays a crucial role in the creation of the treatment program.

EVALUATION OF SOMATOSENSORY SYSTEM

SS comprises the sense of touch, movement, temperature, and pain, whereas it consists of two subsystems (33).

1. Primary System (PS) (Protective System, Protopathic System): Receives and interprets simple senses. It is responsible for the perception of touch, pain, and heat. PS uses the lateral (pain, heat) and anterior (touch) spinothalamic pathways. Through these pathways, the sensation is transmitted to the lateral nucleus of the thalamus and is immediately interpreted, resulting in appropriate motor responses. These motor responses are intended for the defense and protection of the organism. Afterward, the information is transmitted to the somatosensory region of the cortex, and learning is performed by recording such information in the memory (34).

2. Epicritic System (ES) (Discriminative System): ES comprises more complex sensory experiences. ES is responsible for more complex and more integrated senses such as the localization of touch, two-point discrimination, stereognosis, kinesthesia, and the perception of minor temperature changes. Information is transported to the thalamus and from there to the cortex by the dorsal columns and medial lemniscal pathway and then integrated and interpreted in the cortex. The cortex needs previous sensory experiences to perform these functions. In other words, ES sense develops together with a learning process. In conscious

proprioception, namely in the perception of joint movement and position, not only information from joints and muscles but also information from receptors in the skin and memory play a role (35-37).

PS sensory tests are performed with superficial touch (with cotton or fingertip), pain (with a needle), hot (40-45 degrees), and cold (5-10 degrees). ES sensory tests comprise moving and static two-point discrimination, stereognosis, position and vibration sense tests, as well as skill tests.

Depending on the localization and size of the post-stroke lesion, a great variety of sensory clinical pictures occur. Since the distal regions of the extremities are represented contralaterally and more widely in the cortex, the most severe sensory losses after cerebral lesions involve the distal extremities (33). SS losses after a cerebrovascular accident (CVO) are seen at a rate of 25-65% (38). Losses are observed most frequently in two-point discrimination, stereognosis, and conscious proprioception senses (39). Such losses adversely affect the patient's perception of the environment, safe ambulation, and particularly hand skills. Impairment and clumsiness in voluntary motor control occur even in cases with full motor function upon the loss of tactile and proprioceptive senses. It has been reported that the friction between the object and the skin must be perceived by mechanoreceptors and the central nervous system (CNS) must be informed through these mechanoreceptor afferents to adjust the force to be applied during gripping and to ensure coordination of the hand intrinsic muscles (35). The relationship between the sensory and motor performance of the hemiplegic hand has been demonstrated by many researchers. It has been found that discriminative senses including cortical interpretation of information coming from the skin, especially two-point discrimination and stereognosis are the senses that show the highest correlation with hand skills (40).

EVALUATION OF MOTOR CONTROL

Normal voluntary movement requires the formation of basic movement patterns for each extremity, and the coordination of these basic movements between the extremities, the adaptation of the speed of movement according to the task to be performed, and the maintenance of body balance despite changes in the center of gravity. The segmental sensorimotor pool in the spinal cord keeps the muscles innervated from this segment ready and alert in a way that can quickly adapt to sudden movements and movement changes in neighboring segments. In general, these present movement patterns or spinal reflexes are the control mechanisms underlying automatic reciprocal movements such as walking. These patterns are

capable of adapting quickly, for example, walking on smooth or obstructed surfaces is possible by using the ability to adapt quickly. Through the sensory pathways in the spinal cord, environmental perceptions are sent to higher centers and thus higher centers are ensured to direct the movement. The stimulus coming from the brain stem, basal ganglia, cortex, and cerebellum through the medulla spinalis motor pathways are collected in the segmental interneuron pool of the spinal cord and transmitted to the anterior horn motor neurons and from there to the target muscles. Along with containing cranial nerve nuclei, the brainstem manages the tonic responses of the body and extremities according to head movements and positions. In normal humans, such tonic responses constitute the basis of posture and movement. Basal ganglia undertake crucial functions such as adjusting the head posture according to the position of the body, keeping different body parts in balanced harmony, starting the movement, and providing suitable positions for the implementation of learned reciprocal movement patterns (41). The cerebellum adjusts the number of active motor units and their frequency of activity thus ensuring the movement to be performed at a speed, strength, accuracy, and softness suitable for the purpose (42). The sensory cortex organizes hand movements according to the sensory stimuli, and the body movements according to the information in memory and to the stimuli received from the body and the environment (41). The motor cortex initiates the movement and informs the lower centers regarding the form of the movement. These centers make the necessary adjustments for the formation of the movement according to the purpose. Besides, the cortex has direct control over the hand muscles. Any disorder in the system causes abnormal posture and movement patterns. The normal movement also requires connective tissue, muscle, joint, and skin structure; all having normal flexibility.

