

T.C.

YEDİTEPE UNIVERSITY
INSTITUTE OF HEALTH SCIENCES
DEPARTMENT OF PHYSIOTHERAPY AND REHABILITATION

**EFFECTS OF TASK-ORIENTED TRAINING ON
MOTOR AND COGNITIVE FUNCTIONS
IN PATIENTS WITH STROKE**

MASTER OF PHYSIOTHERAPY AND REHABILITATION THESIS

HELİN SU ARKUN, PT

İSTANBUL-2024

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DECLARATION

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree except where due acknowledgment has been made in the text.

Helin Su Arkun, PT.

DEDICATION

I dedicate this thesis to my dear family, who have supported me with their love and encouragement.



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LIST OF SYMBOLS AND ABBREVIATIONS

6MWT	Six Minute Walk Test
ACA	Anterior cerebral artery
AChA	Anterior choroidal artery
ADL	Activities of daily living
AHA/ASA	American Heart Association/American Stroke Association
AICA	Anterior inferior cerebellar artery
BBT	Box and Block Test
BBS	Berg Balance Scale
BI	Barthel Index
BP	Blood pressure
BT	Bobath Training
BTG	Bobath Training Group
CNS	Central nervous system
DLOTCA-G	Dynamic Loewenstein Occupational Therapy Cognitive Assessment- Geriatric Version
FAC	Functional Ambulation Classification
FAT	Frenchay Arm Test
FIM	Functional Independence Measure
FMA	Fugl-Meyer Assessment Scale
HT	Hypertension
ICA	Internal carotid artery
ICF	International Classification of Functioning, Disability and Health
ICH	Intracerebral hemorrhage
LOTCA	Loewenstein Occupational Therapy Cognitive Assessment
MAS	Modified Ashworth Scale
MAS	Motor Assessment Scale
MCA	Middle cerebral artery
MI	Motricity Index
MMSE	Mini Mental State Examination

MVPT-V	Motor-Free Visual Perception Test
PCA	Posterior cerebral artery
PCoA	Posterior communicating artery
RVGA	Rivermead Visual Gait Assessment
SCA	Superior cerebellar artery
STREAM	Stroke Rehabilitation Assessment of Movement
TIA	Transient ischemic attack
TOT	Task-oriented Training
TOTG	Task-oriented Training Group
TUG	Timed up and go test
WHO	World Health Organization
WMFT	Wolf Motor Function Test

ABSTRACT

Arkun, H.S. (2024). Effects of Task-Oriented Training on Motor and Cognitive Functions in Patients with Stroke.

Yeditepe University Institute of Health Sciences, Department of Physiotherapy and Rehabilitation Master Thesis, Istanbul.

The objective of this study is to investigate the effects of task-oriented training (TOT) applied additionally to Bobath training (BT), on motor and cognitive functions in stroke patients. 20 stroke patients with mild cognitive problems according to the Mini Mental State Examination (MMSE) were included in the study, and divided into two groups by randomization: BT+TOT (n=10) (TOTG) and BT (n=10) (BTG). TOTG received TOT in addition to BT, while BTG received only BT. BT and TOT were applied 5 days a week for a total of 8 weeks. Functional Independence Measure (FIM) and Barthel Index (BI) were used to evaluate motor functions, and Mini Mental State Examination (MMSE) and Dynamic Loewenstein Occupational Therapy Cognitive Assessment- Geriatric version (DLOTCA-G) were used to evaluate cognitive functions before and after the intervention. While there was a significant increase in motor function scores in both groups after the intervention, a statistically greater increase was found in TOTG than in BTG ($p < 0.05$). Furthermore, the results showed that TOT applied in addition to BT improved cognitive functions, except memory, more than BT applied alone ($p < 0.05$). To the best of our knowledge, our study is the first study in the literature that aimed to investigate the effects of TOT on both motor and cognitive functions in patients with stroke. In conclusion, combining TOT with BT may be preferred as an easily accessible, safe and effective training method for stroke patients, to improve the motor and cognitive functions and to increase the participation of patients with post-stroke cognitive impairments.

Keywords: Cognition, motor functions, stroke, task-oriented

ABSTRACT (Turkish)

Arkun, H.S. (2024). İnmeli Hastalarda Görev Odaklı Eğitimin Motor ve Kognitif Fonksiyonlar Üzerine Etkileri.

Yeditepe Üniversitesi Sağlık Bilimleri Enstitüsü, Fizyoterapi ve Rehabilitasyon Anabilim Dalı Yüksek Lisans Tezi, İstanbul.

Bu çalışmanın amacı, Bobath terapisine (BT) ek olarak görev-odaklı eğitim (GOE) uygulanmasının inme geçiren hastalarda motor ve kognitif fonksiyonlar üzerindeki etkilerini araştırmaktır. Çalışmaya Mini Mental Durum Testi (MMDT)'ne göre orta seviye kognitif bozuklukları olan 20 inmeli hasta dahil edilmiş ve bu hastalar randomizasyon ile BT+GOE (n=10) (GOEG) ve BT (n=10) (BTG) olarak iki gruba ayrılmıştır. GOEG, BT'ye ek olarak GOE alırken, BTG'ye sadece BT uygulanmıştır. BT ve GOE haftada 5 gün toplamda 8 hafta uygulanmıştır. Motor fonksiyonlar, Fonksiyonel Bağımsızlık Ölçeği (FBÖ) ve Barthel İndeksi (Bİ) kullanılarak, kognitif fonksiyonlar ise MMSE ve Geriatriklere Yönelik Dinamik Loewenstein Ergoterapi Kognitif Değerlendirme Skalası (DLOTCA-G) ile uygulama öncesi ve sonrasında değerlendirilmiştir. Uygulama sonrası her iki grupta da motor fonksiyon skorlarında anlamlı artış görülürken, GOEG' de BTG' ye göre istatistiksel olarak daha fazla artış bulunmuştur ($p < 0.05$). Ayrıca sonuçlar, BT'ye ek olarak uygulanan GOE' nin hafıza haricindeki kognitif fonksiyonları yalnız BT uygulanmasına göre daha fazla geliştirdiğini göstermiştir ($p < 0.05$). Bildiğimiz kadarıyla çalışmamız, inmeli hastalarda GOE'nin hem motor hem de kognitif fonksiyonlar üzerine etkilerini araştırmayı amaçlayan ilk çalışmadır. Sonuç olarak, GOE' nin BT ile birlikte uygulanmasının, inmeli hastalarda motor ve kognitif fonksiyonları geliştirmek ve inme sonrası kognitif etkilenimi olan hastaların tedaviye katılımını arttırmak için kolayca erişilebilen, güvenli ve etkili bir yöntem olarak tercih edilebileceği düşüncesindeyiz.

Anahtar Kelimeler: Biliş, görev odaklı, inme, motor fonksiyonlar

1. INTRODUCTION AND PURPOSE

Stroke described as a neurological dysfunction lasting 24 hours or longer, caused by ischemia, which is the interruption of blood flow to a particular area of the brain, or hemorrhage, which is a focal collection of blood within the brain according to the definition of the American Heart Association/American Stroke Association (AHA/ASA) (1). Stroke, which is the secondary cause of death and primary cause of disability, is a widespread, serious, global health problem that increases with the aging of the population; as well as a major financial problem due to hospital and post-hospital care expenses (2-4).

Stroke leads to limitation in normal movement and function. Loss of strength occurring as hemiplegia or hemiparesis, changes in muscle tone such as spasticity, and abnormal movement patterns are defined as motor impairments resulting from stroke. It is also accompanied by impairments in balance and coordination, gait and posture (5-7). The most widely known impairment caused by stroke is motor impairments that limit function in muscle movement or mobility but cognitive impairments, which occur in 30% of patients, can also disturb the functional outcome after stroke. Impairments in attention, orientation, visual-spatial perception, learning, thinking, problem-solving and memory functions are the most common cognitive impairments that occur after stroke (8-9).

Physiotherapy and rehabilitation approaches is an essential part of stroke treatment to reduce impairment, improve function, and achieve the maximum possible level of independence (10). In the literature, Bobath approach has been reported as being the most popular neurorehabilitation approach used in stroke rehabilitation (5,7,11,12). It is a neurodevelopmental treatment (NDT) based on the release of tonic reflexes, obtainment of postural reactions, and normalization of muscle tone in a neurodevelopmental sequence (12,13). The Bobath approach aims to improve coordination by provoking and establishing normal patterns of movement of the affected side via controlled sensorimotor experiences (5,7,14).

Recently, many authors have debated whether facilitating normal movement patterns is sufficient to improve voluntary movement (15-18). Because in neuroimaging studies, it has been shown that functional improvement is not only a result of the elimination of impairments, but adaptation strategies to compensate for impairments are also an important factor (19-21).

As a reflection of this, currently, task-oriented approaches are recommended to improve patient's capacity to perform motor skills (22). Task-oriented training (TOT) involves repeated practice of tasks related to patient-centered realworld activities organized around a behavioral goal based on models of motor learning principles (23,24). Accomplishing tasks on a wide variety of interventions such as mat activities, sitting, standing, cycling programs, treadmill walking, gait training and up-down stair training can improve upper and lower extremity functions (25). This approach is mainly aimed at restoring motor system functions but in order to ensure functionality and active participation in stroke individuals, cognitive functions should be included as well as motor functions (26,27).

Thus, TOT applied in addition to Bobath training (BT) may improve both motor and cognitive functions in patients with stroke. Therefore, the aim of this study is to compare the effects of TOT in addition to BT in patients with stroke, on motor and cognitive functions compared to BT applied alone.

Two hypotheses were identified in the study:

H0: TOT does not improve cognitive and motor functions in patients with stroke compared to the control group.

H1: TOT is highly effective to improve cognitive and motor functions in patients with stroke compared to the control group.

2. THEORETICAL INFORMATION AND LITERATURE

2.1. Definition of Stroke

The World Health Organization (WHO) defined stroke in 1970 as a clinical syndrome characterized by focal or global loss of cerebral function, lasting longer than 24 hours, and rapidly settling signs and symptoms as a result of impaired cerebral blood flow, with no apparent cause other than vascular causes (28). Stroke, which is the sudden development of a focal neurological deficit, is called a set of symptoms consisting of motor loss, sensory impairment, speech and cognitive problems (5,9,29,30).

Although still widely used and accepted, the World Health Organization's definition is predominantly based on clinical symptoms and significant advances had been made in recognizing and imaging stroke, thus an updated definition was required. To this end, in 2013, AHA/ASA updated the approved definition of stroke to include silent cerebral, spinal cord and retinal infarctions and silent cerebral hemorrhages. The AHA/ASA removed the association with visibly defined clinical symptoms by adding silent pathologies to the accepted definition to establish a tissue-based definition with radiological presentation of infarction or hemorrhage (4,31).

The brain is one of the most metabolically active organs in the body and requires a rich blood flow to provide this activity. Approximately one-fifth of the blood pumped with each heartbeat is used by the brain to meet its metabolic needs. Brain tissue does not have the ability to store oxygen and glucose, therefore, interruption of brain blood flow for a few seconds causes reversible neurological changes and loss of consciousness in the person, while brain activities stop within two minutes and irreversible changes occur after five minutes (32,33).

Hereby, a stroke is when the arteries that supply the brain fail to transmit blood flow from the heart to the brain tissues due to ischemia or hemorrhage, and as a result, the brain tissue undergoes necrosis. An average of 2 million cell deaths occur per minute in a person who has a stroke, and as time progresses, brain damage becomes irreversible (28,32).

2.2. Epidemiology of Stroke

Stroke is a widespread, serious, global health problem. Stroke, which affects approximately 13.7 million people and causes the death of approximately 5.5 million people annually, is therefore stated as a secondary cause of death and a primary cause of disability (1,2,34).

The majority of strokes are ischemic infarctions, with a rate of nearly 87%. While the majority of hemorrhagic strokes consist of first time (primary) hemorrhages, second time (secondary) hemorrhages correspond to an estimated rate of 10% to 25%. The incidence of both ischemic and hemorrhagic stroke increases with age, doubling in people over 55 years of age. Cardioembolic stroke which is a more severe stroke form, appears to be more common in women, while intracerebral hemorrhage (ICH) and brain infarction are more prevalent among men (34-38).

Stroke incidence varies significantly across the world. According to data obtained from the Turkish Statistical Institute, vascular diseases rank first among the causes of death, accounting for 33.4% of the death cases in Turkey. When deaths caused by vascular diseases were examined by sub-causes, it was seen that 41.8% of the deaths were due to ischemic heart diseases, 23.3% were due to other heart diseases, and 18.9% were due to cerebrovascular diseases (35,39).

2.3. Risk Factors for Stroke

Many factors can increase the tendency to stroke. The major risk factor for stroke is hypertension, followed by heart disease and diabetes. When many risk factors coexist, the risk of stroke increases severalfold, even if the levels of individual risk factors are not very high. Stroke risk factors can be classified by taking into account the modifiability of the risk factor (40,41)

2.3.1. Non-Modifiable Risk Factors

These include age, gender, ethnicity-race, previous transient ischemic attack (TIA), and family history-hereditary characteristics. Recent research has shown that the increased risk of stroke in people aged 20-54 may be due to pre-existing factors. The risk rate varies between racial and ethnic groups. Studies conducted in the United States show that the prevalence of hypertension, diabetes, and ventricular hypertrophy is higher in blacks or African Americans than in whites. The prevalence of diabetes and metabolic syndrome is higher in Hispanics than in blacks, whites or African Americans. Thus, it can be said that the risk of stroke is higher in the Hispanic and black population than in the white population, and in particular the risk of hemorrhagic stroke is significantly higher in black people than in the white population of the same age (40, 42-44).

2.3.2. Modifiable Risk Factors

These factors are exceedingly important because timely diagnosis and medical intervention can reduce the risk. The main modifiable risk factors for stroke are hypertension, diabetes, smoking and alcohol intake, lack of physical exercise, and dietary management (43, 45-55).

Hypertension (HT) is one of the most important risk factors for stroke. According to studies, a blood pressure (BP) of 160/90 mmHg or above and a history of HT are important predisposition factors, as seen in 54% of individuals with stroke. It has been reported that a 5-6 mm Hg increase in blood pressure increases the risk of stroke by 42%, and treatment interventions for HT reduce the incidence of stroke symptoms by 36% and 42%, respectively (43,45-47).

Diabetes is a factor that duplicates the risk of ischemic stroke and increases the mortality rate by 20%. Diabetic individuals have a worse prognosis after stroke, including more severe disability and slower functional recovery, than non-diabetic patients (43,48,49).

Smoking tobacco directly increases the risk of stroke. A regular smoker's chance of having a stroke is double that of a non-smoker. Also, Smoking promotes 15% of stroke-related deaths. The effect of alcohol intake on stroke risk depends on the amount of alcohol consumed per day. While low-moderate alcohol consumption, which includes 2 or fewer standard drinks a day for men and 1 drink or less a day for women, reduces the risk of stroke, high alcohol consumption increases this risk (43,50-53).

Being physically inactive and poor eating habits are also risk factors for stroke. Lack of exercise and physical activity is associated with a high incidence of stroke, not only directly increasing the likelihood of a stroke attack, but also in association with other health problems such as high blood pressure, diabetes and obesity. Malnutrition likewise increases the risk of stroke by contributing to hypertension, diabetes obesity. For instance, excessive salt consumption leads to hypertension and is therefore linked to stroke (43,53-55).

2.4. Pathophysiology of Stroke

Stroke is defined as a sudden neurological event caused by disruption of blood flow from blood vessels to the brain. To study the characteristics of stroke, it is important to understand the pathology at the neurovascular level. To know pathological conditions, a thorough understanding of normal neurovascular anatomy patterns is required (4,56).

2.4.1. Neurovascular Anatomy

2.4.1.1. Cerebral Venous System

Venous drainage of the hemispheres is derived from superficial and deep cerebral veins that drain into venous sinuses. Deep cerebral veins, one of which is the internal cerebral vein, drain the more inner parts of the white matter, such as the basal ganglia and parts of the diencephalon. Several deep cerebral veins drain into the great cerebral vein/vein of Galen (57,58).

The discharge of blood from the central nervous system (CNS) to the large vessels emptying to the heart, that is, into the systemic circulation, is performed directly or indirectly. While the caudal medullary veins and spinal cord drain directly into the systemic circulation via vein and plexus network; the remaining CNS proceeds indirectly by draining blood into the small sinuses before bringing it back to the systemic circulation (58-60).

Superficial veins drain into the inferior and superior sagittal sinuses. The superior sagittal sinus, which extends along the midline at the upper edge of the falx cerebri, receives a large amount of outflow from the supratentorial cortex including parietal, frontal, and occipital lobe. The inferior sagittal sinus runs along the inferior edge of the falx cerebri superior to the corpus callosum. The inferior sagittal sinus returns venous blood, with outputs from the internal cerebral veins and the basal veins of Rosenthal, to the straight/rectus sinus, which is fed by the great cerebral vein/vein of Galen. The superior sagittal sinus unites with the straight sinus to make two transverse sinuses. These sinuses then empty into the sigmoid sinuses so that the blood returns to the internal jugular veins (57-60).

