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Faculty of physical education and sports

Bachelor Thesis

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Case study of physiotherapy treatment of a patient after ischemic stroke in basal ganglia with right sided spastic hemiparesis

Bachelor thesis

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Prague, 2023

Decleration

I declare that I have independently processed the bachelor's thesis under the guidance of Mgr. Gabriela Koči and have referenced all the information sources and literature used. This work, nor its substantial part, has been submitted to obtain any other academic degree of the same or similar nature.

In Prague: _____ _____

Author’s signature

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Abstract

Title:

Case study of physiotherapy treatment of a patient after ischemic stroke in basal ganglia with right sided spastic hemiparesis

Objective:

This thesis aims to consolidate theoretical insights into ischemic stroke and present a detailed case report of a patient experiencing right-sided hemiparesis following an ischemic stroke in the basal ganglia

Methods:

This bachelor thesis is structured into two main sections: general and specific. The general section comprehensively covers theoretical aspects related to stroke, encompassing typical physiotherapist examinations for diagnosis, along with a selection of commonly employed methods and procedures in the physiotherapeutic management of these patients. The specific section delves into a case report of a patient post-ischemic stroke, focusing on subsequent right-sided hemiparesis. It includes detailed accounts of the initial and final kinesiological examinations, the progression of individual therapies, and a comprehensive summary of therapy outcomes. The specialized content draws from practical experience gained during continuous professional practice at the Department of Post-operative Rehabilitation at Oblastní nemocnici Kladno, conducted under the guidance of supervisor Bc. Tomás Modlinger, from January 16 to February 10, 2023.

Results:

Significant improvements were observed in various aspects, notably in the overall functionality and active range of motion for the right upper limb.

Conclusion:
Through the completion of this thesis, I have expanded my understanding of stroke pathology and gained insights into the diverse physiotherapeutic methods applicable in addressing this diagnosis.

Keywords:
Stroke, ischemic stroke, basal ganglia, spasticity, right-sided hemiparesis, rehabilitation, physiotherapeutic methods and procedures

Abstrakt

Název:

Případová studie fyzioterapeutické léčby pacienta po ischemické cévní mozkové příhodě v bazálních gangliích s postižením pravé strany těla v podobě spastické hemiparézy

Cíl:

Tato práce si klade za cíl zkonsolidovat teoretické poznatky o ischemické cévní mozkové příhodě a představit podrobnou kazuistiku pacienta trpícího postižením pravé strany těla v důsledku ischemické cévní mozkové příhody v bazálních gangliích.

Metody:

Tato bakalářská práce je rozdělena do dvou hlavních částí: obecné a specifické. Obecná část komplexně pokrývá teoretické aspekty související s cévní mozkovou příhodou, zahrnující typická fyzioterapeutická vyšetření pro diagnostiku, spolu s výběrem běžně používaných metod a postupů ve fyzioterapeutickém řízení těchto pacientů. Specifická část se zabývá kazuistikou pacienta po ischemické cévní mozkové příhodě, zaměřuje se na následné postižení pravé strany těla v podobě hemiparézy. Zahrnuje podrobné popisy počátečního a finálního kineziologického vyšetření, průběh jednotlivých terapií a komplexní shrnutí výsledků terapie. Specializovaný obsah vychází z praktických zkušeností získaných během kontinuální profesionální praxe na Oddělení pooperační rehabilitace v Oblastní nemocnici Kladno, probíhající pod vedením supervizora Bc. Tomáše Modlingera od 16. ledna do 10. února 2023.

Výsledky:

Byly pozorovány významné zlepšení v různých oblastech, zejména v celkové funkčnosti a aktivním rozsahu pohybu pravé horní končetiny.

Závěr:

Prostřednictvím dokončení této práce jsem rozšířil/a své pochopení patologie cévní mozkové příhody a získal/a jsem náhled do různých fyzioterapeutických metod, které lze aplikovat při řešení tohoto diagnózy.

Klíčová slova:

cévní mozková příhoda, ischemická cévní mozková příhoda, bazální ganglia, spasticita, pravostranná hemiparéza, rehabilitace, fyzioterapeutické metody a postupy

List of Abbreviations

ADLs - Activities of Daily Living

AROM - Active Range of Motion

ASIS - Anterior Superior Iliac Spine

BG - Basal Ganglia

CMC - Carpometacarpal

ICH - Intracerebral Hemorrhage

IP - Interphalangeal

LEE - Lower Extremities

LE - Lower Extremity

MCP - Metacarpophalangeal

MTP - Metatarsophalangeal

PIR - Post-Isometric Relaxation

PNF - Proprioceptive Neuromuscular Facilitation

PROM - Passive Range of Motion

ROM - Range of Motion

SI - Sacroiliac

SMS - Sensory Motor Stimulation

UE - Upper Extremity

UEE - Upper Extremities

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1 Introduction

Millions of people are impacted by stroke each year, making it a leading cause of adult disability worldwide. It places a substantial burden on affected individuals, their families, and society due to its serious physical, cognitive, and emotional effects. The most common type of stroke, accounting for approximately 85% of all cases, is an ischemic stroke. This occurs when blood flow to the brain is obstructed, leading to damage in brain tissue. Deep within the brain, the basal ganglia comprise structures that govern movement, cognition, and emotions.

Hemiparesis, the weakness affecting one side of the body, commonly accompanies strokes. It's frequently accompanied by spasticity, marked by increased muscle tension and reflexes. This combination can significantly impede the performance of daily activities, diminishing overall quality of life.

This bachelor's thesis aims to investigate the theoretical aspects of strokes and subsequently apply this understanding within the specialized rehabilitation section dedicated to patient experiencing an ischemic stroke in the left basal ganglia, resulting in subsequent right-sided spastic hemiparesis.

The theoretical part covers the theoretical foundations of strokes, encompassing descriptions of brain anatomy and physiology, various stages of a stroke with their clinical symptoms, and an overview of physiotherapeutic methods and procedures employed in subsequent rehabilitation.

The special part presents a case study involving a patient I worked with during his rehabilitation at Oblastní nemocnici Kladno from January 26th, 2023, to February 7th, 2023. It includes initial kinesiological examination, an overview of individual therapeutic units, the final kinesiological examination, and subsequently, the analysis of the therapy's effectiveness.

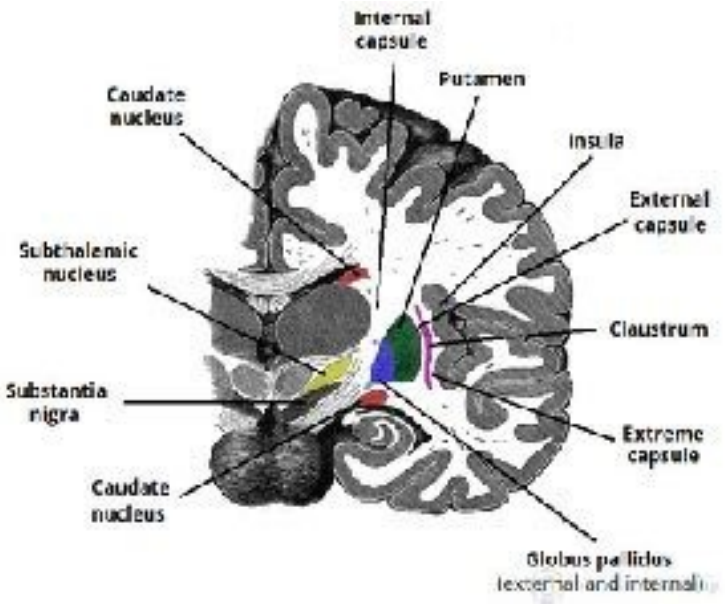
2 Theoretical part

2.1 Anatomical structure of Basal Ganglia

Nestled deep within the brain's hemispheres, the basal ganglia comprises essential structures, notably the corpus striatum and its subdivisions—the nucleus caudatus and putamen. The corpus striatum houses two integral parts: the striosomes, housing modulators like P-substance and neurotensin, and the matrix, hosting substances like somatostatin and enkephalin. Its neurons, predominantly spiny, use GABA as the primary neurotransmitter and rely on dopaminergic receptors for control. Adjacent to the putamen lies the globus pallidus, with distinct boundaries and divisions into pallidum internum and externum, hosting cells from the cholinergic nucleus basalis Meynerti.