Muscle strength, joint range of motion (ROM), muscle tone, endurance, coordination, and skills must be measured for the evaluation of motor control. Manual muscle testing and grip strength measurements are used for the assessment of muscle strength while goniometric tests are used for ROM measurement, Ashworth scale, etc. for muscle tone, and special tests for the assessments such as coordination and skill.

The next step after determining the goals is to decide the treatment approaches to be applied to the patient. For example, the approaches to be preferred in upper extremity weakness due to CVA include neurodevelopmental, biomechanical, and rehabilitative methods. A rehabilitative approach may be recommended in a chronic case. In the rehabilitative approach, it is aimed to make the patient as

independent as possible in later life by teaching practical methods to compensate for the function of the dysfunctional extremity. If a patient is expected to improve, a biomechanical approach based on muscle strengthening may be preferred, or if the patient's voluntary muscle control is not sufficient and primitive movement patterns are dominant, one of the neurodevelopmental approach methods may be preferred. During the treatment, specific exercises are performed. Their purpose is to compensate for the lost function and improve movement. The patient's interest and cooperation in the treatment will increase if the activities are goal-directed types that become handy in daily life. If the chosen activity forces the patient and leads him to despair, a lighter activity must be preferred, while a more difficult one must be preferred if it seems easy. Problems, goals, and treatment approaches must be reconsidered as the patient's performance increases.

Ergotherapy offers a wide variety of intervention approaches contemplated to meet the diverse needs of patients. Various environmental and personal factors such as age, goals, temperament, or identified challenges are taken into account when specifying the intervention that fits the best in a given situation. In the treatment planning process, conditions such as the patient's characteristics, weaknesses and strengths, performance skills, environmental factors, and the expectations of the individual and the family must be taken into consideration. Activities that are meaningful and purposeful for the patient must be selected.

Treatment Strategies

- Restoration; to regain a lost or impaired skill.
- Maintenance; to support the maintenance of acquired skills so that there is no decrease in activity performance.
- Adaptation; to make changes in the environment or task to allow the patient to be more independently involved in an intended activity.
- Protection; to prevent problems that limit activity performance.
- Create or Support; to provide experiences and environments that support activity performance.

Treatment Approaches

There are two basic principles in ergotherapy.

1. The activities used must be goal-directed
2. Activities must be analyzed accurately in terms of performance areas and components

Goal-directed activities provide the maintenance of interest, increase productivity, and play a key role in intrinsic motivation. Selecting appropriate therapeutic activities requires an overall analysis of the activity components and examining their relationship to the goals of treatment.

Most commonly used methods in ergotherapy;

a. Neurophysiological approach
b. Biomechanical approach
c. Rehabilitative approach

All those listed above can be applied separately or in combination. Four major activity groups have been identified in clinical practice. Exercise, scheduled tasks, therapeutic tasks, and adaptive tasks, therapeutic and adaptive tasks are considered the core activities of Ergotherapy (43).