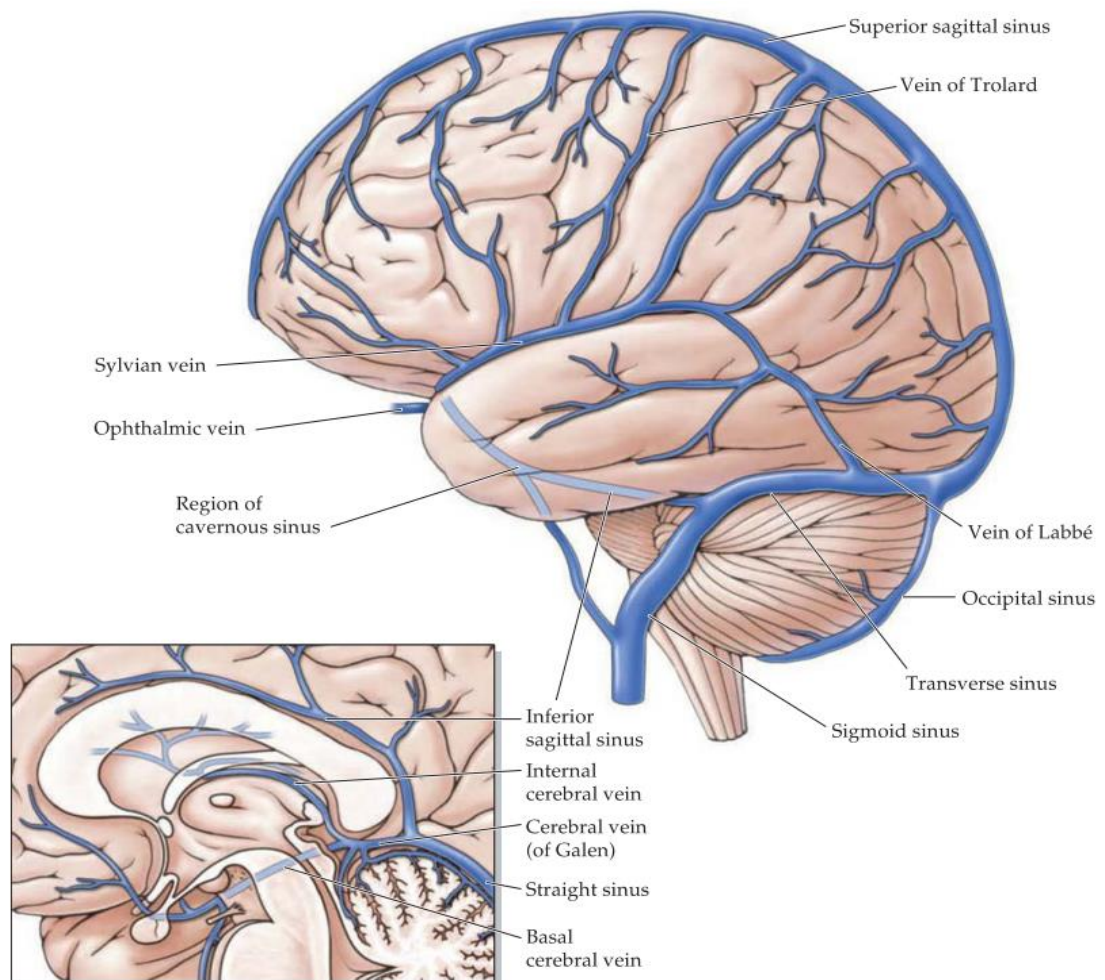


Figure 2.1. Lateral view of the brain, showing major superficial veins and the dural sinuses. Inset shows veins on midline (58).

2.4.1.2. Cerebral Arterial System

The brain's main blood supply is from two arterial systems, which derieve blood from particular systemic arteries: the anterior circulation, that recieves blood from the internal carotid arteries, and the posterior circulation, which is fed by the vertebral arteries. The anterior circulation, also called the carotid circulation, and the posterior circulation, also called the vertebral-basilar circulation, are not independent of each other but are interconnected by arterial networks located on the cortical surface and the ventral part of the midbrain and diencephalon (58,61).

2.4.2. Anterior Circulation

The anterior circulation is a compromise of the supraclinoid carotid and terminal branches, anterior and posterior connecting divisions of the circle of Willis, anterior and middle cerebral arteries. The meningohypophyseal trunk, the inferior cavernous sinus artery, and the capsular artery constitute the three main branches of the cavernous carotid. Tentorial artery, dorsal meningeal artery, and inferior hypophyseal artery are branches of the meningohypophyseal trunk. The incisor of the tentorial artery, the largest of these, is connected to the contralateral tentorial artery, which joins at the incisural apex (60,62).

Ophthalmic Artery

The ophthalmic artery begins from the superomedial facet of the internal carotid artery (ICA) and then rounds upward from lateral to medial, passing over the optic nerve in the majority of cases.

Ophthalmic branches are four groups: the ocular group, consisting of the ciliary arteries and the central retinal artery that feed the retina and choroid, the orbital group, which includes the muscular and lacrimal branches, the extraorbital group, which includes the anterior and posterior ethmoidal, dorsal nasal, supratrochlear, palpebral arteries, and the dural group, which includes the meningeal branches (60,63).

Anterior Cerebral Artery

The anterior cerebral artery (ACA) primarily provides blood to the medial part of the cortical surface, which includes parts of the frontal lobes and the superomedial parietal lobes, located by the longitudinal fissure that separates the two hemispheres of the brain.

The ACA arises from the anterior clinoid part of the internal carotid artery (ICA) and goes anteromedially above the superior surface of the optic chiasm on the route to the longitudinal fissure. After reaching the fissure, it makes an anastomosis with the contralateral ACA, named the anterior communicating artery. This location, although the artery is small, has a major pathological importance as it is the most common site of cerebral aneurysms (36%) (58,64).

Anterior Choroidal Artery

The anterior choroidal artery (AChA) begins from the posterolateral side of ICA and runs medially under the optic tract, lateral to the cerebral crus, to the internal choroidal fissure. Additionally, many anatomical differences have been found in which AChA also begins from the middle cerebral artery (MCA) and the posterior communicating artery (PCoA). The vascular domain of AChA has been a subject of debate recently, which should not be surprising given the diversity of possible paths.

However, regardless of its course, AChA has superficial and deep branches both. While the region of the superficial branches includes the uncus and piriform cortex, the lateral part of the thalamic geniculate nucleus, the hippocampal head, and the amygdala; The vascular zone of the deep branches includes the adjacent auditory and optic radiations, the posterior part of the internal capsule, the tail of the caudate nucleus and the medial part of the globus pallidus (65,66).

Middle Cerebral Artery

In addition to being the largest of the cerebral vessels, MCA is also the most intricately distributed and supplies many important cerebral structures along its tortuous course. Therefore, it is expected that the MCA is the most commonly affected stroke site and that MCA strokes generally have a poor prognosis.

Originating from the ICA bifurcation lateral to the optic chiasm, MCA passes laterally through the frontal lobe and enters the Sylvian fissure between the insular cortex and the temporal lobe. In this region, the artery bifurcates to give rise to two or three main trunks that extending superior and inferior over the surface of the insula. These trunks supply, via arterial arborization, the opercular surface and insular cortex, superior temporal gyrus, middle temporal gyrus, a parietal region that includes most of the postcentral gyrus and inferior parietal lobe, and a frontal region that includes the middle and inferior gyri, most of the precentral gyrus, and the lateral portion of the orbital surface (61,67).

2.4.2.1.1. Posterior Circulation

The posterior cerebral circulation provides only one-third of the entire flow to the brain, yet still maintains many critical functions of the nervous system. This circulation, as known as vertebrobasilar circulation, consists of vertebral arteries, the basilar artery where the vertebrals meet, and the branches of these main channels. This circulation can broadly be said to supply blood posteriorly to the brain, which comprises the occipital lobe, a large part of the brainstem, and the entire cerebellum (68).

Vertebral Arteries

The blood supply of the posterior fossa content is provided totally by vertebrobasilar complex. Vertebral arteries are paired arteries bilaterally arising from the subclavian vessels on both sides of the body. These arteries are divided into four segments. V1, the most proximal section, extends from the subclavian origin of the vessels to the transverse foramen. The next V2 segment then progresses towards the transverse foramen. V3 turns around the atlas at C2 level and enters the dura. After passing over the dura, the arteries turn into V4, the intracranial portion of the vertebral arteries (60,68).

Basilar Artery

Basilar artery replaces the V4 segments after the pontomedullary junction anastomosis and proceeds to the midline along the anterior pons, ending near the pontomesencephalic junction. The artery branches during its course to supply the pons with various perforating arteries, which are classified as paramedian or circumferential according to their distribution. It supplies most of the posterior cortical area via its terminal, which branches into the Posterior cerebral artery (PCA), after supplying the superior and anterior inferior cerebellar arteries (SCA and AICA) to a large cerebellar region. As can be noticed due to the size of this vascular space, basilar artery lesions, although rare, are very serious in terms of prognosis with a high mortality rate. But, individual basilar branch lesions may also occur and lead to a clinical presentation limited to the affected area's functions (68,69).

Posterior Cerebral Artery

The final contribution to the posterior circulation is provided by the bilaterally ascending posterior cerebral arteries, which arise from the bifurcation of the basilar arteries. After leaving the basilar artery, PCA surrounds the midbrain at the pontomesencephalic junction, just rostral to the third, or oculomotor, cranial nerve. Along its posterior path, it passes over the cerebral peduncles and moves towards the ventromedial portion of the cortex, thus proceeding along branches that form the main blood supply to the occipital lobe, the medial and inferior parts of the temporal lobe, and the posterior part of the parietal lobe. Symptoms caused by PCA infarctions are also compatible with the arterial region's functions, such as visual field disturbances (61,70).

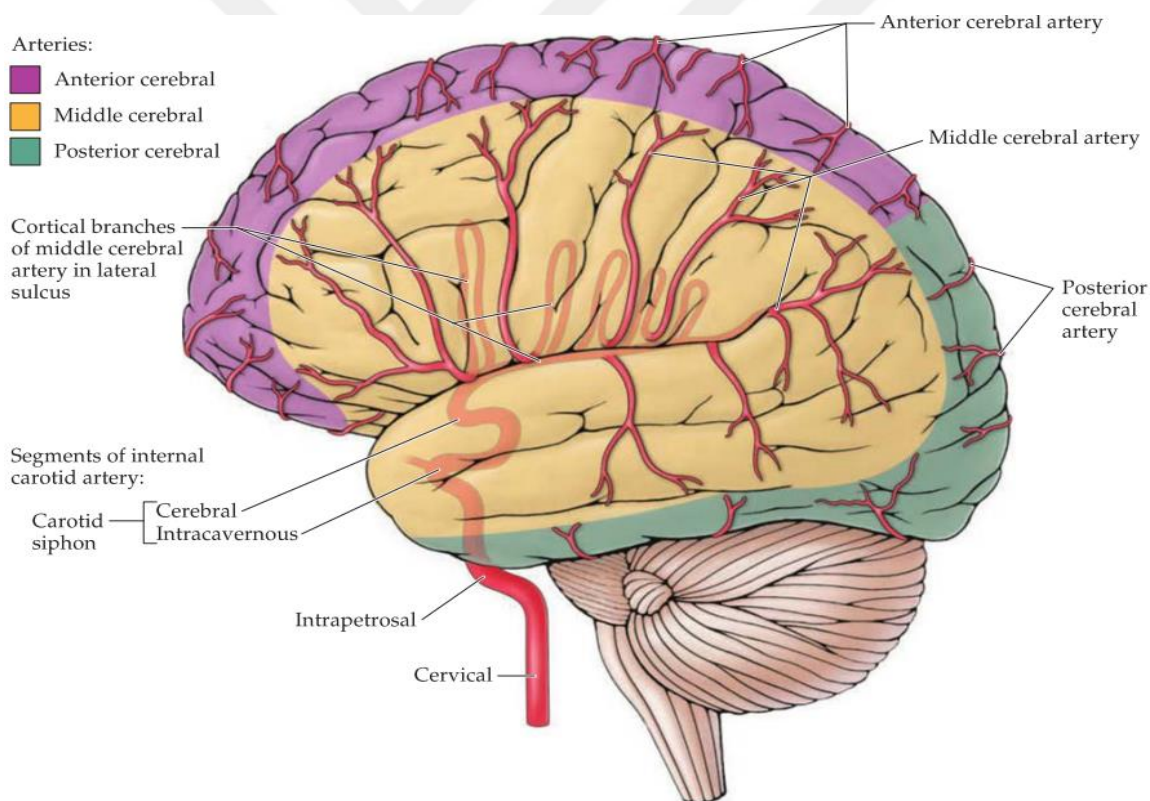


Figure 2.2. The courses of the cerebral arteries in lateral view of the cerebral hemisphere (58).

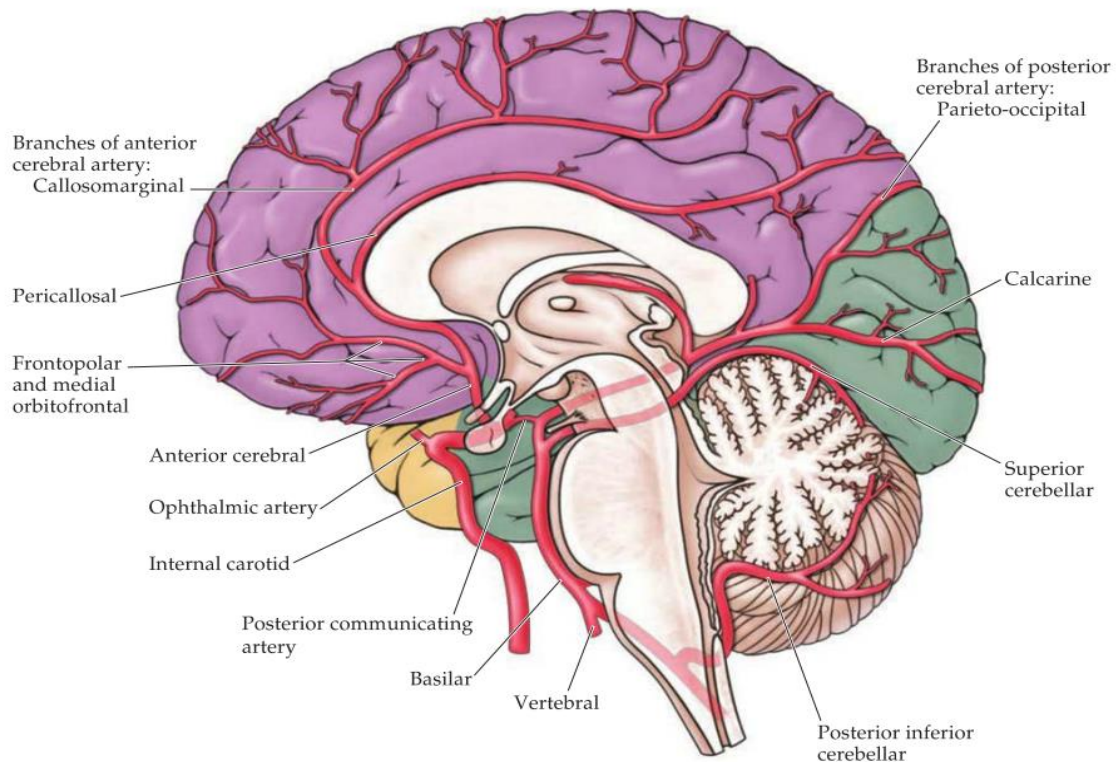


Figure 2.3. The courses of the cerebral arteries in midsagittal view of the cerebral hemisphere (58).

2.4.3. Pathology and Etiology

Although many conditions such as hypoglycemia, other metabolic disorders, trauma and seizure cause focal central damage that begins suddenly and lasts no less than 24 hours, the term stroke can only be used when such a condition develops as a result of a cerebrovascular disease. The underlying pathological process of stroke is that the arteries that supply the brain fail to transmit blood flow from the heart to the brain tissues due to ischemia or hemorrhage, and as a result, the brain tissue undergoes necrosis (28,32,71).

One of the most important determinants in the evaluation of a stroke patient is determining which artery and its branches cause the symptoms. Different clinical syndromes seen in stroke arise from lesions of different areas in the cerebral cortex (41,72).

Classifications regarding etiology are generally made according to the pathology of the lesion and divided into two main groups: ischemic or hemorrhagic. 80% of strokes are ischemic and 20% are hemorrhagic. While ischemic strokes are divided into thrombotic and embolic according to their injury mechanisms, hemorrhagic strokes can develop due to intracerebral and subarachnoid hemorrhage (4,73).

2.4.3.1. Ischemic Stroke

Restriction of blood flow to the brain prevents neurons and other cells from receiving glucose and oxygen, and if blood flow is not restored as soon as possible, this causes cell death. The model of cell death is related to the severity of ischemia. In the mild ischemia seen with reperfusion during cardiac arrest, there is a preferential loss of only certain selectively sensitive neural cell populations. More severe ischemia causes separating neuronal necrosis, in which all neurons die and only endothelial and glial cells are maintained. In complete and permanent ischemia, pannecrosis develops affecting all cell types (71,73,74).

The enzymatic reactions that develop during this active biochemical process and the metabolic products of these enzymes such as eicosanoids, reactive oxygen and nitrogen radicals cause the destruction of the plasma membrane and permanent cell death. If blood flow is restored to ischemic brain tissue before neurons are irreversibly damaged, clinical signs and symptoms will be temporary. Prolonged cessation of blood flow leads to infarction, which is irreversible ischemic damage, and permanent neurological deficit. There are two pathogenetic mechanisms that may cause ischemic stroke which are called thrombosis and embolism. 2/3 of ischemic strokes are reported as thrombosis and 1/3 as embolism, and it is not possible to distinguish between the two on a clinical basis (76-78).

2.4.3.1.1. Thrombotic Ischemic Stroke

Thrombosis can cause stroke by obstructing large cerebral arteries such as ICA, MCA and basilar artery, small penetrating arteries as in lacunar stroke, cerebral veins and venous sinuses. Symptoms typically last from minutes to hours. Thrombotic strokes are often preceded by a history of TIA, as they tend to show similar symptoms and may show repeated involvement of the same area (71,73,79).

2.4.3.1.2. Embolic Ischemic Stroke

Embolism causes stroke when the distal parts of the cerebral arteries are blocked by thrombosis originating from the heart or aortic arch. Embolism in the anterior circulation often causes occlusion of the MCA and its branches, which carry most of the hemispheric blood flow. Embolism in the posterior circulation is often located at the top of the basilar artery or PCA. The characteristic of embolic strokes is that they initially cause maximal neurological deficit. In embolic strokes that develop following TIA, an embolism of cardiac origin may be considered (71,73,77).