These structures collaborate extensively, influencing motor functions and limbic system activities. The nucleus amygdala, deep within the temporal lobe, plays a crucial role in regulating motor, autonomic, and endocrine activities, forming a part of the limbic system. Meanwhile, the claustrum, positioned between the putamen and the insular cortex, remains somewhat mysterious in its precise function but is believed to be influential in neural processing. (Crossman & Neary, 2014)

Figure 1 - Anatomical structure of Basal Ganglia. (TeachMeAnatomy, n.d.)



2.2 Physiology of the Basal Ganglia and Motor System

The basal ganglia are responsible for the selection, inauguration, and inhibition of voluntary movements. To control movement, they cooperate with the motor cortex. The basal ganglia are involved in the regulation and fine tuning of these movements, whereas the motor cortex is in charge of the planning and prosecution of voluntary movement. (Soghomonian & Bolam, 2007)

There are two channels of communication between the motor cortex and the basal ganglia: the direct pathway and the circular pathway. Movement is made easier by the direct pathway, which disinhibits the thalamus, whereas movement is made more delicate by the circular pathway, which inhibits the thalamus.

These two routes combine to control both movement's intensity and direction. Movement is regulated by the complex neuronal network that makes up the motor system. These neurons make motor circuits that appear in the brain and terminate in the spinal cord.

The corticospinal tract is the main pathway that controls voluntary movement of the branches and box. Beginning in the motor cortex, it travels to the spinal cord, where it communicates with lower motor neurons that control muscle compression, for its final destination. In addition to the corticospinal tract, there are other motor pathways that appear in the brainstem and terminate in the spinal cord. These circuits are in charge of revulsions, posture, and balance. (Kandel et al., 2013).

2.3 ischemic stroke

An obstruction in the blood modes feeding the brain with blood causes an ischemic stroke, a specific type of stroke. A blood clot or shrine buildup in the highways may be the cause of the inhibition, which prevents blood inflow to the brain region beyond the blockage. Neurological problems affect brain cells starting to die when there's inadequate blood force. (Mohr et al., 2011)

2.3.1 Causes of ischemic Stroke

Atherosclerosis, characterized by the accumulation of adipose deposits, poses a significant risk by either constricting or obstructing arteries. Uncontrolled high blood pressure amplifies the danger by potentially triggering blood clot formation and inflicting damage upon blood vessel walls. Diabetes, through sustained high blood sugar levels, not only escalates the risk of blood clots but also causes detrimental effects on blood vessels. Additionally, smoking, with its array of chemicals like nicotine, contributes to blood vessel damage, elevating the propensity for blood clot formation. Specific heart conditions, such as atrial fibrillation or the presence of atherosclerosis-induced blockages within the heart's blood vessels, further heighten the potential for blood clot formation, intensifying the overall cardiovascular risk profile. (Mohr et al., 2011)

2.3.2 After effect of Ischemic Stroke

Ischemic stroke can have serious and protracted goods. Cases may include palsy, loss of sensation, trouble speaking and understanding, cognitive impairment, and emotional disturbances, depending on the extent and position of the blockage. Depending on the case's age, general health, and the period of time following the stroke, the inflexibility of these goods may vary.

To stop further brain damage and enhance patient issues, ischemic stroke must be diagnosed and treated snappily. Specifics to dissolve blood clots or stop their

conformation, surgical procedures, and rehabilitation programs to aid cases in recovering from the neurological insufficiency caused by the stroke are all possible forms of treatment. (Mohr et al., 2011)

2.3.3 Types of Ischemic Stroke

2.3.3.1 Thrombotic stroke

When a blood clot develops in one of the arteries that carry blood to the brain, it happens. The clot generally develops in a defined artery as a result of atherosclerosis, a condition in which adipose deposits make up on the inner walls of arteries. Other causes of thrombotic strokes include inflammation, infection, and damage to the arterial wall. The signs of a thrombotic stroke vary on where in the brain the clot is located and how important damage it has caused.(Mohr et al., 2011)

2.3.3.2 Embolic stroke

A blood clot or other foreign object originates in a blood vessel outside the brain, similar to the heart or a significant neck artery, performing in an embolic stroke. One of the brain's lowest blood arteries gets blocked as a result of the clot or other material moving through the bloodstream. The position of the inhibition and the extent of the damage it causes both affect the symptoms of an embolic stroke. (Mohr et al., 2011)

2.3.3.3 lacunar stroke

An inhibition in one of the small arteries located far inside the brain is what leads to a lacunar stroke. The rudimentary ganglia and other deep brain areas are supplied with blood by these arteries. Lacunar strokes can affect language difficulties, palsy or weakness on one side of the body. Ischemic strokes can also be divided into groups grounded on where in the brain they do. A stroke on the left side of the brain can paralyze the right side of the body and vitiate spatial mindfulness, whereas a stroke on the right side of the brain can vitiate language and communication and paralyze the left half of the body. (Mohr et al., 2011)

2.4 Hemiparesis

Hemiparesis, a neurological condition that can produce weakness or palsy in the arm, leg, and sporadically the face, affects one side of the body. Depending on the

beginning reason, hemiparesis can range in inflexibility from slight weakness to total palsy and can be either temporary or endless. (O'Sullivan et al., 2019)

2.4.1 Causes of hemiparesis

Hemiparesis, often stemming from strokes, arises when diminished or interrupted blood flow to the brain results in damage. Its duration can vary, being either transient or permanent, contingent on the stroke's severity. Traumatic brain injuries, such as those incurred in accidents or falls, similarly contribute to hemiparesis by damaging brain tissue, causing weakness or paralysis on one side of the body. Pressure exerted by brain tumors on areas governing movement and sensation can also induce hemiparesis, with its intensity linked to tumor size and location. Additionally, hemiparesis might present as a symptom of multiple sclerosis, an enduring autoimmune condition affecting the central nervous system and nerve fibers that regulate movement and sensation. Furthermore, infections like encephalitis trigger hemiparesis by inflaming brain tissue, thereby impairing nerves responsible for controlling movement and sensation. (O'Sullivan et al., 2019)

2.4.2 Consequences of hemiparesis

Hemiparesis yields multifaceted consequences impacting various aspects of life. Mobility becomes challenging, affecting everyday activities like walking, necessitating the use of mobility aids such as wheelchairs or canes. Muscle weakness on the affected side may worsen over time, leading to atrophy and heightened mobility issues. Sensory deficits may emerge, complicating tasks like dressing or tool use. If facial muscles are affected, speech and communication difficulties may arise, hindering effective expression and interaction. Hemiparesis can significantly alter a person's life, contributing to emotional struggles like depression and anxiety due to its impact on daily functioning. Furthermore, cognitive issues such as impaired memory and decision-making may further compound the challenges, affecting learning and problem-solving abilities. (O'Sullivan et al., 2019)

2.4.3 Treatment of hemiparesis

How hemiparesis is treated depends on its underpinning etiology and degree of inflexibility. Treatment options include using drugs to manage pain or other symptoms,

physical therapy, occupational therapy, speech therapy, and more. Surgery may be necessary from time to time to remove a brain tumor or to release pressure on the brain. numerous people with hemiparesis can recapture part or all of their mobility and function with the right therapy, but recovery may take some time and bear continuing support. (O'Sullivan et al., 2019)

2.5 Motor learning principles and their application in rehabilitation

The acquisition and refinement of motor skills through repetition and experience constitute motor learning. Employing motor learning principles becomes imperative in rehabilitating individuals who have suffered an ischemic stroke affecting the basal ganglia and resulting in right-sided spastic hemiparesis to attain optimal outcomes. Exploring essential motor learning principles and their application in physiotherapy treatments is crucial in this context.