Neurophysiological Treatment Methods are used for individuals whose CNS is damaged congenitally or due to trauma or any disease. This approach uses sensory inputs and developmental steps to adapt to changes in the sensorimotor organization of the CNS (44). As a result of brain damage, the patient may lose basic cognitive and perceptual capacity and functional abilities. The patients may have sensorimotor problems and their movement patterns may be impaired. They may use immature, primitive movement patterns or their movements may be completely under the control of sensory stimuli. Also, they may lose the ability to voluntarily control the direction, speed, power, time, and angular control of their movements. This approach is called the 'neurodevelopmental approach' since the developmental steps and techniques that shed light on the anatomical, functional or behavioral reorganization of the CNS are used for the treatment of these losses. The motor control and cognitive functions of all people are shaped depending on the sensory effects in the environment. Therefore, the neurodevelopmental treatment approach can be applied not only in stroke patients but also in cases with spinal cord and peripheral nerve injuries. Therapists refer to these approach techniques once or twice a week and use them in combination with other methods.

There are various approaches to this treatment method. The most frequently used approaches are;

1. Rood approach
2. Bobath approach
3. Brunnstrom approach
4. Margaret Johnson approach
5. Proprioceptive neuromuscular facilitation (PNF) approach

Rood approach: Rood believed that the patient's motor activities could be improved if proper sensory stimuli were applied to the appropriate receptors. She aimed to derive motor responses using reflexes, and then obtain proper motor patterns by following neurophysiological principles. According to Rood, the first thing to do to have motor control is to obtain reflex muscular responses by introducing controlled sensory stimuli (45). Treatment must be scheduled according to the developmental level of the patient. The aim is to provide the transition from the current level to more advanced developmental levels, namely, to the movements under the control of the supraspinal centers. In motor control physiology, while performing a target-directed movement, the cortex does not send orders to all relevant muscles one by one, but subcortical centers provide appropriate motor performance and coordination by creating facilitation in the required muscles and inhibition in the required muscles. Based on this principle, Rood suggests that the patient must focus on the appropriate movements while being treated, so that the patient can convert reflex movements into coordinated movements by receiving back sensory stimuli from their movements. Very severe patients are unable to act appropriately, but treatment must be directed to this at the earliest stage possible. Particularly since the muscles in the body and proximal extremities are under subcortical control, the use of goal-directed activities in movement patterns involving these regions can be tried. Extremity distals, particularly hand muscles, are under direct cortical control. Patients must do ample and repetitive activities, thus accelerating the learning process, in other words, they must receive ample sensory stimulation. Positioning (proprioceptive sense) comes first among the sensory stimuli. Besides, stimuli are used in the form of tapping and brushing as well as hot, cold, joint compression, stretching, and applying pressure on muscles. Rood approach is based on the idea that somatic, autonomic, and psychological factors interact with motor function. Motor function is closely related to sensory function and treatment must depend on this basis. Sensory stimulation methods such as tapping, and brushing are used to obtain a phasic muscle response. Cold application for visceral stimulation and somatic relaxation, pressure, and stretching application for postural muscle activity are among the methods used (46).

Bobath approach: When the CNS is damaged, abnormal posture and movement patterns occur. These lead to difficulties in ADLs. Bobath associated abnormal sensory perceptions with the formation of abnormal patterns and called it the afferent input phenomenon. It is not possible for a patient with abnormal motor performance to form normal sensorimotor patterns, since the memory formed by sensory experiences develops incorrectly (47). Therefore, Bobath has specified