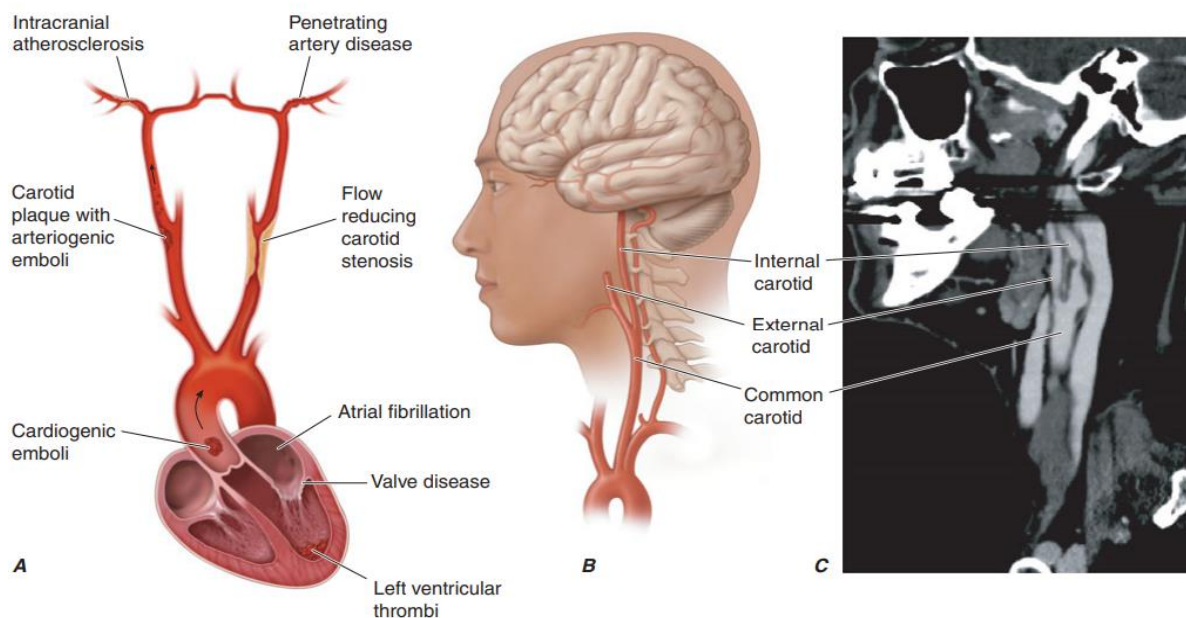


Figure 2.4. Pathophysiology of ischemic stroke. A. Diagram illustrating mechanisms of ischemic stroke. B and C. Diagram and CT angiogram of the carotid arteries which may be associated with ischemia (74).

2.4.3.2. Hemorrhagic Stroke

Hemorrhagic stroke, which accounts for 10-15 percent of all strokes, can impair cerebral function in multiple ways, including destruction of brain tissue and compression of vascular structures resulting in edema. It occurs mostly by starting at the bifurcation points of large cerebral arteries and transmitting the pressure to small susceptible perforating arteries. Hemorrhagic stroke, which accounts for 10-15 percent of all strokes, can impair cerebral function in a variety of ways, including destruction or compression of brain tissue and compression of vascular structures leading to edema (73,80,81).

Headache, nausea, vomiting and impaired consciousness are acute findings seen in hemorrhagic strokes. The prognosis of hemorrhagic stroke, in which 30 to 35 percent of patients reportedly die within 1 to 30 days, is worse in the acute phase than ischemic strokes. Hemorrhagic stroke is subdivided into intracerebral and subarachnoid hemorrhage (71,80,82,83).

2.4.3.2.1. Intracerebral Hemorrhage

The situation that occurs when arterial or venous blood passes into the brain tissue is called intracerebral hemorrhage. It occurs within the parenchyma of the central nervous system. It shows a very sudden onset. This type of hemorrhage causes neurological symptoms by compressing adjacent tissues and disrupting the tissue (82,84-86).

The clinical presentation is closely related to the amount of blood coming out of the vessel, the mass, extent and location of the hematoma if it occurs, and the mortality rate is higher than ischemic stroke (80,85).

2.4.3.2.2. Subarachnoid Hemorrhage

Bleeding that occurs within the subarachnoid space, usually due to arterial and rarely venous causes, is called subarachnoid hemorrhage. This type of hemorrhage increases intracranial pressure, leading to cerebral dysfunction through the toxic effects of subarachnoid blood on the brain tissue. It spreads to the space surrounding the brain and where the cerebrospinal fluid circulates (71,74,83).

Additionally, subarachnoid hemorrhage may be complex by vasospasm resulting in ischemia, rebleeding, intracerebral hematoma formation, or hydrocephalus. It typically manifests itself with headache rather than focal neurological symptoms. Patients describe an acute headache that is very severe and unlike their previous pain (74,80,87).

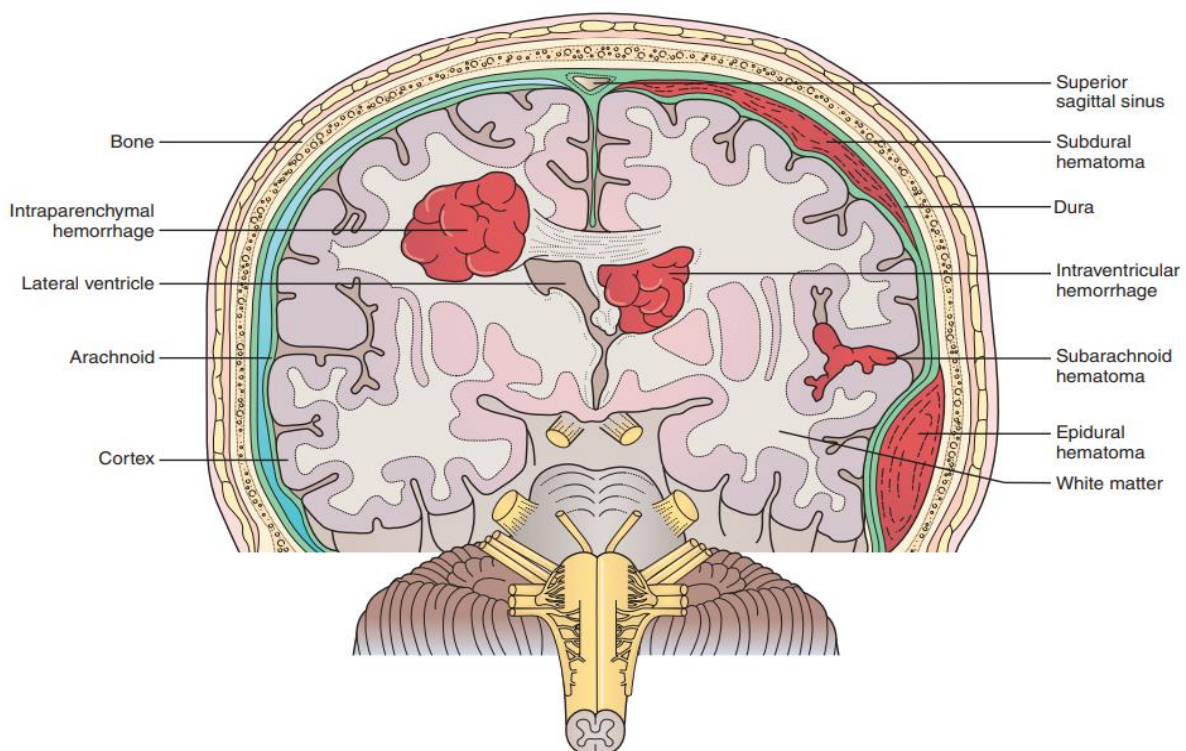


Figure 2.5. Common sites of cerebral hemorrhage (75).

2.5. Functional Impairments Following Stroke

Stroke is the leading cause of functional limitation in adults and causes neurological symptoms that hinder the person's functionality and affect the rehabilitation potential. Impairments affecting functionality after stroke arise from motor, sensory, cognitive and linguistic symptoms. It is important to know that the presence of each symptom is the determining factor in planning the rehabilitation process and type to manage these impairments (1,2,88).

2.5.1. Motor Impairments

The most common problem after stroke is motor disorders. Normal movements and function are limited due to motor impairment. Hemiparesis or hemiplegia occurs in 80-90% of patients. It usually occurs on one side of the patient's body. Muscle tone, posture, strength, coordination and balance may also be affected after a stroke. One or a combination of these anomalies in movement patterns can cause serious disability and limit the patient's activities. Motor disorders such as tone changes, abnormal movement patterns and decreased muscle strength that occur after stroke negatively affect the performance of motor functions such as initiation and control of movement (89,90).

2.5.1.1. Motor Impairments Due to The Location of The Lesion

Different sections of the sensorimotor cortex have a different impact on motor function. Despite significant differences between lesion location and motor deficits, particular sensorimotor deficits can be assigned to lesions in certain cortical regions. Most stroke lesions affect multiple cortical areas, so the resulting deficits often consist of different parts that control the residual motor capacity (89-91).

2.5.1.1.1. Primary Motor Cortex Lesions

Outcomes of the primary motor cortex and premotor area lesions are not fully known. The indecision stems from the insufficient data on the precise margins of ablations or clinical findings. One of the most common motor impairments ensuing a motor cortex lesion is weakness, a decreased strength and coordination of extremities. A significant connection is established between stroke and weakness; The weakness may involve one part of the body, but it mostly occurs affecting more than one part on the same side (91-93).

Loss of manual dexterity, loss of more distal function than proximal, upper extremity being affected more than the lower extremity, hypersensitive stretch reflexes and deep reflexes are motor disorders that occur when the primary motor cortex is affected. In addition, Babinski symptoms, which means that the toe makes an extension movement instead of its normal flexion movement due to the stimulation of the inner surface of the foot, may also occur as a result of this area being affected (92,93).

2.5.1.1.2. Premotor Area Lesions

Since premotor areas play a role in the formation of complex movements, lesions in this region cause more complicated movement impairments compared to the primary motor cortex lesions. Proximal muscle weakness, impairment in the ability to perform proper movement strategies, inability of using spatial cues to choose movements are motor impairments due to premotor area lesions.

Considering that the premotor cortex is involved in the temporal features of motor programming, Apraxia-like symptoms including loss of kinetic flow, temporal disorganization, impairment and inability to perform learned movements may also be attributed to lesions in this region (93-95).

2.5.1.1.3. Posterior Parietal Cortex Lesions

If the posterior parietal cortex is affected, it shows impairment in complex motor and somatosensory functions, leading to somaesthesia. Parietal cortex lesions cause remarkably clumsy and improper hand movements (96).

As the parietal cortex also plays a role in detailing motor behavior sufficient for processing and shaping sensory information, visuomotor ataxia and tactile apraxia are disorders that occur when this region is affected. Visuomotor ataxia is the inability of the arm or head to reach a target. Patients have great difficulty aiming, directing and preshaping their hands. Tactile apraxia is an impairment that affects movements that are influenced only by somatic input, making it difficult to recognize and touch the object (96,97).

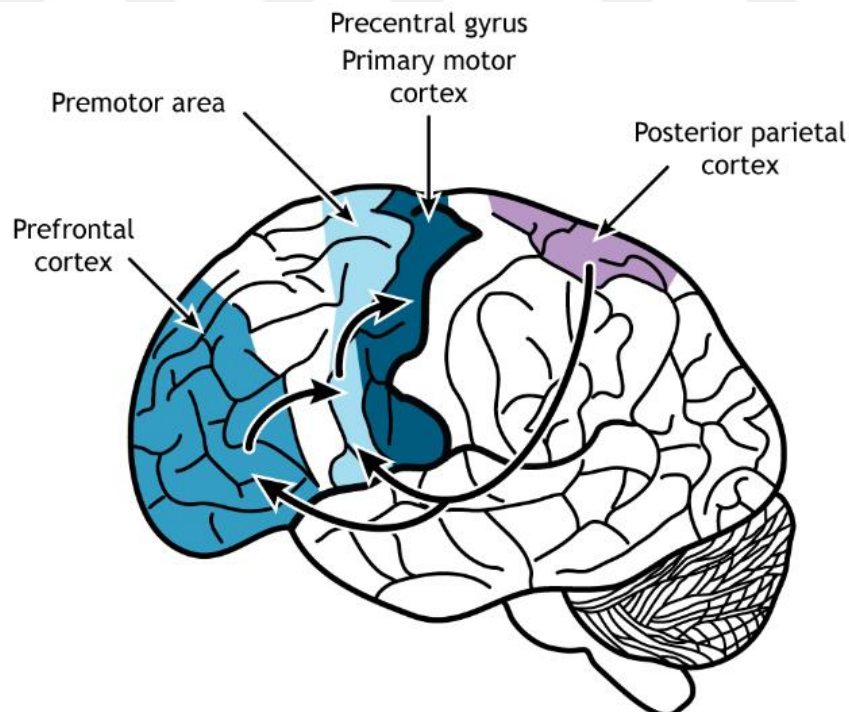


Figure 2.6. Motor regions involved in planning of movement (98).

2.5.2. Sensory Impairments

Sensory deficits following hemispheric stroke may arise from one of the cortical and subcortical structures, most often from the primary somatosensory area located in the postcentral gyrus. In order to effectively plan and process motor movements, accurate and rapid detection and evaluation of sensation, which is an important component of the function, is essential. Without sensory control, without a sense of position in space, it is not possible to initiate and coordinate movement. The organization of purposeful motor movements is achieved by ensuring somatosensory integration (99,100).

Sensory impairment is generally seen together with motor loss. As a disorder in somatosensory functioning, patients may experience a decrease or loss of sensations such as touch, pain and temperature in the opposite half of the lesioned hemisphere. Central neuropathic pain develops in more than half of stroke patients whose somatosensory pathways are affected after stroke. Patients describe sensory disturbances such as numbness, tingling, and burning in the affected body parts due to neuropathic pain. It may also increase the likelihood of learned disuse by causing gradual deterioration of motor function and reducing spontaneous use of the affected hand (100-103).

Post-stroke sensory impairment can range from selective involvement of tactile discrimination or proprioception to involvement of all somatosensory modalities depending on the location and size of the lesion. Sensory disorders that occur after a stroke are astereognosis, that is, the inability to identify the object handled by touching or seeing it, difficulty in perceiving the body position and the relationship of body parts to each other, somatognosia, the lack of awareness of the relationship of the body and body parts, unilateral neglect, that is, neglect of the affected side of the body and the environment on the affected side, right/left discrimination and body image impairments (99,103-106).

All these sensory disorders observed after stroke negatively affect the motor functions and activities of daily living (ADL). Patients who experience sensory impairment in the upper or lower extremities after stroke, have difficulties in many ADL such as eating, wearing, bathing, styling hair, preparing simple meals or deciding on safe water temperature (106,107).

2.5.3. Cognitive Impairments

Cognitive functions are the process by which a person interprets information, has the ability to make choices, integrates this information into daily life, and processes and organizes previous experiences with information from the environment. Cognition and perception are vital for an individual to interact purposefully and competently. Cognition allows the individual to process, store and use information. Perception enables the integration of senses with meaningful information (108,109).

Mental functions are divided into two as global mental functions and specific mental functions according to the International Classification of Functioning, Disability and Health (ICF) classification. Global mental functions include consciousness, intellectuality, orientation, psychosocial functions, personality functions, and sleep. Attention, memory, psychomotor functions, mood, visual-spatial perception, thinking, basic cognitive functions, high-level cognitive functions (abstraction, planning, reasoning, problem solving), calculation and language functions are among the specific mental functions (110).

Cognitive impairments are a significant problem after stroke, occurring in 39% of patients after stroke and continuing to occur in 32% up to three years. Cognitive dysfunctions that occur after stroke cause impairment in patients' motor skills and relearning abilities due to memory problems or poor judgment. At the same time, it significantly impairs the person's quality of life by affecting their professional, social and daily life activities. Studies have shown that there is a convincing relationship even between stroke risk factors and cognitive decline (109,111,112).

Mental disorders occur at various levels in hemiplegic patients due to brain damage and changes in functional and social status. Cognitive changes seen after stroke may occur in global or specific functions. Patients with left hemiplegia are more prone to attention deficits, and patients with right hemiplegia are more prone to perceptual and visual-spatial deficits. While proximity to the frontal lobe increases the severity of the problem, there are also studies showing that lesion localization is not important (113-116).

The cognitive consequences of stroke, or more generally of diseases of the brain's blood supply system, are more commonly described as vascular dementia. However, there are some problems in defining all cognitive problems seen after stroke under this heading. One of these is that a severe cognitive impairment is required to diagnose vascular dementia in a patient with post-stroke cognitive problems. Because this causes patients with less severe but significantly debilitating cognitive impairment to not be identified early, or the patient's cognitive status to be easily exaggerated due to the diagnosis of vascular dementia. Another problem is that it tells little about cognitive impairments, which may differ in each patient and may affect many different specific functions such as perception, attention, language, and memory. Therefore, it would be more accurate to use the concept of vascular dementia for cases where progressive neuronal impairment because of a vascular origin is connected with a progressive, global regression in cognitive functions (117-121).

Among the cognitive dysfunctions that may occur in post-stroke patients, the most common are cognitive learning, problem-solving skills and memory problems. This decline not only affects the person intellectually, but also may affect participation in physical therapy and functional performance in ADL. According to studies, the prevailing opinion is that physical exercise and cognitive training are effective methods to prevent cognitive decline after stroke and reduce its negative effects. It is stated that this effect is effective on cognitive functions through synaptic plasticity and neurogenesis and leads to expression in the hippocampus. In order for stroke patients to reach the maximum possible level of independence, their cognitive functions must be addressed carefully and early, along with the rehabilitation of their motor functions and functional abilities, and multidisciplinary, comprehensive rehabilitation programs must be organized (108,111,112,122,123).

2.5.4. Speech And Language Impairments

Language and speech disorder due to a brain injury is called aphasia. If one or more of the parts of language use, such as choosing the right words, understanding, writing, reading and even making gestures, lose their function as a result of brain damage, a disorder called aphasia occurs. Ischemic and hemorrhagic stroke in the location of the anterior cerebral circulation, particularly in the area of the left MCA, is a frequent reason of aphasia condition (124,125).

Verbal and written forms of expression are mostly structured in the left hemisphere of the brain. Broca's and Wernicke's aphasia are seen in frontal lobe and temporal lobe lesions in this hemisphere. While the patient has difficulty expressing himself in Broca's aphasia, the main problem in Wernicke's aphasia is difficulty in understanding. Apart from these, aphasia may also be accompanied by speech disorders such as apraxia of speech or dysarthria. In motor speech disorders such as dysarthria and apraxia, there is a problem with the weakness of the tongue, lips, throat and respiratory muscles required for verbal communication or the inability to transmit the message from the brain to these muscles. Such problems seen in stroke cause deterioration in the patient's communication, alienation from the social environment, disability and deterioration in the quality of life (124,126).