1. Task-specific training involves practicing specific tasks to improve targeted skills rather than engaging in isolated exercises. For an individual with right-sided spastic hemiparesis, this training may encompass mobility exercises like walking and transfers, alongside daily activities such as dressing, cooking, and feeding.
2. Repetition plays a pivotal role in motor learning by enabling individuals to acquire and retain motor skills. This could involve repeatedly practicing the same task within each session or across multiple sessions for someone with right-sided discontinuous hemiparesis.
3. Feedback is crucial in motor learning as it allows individuals to assess their performance and make necessary adjustments.
4. Practice variability, encompassing performing a task in diverse contexts or situations, aids in generalizing motor skills. For individuals with right-sided spastic hemiparesis, this might mean practicing the same task in varied positions, using different tools, or within different settings.
5. Transfer refers to utilizing a learned motor skill from one task in another context. In the case of individuals with right-sided spastic hemiparesis, this transfer could involve applying motor skills learned from task-specific training to similar tasks requiring analogous motor abilities, such as walking and climbing stairs.

Utilizing these motor learning principles stands as pivotal in optimizing physiotherapy outcomes for patients dealing with ischemic strokes affecting the basal ganglia and inducing right-sided spastic hemiparesis. By formulating exercises relevant to specific activities, providing feedback, diversifying practice contexts, and fostering skill transfer to various tasks, therapists can integrate these concepts into a patient's treatment plan. This approach enables patients to enhance their motor abilities and regain functional independence.Compensation denotes a patient's ability to substitute pre-stroke behaviors with new strategies to achieve tasks. While learning is essential, brain repair isn't a prerequisite for this adaptation. Compensation spans across all functional domains, facilitating adaptation without necessitating neurological restoration. (Bernhardt et al., 2017)

2.6 Tests for diagnosis

A physiotherapist has the ability to perform several tests on individuals experiencing an ischemic stroke affecting the basal ganglia and resulting in right-sided spastic hemiparesis. These tests serve to diagnose the condition accurately and chart the most appropriate course of action. Below are some potential tests that can be administered.

2.6.1 Muscular tone assessment

A physiotherapist performs an assessment of theindividual's muscular tone to detect any signs of spasticity or flaccidity. The Modified Ashworth Scale serves as a tool to evaluate the extent of muscular tone in individuals experiencing spasticity. Additionally, an assessment of the range of motion (ROM) in a non-resisted setting helps the physiotherapist gauge flaccidity and ascertain the joint's mobility.

Using a portable dynamometer, the physiotherapist assesses the patient's muscle strength, pinpointing specific muscles that might necessitate targeted strengthening exercises. Furthermore, the physiotherapist conducts sensory tests to ascertain any loss or altered sensations on the affected side. This comprehensive evaluation aids in understanding the individual's condition and tailoring an effective treatment plan. (Pandyan et al., 2005)

2.6.2 Balance testing

Assessment of balance holds paramount importance in evaluating individuals who have experienced an ischemic stroke. Physiotherapists employ tools such as the Berg Balance Scale to evaluate a patient's balance and susceptibility to falls. A study conducted by Elsisi et al. in 2021 examined the impact of balance exercises on an individual with post-stroke hemiparesis, specifically observing improvements in balance, gait, and functional abilities. This research sheds light on the efficacy of balance exercises in enhancing the overall physical condition of post-stroke individuals

2.6.3 Gait analysis

By closely observing the patient's gait pattern, the physiotherapist can discern any irregularities or abnormalities. Analyzing the gait assists in selecting the most suitable gait-training exercises. Inzelberg et al. in 2018 conducted research examining the impact of therapeutic horseback riding on the balance capabilities of individuals dealing with post-stroke hemiparesis. Their study sheds light on the potential benefits of such interventions in improving balance and overall mobility for these individuals.

2.6.4 Functional tests

A functional test assesses the individual's ability to perform daily living activities (ADLs). Physiotherapists often utilize tools like the FIM (Functional Independence Measure) or Barthel Index to measure the patient's functional capacity in executing these essential tasks. (Bernhardt et al., 2017)

2.6.5 Cardiovascular endurance testing

Following a stroke, individuals may experience a decline in cardiovascular endurance. To evaluate the patient's endurance level, a physiotherapist often employs a six-minute walk test. This assessment aids in designing a suitable exercise program tailored to the individual's endurance capacity. (Bernhardt et al., 2017)

2.7 Phases of treatment

Treating a case with right-sided spastic hemiparesis after an ischemic stroke in the basal ganglia involves a comprehensive multidisciplinary approach, integrating physical therapy, occupational therapy, speech therapy, and cognitive-behavioral therapy. These varied treatments and strategies are applied throughout different phases of stroke rehabilitation.

Initially, the acute phase treatment concentrates on urgent medical intervention and early rehabilitation. This critical phase aims to stabilize the patient's condition medically and prevent further damage to the brain. Simultaneously, early rehabilitation practices commence to address immediate complications and enhance recovery. Activities during this phase may encompass gentle range-of-motion exercises, frequent repositioning to prevent pressure ulcers, and specific breathing exercises to reduce the risk of pneumonia.Transitioning to the subacute phase treatment, rehabilitation extends into both hospital and community settings. As the patient stabilizes medically and becomes capable of tolerating intensive therapy, this phase begins. Therapy in this stage involves a range of interventions, including cognitive-behavioral therapy, occupational therapy, speech therapy, and targeted exercises. Treatment activities might encompass active range-of-motion exercises, strength training, balance and gait exercises, and techniques like electrical stimulation to manage spasticity. Finally, moving into the chronic phase treatment, rehabilitation extends into long-term care and community reintegration. This phase starts as the patient approaches their maximum recovery potential in the hospital and prepares for transitioning to the community. Throughout this phase, the patient might continue to receive cognitive-behavioral therapy, occupational therapy, speech therapy, and physical therapy as needed. The primary focus during this phase shifts towards community reintegration and enhancing the patient's overall quality of life. (Winstein et al., 2016)

2.8 Physical interventions and exercises for stroke rehabilitation

Physical therapy interventions for stroke rehabilitation encompass a wide range of exercises and modalities aiming to enhance mobility, function, and quality of life. These treatments encompass functional training, hydrotherapy, electrical stimulation, balance and gait training, strength exercises, and range-of-motion exercises. Additionally, newer rehabilitation approaches such as occupational therapy, speech therapy, and cognitive-behavioral therapy are utilized. (Coupar, Pollock, & van Wijck, 2012)

Occupational therapy focuses on improving a patient's ability to perform daily tasks like eating, dressing, and maintaining personal hygiene. Speech therapy aims to enhance communication and swallowing abilities. Cognitive-behavioral therapy

addresses the emotional and mental impacts of stroke, supporting both the patient and their family through the challenges of rehabilitation. (Han et al., 2017)

In an interdisciplinary approach to stroke rehabilitation, physical therapy, occupational therapy, speech therapy, and cognitive-behavioral therapy are integrated. The treatment plan should consider the patient's unique objectives, goals, and requirements concerning their physical, cognitive, and emotional well-being. With appropriate rehabilitation, patients can experience significant improvements in mobility, function, and quality of life. (Han et al., 2017)