developmental stages. The recovery of the patient follows these stages. It is intended for the static and dynamic postural responses to be generated. Besides, it is expected that the extremities will move from broad movement patterns to fine movements, from proximal movements to distal movements, and from isometric movements to eccentric and concentric movements during such developmental stages. While the associated movements are prevented, the integration of the movements of both body halves is ensured. The abnormal tone is always prevented, and a normal tone is tried to be acquired. After the desired muscle response is generated, frequent repetitions are made, and this movement is tried to be used functionally later on. Voluntarily controlled movements are always encouraged. In the Bobath approach, the increased muscle tone dominated by primitive reflexes is tried to be inhibited. Reflex inhibiting postures (RIP) is a treatment system introduced by Bobath for this purpose. RIPs are the opposite of spastic postures that partially dominate the patient and prevent voluntary movements. These facilitate the patient's sensory perceptions to shift from abnormal patterns to normal patterns. Bobath takes advantage of the recovery and balance reactions under the control of the higher centers in the normalization of increased tone. The RIPs suitable for the patient are determined after an evaluation phase. The key position leading to increased tone is determined in each patient, whereas the reverse positioning is used to relax the whole body. Key positions are the body and proximal extremity positions, which are usually dominated by primitive reflexes. For example, the extension of the head activates extensor tone in the whole body, while it inhibits the flexor tone. Flexion of the head presents the opposite effect. Internal rotation of the extremity inhibits extensor tone, while external rotation inhibits flexor tone. RIPs are also used in antispastic orthoses. Hand-wrist splints that keep the wrist in 30° extension, the fingers in the abduction and full extension, and the thumb in the abduction and extension are used for this purpose in hemiplegic patients (48). The aim of the Bobath technique, which is preferred particularly in strokes with intense spasticity and poor postural control, is to normalize muscle tone, to ensure postural control and functional development of movement by using key control points and reflex inhibitory patterns. Visual, auditory, and tactile stimuli are also used in the Bobath technique (49).

Brunnstrom's approach: It is a scheduled treatment approach for hemiplegic patients. The developmental stages determined by Twitcel during the recovery of stroke patients were taken as the starting point (50). Initial movements occur as synergies in hemiplegic upper and lower extremities. As the healing phases progress, these patterns break down, and thus isolated joint movements occur. A sep-

arate treatment program is prescribed for each stage. Brunnstrom makes use of tonic neck reflexes, tonic labyrinth reflexes, tonic lumbar reflexes, and associated movements to bring out the first movements. For example, the Raimiste phenomenon, inspired by associated movements, is used to initiate synergetic movement patterns in the shoulder and hip areas. The patient's arms are held in horizontal abduction, and the adduction of the healthy arm is resisted to initiate shoulder adduction, which is the dominant component of extensor synergy, in the poor arm. In Brunnstrom approach, after synergies emerge and the patient voluntarily completes the synergies, tonic reflexes and associated movements are left, however proprioceptive and exteroceptive stimuli continue to be used (49,51).

Margaret Johnson approach: In this approach, the main goal of the treatment of patients with CVA has been determined to be fighting spasticity 24 hours a day. Treatment is based on reflex inhibition using air splints and positioning. The most important feature and difference from other methods is the use of pressure splints (air-splint), which has an inhibitory effect on spasticity (52).

Proprioceptive neuromuscular facilitation (PNF): In this technique developed at the Kaiser institute, Dr. Kabat observed that stretching a group of topographically aligned muscles results in a diagonal motion. He noticed that functional movements were similarly spiral or diagonal. Sherrington's diffusion, successive induction, and reciprocal innervation principles were used in this approach (53). The stimulus that plays a role in spreading is the transmission of resistance and tension occurring in the contracted muscle to neighboring tissues. During the treatment, the resistance applied together with the stretching causes the movement to be transmitted from the strong muscle groups to the weak ones. Subsequent activation can also be used to generate a voluntary muscle response. Weak agonists are tried to be activated by applying resistance to the strong antagonist muscle. Slow reciprocal inhibition is used, and movement is brought out in weak muscle groups by giving them a 'hold' command. One drawback of this treatment is that it may increase the imbalance between weak and strong muscle groups. Reciprocal innervation is the inhibition of reflexes by voluntary movement. Normally, the agonist muscle contracts against resistance while the antagonist muscle relaxes and extends, thus movement smoothness is acquired. This physiological principle is used in the treatment to achieve relaxation in spastic antagonists with the slow-looking hold-relax technique. PNF aims to increase the neuromuscular response and facilitate the emergence of voluntary movement by stimulating the proprioceptors in the affected extremity. In this technique, functional movement patterns in spiral and diagonal directions are used instead of

classical approaches that strengthen individual muscles. The upper extremity is positioned according to these selected movement patterns, and it is aimed for the muscle to contract throughout its entire range of motion, from its longest position to its shortest position. Visual, auditory, and tactile stimuli are included in the basic components also in the PNF technique (50).