2.6. Recovery After Stroke

Humans show a significant capacity to recover from functional impairments that occur after brain injury. Although recovery does not result in complete reversal of functional loss, the organism is capable of regaining some functions lost following brain injury. Clinical studies show that, with variability between patients, the initial severe neurological deficit seen in stroke patients improves significantly over time. Because the cerebral cortex has the ability to reorganize and this reorganization is maximum in the first 6 months. Improvement in functional impairments may be attributed to spontaneous neurological recovery or behavioral compensation, or both. Although spontaneous and functional recovery are parallel to each other, the recovery in the first 3 months is generally spontaneous, and subsequent improvements are functional and individual (127-129).

2.6.1. Spontaneous Recovery

Spontaneous recovery in neurological functions is the process that occurs when pathologies such as ischemia, metabolic damage, hemorrhage and pressure disappear in the acute period after stroke, the ischemia in the penumbra is re-blooded, and the edema decreases and the pressure is eliminated (130,131).

As edema decreases and blood flow is regulated, non-functioning neurons can begin to function again within weeks. One of the basic mechanisms of reorganization is the activation of masked latent pathways in the brain after stroke, forming new synaptic connections and assuming the new function (74,132).

2.6.2. Functional Recovery

Within the limits of physical disabilities, improvement in the ability to perform ADL is called functional recovery. Within the limits of physical disabilities, improvement in the ability to perform ADL is called functional recovery. This recovery occurs through neuroplasticity. Neuroplasticity refers to changes in the structural parts, neurons functions in brain and the synapses produced by these neurons, relying on various environmental stimulus. A stimulated neuron can stimulate other neurons around it, causing neuroplastic changes. With neuroplasticity, increased branching of dendrites, lengthening of their length, formation of new synapses and changes in the effectiveness of existing ones can be observed, as well as the formation of new neurons, their survival and increased resistance to deterioration under stress (133-135).

Shortly after stroke, a contralesional shift of activation towards the unaffected hemisphere is observed. This is followed by activation of brain structures involved in learning, including the cerebellum, basal ganglia, and frontal cortices. The fastest motor recovery occurs within 30 days and can take up to a year. Since the upper extremity is more affected than the lower extremity at the beginning of the healing process, motor recovery of the arm is more limited. There may be improvements in aphasia, which is seen in approximately 1/3 of acute stroke patients, for up to a year, but it occurs slower and takes longer than motor recovery. The recovery of perception functions occurs in the first 3-6 months (124,130,135,136).

Recent experimental studies suggest that new motor skills acquired through intensive practice and frequent repetition are essential for long-term brain plasticity. Considering the mechanisms of neural plasticity and looking at the study results, programs involving repetitive practice in which patients actively participate are effective in the treatment for the recovery of the brain and restoration of functional gain after stroke (22,23,25,27,137,138).

2.7. Stroke Rehabilitation

Although individuals who survive a stroke may experience permanent neurological disorders, approximately 80% of the population with mild and moderate disabilities can benefit from rehabilitation services. The aim of rehabilitation for individuals with stroke is to maximize their functional independence by improving their motor and cognitive skills (10,139,140).

It is extremely important to implement the rehabilitation process early in ensuring motor learning and functional return after stroke. The most significant return in neurological function occurs within the first three months after the accident. If the patient's medical treatment is planned and his vital signs are stable, an early rehabilitation period is very important to make optimum use of brain plasticity and reorganization capacity (130,133-136,139,141).

Since many areas of the brain are affected in stroke, combined disorders are seen clinically. Many factors such as the patient's cognitive status, motivation, previous and current functional level, and need for medical care play a role in choosing the ideal rehabilitation for the patient. To enable the person reach the maximum level of independence in physical, psychological, social and professional aspects and to increase the quality of life, different physiotherapy and rehabilitation approaches are applied (11,12,23,139).

The first approaches developed in the field of neurological rehabilitation emerged with the studies of Rood, Kabat and Knott, Brunnstrom and Bobath. They based these methods on neurophysiological foundations. Although these neurophysiological approaches are still valid in today's stroke rehabilitation, different approaches that emphasize the quality of movement, functionality and goal-oriented training and are developed based on motor learning principles have also been used (22-25, 141-143).

2.7.1. Neurodevelopmental Treatment

Neurodevelopmental approaches generally aim to reveal normal posture and movement and reduce abnormal tone. In NDT, all problems are addressed holistically in training, taking into account the perceptual problems that exist in addition to the motor problems in stroke. Neurophysiological approaches include the combined use of many techniques such as manual techniques, auxiliary equipment such as pressure splints, sensory stimulation such as taping and stroking, cross-facilitation and biofeedback, and environmental regulations. The most frequently used neurophysiological approach in stroke patients is the Bobath method (5,7,11-13,139,142).

2.7.1.1. Bobath Training

The Bobath method is a NDT approach used by therapists to help individuals regain function and movement. Bobath training (BT) is used in the treatment of individuals with neurological dysfunction. Therapists apply approaches passed down from generation to generation to uncover and reestablish typical movement patterns, utilizing therapist-controlled sensorimotor experiences. BT has some key features and principles. It focuses on the problems caused by central nervous system lesions in the coordination of posture and movement and the atypical features of muscle tone that directly affect function. Bobath clinicians believe that these functional limitations can be changed in the context of ADL (14-16,142-144).

Movement quality is a skill and mechanical event that involves a series of fine and coordinated movements involving many body parts. The quality of movement, which is difficult to fully perform in individuals with stroke, constitutes the cornerstone of the Bobath method. According to this approach, importance should be given to quality of movement in stroke patients from the early stages. Movements of poor quality or in the wrong pattern may lead to impairments that will affect the patient's functionality, such as gait disorders, in the future. Repeating movements in a quality pattern from the early period onwards can lead to better achievements in the long term (128,139,143,145).

Bobath approach is a holistic approach. Since the innervation of the trunk muscles is bilateral, sensory impairment also occurs on the unaffected side, and symptoms such as cognitive and balance impairments concern the whole body, the bobath approach evaluates hemiparesis not as a unilateral disease but as a disease that affects the whole body. This approach emphasizes the bilateral use and symmetry of the trunk in daily living activities such as sitting to standing and walking. The trunk is important for proximal stabilization of selective movements of the extremities. Trunk and neck stabilization is at the forefront in evaluation and treatment, and the trunk, upper extremity and lower extremity are included in the treatment program (14-17,128,142,143,145).

Although there are studies showing the positive effects of the BT on stroke patients, the results of systematic review studies indicate that the Bobath approach is not superior to other rehabilitation approaches in terms of mobility, activities of daily living, sensorimotor control of the upper and lower extremities, motor control of gait, health-related quality of life, and cost effectiveness (22,23,146,147).

2.7.2. Task-Oriented Training

In recent years, with the increasing emphasis on neuroplasticity following CNS disorders, interest in task-oriented training (TOT) has also increased. Behavioral experience has been noted to be a powerful inducer of neuroplastic change, especially in the cerebral cortex. The method called TOT is a motor learning-based rehabilitation approach that facilitates the reshaping of the central nervous system and neural reorganization and is based on multiple repetitions of motor performance (20-24,148).

This training can include a wide range of functional tasks such as exercises to achieve tasks, sit-to-stand exercises, walking training, treadmill training, cycling programs, endurance training and station training, use of the upper extremities in grasping and reaching activities, and mental imagery (24-27).

Task-oriented training is a task and patient focused training. The patient is actively involved in every stage of rehabilitation. Rehabilitation goals established within the scope of the tasks are taken into account, taking into account the patient's expectations and functional status. Goals that meet the patient's needs, are clearly defined, realistic and achievable within a certain period of time are planned (140,146,148).

The main principles of task-oriented training are:

- **Specificity of training:** The first principle is to plan the training individually. A meaningful, realistic and motivating treatment program should be created while determining the individual's deficiencies in functional performance in line with his social role, wishes and needs, and planning appropriate goals for them. Thus, the training becomes specific to the individual (149,150).
- **Restricted use of unimpaired limbs:** According to the results of the studies, the width of the cortical representation area of any body part varies depending on the frequency of use of that area. In task-oriented training, the use of the unaffected side is restricted in order to increase the use of the affected side. Likewise, for this purpose, training is performed by preventing the extremities of the unaffected side from supporting the impaired limbs during functional activities (151,152).
- **Repetitive training:** The intensity of multiple repetitions of a task enhances neuroplastic changes, increases performance, facilitates learning, and forms the most important basis of motor learning. In order for the person to achieve gains such as motor adaptation, being able to choose the right movement for the activity, and developing skills, opportunities to increase use should be provided during the treatment period (25,148,149).

- **Shaping:** It is the principle based on gradually increasing the difficulty and content of the functionality of the given task over time. Considering that patients may be frustrated when faced with a new difficult task, they start with the simplest motor task and make it more difficult until they complete the function that can be tolerated. In other words, exercise formation should be progressed from easy to difficult, from simple to complex (23,26,27,149).
- **Choosing a salient task:** The importance of the functional task to the patient increases his motivation in practice. For example, since walking is a vital function for most patients, motivation is always high in exercises related to this. While cooking may be a source of motivation for some patients regarding upper extremity functions, being able to use repair tools or dressing up may be a motivating goal for some patients. The tasks used should be created taking into account the patient's sociocultural situation, goals and personal needs (140,148,149).
- **Performance Feedback:** Feedback is also essential factor in post-stroke training. Because sensorimotor feedback is important for motor learning. Feedback can be given by the therapist, increasing sensory feedback through motor training is necessary to improve results after therapy (153,154).

3. MATERIALS AND METHODS

3.1. Subjects

This randomized controlled study consisted of 20 patients aged 18-80 years, who were diagnosed with stroke, admitted to Eksen Health Inpatient Physical Therapy and Rehabilitation Center. The Yeditepe University Non-Interventional Ethics Committee approved the study protocol on 12.05.2023, and the issue number was 202305Y0395 (Appendix 1). The study was also registered to ClinicalTrials.gov (NCT06196411). The sample size was analyzed with using G*Power (G*Power Ver. 3.1.9.4) program. This analysis determined the sample size required with the Type I error probability of 0.05 and a power (probability) of 0.90 as 6 subjects for the study and 6 subjects for the control group. The inclusion and exclusion criteria of the study are indicated below.

3.1.1. Inclusion criteria

- Volunteering to participate in the study
- Being age of 65-80 years
- Having hemiplegia diagnosis following stroke
- Having stroke diagnosis at least two weeks ago
- Having stable vital signs
- Having Mini Mental State Examination (MMSE) score between 18-23 points

3.1.2. Exclusion Criteria

- Having global aphasia and/or severe apraxia
- Having dementia or Alzheimer's diagnosis prior to stroke
- Discontinuing treatment
- Receiving rehabilitation service previously

3.1.3. Flow Chart of the Study Process

Patients were recruited from Eksen Health Inpatient Physical Therapy and Rehabilitation Center between June and September 2023. Mini Mental State Examination (MMSE) was applied face to face by the researcher and the patients who scored between 18-23 were included in the study (Appendix 4). Then, the patients were divided into two groups: TOT Group (TOTG) (n=10) and BT Group (BTG) (n=10) using the block randomization method. While the TOTG received a task-oriented training program in addition to Bobath training 5 days a week for 8 weeks, only Bobath training was applied to the BTG.

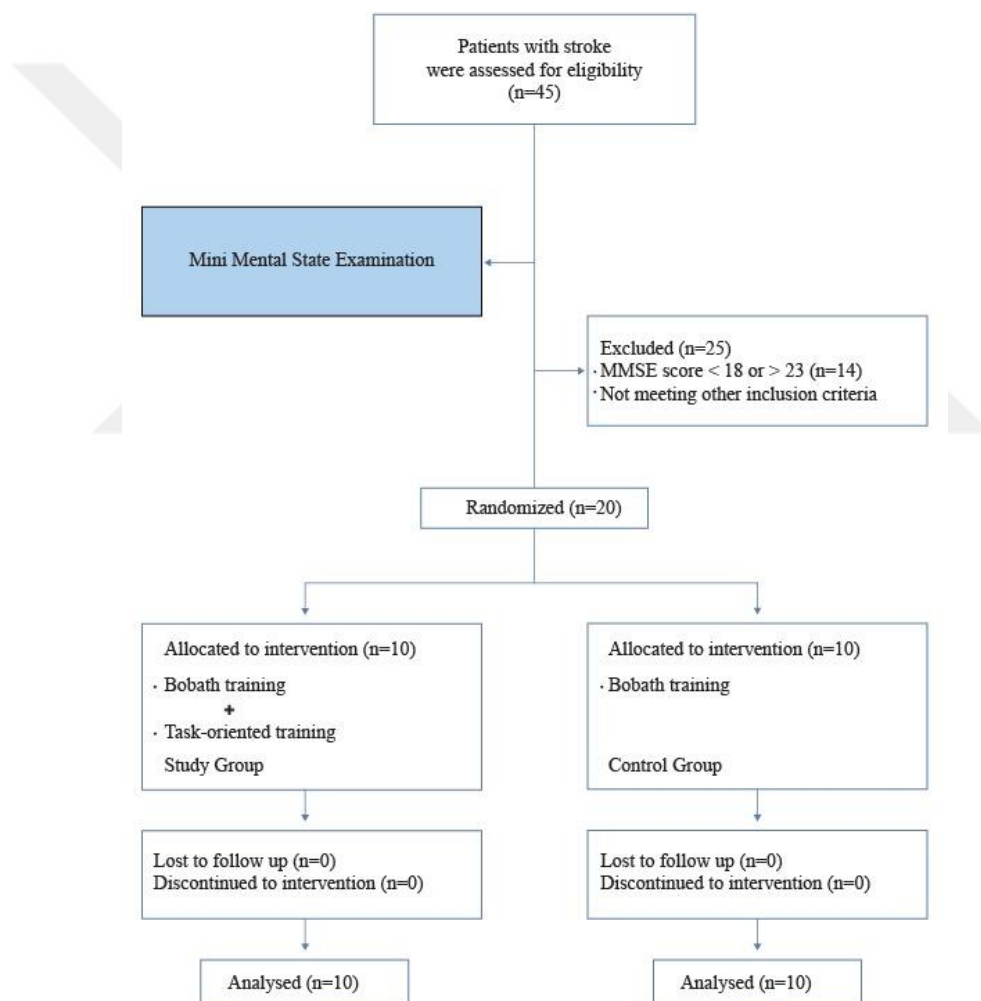


Figure 3.1. Flow Chart of The Study

3.1.4. Study Protocol

The volunteers included in the study were divided into two groups: TOTG (n = 10) and BTG (n = 10). Bobath training and task-oriented training program were applied to the TOTG, and only Bobath training was applied to the BTG (Figure 3.2.). The attached form containing demographic and clinical characteristics was filled in for all participants in the 2 groups during the face-to-face interview (Appendix 3). To evaluate motor functions, Functional Independence Measure (FIM) and Barthel Index (BI), and to evaluate cognitive functions Mini Mental State Examination (MMSE) and Dynamic Loewenstein Occupational Therapy Cognitive Assessment-Geriatric version (DLOTCA-G) were administered to all participants in the 2 groups before and 8 weeks after training (Appendix 4) (Appendix 6) (Appendix 7). The results of these tests were evaluated by comparing the study and control groups.

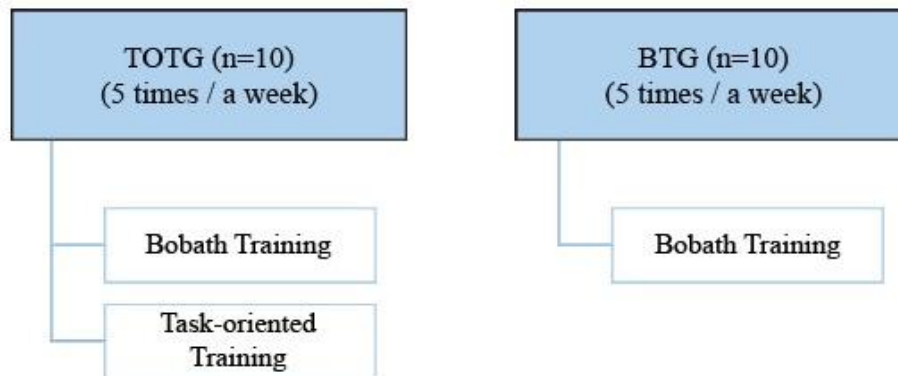


Figure 3.2. Study protocol for TOTG and BTG

3.2. Assessment Methods

3.2.1. Demographic Features and Clinical Symptoms Information Form

Patient's characteristics such as age, gender, educational status, time from the onset of stroke, the side of the brain lesion and its specific location were recorded by the physiotherapist by asking questions to the patients and families and taking a detailed history during the face-to-face interview (Appendix 3).

3.2.2. Mini Mental State Examination (MMSE)

The Mini Mental State Examination, published by Folstein et al. in 1975, is an easy-to-apply test that is translated into many different languages to use both in the diagnosis and treatment process for evaluating cognitive functions and dementia (155). MMSE has strong validity in identifying cognitive impairment after stroke, with acceptable sensitivity, specificity and Turkish translation, validity and reliability study was performed by Güngen et al. in 2002 (156,157).

MMSE grouped under five main subset of cognitive status headings which are orientation, memory, attention, language and visuospatial proficiency (155). It is evaluated out of 30 points in total. It is defined as normal between 24-30 points, mild dementia between 18-23 points, and severe dementia between 17 points and below (158). The application time of the test is 10-15 minutes on average, it can be administered easily and quickly (157).

In the study, the questions of the test were first asked face to face to patients diagnosed with stroke by the researcher in order to determine the participants to be included in the study, and the answers were recorded. This test was re-applied to all participants in the two groups after the 6-week training program, with the same application method, to measure the change, and the results were compared.

3.2.3. Dynamic Loewenstein Occupational Therapy Cognitive Assessment-Geriatric version (DLOTCA-G)

The Dynamic Loewenstein Occupational Therapy Cognitive Assessment-Geriatric version (DLOTCA-G) is an accurate and reliable assessment tool developed to evaluate cognitive abilities comprehensively in people with brain damage (159). DLOTCA-G is a geriatric and dynamic version of the Loewenstein Occupational Therapy Cognitive Assessment (LOTCA) to measure learning potential, awareness and identify thinking cues, in addition to collecting information about patients' cognitive abilities and impairments as in the static assessment (160,161).