2.9 Medical interventions

2.9.1 Surgical procedures

The selection of a surgical procedure for a patient with an ischemic stroke affecting the basal ganglia and resulting in right-sided spastic hemiparesis is contingent upon the underlying cause of the stroke. Among the various surgical methods available, thrombectomy involves removing brain blood flow-obstructing blood clots using a catheter, exhibiting optimal efficacy within the initial 24 hours of stroke onset and proving beneficial for certain patients. Craniotomy, on the other hand, necessitates the delicate opening of a section of the skull to address clot dissolution or repair of damaged brain blood vessels, albeit carrying potential risks like bleeding, infection, and neurological complications. Carotid endarterectomy surgically eliminates plaque buildup in carotid arteries to prevent blockage-induced strokes, known for its generally low-risk profile and minimal complications. Aneurysm clipping or coiling intervenes in weak blood vessel spots to avert hemorrhagic strokes, with coiling employing tiny metal coils to impede blood flow and encourage clotting and clipping placing a small clip to prevent aneurysm rupture. (Mayo Clinic Staff, n.d.). Each procedure carries potential risks but addresses specific stroke-related issues, influencing the choice of surgery in a comprehensive stroke management approach. (Chang et al., 2022)

2.9.2 Prevention

Preventing injuries in cases of right-sided spastic hemiparesis and basal ganglia issues following an ischemic stroke involves a multi-tiered approach. Primary prevention focuses on reducing stroke risk factors by managing conditions like diabetes, hypertension, and adopting a healthy lifestyle with exercise and smoking cessation. Secondary prevention targets stroke recurrence through medications like aspirin, warfarin, and lifestyle adjustments. Tertiary prevention aims at minimizing impairment and aiding recovery through rehabilitation, utilizing physical activity, social support, and assistive technologies. A comprehensive injury prevention strategy considers individual needs, encompassing the stages of prevention to mitigate risks, manage complications, and facilitate personalized recovery for stroke survivors. (Chang et al., 2022)

2.10 Up to date physiotherapy interventions for stroke rehabilitation

Utilizing evidence-based physiotherapy interventions is crucial for the rehabilitation of patients experiencing ischemic stroke with basal ganglia involvement and right-sided spastic hemiparesis. Effective interventions are outlined below.

- The therapist's goal is to improve function and normalize movement patterns using Neurodevelopmental Treatment (NDT), a hands-on approach. Techniques like re-education, facilitation, and inhibition of movement enable patients to achieve enhanced mobility and an increased capacity for daily tasks (Vaughan-Graham et al., 2015)

- Constraint-Induced Movement Therapy (CIMT) aims to strengthen motor function by restricting the use of a functioning limb and intensively training the injured limb. This method encourages the use of the impaired limb for repetitive practice and functional tasks, serving as a rehabilitation strategy. (Wu, Chuang, Lin, & Chen, 2013)

- Task-focused training involves the creation of exercises that specifically target individual motor abilities. These exercises concentrate on functional tasks relevant to the patient's needs. Regular practice and feedback during these exercises enhance the patient's motor learning. (Winstein et al., 2016)

• Virtual reality therapy employs computer-generated settings and conditioning to simulate exercises, promoting motor development and function enhancement. Patients engage with virtual scenarios and complete exercises tailored to refine specific motor skills. (Karkhaneh & Ghasemi, 2017)

• Electrical Stimulation: Research has consistently shown the efficacy of electrical stimulation in enhancing motor learning, reducing stiffness, and strengthening muscles. Therapists use electrical stimulation to activate injured muscles or nerves, facilitating improved muscular function. Li et al. in 2019 conducted clinical trials examining the impact of electroacupuncture combined with rehabilitation training on spasticity in hemiplegic upper limbs following a stroke.

• Mobility & Gait: Many stroke survivors prioritize regaining the ability to walk independently. Post-stroke, diminished walking capacity can lead to restricted social interactions and an increased risk of social isolation. For individuals facing walking difficulties, a consistent and adapted practice of walking or related exercises in a familiar environment is crucial. Various methods can aid in achieving this goal. Such as effects of binary-task training on the balance and cognition of stroke patients. (Ghai, Ghai, & Effenberg, 2017)

• Electromechanical-Assisted Gait Training: Stroke survivors facing challenges in walking independently could benefit from exploring electromechanical-assisted gait training with body weight support.(Elsisi, Zayed, & Mosaad, 2021)

• Enhancing Stride Length and Gait Speed: To improve stride length and gait speed, integrating cadence cueing with traditional gait training techniques can be effective. Das & Biswas in 2016 investigated the impact of task-specific circuit class training on gait parameters in individuals with chronic stroke.

• Customized Lower Limb Orthoses: Tailored lower limb orthoses can significantly alleviate walking limitations. These orthoses, when worn, have been shown to enhance walking speed for the user.(Tyson & Kent, 2009)

• Functional Conditioning for Stroke Rehabilitation: Offering high-intensity, repetitive, and task-specific functional conditioning exercises is crucial for stroke patients aiming to improve arm movement. These exercises should cater to the

individual's needs, potentially focusing on bilateral or unilateral movements depending on the activity. (Winstein & Wolf, 2014)

3. Special part

3.1 Methodology of work

The special section of my bachelor's thesis focuses on a detailed case study involving a patient with whom I actively collaborated during a continuous professional practice at Oblastní nemocnice Kladno, supervised by Bc. Tomáš Modlinger from January 16 to February 10, 2023.

The aim of this segment was to record the therapy's progression and the application of specific rehabilitative procedures post-stroke. These techniques were acquired during my physiotherapy studies at the Faculty of Physical Education and Sport, Charles University.

For this case study, I selected a patient who had experienced hypertensive ICH hemorrhage in the left BG in October 2021, followed by an ischemic stroke in the same area in August 2022. During my practice, the patient was hospitalized due to complications arising from right-sided spastic hemiparesis. This work was conducted after securing informed consent from the patient (see Sample Informed Consent - Annex No. 2) and subsequent endorsement from the Ethics Committee of the Faculty of Physical Education and Sport, Charles University (see Request for Ethics Committee Opinion - Annex No. 1).

The formulation of short and long-term therapeutic plans commenced with a comprehensive initial kinesiological examination and a thorough medical history collection. Based on these assessments and the patient's primary subjective goals, therapeutic interventions were planned. Each session was tailored to accommodate the patient's prevailing condition and specific challenges.

A total of 8 therapeutic sessions were conducted, including the initial and final measurements. The patient commenced therapy with me 3 days after his arrival at the rehabilitation department on January 23, 2023, engaging in outpatient therapy. This setting provided a fully equipped area with therapeutic amenities like adjustable beds,

parallel bars, soft mats, and various exercise aids. Concurrently, daily occupational therapy focused on enhancing grip and fine motor skills. This encompassed diverse activities such as hand tissue release, mirror therapy, bead threading, and working with modeling clay.

Following these sessions, a concluding kinesiological examination was administered, evaluating the therapy's impact by comparing key observations before and after the commencement of physiotherapeutic intervention.

Diverse therapeutic methods rooted in neurophysiology were employed throughout the therapy. These methods encompassed proprioceptive neuromuscular facilitation according to Kabat, Lewit's post-isometric relaxation, post-isometric relaxation with stretching according to Janda, sensory-motor stimulation methods according to Janda and Vávrová, and dynamic neuromuscular stabilization according to Kolář. Additionally, individualized therapeutic physical education, Lewit's mobilization, and active exercises targeting balance, stability, and gait training were integrated into the sessions.