Briefly, Brunnstrom and the PNF approach focus on the patient's attention to movement. The Rood and Bobath approaches, however, underline the importance of bringing out goal-directed movement subcortically. Brunnstrom approach uses primitive reflexes to bring out movement when the patient is unable to perform the movement, while the Bobath approach, contrary to this, actively inhibits the emergence of these reflexes.

Biomechanical Treatment Methods; The biomechanical approach is suitable for patients who have difficulties in ADL due to problems with ROM, strength, and endurance, but are able to initiate movement voluntarily. Before the biomechanical approach treatment, patients must be evaluated in detail in terms of sensation, ROM, and muscle strength. In the treatment, a schedule is prepared according to the needs of the patient. The schedules are aimed at four main goals (33).

1. Preventing ROM limitations
2. If limited, increasing ROM
3. Increasing muscle strength
4. Increasing endurance

Preventing ROM limitations: If the patient does not have the muscle strength to move the joint and there is no medical problem in the movement of this joint, passive ROM exercises must be applied to the patient at regular intervals and the joint must be properly positioned between exercises. Thus, the shortening of tendons, muscles, ligaments, and articular structures is prevented. In cases where the development of contracture and ankylosis is inevitable, it is important to keep the joint in the most functional position possible. Orthoses or splint use may be required for this purpose.

Increasing ROM: Joint limitations that cause difficulties and deformity in ADL need to be treated. Exercises can be beneficial in relaxing contractures originating from soft tissues such as skin, muscle, tendon, and ligaments. The situations in which exercise will not be beneficial are bone ankylosis, joint arthrodesis, and long-term contractures, resulting in soft tissue losing its flexibility and becoming fibrotic, severe joint deformity, and subluxations. Maximum stretching exercises are used in the treatment of contractures originating from soft tissue. The max-

imum stretch is to hold the joint at the angle that causes discomfort, for a few seconds. Stretching may be done actively or passively. In active stretching, the patient adjusts the amount, speed, angle, and direction of the stretching according to the pain. Methods that provide passive stretching are manual stretching, traction orthoses, joint manipulation, PNF, exercise, or activities (54). In manual stretching, which is the most commonly used method, the therapist gets the patient to perform each stretch up to the maximum stretching angle. During passive stretching, the proximal of the joint is stabilized and the distal is moved slowly. If possible, active participation of the patient in the movement must be ensured since reflex relaxation occurs in the antagonist muscle during active movement. The pain must not persist after the stretching exercise. If the pain persists for several hours, it means that the stretching was done more severely than necessary. Manipulation is a method of applying a stretching that is strong enough to break adhesions and is recommended to be performed under anesthesia. In the PNF method called the hold-relax technique, isometric contraction is created for 4-6 seconds at the end point of the restriction. During this contraction, resistance is applied to the shortened muscle. A relaxation period lasting 2 seconds follows the isometric contraction. At the same time, the therapist tries to widen the maximum tension angle by applying passive stretching for 8 seconds. Physiologically, at maximum contraction, the Golgi tendon organs in the motor units make an inhibitory effect and relaxation occur in that muscle. During such relaxation, more stretching can be applied.

Increasing muscle strength: In the program to increase muscle strength, the parameters such as the type, duration, intensity, speed, number of repetitions, and frequency of exercise during the day must be specified. Exercises are performed against gradually increasing resistance to increase muscle strength. The exercises having an intensity that exceeds 50% of the maximum contraction capacity are strengthening exercises. It has been demonstrated that when a strengthening exercise is performed on one extremity, some strength increase is also achieved in the symmetrical extremity. It has been reported that such strength increase may develop between 30-50% (55).

The types of exercises used for strengthening purposes are as follows;

a. Isometric exercises: Short maximal isometric exercise is the contraction of the muscle, having its maximum capacity, for 6 seconds per day. Methods such as increasing contraction time and resistance may be tried to increase the effect. During contraction, the length of the muscle remains constant.

b. Isotonic exercises: Concentric contraction occurs in the muscles. These exercises have some types that vary depending on the performance of the relevant muscle group.