DLOTCA-G covers the cognitive aspects that patients need for optimal performance of a task more than any other dynamic assessment tool that can only assess patients' memory and classification functions (160). It is a battery test with a test booklet and test kits including 24 items in 8 cognitive domains which are orientation, awareness, memory spatial perception, visuomotor construction, visual perception, praxis and thinking operation (159,160).

Eight main sections of DLOTCA-G and sub-tests of these sections were applied to the patients to be included in our study. These applications were performed before and after the treatment for both groups as follows:

- **Orientation:** To evaluate orientation, 2 subtests consisting of place and time orientation were applied. In both subtests, four questions asking the location as city and full address and the time as day, month, year and hour were used. The answers of the patient were evaluated with a score between 0-2.
- **Awareness:** This section consists of three questions: reason for hospitalization, recognizing cognitive impairment before and after testing. Each question was scored between 1-3 according to the answer given by the participant.

- **Memory:** In the memory part, the patient was first shown a photo of a famous person and told to keep it in mind. Then, the tissue in the kit was shown to the patient and hidden somewhere, and he was asked not to forget the object and the place where it was hidden. Finally, the toothbrush, salt shaker, keychain, ring and candle were placed in front of the patient and the patient was asked to memorize these objects. After 20 minutes, the questions that were asked to be remembered in these tests were asked and scored between 1 and 4 according to the answers given.



Figure 3.3. DLOTCA-G testing memory section.

- **Spatial Perception:** This evaluation was carried out in 3 subsections which are the spatial awareness of the person's body position, spatial relationship on examiner and in the near environment. In the first part, the patient was asked to show his right hand and left leg, put his right hand on his left ear, and put his left hand on his right leg. For the second part, the patient was asked to point to the examiner's right eye, left shoulder, left leg, and right hand, respectively. For the second part, the patient was asked to point to the practitioner's right eye, left shoulder, left leg, and right hand, respectively. In the last part, the patient was asked which side he was in relation to the door, which side the window was in relation to him, and what the objects were to his right and left. Answers were scored between 0-1 points for each question.



Figure 3.4. DLOTCA-G testing spatial perception section.

- **Praxis:** Three subtests were conducted to assess praxis. First, the patient was asked to imitate examiner's movements as if reflected in a mirror. To do this, the examiner held her right ear with her right hand, touched her neck and then her opposite shoulder with her palm, placed the dorsal side of her hand on his opposite cheek, and touched the 3rd and 4th fingers with her thumb three times. Subsequently, the patient was asked questions about the use of objects. The patient was shown a comb and asked how to use it, paper and scissors were placed in front of him and he was asked how to divide the paper into equal parts, an envelope and paper were placed in front of him and asked what he could do to send a letter, and he was asked to remove the nails from a jar. Lastly, the symbolic actions section included imitating the activities of brushing teeth, opening the door with a key, cutting bread with a knife, and talking on the phone without using the object.



Figure 3.5. DLOTCA-G testing praxis section A. Motor imitation B. Utilization of objects.

- **Visual Perception:** In this section, the patient was asked to identify the objects in the booklet and the nested shapes shown on the given card. While evaluating object constancy, they were asked to identify 4 different shapes shown from different angles in the booklet. Each test were scored between 1-4.



**Figure 3.6. DLOTCA-G testing visual perception section A. Object identification
B. Object constancy.**

- **Thinking Operations:** This section included categorization and ordering. Categorization; The patient was asked to divide the cards with various shapes into 2 groups and to name these 2 groups. If the patient could divide into two groups, he was asked to divide into four groups in more detail and name also these groups. Pictorial sequence; The patient was asked to arrange 5 picture cards given in a mixed order to describe an event.

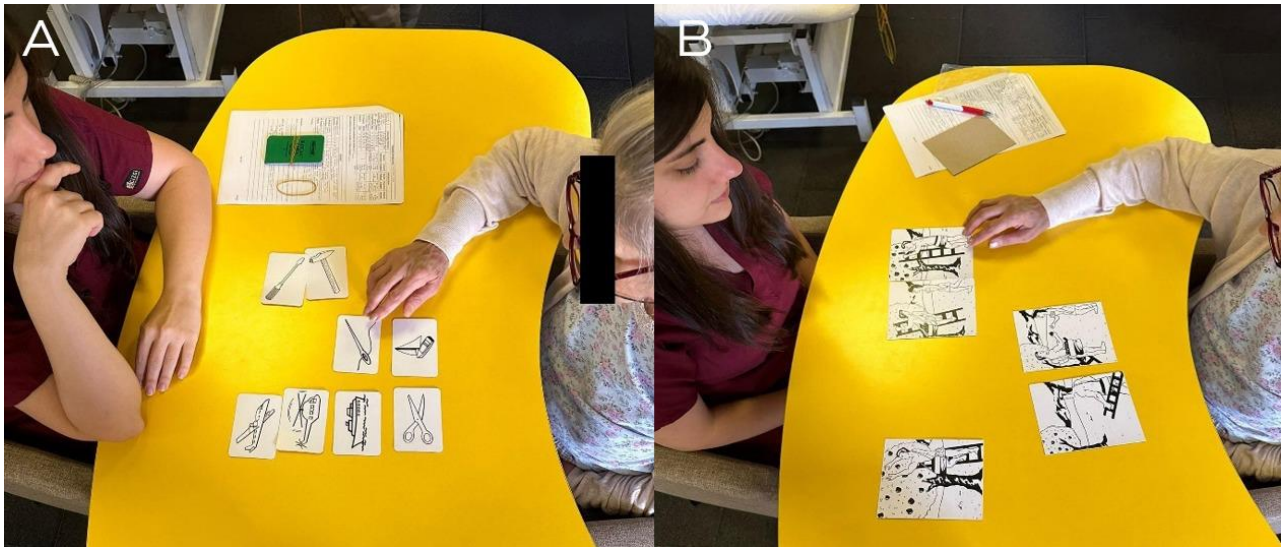


**Figure 3.7. DLOTCA-G testing thinking operations section A. Categorization
B. Pictorial Sequence**

- Visuomotor Construction:** This section consists of 6 subtests and the performance of the patients in each section were scored between 1-5 points. The first subtest is copying geometric shapes; The patient was asked to draw 3 different shapes shown on the cards. Secondly, the patient was asked to rebuild the design from the model shown on the booklet in order to measure the ability of reproducing a two-dimensional model. In the third part, the patient was asked to reconstruct the pattern on the pegboard using pegs. The following parts included creating the 3D shape with the given colored cubes for color block design, and creating the butterfly shape for jigsaw puzzle creation.

The last part was the clock drawing part, for which the patient placed the numbers of the clock in a circle given as a hollow and turned this circle into a clock pointing the hands to 11:10.

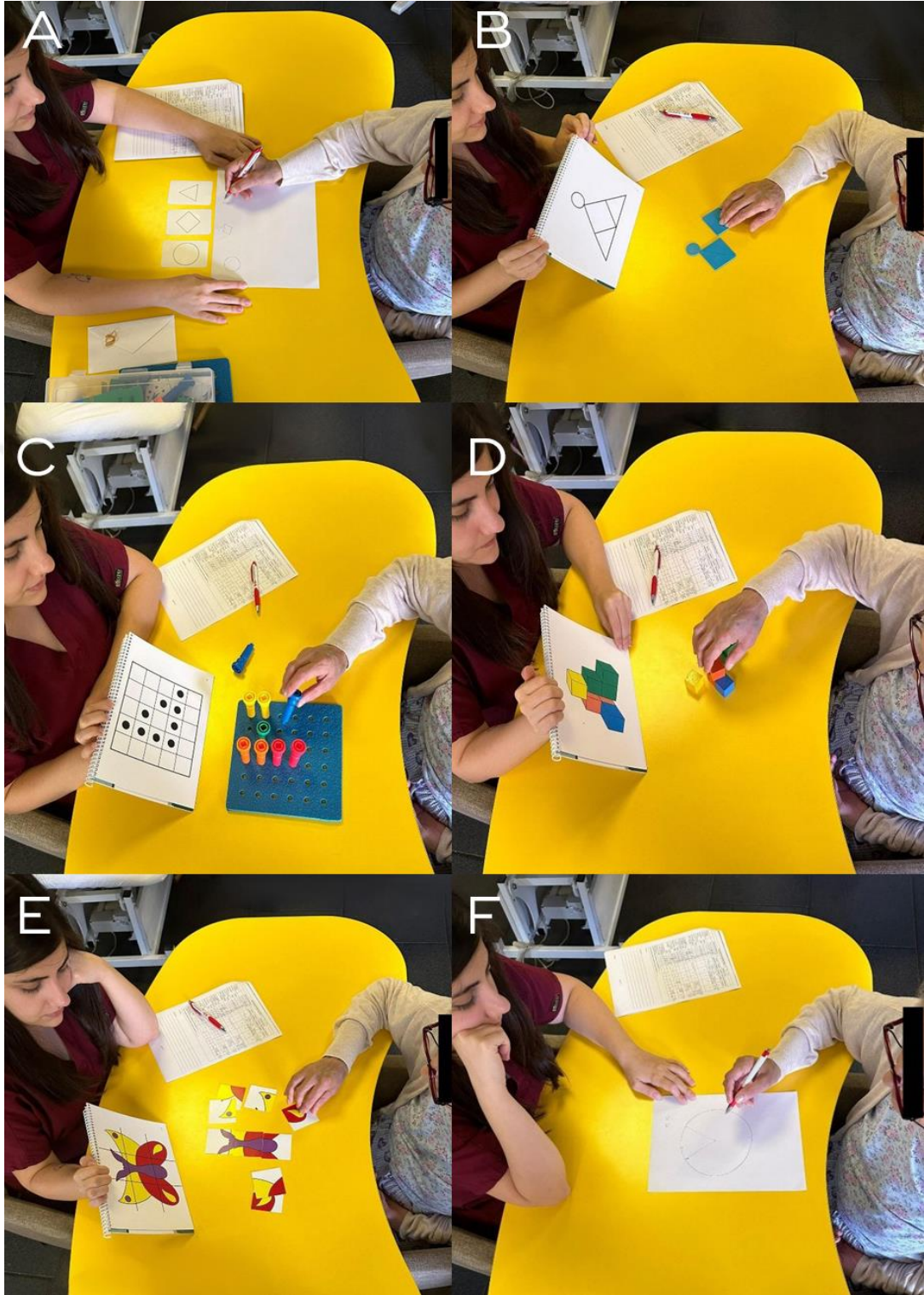


Figure 3.8. DLOTCA-G testing visuomotor construction section A. Copying geometric forms B. Two-dimensional model C. Pegboard construction D. Colored block design E. Puzzle F. Clock Drawing

3.2.4. Functional Independence Measure (FIM)

The Functional Independence Measure is a simple, convenient and effective measure of disability that can be used to assess and rate functional status in patients with stroke (162). The validity of the FIM has been supported by many studies and it has been translated into Turkish and adapted to be used in Turkey (163). There are 18 items in the FIM that indicate the level of disability and the burden of care (164). These items are grouped into 2 subscales which are motor (13 items) and cognition (5 items) (165). These two main sections are also evaluated with subgroups within themselves: Motor functions; self-care (6 items), sphincter control (2 items), transfer (3 items), walking (2 items), stairs (1 item) and cognitive functions; communication (2 items) and social perception (3 items) subgroups (164). Evaluation is made out of 7 points (165). Accordingly, the scores given between 1-7 points express the following situations;

- 7 points: The activity is done safely and in sufficient time. (Complete independence)
- 6 points: Use of an assistive device is required to perform the activity, or the activity takes a long time or there is a security problem. (Modified independence)
- 5 points: The activity is done under supervision. (Supervision)
- 4 points: The patient does 75% or more of the activity. (Minimal assistance)
- 3 points: The patient does 50% or more but less than 75% of the activity. (Moderate assistance)
- 2 points: The patient does more than 25% but less than 50% of the activity. (Maximal assistance)
- 1 point: The patient does less than 25% of the activity. (Complete dependence)

The total score is obtained by summing the scores for each item (166). The sub-total score to be obtained from the motor subscale is between 13 and 91, and from the cognition subscale, a value between 5 and 35. Therefore, the total score for the FIM tool corresponds to a value between 18 and 126, where a higher score means a higher level of independence (164). In our study, the FIM for all participants was filled by the physiotherapist before and after the treatment by observing the patient's performance or by asking the patient to perform the activity (Appendix 6).

3.2.5. Barthel Index (BI):

The Barthel Index (BI) is one of the most commonly used rating scales to measure functional limitations in patients with neurological problems such as stroke for longitudinal assessment (162). BI is a scale in which 10 variables including activities of daily living and mobility are evaluated according to support dependency and time (167). These 10 items are feeding, toileting, bathing, dressing, controlling bladder and bowel, getting on and off a toilet, transferring from wheelchair to bed, walking (or using a wheelchair if unable to walk) and stair climbing (168).

Each item is graded between 0-10 or 0-15 points, depending on the activity, in terms of how much help the patient needs to complete the task (0=can't, 5=needs major help, 10=needs minor help, 15=independent) (169). The overall score is calculated by adding the scores of each rating (34). Scores increase in multiples of 5 to a value between 0 and 100, with higher scores indicating greater functionality (167). If the total score is between 0-20, it results in total dependency, between 25-60 as severe dependency, between 65-85 as moderate dependency, and between 85-95 as slight dependency (169). In our study, the BI for all participants was filled by the physiotherapist before and after the treatment by observing the patient's performance or by asking the patient to perform the activity. (Appendix 7).

3.3. Interventions

3.3.1. Bobath Training

Bobath Concept includes sensory, perceptual and adaptive exercises aimed at improving function through mobilisation, weight-bearing, practicing more normal movement patterns and performing more efficient, less effortful tasks (145). In this study Bobath training exercises applied to all participants in both groups for 8 weeks, 5 days a week. The exercises are standard and applied gradually from bed to walking exercises.

Exercise Type	Intensity	Frequency
Bobath Exercises	1st to 4th week (10 repetitions / 3 sets per exercise) - Shoulder flexion and abduction - Shoulder and elbow flexion - Shoulder and scapula mobilization	Five days / week at the clinic Total duration: 8 weeks

Figure 3.9. Components and progression of Bobath training program I

Exercise Type	Intensity	Frequency
Bobath Exercises	- Placing the hemiplegic hand on the opposite shoulder and hip  - Hip flexion and extension  - 15 degrees of knee flexion to prepare for the stance phase of walking 	Five days / week at the clinic Total duration: 8 weeks

Figure 3.10. Components and progression of Bobath training program II

Exercise Type	Intensity	Frequency
Bobath Exercises	- Hip internal and external rotation	Five days / week at the clinic Total duration: 8 weeks
		
	- Hip bridge	
		
	- Sitting balance exercises	
		

Figure 3.11. Components and progression of Bobath training program III

Exercise Type	Intensity	Frequency
Bobath Exercises	- Weight bearing exercises for upper and lower extremities on both sides	Five days / week at the clinic Total duration: 8 weeks
		
- Sit to stand training		
		
- Standing balance training		
		

Figure 3.12. Components and progression of Bobath training program IV

Exercise Type	Intensity	Frequency
Bobath Exercises	- Taking a step forward and sideways on the stair with the unaffected lower extremity  - Drawing a figure on the floor with the unaffected lower extremity on the parallel bar  - Taking a step with hemiplegic lower extremity and locking the knee 	Five days / week at the clinic Total duration: 8 weeks

Figure 3.13. Components and progression of Bobath training program V

Exercise Type	Intensity	Frequency
Bobath Exercises	5th to 8th week (15 repetitions / 3 sets per exercise) - Drawing a circle with arm in shoulder flexion  - Lifting an extremity in hip bridge  - Sitting posture exercises 	Five days / week at the clinic Total duration: 8 weeks

Figure 3.14. Components and progression of Bobath training program VI

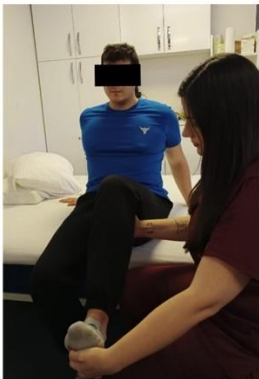
Exercise Type	Intensity	Frequency
Bobath Exercises	5 th to 8 th week (15 repetitions / 3 sets per exercise)	Five days / week at the clinic Total duration: 8 weeks
- Shoulder and elbow flexion		
		
- Pronation and supination		
		
- Placing the hemiplegic hand on the head or opposite shoulder		
		
- Hip flexion and extension with ankle dorsiflexion		
		

Figure 3.15. Components and progression of Bobath training program VII

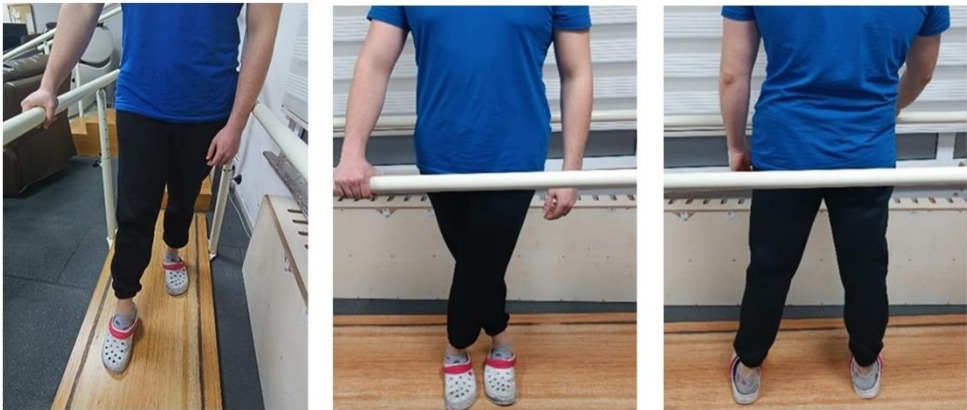
Exercise Type	Intensity	Frequency
Bobath Exercises	5th to 8th week (15 repetitions / 3 sets per exercise) - Knee flexion and extension with ankle dorsiflexion  - Walking forward, backward, crisscross, sideways  - Going up and down stairs 	Five days / week at the clinic Total duration: 8 weeks

Figure 3.16. Components and progression of Bobath training program VIII

3.3.2. Task-oriented Training

Task-oriented training includes organizing activities that require skills between the individual and the environment and optimizing functions by setting specific goals (170). In our study, task-oriented training applied to TOTG 5 days a week, for a total of 8 weeks, in addition to Bobath training.