3.2 Anamnesis

Examined person: P.k - Male

Year of birth: 1965

Diagnosis: Ischemic stroke in basal ganglia with right sided spastic hemiparesis

Anamnesis (Medical history):

PA (Personal Medical Anamnesis):

- The patient had hypertensive intra-cerebral hemorrhage in the left basal ganglia on October 10, 2021, and was managed conservatively.
- He was suffering from right sided spastic hemiparesis (predominantly affecting his upper limb) and dysarthria so he was admitted to undergo rehabilitation for the right extremities along with speech therapy.
- The patient then had an ischemic stroke in the left basal ganglia and was hospitalized in “kladno hospital” from July 12 to August 2, 2022.
- After that he started his stay at the rehabilitation department.

- The patient still experiences ongoing complications because of the right side spastic hemiparesis.
- The patient came back to the rehabilitation department on January 23, 2023 at "kladno hospital" to receive therapy.

OA (Occupation Anamnesis):

- He is a former locksmith.
- He has partial disability pension.

SA (Social Anamnesis):

- The patient is living with his wife in a detached house.

FUA (Functional Anamnesis):

- Self-sufficiency: Partially self-sufficient.
- Mobility: Able to sit independently with stability and is fully mobile in bed.
- Accessibility: The house has no stairs.
- Bathroom facilities: The patient has a shower stall.

FA (Family Anamnesis):

- Mother: AIDS
- Father: Dementia
- Brother: Multiple Myeloma
- Children: 2-Healthy

IA (Injury Anamnesis):

- Fracture: Fracture of the left arm at the age of 13.
- Knee injury: Distortion of the right knee in 2014. MRI revealed a fissure in the posterior horn of the medial meniscus.
- Eye injury: Injury to the left eye at the age of 32 resulting in a corneal laceration. A small metallic substance is present.

Surgery:

- Previous abscessed epididymitis, resulting in right orchiectomy (removal of the right testicle) in June 2022.
- Stent Implantation.

MA (Medication/Pharmacological Anamnesis):

Current Medications:

- Prestarium Neo 5 mg: 1 tablet in the morning
- Zoloft 50 mg: 1 tablet in the morning
- Lyrica 150 mg: 1 tablet in the morning, 1 tablet in the evening
- Baclofen 10 mg: 1 tablet three times a day
- Magnesii lactici 0.5 g: 1 tablet in the evening
- Pantoprazol 20 mg: 1 tablet in the morning
- Aescin Teva 20 mg: 2 tablets three times a day
- Diclofenac AL 50 mg: 1 tablet for pain, maximum 3 times a day with a minimum interval of 8 hours
- Belosalic 0.5 mg/g + 30 mg/g ointment: Apply once daily topically for psoriasis
- Belosalic 0.5 mg/g + 20 mg/g solution: Apply once daily for the scalp

AA (Allergy Anamnesis):

- Penicillin

RHB (Past Rehabilitation):

- When he was previously hospitalized in the department from July 12 to August 2, 2022. The patient underwent a rehabilitation stay.
- The patient was attending the spasticity clinic where botulinum toxin injections are administered, speech therapy sessions, and day care.

Excerpt from patient's health care file:

- EKG record from 23.01.2023 : Sinus rhythm, heart rate of 81 beats per minute, intervals within normal limits. P wave morphology is intermediate. No acute focal changes observed. In Conclusion: Sinus rhythm, no significant abnormalities detected.
- Z509- Rehabilitation for right-sided spastic hemiparesis
- G811- Right-sided spastic hemiparesis with severe to complete paralysis in the upper limb and mild to moderate paralysis in the lower limb.
- I612- Intra-cerebral hemorrhage in the left basal ganglia, typical hypertensive etiology, managed conservatively since October 10, 2021.
- I10- Hypertension under therapy.
- F801- Mixed receptive-expressive language disorder in gradual regression.

- Z878- Status post-percutaneous endoscopic gastrostomy (PEG) tube insertion from November 1, 2021, to February 3, 2022.
- N450- History of recurrent epididymitis. Abscessed epididymitis in the left testicle requiring orchiectomy on June 16, 2022.
- L400- Psoriasis vulgaris.
- A530- Latent syphilis, currently non-infectious. Positive reactive antibodies to Treponema pallidum since October 11, 2021.
- N209- Nephrolithiasis in the right kidney since November 2021. History of stent implantation in August 2014.
- Z619- History of fracture of the left humerus. History of knee injury in 2014, with MRI showing a fissure in the posterior horn of the medial meniscus. History of eye injury in 1997 with a corneal laceration and a small metallic tattoo.
- U089- History of COVID-19 infection in 2021.
- M5499- Chronic pain in the neck and lower back as per doctor's assessment.
- Z720- Former smoker.

Indication of Rehabilitation:

- Improve mobility and stretch spastic muscles.
- Reduce spasticity.
- Gait training.
- Speech therapy.
- Achieve self-sufficiency in activities of daily living (ADL).

Differential balance:

The patient previously had an intra-cerebral hemorrhage in the left basal ganglia. Subsequently, an ischemic stroke occurred, likely stemming from alterations in the blood vessel condition in the initially affected area. These changes might have caused diminished blood flow or blockage in smaller vessels, resulting in an ischemic stroke within the same region or neighboring areas of the brain.

With the patient suffering from right sided spastic hemiparesis after an ischemic stroke in the left basal ganglia, this will be leading to several issues. These include weakened or paralyzed muscles on the right side, causing stiffness (spasticity) and abnormal movements. Mobility challenges arise, impacting independent movement, while

coordination and fine motor skills on the right might be affected, impacting tasks like writing or holding objects. Speech and language issues, altered sensations, cognitive changes, emotional shifts , and limitations in daily activities might also occur.

It is worth mentioning that it will be expected to have several limitations affecting examinations and therapy. These include restricted range of motion due to spasticity and weakness, hindering joint assessment, and muscle evaluation. Altered sensation on the affected side complicates sensory testing and patient feedback during therapy. Compensatory movements may lead to overuse injuries on the unaffected side during therapy sessions. Communication barriers like aphasia may impede information exchange during assessments and therapy. Balance issues pose fall risks, demanding additional safety measures. Cognitive deficits post-stroke can hinder therapy comprehension, and fatigue onset limits both examination and therapy duration. Understanding these limitations is critical for customized and safer treatment approaches, managing recovery expectations effectively.

3.3 Initial kinesiological examination

I started conducting the initial kinesiological examination on 26.01.2023.

3.3.1 Status praesens:

objective:

The patient is conscious, oriented and cooperative.

The is not using any assistive devices at the moment, he was using a walking aid before.

- He is right handed.
- He is wearing glasses.
- Height: 178 cm
- Weight: 94 kg
- BMI: 29.7- overweight
- Observations along with findings from examining the patient when he came to the rehabilitation department on 23.01.2023:

- No signs of jaundice or cyanosis.
- Adequate hydration and nutrition.

- Eupnea is observed.
- Fatigue disorder is present.
- Mild dysarthria and slower memory retrieval.
- Head is not painful, normal cranial nerve outputs, equal pupil size, positive pupillary light reflex, sclera is clear, conjunctiva well perfused, right corner of mouth slightly drooping.
- No palpable lymph nodes on neck.
- Clear vesicular breathing, normal breath sounds, quiet, no murmurs.
- Abdomen is soft, non-tender, no rigidity. No hepatomegaly or splenomegaly.Negative Murphy's sign bilaterally.
- Extremities are without swelling or signs of inflammation. But some psoriatic changes were observed.

Subjective:

- The patient reports that he is feeling well overall.
- Expresses dissatisfaction with poor mobility specifically in the upper limb.
- Doesn't report any pain-related issues.
- Doesn’t experience any respiratory difficulties.
- Doesn’t report any urinary difficulties.
- Doesn’t encounter any problems with swallowing.

3.3.2 Neurological examination

Higher functions

- The patient is well oriented; the cognitive sense of his status in time, place and person are not affected.
- The patient has slower memory retrieval (delayed recall) , especially in recalling recent events.
- Signs of mild dysarthria are present, the patient has imprecise pronunciation of sounds leading to distorted or mumbled speech.