- Progressive assistive exercises
- Active, active-assist exercises
- Progressive resistive exercises
- Regressive resistive exercises

c. Isokinetic exercises: This is an effective method to increase muscle strength. It is a dynamic and concentric exercise type during which the movement speed is kept constant. Strength increase is provided at the muscle length at which the resistance is applied to the muscle with isometric exercises, in other words, at the angle the exercise is performed. It is not possible to strengthen the muscle in all range of motion angles with isotonic exercises. No matter how much effort the person makes in isokinetic exercise, the speed of joint movement remains constant. The isokinetic exercise device applies a resistance that is equal to the applied force and thus measures the applied force. A well-cooperating person exerts maximum force and applies such force at all angles of the movement, thus maximally contracting the muscles in the full range of motion and strengthening all the muscles involved in the exercise at all angles of the movement (56).

d. Eccentric exercises: In this type of exercise, intramuscular tension increases even though the muscle extends. This contraction type is crucial in human movements. The triceps muscle contracts this way when slowly lowering a heavy object in the hand, while the hamstring muscle contracts the same way when going down the stairs. The muscles contract to reduce the speed of a movement in such cases. A positive task is being performed in concentric contraction while no task is being performed in isometric contraction. In eccentric contraction, however, the negative task is the point in question (57). Eccentric contraction requires less energy, therefore metabolically it is more efficient.

Increasing endurance: The increase in the endurance of the muscles occurs together with some adaptations in both the cardiopulmonary and musculoskeletal systems. Endurance-enhancing exercises provide an extension of effort time and resistance to fatigue. Even though low-rep exercises with high weights are effective for muscle strengthening, low-weight, high-repetition exercises are more effective in increasing endurance. Strengthening is also provided if endurance-enhancing exercises are performed up to the fatigue threshold. These exercises consist of the repetition of activities that cause mild fatigue with increasing durations,

whereas the motor units can find the opportunity to recover between contractions. Endurance exercises aim to increase the number of repetitions of the contraction without fatigue if the isotonic contraction is in question and to extend the duration of the contraction if the isometric contraction is in question. If the general condition of the patient does not allow increasing the exercise time, it is effectual to initially increase the number of exercises during the day. If these exercises are performed to the fatigue threshold, a strength increase is also provided. Briefly, endurance training is performed by increasing the duration and repetition of the exercise, so that resistance exercises do not exceed 50% of the maximum contraction capacity. In this treatment, hobby activities such as fine arts, cycling, swimming, and walking are also used to attract the patient's attention.

Rehabilitative Treatment Methods: Rehabilitation refers to sweeping the individual back to the best possible level of physical, mental, social, occupational, and economic self-sufficiency. In the rehabilitative approach, measures are used to make it easier for the patient to live as independently as possible with the remaining capacity. The purpose of this approach is to help the patient learn to compensate for or adapt to their physical limitations. The rehabilitation approach is a dynamic process and requires the patient to be a part of the rehabilitation team. In general, the rehabilitative approach is used in combination with neurodevelopmental or biomechanical approaches. It is aimed to make the individual independent in social and occupational activities during ADL.

DAILY LIVING ACTIVITIES

A. Self-care activities

- Nutrition: This requires sufficient ROM, sufficient coordination, and sufficient strength. For example, stabilization of the plates is necessary if the coordination is not well. Deep plates are more suitable for those who use only one hand functionally. Cutting activity can be performed with successive flexion and extension movements of the functional hand by using knives with rounded tips. For those with limited hand control, heavy and deep containers, plates with raised edges, and non-slip mats can help the patient to eat comfortably and without spilling. Fork, spoon, and knife handles can be made bulky for easy grasping.
- Dressing: Active ROM, coordination, strength, and sitting balance along with body control must be sufficient to perform this activity. With some modifications, the person can put on and take off clothes easily. For example, avoiding

buttoned clothes and wearing elastic ones, using clothes with bigger buttons, and wearing trousers and shoes with Velcro bands can make dressing easier. In patients with poor motor force, auxiliary tools such as button hooks, zipper pullers, elastic shoelaces, and reach bars can be used to facilitate these procedures.