Task-oriented training was consist of performing the sitting, standing and walking exercises by performing tasks for specific goals. Exercises were performed by accomplishing tasks such as touching the ball with the upper or lower extremities, reaching for the ball, crossing various tracks to move blocks from one place to another, walking through obstacles or climbing stairs. The exercise level in the training program started from easy tasks and progressing to more difficult tasks.

Exercise Type	Intensity	Frequency
Task - Oriented	1st to 4th week (5 repetitions / 2 sets per exercise) - Reaching out and collecting colorful pom-poms scattered on the table surface and placing them in the bowls.  - While sitting, reaching out and picking up the ball on the ground and throwing into the box.  - Score a goal by kicking the ball into the box. 	Five days / week at the clinic Total duration: 8 weeks

Figure 3.17. Components and progression of task-oriented training program I

Exercise Type	Intensity	Frequency
Task - Oriented	1 st to 4 th week (5 repetitions / 2 sets per station) - Standing up, reaching for the cups on the shelf and arranging them in order according to the numbers written on them.	Five days / week at the clinic Total duration: 8 weeks



5th to 8th week
(5 repetitions per station)

- Walking around the cylinder obstacles and reaching the table to solve the puzzles consisting of different shapes and colors.

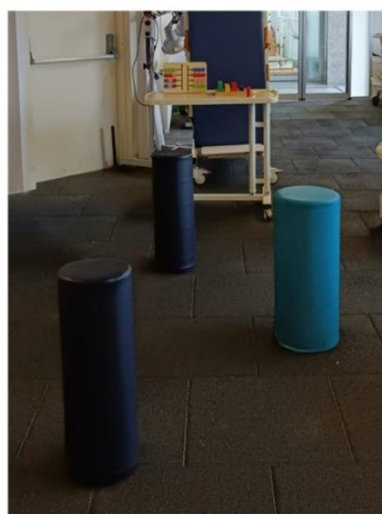
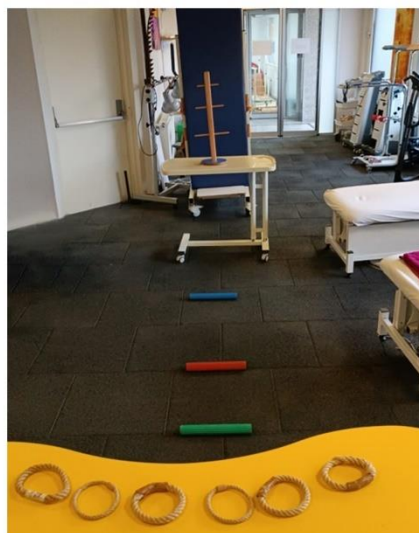


Figure 3.18. Components and progression of task-oriented training program II

Exercise Type	Intensity	Frequency
Task - Oriented	5 th to 8 th week (5 repetitions per station) - Picking up the rings one by one, walking over the obstacles on the ground and passing them onto the wooden sticks on the table.	Five days / week at the clinic Total duration: 8 weeks



-Turning the key, inserting the light bulb into the socket, turning the valve, turning the light switch on and off, opening different locks, plugging in the socket, turning the door handle, opening and closing zippers, buttons and laces.

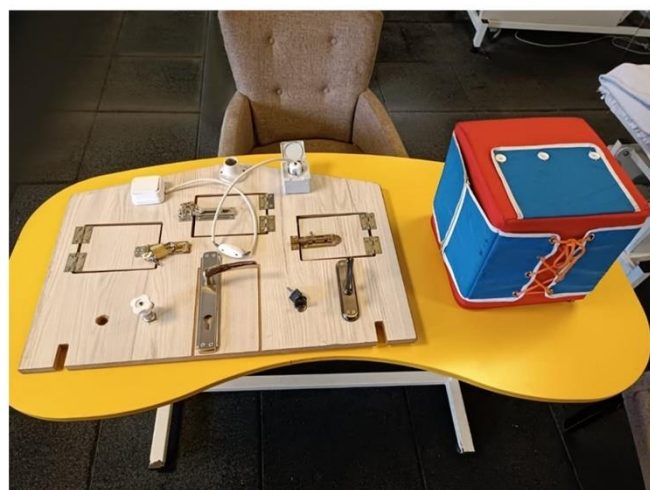


Figure 3.19. Components and progression of task-oriented training program III

Exercise Type	Intensity	Frequency
Task - Oriented	5 th to 8 th week (5 repetitions per station)	Five days / week at the clinic Total duration: 8 weeks
-Taking a lego from the box at the beginning of the parallel bar, walking on the parallel bar, climbing the steps and dropping the lego into the box there.		



- Walking over obstacles on the parallel bar, picking up the ball on the first step of the stair and throwing it to the sticky trays on the upper steps.



Figure 3.20. Components and progression of task-oriented training program IV

3.4. Statistical Analysis

The analyses in this study were conducted utilizing SPSS version 26.0 (SPSS Inc. Chicago, IL, USA). Normality of the data was examined using the Shapiro-Wilk Test. The numerical data summary was presented as mean $\pm$ standard deviation, while categorical data was represented using ratios. Comparison between the experimental and control groups' variables before and after training was conducted using the Wilcoxon test and the Mann-Whitney U test to identify differences. A significance level of 0.05 was accepted.



4. RESULTS

The study included 20 stroke patients who applied between June and September 2023 to Eksen Health Inpatient Physical Therapy and Rehabilitation Center of Istanbul, Turkey. The intervention duration for participants in the analysis was 8 weeks.

4.1. Physical Characteristics and Demographic Information

The subject's mean value $\pm$ standart deviation of age, body weight, body height, body mass index and time since stroke were shown in Table 4.1. There were no statistically differences in these variables between two groups ($p > 0.05$).

Table 4.1. Physical Characteristics and Time After Stroke of the TOTG and BTG

	TOTG mean$\pm$SD	BTG mean$\pm$SD	t value	p value
Age (year)	73.8 $\pm$ 5.18	72.8 $\pm$ 6.37	0.38	0.705
Weight (kg)	70.7 $\pm$ 16.7	76.6 $\pm$ 16	-0.805	0.432
Height (m)	1.64 $\pm$ 0.08	1.66 $\pm$ 0.09	-0.509	0.617
BMI (kg/m²)	25.81 $\pm$ 4	27.47 $\pm$ 4.73	-0.847	0.408
Days Post-stroke	23.3 $\pm$ 8.61	26.5 $\pm$ 10.82	-0.731	0.474

Data expressed as mean $\pm$ standard deviation. **BMI**: Body mass index. **TOTG**: Task-Oriented Training Group
BTG: Bobath Training Group

The gender, educational status, dominant and hemiplegic side of the participants in the study groups were given in Table 4.2. The dominant and hemiplegic side of most of our participants is the right side (95%) (65%), and 65% (n=13) of subjects are women, 35% (n=7) are men. No significant difference was found comparing two groups ($p > 0.05$), (Table 4.2.).

Table 4.2. Comparison of Demographic Parameters and Hemiplegic Side Distribution Between Groups

		TOTG %(n)	BTG %(n)	p value
Gender	Female	4 (40)	3 (30)	0.66
	Male	6 (60)	7 (70)	
Education	Primary School	2 (20)	2 (20)	0.71
	Secondary School	1 (10)	1 (10)	
	High School	4 (40)	2 (20)	
	University	3 (30)	5 (50)	
Dominant Side	Right	9 (90)	10 (100)	0.33
	Left	1 (10)	0 (0)	
Hemiplegic Side	Right	6 (60)	7 (70)	0.66
	Left	4 (40)	3 (30)	

Data expressed as % (n). **TOTG:** Task-Oriented Training Group **BTG:** Bobath Training Group

Comparison of the stroke type and specific location of the lesion were presented at Table 4.3. 80% (n=8) of the participants in TOTG and 70% (n=7) of those in BTG have ischemic stroke, and 20% (n=2) of the participants in TOTG and 30% (n=3) of those in BTG have hemorrhagic stroke. Correspondingly, there was no statistical difference between two groups ($p>0.05$), (Table 4.3.).

Table 4.3. Comparison of Type and Location of Brain Lesions Distribution Between Groups

		TOTG %(n)	BTG %(n)	p value
Stroke Type	Ischemic	8 (80)	7 (70)	0.62
	Hemorrhagic	2 (20)	3 (30)	
Specific Location	Frontal Lobe	1 (10)	2 (20)	0.66
	Parietal Lobe	0 (0)	1 (10)	
	Temporal Lobe	3 (30)	2(20)	
	Thalamus	1 (10)	1 (10)	
	Internal Capsule	2 (20)	2 (20)	
	Basal Ganglia	1 (10)	2 (20)	
	Cerebellum	1 (10)	0 (0)	
	Brain Stem	1 (10)	0 (0)	

Data expressed as % (n). **TOTG**: Task-Oriented Training Group **BTG**: Bobath Training Group

4.2. Comparison of Baseline Variables

Baseline variables were compared between the two groups shown in Table 4.4. and Table 4.5. with using an independent samples t-test. The mean value of Functional Independence Measure, Barthel Index and Mini Mental State Examination scores in BTG were found higher in compared with TOTG ($41.2 \pm 5.05, 40.5 \pm 5.81, 26.5 \pm 10.01, 25 \pm 9.42, 20.3 \pm 1.56, 19.8 \pm 1.47$ respectively), (Table 4.4.). In table 4.5., DLOTCA-G cognitive functions scores before the intervention were compared between the two groups. The data emphasized that there was no statistical significance in FIM, BI, MMSE and DLOTCA-G scores ($p > 0.05$), (Table 4.4.), (Table 4.5.).

Table 4.4. Comparison of FIM, BI and MMSE Between TOTG and BTG Before Intervention

	TOTG mean$\pm$SD	BTG mean$\pm$SD	t value	p value
Functional Independence Measure (FIM)- Motor	24.90 $\pm$ 5.1	26.40 $\pm$ 4.4	-0.703	0.491
Functional Independence Measure (FIM)- Cognitive	15.6 $\pm$ 2.5	15.1 $\pm$ 3.17	0.391	0.701
Functional Independence Measure (FIM)- Total	40.5 $\pm$ 5.81	41.2 $\pm$ 5.05	-0.287	0.777
Barthel Index (BI)	25 $\pm$ 9.42	26.5 $\pm$ 10.01	-0.345	0.734
Mini Mental State Examination (MMSE)	19.8 $\pm$ 1.47	20.3 $\pm$ 1.56	-0.735	0.472

Data expressed as mean $\pm$ standard deviation. **TOTG**: Task-Oriented Training Group **BTG**: Bobath Training Group

Table 4.5. Comparison of Cognitive Functions Between TOTG and BTG Before Intervention

	TOTG mean±SD	BTG mean±SD	t value	p value
DLOTCA-G Orientation	0.71±0.3	0.80±0.32	-0.628	0.538
DLOTCA-G Awareness	1.76±0.58	1.73±0.56	0.391	0.701
DLOTCA-G Memory	2.09±0.38	2.03±0.5	-0.327	0.748
DLOTCA-G Spatial Perception	0.54±0.15	0.53±0.14	0.135	0.894
DLOTCA-G Praxis	0.71±0.18	0.70±0.18	0.198	0.845
DLOTCA-G Visual Perception	2.63±0.61	2.76±0.6	-0.485	0.634
DLOTCA-G Thinking Operations	1.95±0.59	2.05±0.59	-0.374	0.713
DLOTCA-G Visuomotor Construction	2.21±0.35	2.15±0.34	0.429	0.673

Data expressed as mean ± standard deviation. **DLOTCA-G:** Dynamic Loewenstein Occupational Therapy Cognitive Assessment- Geriatric version **TOTG:** Task-Oriented Training Group **BTG:** Bobath Training Group

4.3. Changes in Motor and Cognitive Functions

When the evaluations of the groups before and after the intervention were compared, statistically significant improvements were found in some motor and cognitive function parameters in both TOTG and BTG. While the FIM-motor, FIM-total, BI scores changed statistically significantly on BTG after the intervention compared to the baseline value, in addition to these parameters, the FIM-cognitive score also changed significantly on TOTG ($p<0.05$), (Table 4.6., Table 4.7., Table 4.8.).

The FIM motor subtest value, which was initially 24.90 ± 5.1 in TOTG, increased to 62.10 ± 11.59 , while in BTG it increased from 26.40 ± 4.4 to 48.20 ± 10.88 . Thus, FIM-motor score increased significantly in both groups, and the difference between the increase value of the two groups was statistically significant ($p = 0.003$). The mean of FIM cognitive subtest scores increased in both groups, although statistically significant difference was only observed in TOTG ($p=0.005$). While the FIM total score was 40.5 ± 5.81 at baseline in TOTG, it increased to 89.2 ± 11.59 . In BTG, it was 41.2 ± 5.05 at baseline and it increased to 67.9 ± 12.49 . In this way, the difference in the significant increase in the two groups was found to be statistically significant ($p = 0.003$). In addition, BI score, which is another motor function parameter, increased statistically significantly from 26.5 ± 10.01 to 50 ± 11.78 in BTG ($p=0.005$). In TOTG, it increased statistically more than BTG, increasing from 25 ± 9.42 to 70 ± 12.69 ($p=0.001$), (Table 4.6.).

Table 4.6. In-group Changes and Comparison of FIM and BI Score at the Baseline and Post-Test

	TOTG mean±SD					BTG mean±SD					%95 CI	p
	Baseline	After	Δ	z	p	Baseline	After	Δ	z	p		
FIM-Motor	24.90±5.1	62.10±11.59	37.2±9.44	-2.803	0.005	26.40±4.4	48.20±10.88	21.8±8.84	-2.812	0.005	(0)- (0.139)	0.003
FIM-Cognitive	15.6±2.5	28.1±2.8	12.5±2.54	-2.807	0.005	15.1±3.17	19±4.94	3.9±4.3	-2.200	0.028	(0)- (0.139)	0.000
FIM-Total	40.5±5.81	89.2±11.59	48.7±9.73	-2.814	0.005	41.2±5.05	67.9±12.49	30±10.32	-2.807	0.005	(0)- (0.139)	0.003
BI	25±9.42	70±12.69	45±8.4	-2.825	0.005	26.5±10.01	50±11.78	23.5±8.83	-2.810	0.005	(0)- (0.139)	0.001

Data expressed as mean ± standard deviation. **FIM**: Functional Independence Measure **BI**: Barthel Index **TOTG**: Task-Oriented Training Group **BTG**: Bobath Training Group

Table 4.7. showed that there was statistically difference between the baseline and after intervention scores of MMSE in TOTG. (p=0.005). The mean of MMSE score increased in BTG while it was not significant. (p=0.130).

Table 4.7. In-group Changes and Comparison of MMSE Score at the Baseline and Post-Test

	TOTG mean±SD					BTG mean±SD					%95 CI	p
	Baseline	After	Δ	z	p	Baseline	After	Δ	z	p		
MMSE	19.8±1.47	26.8±1.61	7±1.69	-2.814	0.005	20.3±1.56	21.1±2.5	0.8±1.47	-1.513	0.130	(0)- (0.139)	0.000

Data expressed as mean ± standard deviation. **MMSE**: Mini Mental State Examination **TOTG**: Task-Oriented Training Group **BTG**: Bobath Training Group

The major effect comparing TOTG and BTG in terms of cognitive functions was significant in terms of DLOTCA-G scores, indicating that there is a difference in the efficiency of the two protocols ($p<0.05$), (Table 4.8.). In TOTG, orientation, awareness, memory, spatial perception, praxis, visuomotor construction, visual perception and thinking operations functions improved statistically. A significant increase was observed in orientation, memory, praxis, and visuomotor construction parameters in BTG. Furthermore, all cognitive function parameters except memory were significantly improved in TOTG compared to BTG after eight weeks of interventions ($p<0.05$), ($p=0.971$), (Table 4.8.).

Table 4.8. In-group Changes and Comparison of DLOTCA-G Scores at the Baseline and Post-Test

	TOTG mean±SD					BTG mean±SD					%95 CI	p
	Baseline	After	Δ	z	p	Baseline	After	Δ	z	p		
DLOTCA-G Orientation	0.71±0.3	1.76±0.2	1.05±0.367	-2.812	0.005	0.80±0.32	1.08±0.37	0.28±0.12	-2.823	0.005	(0)-(0.139)	0.000
DLOTCA-G Awareness	1.76±0.58	2.86±0.23	1.1±0.49	-2.814	0.005	1.73±0.56	2±0.6	0.26±0.49	-1.429	0.028	(0)-(0.139)	0.002
DLOTCA-G Memory	2.09±0.38	2.53±0.54	0.43±0.31	-2.530	0.011	2.03±0.5	2.43±0.47	0.40±0.3	-2.311	0.021	(0.861)-(1)	0.971
DLOTCA-G Spatial Perception	0.54±0.15	0.93±0.08	0.39±0.16	-2.812	0.005	0.53±0.14	0.57±0.2	0.04±0.21	-0.655	0.512	(0)-(0.139)	0.001
DLOTCA-G Praxis	0.71±0.18	1.6±0.18	0.88±0.09	-2.814	0.005	0.70±0.18	1.15±0.31	0.45±0.32	-2.601	0.009	(0)-(0.139)	0.001
DLOTCA-G Visual Perception	2.63±0.61	3.76±0.35	1.13±0.52	-2.814	0.005	2.76±0.6	2.99±0.41	0.23±0.58	-1.265	0.206	(0)-(0.139)	0.004
DLOTCA-G Thinking Operations	1.95±0.59	2.8±0.71	0.85±0.33	-2.859	0.004	2.05±0.59	2.35±0.66	0.3±0.42	-1.897	0.058	(0)-(0.139)	0.007
DLOTCA-G Visuomotor Construction	2.21±0.35	3.73±0.21	1.51±0.37	-2.807	0.005	2.15±0.34	2.58±0.39	0.43±0.42	-2.453	0.014	(0)-(0.139)	0.000

Data expressed as mean ± standard deviation. **DLOTCA-G**: Dynamic Loewenstein Occupational Therapy Cognitive Assessment- Geriatric version **TOTG**: Task-Oriented Training Group **BTG**: Bobath Training Group

5. DISCUSSION

The findings of this study indicated that TOT, applied additively to BT, was effective on motor functions and cognitive functions of orientation, awareness, memory, spatial perception, praxis, visuomotor construction, visual perception and thinking operations in patients with stroke.