Examination of the cranial nerves

I. Olfactory nerve: intact; patient is able smell different odors.Optic nerve: intact; visual field and visual acuity tests showed no abnormal results.
II. Oculomotor nerve: intact; normal papillary reactions to light and accommodation as wells as no pathological findings for extra-ocular movements (which was tested along with IV and VI cranial nerves).
III. Trochlear nerve: intact; no pathological findings for extra-ocular movements (which was tested along with III and VI cranial nerves).
IV. Trigeminal nerve: intact; No pathological findings in the following: sensation in the face (touch, pain, and temperature perception) , Motor function of temporal and masseter muscles, and corneal reflex.
V. Abducens nerve: intact; no pathological findings for extra-ocular movements (which was tested along with III and IV cranial nerves).
VI. Facial nerve: Slight drooping of right corner of mouth is observed. However, there is no weakness or asymmetry while performing various facial movements (smiling, frowning, raising eyebrows, closing eyes tightly, and puffing cheeks).
VII. Vestibulocochlear nerve: hearing is intact, balance is slightly impaired.
VIII. Glossopharyngeal nerve: it was tested along with X cranial nerve. Taste, swallowing, and gag reflex are intact but the patient's ability to articulate sounds was impaired.
IX. Vagus nerve: same results as for the previous one.
X. Accessory nerve: Reduced strength and size of trapezius and sternocleidomastoid muscles on right side compared with the left one.
XI. Hypoglossal nerve: The tongue is not protruded fully, reduced speed and precision in tongue movements, no deviation of tongue to one side is noticed.

Examination of upper extremities:

Superficial sensation (non-cortical sensory system)

Superficial sensation was examined bilaterally including dermatomes C4-T1 by assessing the following:

- Light touch: Physiological in all dermatomes.

- Pain sensation: Physiological in all dermatomes.
- Temperature perception: Physiological in all dermatomes.

Deep sensation (cortical sensory system)

The following tests were assessed with no visual control (patient was asked to keep his eyes closed).

- Position sense: Physiological bilaterally, the patient was able to identify in which direction his finger was moving (up or down).
- Kinesthesia: Physiological bilaterally, the patient was able to tell when was the beginning and end of movement of his finger.
- Stereognosis: it was tested only for left upper limb and it was physiological, the patient was able to identify familiar objects placed into his hand like a pen and keys.

Deep tendon reflexes

Table 1 - Deep tendon reflexes of UEE (initial examination)

Deep tendon reflex	Right	Left
Biceps	3+	2+
Triceps	3+	2+
Flexors	4+	2+

- The grading system used:

0: Absent reflex

1+: Hyporeflexia (diminished response), indicating a very mild or reduced reflex compared to normal

2+: Normal reflex, indicating a typical or expected response within the normal range

3+: Hyperreflexia (exaggerated response), indicating a brisker or more pronounced response than normal

4+: Clonus, a rhythmic, oscillating series of contractions and relaxations following sustained stretching of the tendon, indicating a significantly exaggerated response.

Examination of paretic signs

Table 2 - Paretic signs of UEE (initial examination)

Paretic sign	Right	Left
Mingazzini	Not tested	Negative
Dofour	Not tested	Negative
hanzal	Not tested	Negative
barré	Not tested	Negative
Rusecké	Not tested	Negative
Retardation phenomenon	Not tested	Negative

- The paretic signs could not be tested properly on the right side due to weakness and limited mobility of the patient's right upper limb. However if we will allow the limited execution of movement for each test it will be considered positive for all tested signs.

Examination of spastic (irritation) signs

Table 3 - Spastic signs of UEE (initial examination)

Spastic sign	Right UE	Left UE
Juster	Positive	Negative
Trömner	Positive	Negative
Hoffmann	Positive	Negative

Examination of Cerebellum functions

- The patient was asked to touch his nose with his right index finger and then reaches out to examiner's finger, repeating the movement several times. During this action, an oscillating tremor became noticeable, intensifying in speed as approaching the target, and exhibiting a lack of smoothness in execution.
- These indications suggested the existence of intention tremor and dyssynergia, indicating the presence of cerebellar signs. However, assessing dysmetria was not feasible due to the patient's limited mobility in the right upper extremity, impeding his ability to reach the target.

- To counter the immobility of the right upper extremity, my supervisor conducted an alternate test. The patient was asked to touch his umbilicus with his index finger revealing the absence of intention tremor , dyssynergia, and dysmetria in this test.
- No cerebellar impairments were observed while assessing the left upper extremity during the previously mentioned tests.
- Dysdiadochokinesis was absent for the left side. However, it cannot be tested in the standard way for the right side due to the patient's inability to fully supinate his right arm. Yet, when the patient performed rapid alternating movements of supination and pronation but within his manageable range, there was no abnormal findings.

Precision and strength of grips

The right hand displays impaired fine motor skills and grip strength, preventing the testing of both precision and power grips. Various precision grips such as pinch, pad-to-pad, tripod, and lateral grips, along with power grips like spherical, cylindrical and hook grips, couldn't be evaluated.

However, these grip variations were successfully assessed on the left hand, revealing no observable deficits.

Examination of lower extremities :

Superficial sensation (non-cortical sensory system)

Superficial sensation was examined bilaterally including dermatomes L2-S2 by assessing the following:

- Light touch: Physiological in all dermatomes.
- Pain sensation: Physiological in all dermatomes.
- Temperature perception: Physiological in all dermatomes.

Deep sensation (cortical sensory system)

The following tests were assessed with no visual control (patient was asked to keep his eyes closed):

- Position sense: Physiological bilaterally, the patient was able to identify in which direction his toe was moving (up or down) with eyes closed.
- Kinesthesia: Physiological bilaterally, the patient was able to tell when was the beginning and end of movement of his toe.

Deep tendon reflexes

Table 4 - Deep tendon reflexes of LEE (initial examination)

Deep tendon reflex	Right	Left
Patellar	3+	2+
Achilles	4+	2+

Examination of paretic signs

Table 5 - Paretic signs of LEE (initial examination)

Paretic sign	Right	Left
Mingazzini	Positive	Negative
Barré	Positive	Negative
Retardation phenomenon	Positive	Negative

Examination of spastic (irritation) signs

Table 6 - Spastic signs of LEE (initial examination)

Spastic sign	Right	Left
Babinski	Negative	Negative
Siccard's	Negative	Negative
Chaddock's	Negative	Negative
Oppenheim's	Negative	Negative
Rossolimo's	Negative	Negative

Examination of Cerebellum functions

- The patient performed the heel to shin test, aimed to touch the examiner's finger with his big toe, and execute rapid alternating movements, moving the feet up and down (within a manageable range for the right foot).

- No abnormal findings were observed bilaterally.

Examination of Abdominal reflexes

- The Epigastric, Mesogastric, and Hypogastric reflexes were evaluated, showing bilateral hyporeflexia in all.

3.3.3 Postural Examination

The patient was able to stand independently throughout the whole examination of posture.

Static postural examination:

Posterior view:

- Base of support - slightly narrow width of stance between heels. He has a wider stance on right leg (affected side) while left leg is closer to the centre of the body.
- Weight distribution - Greater load of body weight is on the left lower extremity.
- Heels - spherical shape of both heels. Right heel appear to be elevated slightly (less contact with the floor) and left heel appear to be in a neutral position.
- Feet - the right foot is slightly in front of the left one.
- Ankle joint - right foot is externally rotated.
- Achilles Tendon - thicker on left and deviated laterally on right.
- Calf muscles - the calf muscles on the left side appear more prominent, while they appear flatter and less defined on the right side.
- Knee joints - right knee looks slightly flexed and shows signs of valgus alignment.
- Popliteal line - deeper on the right side.
- Thigh muscles - more tense and contracted appearance on the right side.
- Thoracobrachial triangles - significantly larger and more angular on the left side.
- Position of pelvis - lateral pelvic tilt to the right.
- Paravertebral muscles - appear to be more contracted on right lumbar area.