- Hygienic activities: For these activities, the person must have enough grip strength to hold the necessary tools, enough ROM to reach all parts of the body, good body control, sitting balance, and gross motor coordination. When hand functions are limited, various adaptations can be used to perform these activities. For example, belts for stabilizing toothbrushes or hairbrushes, and brushes with sponges attached to them can be helpful.
- Bathroom-toilet activities: Gross and fine motor coordination are complex activities that require sufficient ROM and body control. To facilitate this function, one-fingered bag-shaped gloves that prevent soap from slipping, long-handled sponges, faucets that can be opened and closed easily, raised tub and toilet seats, and benches that facilitate transfer can be used. There must be anti-slip flooring in the bathrooms and grab bars on the walls.
- Kitchen activities: These are repetitive and challenging activities. The patient must be taught methods of self-protection and how to minimize hazards in the kitchen. Kitchen utensils must be placed on the lower shelves and hooked shelves must be used. Facilitative devices such as wall-mounted can openers, cutting boards, and spring back scissors can be used.

B. Mobility

Functional mobility is the ability of a person to move from one position in space to another. In-bed activities involve transfers, ambulation, wheelchair activities, and driving.

- In-bed activities: Turning in bed refers to the movements of sliding up, down, or sideways, straightening, and sitting up in bed. Independent in-bed activities require upper extremity strength and endurance along with head control. The side rails placed along the edge of the bed reduce the time and energy consumption of the person for bed activities.
- Transfer: Individuals must be able to transfer their wheelchair, bed, chair, and car without support to be independent during ADL. Wheelchair transfers have various forms depending on the functional limitations of the patient.

a. Stand-pivot transfer; This is the best method for patients with short-time standing balance. It requires sufficient hip and knee flexion along with good sitting

balance. In this transfer type, the patients get up from the chair, come to a standing position, turn and sit in the chair next to them. Another modification of this transfer type may be done in the form of rotation while sitting. The patients having a good sitting balance and upper extremity strength lift their hips, turn, and sit in another chair without standing up.

b. Transfer by slide board; After the board is placed between the wheelchair and the bed, the patients perform their transfer by sliding their hips.

c. Wheelchair-floor transfer; The patients lower the footrest and put their feet on the floor, then flex forward, put their hands on the floor, and pull themselves to the floor. In another method, once the footrest is lowered and the patients put their feet on the floor, the patients slide to the side of the wheelchair and rotate to sit on one side of the hips. They place their hands on the wheelchair, put their knees on the floor with a powerful push, then sit on the hips.

The therapists take action within the scope of a plan once the functional activities that the patient needs are specified. The use of activities required for the occupational needs of the patient for educational purposes may help him return to work. If the patient's functional status is at a level to be able to continue his profession, he must be supported to return to work and active life as soon as possible. If necessary, the task is adapted to the patient with some changes made in the working environment. However, if the patient has a job that he cannot continue with a disability, a new job must be taught to the patient according to previous abilities and current functional potential, and the patient must be brought to a productive condition. If the desired functional level cannot be reached despite the treatment and the other side of the patient is healthy, independence must be sought by increasing the working capacity of the functional side. For example, if the motor functions of the plegic side of a right hemiplegic person do not return, the techniques to increase the functionality of the intact left upper extremity must be taught.

Ergotherapy aims to achieve functional independence or to develop psychosocial adjustment to permanent disability. However, the criteria to guide how to select patients for occupational therapy programs have not been fully determined, yet. The heterogeneity of functional and health problems experienced by stroke patients makes it difficult to evaluate the multiple outcomes of rehabilitation. Despite the growing literature suggesting that improving functional performance after rehabilitation programs may be related to early treatment, there are inconclusive findings on when and where occupational therapy must be given.

Ergotherapy is a method that is well tolerated by patients, inexpensive, has no undesirable effects, can be tailored to the individual needs of patients, and encourages patients' participation in treatment. As a result of increased independence in self-care and mobilization, the quality of life increases, and the burden on the health system decreases. Occupational therapy programs after stroke are likely to receive more interest in the future when the increasing morbidity and longevity in the population are taken into consideration.

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