This study showed that, although there was a statistically significant improvement in motor functions in both groups after the eight-week intervention in in-group comparisons, TOT was more effective on motor functions due to the statistically higher increase in both FIM and BI results in the TOTG compared to BTG in intergroup comparisons. The remarkable findings of this study were that the increase in MMSE, FIM-cognitive and DLOTCA-G scores, which are cognitive functions evaluation parameters, was found to be statistically higher in TOTG compared to BTG in all cognitive functions except memory function.

Stroke is one of the primary causes of disability by causing paralysis in the opposite half of the affected area. Decrease in muscle strength, resulting atrophy, changes in muscle tone, and joint limitations are motor impairments that limit performance in daily living activities in stroke patients (88-90,171,172). In the literature, BT, a NDT method, is the most frequently researched and used treatment approach in stroke patients to improve motor functions. Although studies involving TOT is more limited than BT, researchers have recently turned to task-oriented treatment approaches, as active and intensive repetitive training of planned motor activities specific to tasks suitable for daily living activities increases functional recovery (5,7,15-24,170).

Manzoor et al. In 2023, they applied TOT to stroke patients for 12 weeks and compared the effects of TOT and NDT on upper extremity motor functions. In order to make this comparison, task-specific exercises for the upper extremity were applied to one group 3 days a week for 12 weeks, and NDT was applied to the other group at the same frequency. The motor function and spasticity values of the participants were evaluated with the Fugl-Meyer Assessment Scale (FMA) and Modified Ashworth Scale (MAS) before and after the treatment. According to the results of the study, although significant improvements occurred with both treatment methods, TOT was found to be more effective in motor functions and spasticity management (173).

Shah et al. Later that year, in line with the study of Manzoor et al., they conducted a study in which they applied TOT to stroke patients in order to improve upper extremity motor functions. To measure motor functions, the Motor Assessment Scale (MAS) was applied before and after the 4-week intervention. This study reported that applying TOT 5 days a week for 4 weeks statistically improved upper extremity motor functions in patients with stroke (174). In a systemic review that included 13 controlled trials in which a total of 636 stroke patients were examined, the effects of BT on upper extremity motor functions were compared with TOT and robotics. When the results of studies including Wolf Motor Function Test (WMFT), Frenchay Arm Test (FAT), Box and Block test (BBT), Motricity Index (MI), FMA and upper extremity muscle strength tests are examined, BT was found to be significantly less effective than TOT and robotics in activities and muscle strength of the arm (175). There are also studies investigating the effects of TOT on lower extremity motor functions after stroke. In the study conducted by Yang et al., patients who had a stroke once and were hemiparetic on one side were divided into two groups. While progressive TOT was applied to one group, no rehabilitation training was performed to the other group. The progressive TOT program consisted of various stations designed to functionally use the muscles in the lower extremities, such as walking over blocks or doing sit-to-stands from different heights. The improvements were made by increasing the number of repetitions and increasing the complexity and difficulty of the exercises performed at the stations. Muscle strength was evaluated with a dynamometer, and functional performance was evaluated with the six-minute walk test (6MWT), step test and timed up and go test (TUG). As a result of the study, significant improvements were observed in all parameters in the TOT group and therefore TOT was found to be an effective method to regain the lower extremity muscle strength and functions lost after stroke (176). A study in which TOT was applied as a circuit station training, similar to the study by Yang et al., was conducted by Verma et al. in 2015. Among the stroke patients divided into two groups, the patients in the study group received TOT, which consists of functional exercises such as standing up, walking, turning, and climbing stairs, 7 days a week for 2 weeks, while the patients in the control group received BT for the lower extremities. As a result of the evaluations made using Functional Ambulation Classification (FAC), 6MWT, and the Rivermead Visual Gait Assessment (RVGA) at the 2nd week and the follow-up at the 6th week, it was found that the outcome measures of the study group increased significantly more than the control group (177).

Compatible with the literature, our study present that applying TOT in addition to BT, 5 days a week for 8 weeks, in stroke patients significantly improved motor and cognitive functions compared to the group receiving BT alone. Similar to the studies, TOT consisted of stations that included various functional activities and were performed progressively according to the difficulty of the activities involved. As it can be seen, while many studies focused on either upper or lower extremity functions, in our study the intervention included both upper extremity activities such as throwing, reaching, solving puzzles, and lower extremity activities such as walking, climbing stairs, kicking a ball. Additionally, in our study, we used FIM and BI, which measure the level of functionality in all aspects. Although studies involving the TOT program which consists of functional exercises based on ADLs that involve all extremities of the patient are limited, a similar study to ours was conducted by Choi et al. with 20 stroke patients. While the patients in the study group participated in a progressive TOT program in which activities such as walking indoors and outdoors, climbing stairs, reaching, carrying and catching objects, traditional physiotherapy methods were applied to the patients in the control group. For both groups, the intervention lasted 5 days a week for 4 weeks. The level of functions was evaluated using BI, and in this study, balance was also evaluated using the Berg Balance Scale (BBS). Although BI and BBS scores increased significantly in both groups after training, the increase in the results of the study group was significantly greater than that of the control group (178).

Another finding of this study is that cognitive functions which improved statistically more in TOTG than in BTG, except for memory function. Cognitive impairments are a significant problem after stroke, occurring in 39% of patients. It delays the start of rehabilitation and reduces the quality of rehabilitation, making it difficult to perform functional activities of daily living (109,111,112). In the literature, studies commonly focus on the impact of motor function after stroke and include treatment programs (170,173-178). However, cognitive effects are not adequately included in the treatment process, and there are very few studies that examine cognitive functions thoroughly. To our knowledge, there isn't any study in the literature investigating the effect of TOT on cognitive function parameters in stroke patients but there are a restricted quantity of studies in which TOT was applied to patients with post-stroke cognitive impairments (179-181).

Tang et al. conducted a study to determine how effective a task-specific approach can be on motor skills in stroke patients with impaired cognitive functions compared to NDT. In this study, as in our study, MMSE was performed on stroke patients and those with mild cognitive impairment were included. A problem-focused voluntary training program consisting of individually selected exercises was applied to patients in the study group. Joint range of motion and weight-bearing exercises, walking and stair training, was applied to the control group. Patients in both groups attended 50-minute sessions 6 days a week for 8 weeks throughout the study. Stroke Rehabilitation Assessment of Movement (STREAM) scores increased in both groups at the end of the intervention, but increased significantly more in the study group. This shows that a task-specific approach is an effective method to improve motor functions in stroke patients with cognitive impairments (179). Park et al. also published a case study in which they applied TOT to two stroke patients with cognitive impairments and evaluated its effects on upper extremity functions and ADL. These two stroke patients had TOT for 2 weeks, 5 days a week. In this study, functionality was measured using FIM before and after the intervention, as in our study. The increase in FIM scores of both patients supported the effectiveness of TOT in stroke patients with cognitive impairment, despite the small number of participants in the study (180).

Cognitive impairments seen in stroke patients are mostly caused by restriction of blood flow to the left frontal, temporal region and thalamus, and the right parietal region. However, since many cognitive functions may be affected, it cannot be predicted based only on the affected area (181). The first cognitive function we evaluated in our study is orientation. Orientation is the capability to comprehend and express time, location and individual information (182). Impairment in orientation was found in studies in 14% of patients within 1 week after stroke onset and in 23-41% of patients evaluated 10 days later (183,184). Disorientation is accepted as a pointer of overall cognitive function impairment and thus, a main component in mental condition evaluation (185). Exercise improves a person's processing of information about the environment and situation by increasing cerebral blood volume in the brain and increasing cognitive activity and alertness stimulated through increases in brain neurotransmitters such as dopamine and norepinephrine. In addition, exercise allows for better cognitive performance as it reduces depressive symptoms (186). In our study, it was found that after the intervention, mean DLOTCA-G orientation scores of both groups increased significantly, with a statistically more increase in TOTG.

Another cognitive function we evaluated is awareness, which is the ability to understand insufficiencies or difficulties caused by injury or to identify the subjective involvement of an individual with impaired function (189). In addition, awareness is knowing what the disorder is, as well as knowing which functional activity in daily life it affects (190). Leung et al. conducted a systematic review investigating assessment and interventions for impaired awareness function after stroke. According to this review, treatment approaches in which patients repeatedly perform selected functional tasks can reveal capabilities and difficulties in using the involved extremity and therefore increase awareness by improving patients' realising of their abilities (191). Correspondingly, in our study, a statistically significant increase was found in the DLOTCA-G awareness scores of patients in TOTG.

Memory impairments frequently occur as a cognitive challenge post-stroke, impacting one's capacity to perform functional tasks effectively (192). It occurs with a rate of 23-55% after stroke and continue with a rate of approximately 11% within one year (193). Training initiatives aim to either rehabilitate impaired memory functions or instruct patients on adaptive strategies to manage them. The findings from a Cochrane review indicate that there is a degree of support for the efficacy of rehabilitation in addressing memory difficulties immediately following treatment. However, these improvements do not persist in the long term during follow-up assessments. This may due to the patients gradually adapted to managing their memory issues over time, but not enough to be sufficient in the long period of time. In general, there is not enough evidence to prove or disprove the effectiveness of rehabilitation on memory function or ability to perform activities and the superiority or inferiority of rehabilitation approaches over each other has not been found to be significant (194). The findings of our study showed that although the DLOTCA-G memory scores of patients in both TOTG and BTG increased after treatment, no statistically significant difference was found between the two groups.

Visuospatial perception is a mechanism that the central nervous system helps make decisions by integrating visual information coming to the retina, the size, shape and spatial relationship of the object (195). Visual perception pertains to accurately observing and understanding visual cues, whereas spatial perception involves recognizing the relative positions of one's body and surrounding objects in the environment (196). Perception impairment is characterized by a reduced capacity to unconsciously interpret visual information resulting from interactions among the frontal and parietal lobes. It's estimated that 35–75% of individuals with brain injuries encounter challenges in perception, restricting their

independence in performing functional activities (197). TOT employs a practical functional method in rehabilitating neurological patients, instructing them on tailored strategies to navigate evolving surroundings. Moreover, to optimize learning, this training method integrates task-oriented activities aligned with patients' individual activities, prioritizing engagement between patients and the environment (152,153,177). In the study conducted by Lee et al., stroke patients were divided into two groups: TOT group and conventional therapy group. Before and after the intervention, which was applied every day of the week for 8 weeks, motor functions were evaluated using FIM, and visual perception was evaluated using MMSE and Motor-Free Visual Perception Test (MVPT-V). According to the results of the study, both motor function and visual perception parameters in the TOT applied group increased statistically significantly compared to the conventional treatment group (198). In our study, a significant increase in both visual and spatial perception scores of DLOTCA-G was found in the TOTG.

Apraxia mostly occurs in stroke patients with lesions in the left hemisphere, which is the dominant side in storing and performing learned movements. Praxis is the planning and execution of voluntary movements that require skill and apraxia is the inability to perform these movements despite having sufficient desire and physical movement capacity (199). According to a systematic review on apraxia management, apraxia typically resolves on its own within the initial weeks of rehabilitation, but integrating apraxia treatment into a rehabilitation program is crucial, given the significant correlation between praxis function during early rehabilitation and dependency levels in performing ADLs. Learning normal movement patterns after injury and incorporating repetitive activity into the early stages of rehabilitation enhances the development of praxis by supporting the establishment of the motor schema. Additionally, a task-focused, functional and structured treatment approach plays a more important role in improving praxis by incorporating verbal, visual or tactile inputs, combining planning movement with the use of objects to reach a goal or accomplish a task (200,201,202). Parallel to this, the results of our study show that although DLOTCA-G praxis scores increased in both groups after the intervention, there was a statistically greater increase in TOTG.

Thinking operations function was evaluated as categorization and ordering skills in the current study. Specifically, being able to divide objects into groups related to each other and sequencing the activities required to carry out an event from beginning to end. These functions necessitate advanced cognitive skills like problem-solving, planning, and implementation alongside logical reasoning skills (203). We assumed that TOT could be effective in improving thinking functions because it involves motor programs that are executed in a specific order to complete a task and also incorporates planning (20-24,148). Considering the results of the study, it was revealed that there was a significant increase in the mean values of DLOTCA-G thinking operations scores only in TOTG.

Visual-motor skills encompass the capacity to comprehend and interpret visual depictions and spatial connections, utilizing this knowledge to execute a manual task. It's a complex function influenced by various factors, demanding numerous cognitive skills including visual-motor coordination, perceptual abilities, spatial awareness, motor planning, coordination, organization, direction, and classification (204). This may explain why, considering the outcomes of other DLOTCA-G subtests, while DLOTCA-G visuomotor construction subtest scores of both groups were increased, the patients in TOTG exhibited statistically greater improvement. In addition to this, various 2- and 3-dimensional puzzles in different colors and shapes, which are the evaluation criteria of this function, are included in the TOT in our study.

The study is subject to a few limitations. First, the findings of this study can not represent all individuals experiencing post-stroke cognitive difficulties, given that only patients with mild cognitive impairments participated in the study. Secondly, neither group of patients underwent assessments during the 8-week intervention period, which could have provided valuable insights into short-term effects. Additionally, both the BTG and TOTG lacked long-term follow-up data post-intervention. Another limitation is the absence of blinding in the study and the lack of a placebo group. Blinding in studies enhances reliability and mitigates bias, while a placebo group is instrumental in discerning the genuine effects of interventions.

The strengths of study are that as far as we know, no prior studies in the literature have examined the impact of TOT on cognitive function parameters thoroughly in stroke patients. Consequently, our study will enrich the existing literature by demonstrating the utilization of TOT in managing cognitive impairments following stroke. Additionally, all therapeutic approaches implemented in our investigation are conservative in nature and are devoid of adverse effects. Another advantage is the utilization of validated and reliable scales, supported by a sample size.



6. CONCLUSION

In conclusion, to the best of our knowledge, the current study is the first study in the literature that aimed to investigate the effects of TOT on both motor and cognitive functions in patients with stroke. The application of TOT addition to BT showed better results in improving motor functions and cognitive functions of orientation, awareness, memory, spatial perception, praxis, visuomotor construction, visual perception and thinking operations. Combining TOT with BT could be noninvasive and accessible training method for post-stroke patients having mild cognitive impairments.



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8. APPENDICES

8.1. Appendix 1: Ethical Committee Approval



T.C.
YEDİTEPE ÜNİVERSİTESİ REKTÖRLÜĞÜ
Girişimsel Olmayan Klinik Araştırmalar Etik Kurulu

Sayı : E.83321821-805.02.03-193
Konu : Etik Kurul Karar Yazısı

Sayın Dr. Öğr. Üyesi Elif Develi

Yeditepe Üniversitesi Girişimsel Olmayan Klinik Araştırmalar Etik Kuruluna etik onay için başvuru yapılmış olan araştırma önerisinin başlığı, araştırmacılar, başvuru numarası, sunulan belgeler ve toplantı bilgileri aşağıda yer almaktadır. İlgili araştırma önerisi, etik kurulumuz üyeleri tarafından değerlendirilmiş olup, etik ve bilimsel açıdan **UYGUN** olduğuna karar verilmiştir.

Araştırma Başlığı:	İnmeli Hastalarda Görev Odaklı Eğitimin Kognitif ve Motor Fonksiyonlar Üzerine Etkisi
Araştırmacılar:	Fzt. Helin Su Arkun, Dr. Öğr.Üyesi Elif Develi, Prof. Dr.Turan Uslu
Başvuru Numarası:	202305Y0395

TOPLANTI BİLGİLERİ			
Toplantı Tarihi:	12.05.2023	Toplantı Yeri:	Çevirim içi (Google Meet)

SUNULAN BELGELER	
Islak imzalı başvuru dosyası, CD veya USB belleğe kaydedilmiş başvuru dosyası ve elektronik başvuru	
Araştırma başlığı ve araştırmacıların isimleri	
Başvuru dilekçesi	
Başvuru formu	
Araştırmacının;	
• Niteliği	
• Önemi ve özgün değeri	
• Amaç ve hedefleri	
• Yöntemi	
• Yönetimi	
• Yaygın etkisi	
• Araştırma bütçesi (Mevcutsa)	
• Süresi ve uygunluğu (Zaman cetveli)	
• Kaynakları	

Bu belge, güvenli elektronik imza ile imzalanmıştır.

Belge Doğrulama Adresi : <http://belgedogrulama.yeditepe.edu.tr/bg.aspx?id=9867C05C-1245-401D-B2B1-7B9E81410105>

Yeditepe Üniversitesi 26 Ağustos Yerleşimi, İnönü Mahallesi Kayışdağı

Caddesi 34755

Ataşehir / İSTANBUL

Telefon No: (0216) 578 00 00 Faks No : (0216) 578 02 99

İnternet Adresi www.yeditepe.edu.tr

Kep Adresi : yeditepeuniversitesi@hs03.kep.tr

Bilgi İçin: Sevgi BAYRAKTAR

Unvan: Uzman Yardımcısı

Telefon No: (0216) 578 00 00 / 6347



Bilgilendirilmiş Gönüllü Olur Formu (yapılan araştırmaya özel olarak hazırlanmış)
Taahhütname-1 Araştırmanın yapılacağı kurumdan izin alma sorumluluğunun araştırmacılara ait olduğuna dair taahhüt
Taahhütname-2 Dünya Tıp Birliği Helsinki Bildirgesinin son versiyonunun ve Sağlık Bakanlığı'nın ilgili tüm kılavuzlarının okunmasına dair taahhüt
Taahhütname-3 Daha önce yapılmış etik kurul başvuruları mevcut olup olmadığına dair taahhüt
Taahhütname-4 Araştırma sırasında araştırma bütçesinde yer almayan ve gönüllünün kendisine veya Sosyal Güvenlik Kurumuna ek yük getirecek hiçbir işlem uygulanmayacağına dair taahhüt
Taahhütname-5 COVID-19 hastalarında tedavi yaklaşımları ve bilimsel araştırmalar genelgesi okunmasına dair taahhüt
Taahhütname-6 Millî Eğitim Bakanlığı Araştırma Uygulama İzinleri konulu yazının okunmasına dair taahhüt
Araştırmacıların her birisine ait özgeçmiş formu
Ek belgeler (Varsa kullanılan ölçek)

Prof. Dr. Didem ÖZDEMİR
ÖZENEN
Başkan

Doç. Dr. Gökhan ERTAŞ
Başkan Yardımcısı

Doç. Dr. Elif SUNGURTEKİN EKÇİ
Raportör

Prof. Dr. Feryal SUBAŞI
Üye

Doç. Dr. Binnur OKAN
BAKIR
Üye

Dr. Öğr. Üyesi Emine Nur
ÖZDAMAR
Üye

Dr. Öğr. Üyesi Sevim ŞEN OLGAY
Üye

Bu belge, güvenli elektronik imza ile imzalanmıştır.