- Spine - the curvature is prominent in the lumbar and thoracolumbar areas, moderate kyphosis is visible in thoracic area.
- Scapula - higher on left side.
- Shoulder - both shoulders are protracted, left one is higher while right one is depressed and adducted.
- Trapezius muscle - larger on the left side.
- Upper limb - slightly flexed elbow, slightly pronated forearm , noticeable clenched fingers on right side and also slightly flexed elbow on left side.
- Head - marked anterior tilt.

Right side view:

- Weight distribution - Reduced weight bearing on right side.
- Ankle joint - slight plantar flexion.
- Knee joint - semiflexed and in valgus position.
- Pelvis - moderate anterior tilt.
- Lumbar vertebrae - slight lordosis.
- Thoracic vertebrae - moderate Kyphosis.
- Cervical vertebrae - moderate lordosis.
- Shoulder - protracted and depressed.
- Upper limb - elbow slightly flexed, forearm slightly pronated and noticeable clenched fingers.
- Head - marked anterior tilt.

Left side view:

- Weight distribution - more weight shift to the left side (increased contact along the lateral border of the left foot).
- Ankle joint - neutral position.
- Knee joint - hyperextended.
- Pelvis - moderate anterior tilt.
- Lumbar vertebrae - slight lordosis.
- Thoracic vertebrae - moderate Kyphosis.

• Cervical vertebrae - moderate lordosis.
• Shoulder - protracted and elevated.
• Upper limb - elbow slightly flexed.
• Head - marked anterior tilt.

Anterior view:

• Base of support - slightly narrow width of stance between heels. He has a wider stance on right leg (affected side), while left leg is closer to the centre of the body.
• Feet - the right foot is slightly in front of the left one.
• Ankle joint - right foot is externally rotated and slightly in plantar flexion (toes slightly curled).
• Weight distribution - Greater load of body weight is on the left lower extremity.
• Tibialis anterior muscle - signs of atrophy on the right side.
• Knee joints - right knee is slightly semi-flexed while left one is hyperextended.
• Patella - Right patella appears rounded , slightly higher and is pointing outwards.
• Thigh muscles - more defined on the left side.
• Position of pelvis - lateral pelvic tilt to the right.
• Navel - slightly deviated to the left side.
• Thoracobrachial triangles - significantly larger on the left side.
• Chest - appears more tense on right side and right nipple is slightly higher than left one.
• Shoulder - both shoulders are protracted , left shoulder is noticeably higher than right one which is depressed , adducted and internally rotated.
• Trapezius muscle - larger on the left side.
• Upper limb - slightly flexed elbow , slightly pronated forearm , noticeable clenched fingers on right side and also slightly flexed elbow on left side.
• Head - marked anterior tilt.

Palpation of the pelvis:

• height and symmetry of the iliac crest - left side is higher than right side.

- height and symmetry of the Posterior superior iliac spine (PSIS) -Not Symmetrical, slightly higher on left side.
- height and symmetry of the Anterior superior iliac spine (SIAS) - Not Symmetrical, slightly higher on left side.
- So overall the pelvis is laterally tilted to the right.
- No signs of torsion.
- Moderate anterior tilt.

Dynamic spine examination:

Flexion:

- The overall range of motion is incomplete.
- The spreading out of thoracic and cervical spine is not present.
- No fluency when returning back to upright position.

Lateral flexion:

- It was Asymmetrical, the ROM was bigger to the left side.
- In both lateral to the right and left, the functional curve is missing at the thoracic and cervical spine and the patient couldn't keep an upright posture towards the end of the movement excursion.
- In lateral flexion to the left side the patient was rotating his trunk in a clockwise direction.
- No fluency when returning back to upright position.

Extension :

- The overall range of motion is incomplete.
- The flattening of thoracic spine is not present.
- No fluency when returning back to upright position.

Specific Testing

1. Romberg test I, II , III:

- Romberg I: Stable.
- Romberg II: Relatively stable but with a bit difficulty maintaining balance.
- Romberg III: Unstable stance with compensatory movements.

2. **Trendelenburg sign test:**

- Standing on right leg: Patient couldn't perform the test , it was so challenging for him to lift the left leg off the ground and hold it in the test position.
- Standing on left leg: The test was positive, he was able to maintain balance for few seconds, but with pelvis drop to the right side, he was doing compensatory movements to maintain balance, like leaning with trunk towards left side and rotating in clockwise direction.

3. **Vele test:**

- The left foot exhibits normal stability (grade 1), while the right shows slight impairment indicated by pressed toes (grade 2).

4. **Standing on two scales:**

- The patient weighs 94 kg, his weight was distributed into 34 kg on the right and 60 kg on the left.
- So the patient loads more weight on the left side with a 28% of body weight.
- This difference is greater than the tolerated range (10% - 15%) which indicates impaired balance.

Modification of standing

1. **Standing on tiptoes:**

- The patient couldn't perform it properly and rise up fully due to inability to balance and keep control of right ankle.

2. **Standing on heels:**

- The patient was capable to hold it for few seconds but he was having difficulties to maintain balance leaning more on left side due to reduced dorsiflexion of the right ankle.

3. **Single-leg stance test:**

- Patient couldn't perform the test on his right leg.
- Patient was able to stand on his left leg but for less than 10 seconds and he was leaning towards. his left side with observation of twitch activity of tendons of left foot.
- It was not tested with eyes closed.

3.3.4 Gait Examination

Patient walked independently during the examination and he didn't report any pain.

- Width of base of support - slightly narrow, while walking he is adopting a wider base of support on the right side.
- Position of feet - right foot exhibits external rotation (toe-out gait).
- Walking rhythm - disrupted rhythm of walking ,the patient has prolonged time spent on weight bearing phases on the left side. Also the timing of steps is altered due to inconsistencies in the initiation of the swing phase on the right side.
- Walking speed - Overall the walking speed is slow due to the need of patient to be cautious and decreased push-off power by right foot.
- Stride length - irregular, the patient takes shorter steps on right side.
- Position and movement of the lower limb - the patient was swinging the right leg outward in a semi-circular motion (hemiplegic gait). There was a reduced force during both heel strike and toe off. Limited knee flexion during swing phase and limited hip extension during terminal stance phase.
- Position and movement of pelvis - The pelvis exhibits asymmetrical position and movement. Lateral pelvic tilt to the right is seen during stance phase and also becomes more pronounced when pelvis shows upward movement on the left side during the swing phase of right leg
- Centre of gravity - shifted to the left, increased loading on left side of the body
- Position and movement of the trunk - slight anterior tilt of trunk and limited trunk extension which affected his ability to maintain an upright posture (forward leaning posture). The trunk movement was asymmetrical, rotation and lateral flexion are reduced on right side while slightly increased on left side (to align with the shifted centre of gravity).
- Position and movement of the head - slight anterior tilt , slight lateral tilt and rotation to left side (aligned with the trunk).
- Position and movement of the upper limb - Reduced arm swinging of the right arm with slightly flexed elbow, slightly pronated forearm, clenched fingers on right side (resembling Wernicke-Mann position).

- Gait Endurance - the patient exhibits signs of fatigue during prolonged walking , he experiences discomfort which further worsens the efficiency of walking and also increased respiratory gait.
- Other observations - the patient encounters challenges with turning and changing direction, demanding an expansion in the width of base of support to reduce the risk of loss of stability. Patient needs assistance for going up and down the stairs.