Belge Doğrulama Adresi : <http://belgedogrulama.yeditepe.edu.tr/bg.aspx?id=9867C05C-1245-401D-B2B1-7B9E81410105>

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Bilgi için: Sevgi BAYRAKTAR

Unvan: Uzman Yardımcısı

Telefon No: (0216) 578 00 00 / 6347



8.2. Appendix 2: Informed Written Consent



ÇALIŞMANIN ADI: İnmeli Hastalarda Görev Odaklı Eğitimin Motor ve Kognitif Fonksiyonlar Üzerine Etkisi

Sayın katılımcı,

*Sizi yukarıda adı yazılı, Eksen Sağlık Yatılı Fizik Tedavi ve Rehabilitasyon Merkezi'nde gerçekleştirecek olan araştırmamıza davet ediyoruz. Çalışmaya katılmama veya katıldıktan sonra ayrılma hakkına sahipsiniz. Çalışmaya katılıp katılmama kararı tamamen size aittir ve gönüllülük esasına dayanmaktadır. Katılmak isteyip istemediğinize karar vermeden önce araştırmanın neden yapıldığını, bilgilerinizin nasıl kullanılacağını, çalışmanın neleri içerdiğini, olası yararları ve risklerini ya da rahatsızlık verebilecek yönlerini anlamanız önemlidir. Lütfen aşağıdaki bilgileri dikkatlice okumak için zaman ayırınız. Eğer çalışmaya katılma kararı verirsiniz, **Çalışmaya Katılma Onayı Formu**'nu imzalayınız. Çalışmadan herhangi bir zamanda ayrılmakta özgürsünüz. Çalışmaya katıldığınız için size herhangi bir ödeme yapılmayacak ya da sizden herhangi bir maddi katkı/malzeme katkısı istenmeyecektir.*

ÇALIŞMANIN KONUSU VE AMACI:

İnme, hem fiziksel hem de bilişsel bozukluklara sebep olan, tedavinin önem arz ettiği, yaygın görülen bir hastalıktır. Bu araştırma ile inmeli bireylerde görev odaklı eğitim programının motor ve kognitif fonksiyonlar üzerine etkilerinin araştırılması hedeflenmiştir. Araştırmamıza inme tanısı almış ve çalışmamıza uygun bulunmuş gönüllü yetişkin bireyler dahil edilecektir. Bu araştırmaya katılıp katılmamakta tümü ile özgürsünüz. Gerek duyduğunuz tüm bilgileri istemeye ve doğru, açık, anlaşılır bilgi almaya hakkınız vardır.

ÇALIŞMA İŞLEMLERİ:

Çalışmaya katılmayı gönüllü olarak kabul eden tüm katılımcılara demografik ve klinik özellikleri araştırmacılar tarafından hazırlanan Değerlendirme Formu ile sorgulanacaktır. Kognitif fonksiyonları değerlendirmek üzere Mini Mental Durum Testi (MMDT) ve Dinamik Loewenstein Ergoterapi Konitif Değerlendirmesi (DLEKD) yapılacaktır. Motor fonksiyonlar ise Fonksiyonel Bağımsızlık Ölçeği (FBÖ) ve Barthel İndeksi (Bİ) kullanılarak değerlendirilecektir. Katılımcılar tedavi için iki gruba ayrılacaktır: Birinci gruba 6 hafta boyunca haftada 5 gün görev odaklı eğitim programı ve Bobath egzersizleri uygulanacaktır. İkinci gruba ise 6 hafta boyunca haftada 5 gün yalnızca Bobath egzersizleri uygulanacaktır.

ÇALIŞMADA YER ALMAMIN YARARLARI NELERDİR?

Bu çalışmaya katıldığınızda, bilime yeni bilgiler kazandırılmasına katkıda bulunmuş olacaksınız.

BU ÇALIŞMAYA KATILMAMIN MALİYETİ NEDİR? (Bu bölüm aynen korunacaktır)

Çalışmaya katılmakla parasal yük altına girmeyeceksiniz ve size de herhangi bir ödeme yapılmayacaktır.

ÇALIŞMAYA KATILMALI MIYIM?

Bu çalışmada yer alıp almamak tamamen size ve çocuğunuza bağlıdır. Şu anda bu formu imzalasanız bile istediğiniz herhangi bir zamanda bir neden göstermeksizin çalışmayı bırakmakta özgürsünüz.

KİŞİSEL BİLGİLERİM NASIL KULLANILACAK?

Çalışma doktorunuz kişisel bilgilerinizi, araştırmayı ve istatistiksel analizleri yürütmek için kullanacaktır ancak kimlik bilgileriniz gizli tutulacaktır. Yalnızca gereği halinde, sizinle ilgili bilgileri etik kurullar ya da resmi makamlar inceleyebilir. Çalışmanın sonunda, kendi sonuçlarınızla ilgili bilgi istemeye hakkınız vardır. Çalışma sonuçları çalışma bitiminde tıbbi literatürde yayınlanabilecektir ancak kimliğiniz açıklanmayacaktır.

SORU VE PROBLEMLER İÇİN BAŞVURULACAK KİŞİLER :

ADI : Helin Su Arkun

GÖREVİ : Araştırma Yürütücüsü

ÇALIŞMAYA KATILMA ONAYI

Yukarıdaki bilgileri ilgili araştırmacı ile ayrıntılı olarak tartıştım ve kendisi bütün sorularımı cevapladı. Bu bilgilendirilmiş olur belgesini okudum ve anladım. Bu araştırmaya katılmayı kabul ediyor ve bu onay belgesini kendi hür irademle imzalıyorum. Bu onay, ilgili hiçbir kanun ve yönetmeliği geçersiz kılmaz. Araştırmacı, saklamam için bu belgenin bir kopyasını çalışma sırasında dikkat edeceğim noktaları da içerecek şekilde bana teslim etmiştir.

<i>Katılımcının Adı Soyadı:</i>		<i>Tarih ve İmza:</i>
<i>Telefon:</i>		

<i>Hasta Yakını /Vasinin Adı Soyadı:</i>		<i>Tarih ve İmza:</i>
<i>Telefon:</i>		

<i>Araştırmacının Adı Soyadı:</i>		<i>Tarih ve İmza:</i>
<i>Telefon:</i>		

<i>Tanığın Adı Soyadı:</i>		<i>Tarih ve İmza:</i>
<i>Telefon:</i>		

8.3. Appendix 3: Demographic Features and Clinical Symtoms Information Form

Hastanın Adı Soyadı:	Tarih:
Doğum Tarihi:	Cinsiyet (K-E) :
Boy (m):	Kilo (kg):
Eğitim durumu:	
Şikayet:	
Hikaye:	
Beynin etkilenen tarafı (Sol-Sağ-Bilateral):	
Lezyonun spesifik lokasyonu:	

8.4. Appendix 4: Mini Mental State Examination (MMSE)

MİNİ MENTAL DURUM TESTİ

ORYANTASYON (Her doğru cevap 1 puan, toplam 10 puan)

Hangi yıl içindeyiz?	Hangi ülkede yaşıyoruz?
Hangi mevsimdeyiz?	Şu an hangi şehirde bulunmaktasınız?
Hangi aydayız?	Şu an bulunduğunuz semt neresidir?
Bugün ayın kaçı?	Şu an bulunduğunuz bina neresidir?
Hangi gündeysiniz?	Şu an bu binada kaçınıcı kattasınız?

KAYIT HAFIZASI (Toplam puan 3)

• Size birazdan söyleyeceğim üç ismi dikkatlice dinleyip ben bitirdikten sonra tekrarlayın
(Masa, Bayrak, Elbise) (20 sn. süre tanınır. Her doğru isim 1 puan).

DİKKAT VE HESAP YAPMA (Toplam puan 5)

• 100'den geriye doğru 7 çıkartarak gidin. Dur deyinceye kadar devam edin.
(Her doğru işlem 1 puan: 100, 93, 86, 79, 72, 65)

HATIRLAMA (Toplam puan 3)

• Yukarıda tekrar ettiğiniz kelimeleri tekrar söyleyin
(Masa, Bayrak, Elbise) (Her kelime 1 puan)

LİSAN (Toplam puan 9)

a. Bu gördüğünüz nesnelerin isimleri nedir?

(Saat, Kalem) (20 sn. süre tanınır. 1'er puan, toplam 2 puan.)

b. Şimdi size söyleyeceğim cümleyi dikkatle dinleyin ve ben bitirdikten sonra tekrar edin.

"Eğer ve fakat istemiyorum" (10 sn süre tanınır. 1 puan.)

c. Şimdi sizden bir şey yapmanızı isteyeceğim, beni dikkatle dinleyin ve söyledigimi yapın.

"Masada duran kâğıdı elinizle alın, iki elinizle ikiye katlayın ve yere bırakın lütfen"

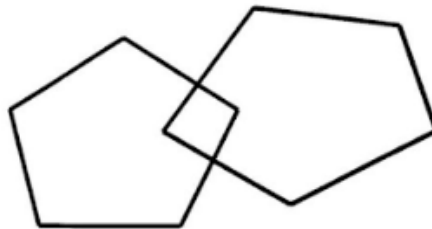
(Toplam puan: 3, süre: 30 sn. her bir doğru işlem: 1 puan)

d. Şimdi size bir cümle vereceğim. Okuyun ve yazıda söylenen şeyi yapın. (1 puan)

(Bir kâğıda "GÖZLERİNİZİ KAPATIN" yazıp hastaya gösterin)

e. Şimdi vereceğim kâğıda aklınıza gelen anlamlı bir cümleyi yazın (1 puan)

f. Size göstereceğim şeklin aynısını çizin; aşağıdaki şekli arka sayfaya (1 puan)



8.5. Appendix 5: Functional Independence Measure (FIM)

FONKSİYONEL BAĞIMSIZLIK ÖLÇEĞİ

KENDİNE BAKIM				
A. Yemek yeme				
B. Kendine bakım (traş,makyaj vs)				
C. Yıkama				
D. Üst taraf giyimi				
E. Alt taraf giyimi				
F. Tuvalet kullanımı-temizliği				
SFİNKTER KONTROLÜ				
G. Mesane bakımı				
H. Bağırsak bakımı				
TRANSFER				
I. Yatak, sandalye, tekerlekli sandalye				
J. Tuvalet				
K. Banyo, duş				
YER DEĞİŞTİRME				
L. Yürüme, tekerlekli sandalye, Her ikisi				
Y	TS	Hİ		
M. Merdiven				
Motor Skor Toplamı				
İLETİŞİM				
N. Anlama	İşitsel	Görsel	Her İkisi	
	İ	G	Hİ	
O. İfade edebilme:	Sesli	Sessiz	Her İkisi	
	S	M	Hİ	
SOSYAL ALGILAMA				
P. Sosyal katılım (etkileşim)				
R. Problem çözme				
S. Hafıza				
Kognitif Skor Toplamı				
Total Skor:				

Her bir soru için puanlar:

7 Puan: tam bağımsız (cihazsız,yardımcı bir kişi olmadan, zamanında)

6 Puan: Kısmi bağımsız (Yardımcı cihaz yardımıyla ya da normalden daha uzun sürede, yardımcı bir kişi olmadan)

5 Puan: Yardımcı kişinin fiziksel yardımı gerekmez, sözel uyarılar yeterlidir.

4 Puan: Minimal yardım (Hafif bir fiziksel temas, hasta gerekli çabanın en az %75'ini sarf eder.)

3 Puan: Orta derece yardım (Hasta gerekli çabanın %50-75 kadarını sarf edebilmektedir.)

2 Puan: Maksimum yardım (Hasta gerekli çabanın %25-50 kadarını sarf edebilmektedir.)

1 Puan: Tam yardım (Hasta gerekli çabanın %0-25 kadarını sarf edebilmektedir.)

8.6. Appendix 6: Barthel Index (BI)

BARTHEL GÜNLÜK YAŞAM AKTİVİTELERİ İNDEKSİ

Beslenme	Tam bağımsız yemek yemek için gerekli aletleri kullanabilir.	☐ 10
	Bir miktar yardıma ihtiyaç duyar.	☐ 5
	Tam Bağımlıdır.	☐ 0
Yıkanma	Hasta yardımsız olarak küvette yıkanabilir, duş alabilir ya da keselenebilir.	☐ 5
	Yardıma ihtiyacı vardır.	☐ 0
Kendine Bakım	Elini yüzünü yıkanabilir dişlerini fırçalayabilir, traş olabilir, makyaj yapabilir.	☐ 5
	Kişisel bakımda yardıma ihtiyaç duyar.	☐ 0
Giyinip Soyunma	Hasta giyinip soyunabilir. Ayakkabı bağlarını çözebilir.	☐ 10
	Yardıma gereksinim duyar (İşin en az %50'sini kendisi yapabilmelidir.)	☐ 5
	Tam Bağımlıdır.	☐ 0
Bağırsak Bakımı	Suppozituar kullanabilir ya da gerekirse lavman yapabilir.	☐ 10
	Hasta belirtilen aktiviteler için yardıma gereksinim duyar.	☐ 5
	İnkontinansı mevcuttur.	☐ 0
Mesane Bakımı	Hasta gece ve gündüz mesanesini kontrol edebilmelidir. Sonda bakımını bağımsız bir şekilde kendisi yapabilmelidir.	☐ 10
	Bazen tuvalete yetişemez ya da sürgüyü bekleyemez altına kaçırır.	☐ 5
	İnkontinandır veya kateterlidir ve mesanesini kontrol edemez.	☐ 0
Tuvalet Kullanımı	Duvardan ya da bardan destek alabilir tuvalet kağıdını kendi kullanabilir.	☐ 10
	Elbiselerini giyip çıkarmak, tuvalet kağıdını kullanmak için bir miktar yardım.	☐ 5
	Tam bağımlıdır.	☐ 0
Tekerlekli Sandalyeden Yatağa ve Ters Transferler	Tam bağımsızdır.	☐ 15
	Geçişler sırasında minimal yardım alır (sözel veya fiziksel).	☐ 10
	Tek başına yatakta oturma pozisyonuna geçebilir ama geçiş için yardım alır.	☐ 5
	Tam bağımlıdır.	☐ 0
Mobilité	Düzgün yüzeyde yürüme	
	Hasta yardımsız olarak 45 metre yürüyebilir. Bireys, baston, koltuk değneği, yürüteç kullanabilir (Bireys kullanıyorsa kilitleyip açabilmeli, oturup kalkabilmeli, mekanik destekleri yardımsız kullanabilmelidir.)	☐ 15
	Hasta bir kişinin sözel veya fiziksel yardımıyla 45 metre yürüyebilir.	☐ 10
	Tekerlekli sandalyeyi kullanabilme (uygunsa)	
	Hasta yürüyemez ama tekerlekli sandalyeyi kullanabilir. Hasta köşeleri dönebilir. Yatağa, tuvalete yanaşabilir.	☐ 5
	Tekerlekli sandalyede oturabilir ancak kullanamaz.	☐ 0
Merdiven inip çıkma	Bağımsız inip çıkabilir, ancak destek kullanabilir (tırabzan, baston, koltuk değneği...)	☐ 10
	Hasta yukardaki işleri yapmak için yardıma veya gözetime ihtiyaç duyar.	☐ 5
	Yapamaz.	☐ 0

Toplam Puan (0-100):

8.7. Appendix 7: Photo Permission

Resim Çekimi ve Kullanımı Yayın Hakkı Devir Sözleşmesi Formu

Çalışma sırasında çekilmiş fotoğraflarımın gereği halinde, kimlik bilgilerim verilmeyecek şekilde GÖZLERİ KAPALI olarak bilimsel çalışmalar, tezler, eğitim faaliyetleri ve bilimsel yayınlar için kullanılmasına İZİN VERDİĞİMİ beyan ederim.

Akademik çalışmalarda yayınlanacak resimlerimin yazım ve yayın kurallarına uygun olarak hazırlanıp sunulmasından proje yürütücüsü sorumludur (.../.../....).

Gönüllü / Hasta Adı Soyadı:

İzni veren kişi (Gönüllü / Hasta ya da velisi / vasisi) Adı Soyadı İMZA:

Proje yürütücüsü Adı Soyadı İMZA:

8.8. Appendix 8: Curriculum Vitae

Kişisel Bilgiler

Ad	Helin Su	Soyad	Arkun
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Öğrenim Durumu

Derece	Alan	Kurumun Adı	Mezuniyet Yılı
Yüksek Lisans	Fizyoterapi ve Rehabilitasyon	Yeditepe Üniversitesi	
Lisans	Fizyoterapi ve Rehabilitasyon	Yeditepe Üniversitesi	2021
Lise	Matematik- Fen	Kdz. Ereğli Fen Lisesi	2017
İlköğretim		TED Kdz. Ereğli Koleji	2013

Yabancı Diller	Sınav Notu
İngilizce	YÖKDİL: 82,50

İş Deneyimi

Görevi	Kurum	Süre
Fizyoterapist	Eksen Sağlık Yatılı Fizik Tedavi ve Rehabilitasyon Merkezi	2021-Halen

Bilgisayar Bilgisi

Program	Kullanma Becerisi
Microsoft Office	İyi