3.3.5 Assessment of spasticity

- The assessment of spasticity was conducted using the Modified Ashworf Scale (MAS).
- Specifically, testing was limited to the right upper and lower extremities, as no signs of spasticity were observed in the left side.
- While assessing the soleus muscle, there was a clonus observed that lasted for few seconds.

Table 7 - Spasticity assessment using MAS (initial examination)

Muslce(s) tested	Grade
Shoulder adductors	1+
Biceps brachii	1
Triceps brachii	3
Forearm supinators	2
Forearm pronators	1+
Wrist flexors	1+
Finger flexors	2
Hip flexors	1
Hip adductors	1+
Hamstrings	1
Quadriceps	1
Gastrocnemius	2
Soleus	3

- The grading system is as follows:

0: No increase in muscle tone

1: Slight increase in muscle tone, with a catch and release or minimal resistance at the end of the range of motion when an affected part is moved in flexion or extension

1+: Slight increase in muscle tone, manifested as a catch, followed by minimal resistance through the remained (less than half) of the range)

2: A marked increase in muscle tone throughout most of the range of motion, but affected parts are still easily moved

3: Considerable increase in muscle tone, passive movement difficult

4: Affect part(s) rigid in flexion or extension

3.3.6 Examination of movement stereotypes by janda

Hip extension

On right side:

- Movement is initiated in the ipsilateral paravertebral muscles.
- Delayed and impaired activation ipsilaterally of both the gluteus maximus muscle and the ischiocrural muscles.
- Movement is not smooth with reliance on turning pelvis to left side to lean on and straight lift the right leg into extension.

On left side:

- Exhibits coordinated and normal timing of activation of ipsilateral gluteus maximus muscle and the ischiocrural muscles.
- Increased activity of contralateral paravertebral muscles.
- Smoother with a greater range of motion.

Hip abduction

On right side:

- impaired activation of gluteus medius , gluteus minimus and tensor fascia latae muscles.
- Noticeable quadratus mechanism with poor execution and coordination
- Noticable tensor mechanism

On left side:

- Moderate quadratus mechanism.
- Moderate tensor mechanism.

Trunk flexion

- He failed to perform the movement
- Attempting the execution is initiated by moving the pelvis and lifting up the lower extremities (Hyper-activation of iliopsoas muscle).
- He is still struggling to sit up even with when asking him to push down his feet (ankle plantar flexion) against my resistance.

Neck flexion

- He protracted his head (sternocleidomastoid dominance) and there was no continuous arched neck flexion.

Shoulder Abduction

On right side:

- Initiated the movement by elevation of shoulder (hyper-activation of upper part of trapezius muscle).
- Not fluent, with slight side bending to the left.
- Not coordinated scapular movement, with hyper- activation of lower scapula fixators ipsilaterally.

On left side:

- Initiated the movement by elevation of shoulder (hyper-activation of upper part of trapezius muscle).
- More fluent, with greater range of motion.
- More coordinated scapular movement.

3.3.7 Breathing pattern assessment

- The patient exhibits predominant abdominal breathing with limited ribcage mobility and chest expansion are noted. However, a slight expansion of the chest was observed

during inhalation. These patterns were present while standing , sitting and lying down in supine position

- The patient maintains Eupnea breathing and exhibits clear vesicular breathing at rest. Nevertheless, a fatigue disorder is apparent, manifesting in heightened breathlessness in response to physical activity.

3.3.8 Examination of deep stabilization system (According to prof. Kolář)

1. Extension test:

- Reduced activation of lateral abdominal muscles.
- Higher activity of paravertebral muscles, particularly on the right side.
- Difficulty maintaining a stable pelvis.
- Increased activity of ischiocrural muscles.

2. Trunk diaphragm test:

- Limited ability to expand the lower part of chest laterally and dorsally against resistance. After more attempts, he was able to do it better but only with a small force and for a short time.
- Cranial migration of ribs was noted.
- Limited expansion of lateral chest, particularly on the right side.

3. Intra-abdominal pressure test:

- Difficulty generating sufficient intra-abdominal pressure.
- Increased activity in the upper abdominal muscles.
- The navel moves upward.

3.3.9 Special Tests

Timed up and go test (TUG):

- It is used as an assessment to evaluate a person's mobility, balance, and risk of falling. It measures the time taken for an individual to stand up from a standard armchair, walk a short distance (about 3 meters or 10 feet), turn around, walk back, and sit down again.

• The procedure is as follows:

Setup:

- Place a chair with a standard seat height and armrests in an open area.
- Instruct the participant to sit with their back against the chair, arms resting on the armrests, and feet flat on the floor.

Instructions:

- Explain the task to the participant: They will stand up from the chair, walk to a marked spot about 3 meters away, turn around, walk back, and sit down again.
- Use a stopwatch or a timer to record the time taken for the complete task.

Execution:

- On the signal, the participant rises from the chair, walks to the designated spot at a comfortable pace (without running), turns around, walks back, and sits down.

Scoring:

- Record the time taken in seconds. Shorter times generally indicate better mobility and lower fall risk.

• The interpretation is as follows:

- <10 seconds: Typically indicates normal mobility.
- 10-20 seconds: Suggests mild to moderate mobility impairment.
- >20 seconds: Indicates significant mobility issues or an increased fall risk.

• The patient completed the test in 14 seconds which suggests mild to moderate mobility impairment.

Barthel index (BI):

• It was used to assess the patient's level of independence in performing basic activities of daily living (ADLs).

Table 8 - Barthel index (initial examination)

Activity	Execution of activity	Score points
Food and fluid intake	Independently without assistance	10
	With assistance	**5**
	Unable to perform	0

Activity	Execution of activity	Score points
Dressing	Independently without assistance	10
	With assistance	**5**
	Unable to perform	0
Bathing	independently or with assistance	**5**
	Unable to perform	0
Personal hygiene	independently or with assistance	**5**
	Unable to perform	0
Urinary continence	Fully continent	**10**
	Occasionally incontinent	5
	Permanently incontinent	0
Bowel continence	Fully continent	**10**
	Occasionally incontinent	5
	Permanently incontinent	0
Toilet use	Independently without assisstance	**10**
	With assistance	5
	Unable to perform	0
Transfer from bed-chair	Independently without assistance	**15**
	With little assistance	10
	Able to sit	5
	Unable to perform	0
Walking on flat surfaces	Independently for >50 meters	**15**
	With assistance for 50 meters	10
	On a wheelchair for 50 meters	5
	Unable to perform	0

Activity	Execution of activity	Score points
walking on stairs	Independently without assistance	10
	5	
	With assistance	0
	Unable to perform	

- Proposed guidelines for interpreting the scores are as follows:

0-40 : highly dependent

45-60 : moderate dependence

65-95 : mild dependence

100 : Independent

- The patient scored a total of 85 points, indicating mild dependence in his abilities. While observing, I noticed moments when he was able to perform activities such as eating, dressing, and even tasks not listed previously, like opening doors and picking up objects. However, he relied entirely on his unaffected left upper limb which resulted in inefficient execution of these activities, given that it's his non-dominant limb.

Extended Barthel Index (EBI):

- It helps to assess the need for assistance in managing daily activities, where cognitive abilities are a prerequisite.

1. Understanding

15 = Unimpaired (not including patients who only understand written language).

10 = Understands complex factual content, but not abstract concepts.

5 = Understands simple requests.

0 = Doesn't understand.

2. Communication

15 = Able to express almost everything.

5 = Able to express simple factual content.

0 = Unable or almost unable to express themselves.

3. Social interaction

15 = Unimpaired.

5 = Occasionally uncooperative, aggressive, lacks appropriate distance, withdrawn.

0 = (Almost) uncooperative.

4. Daily problem solving (Planning the course of various actions, adapting to changes, meeting deadlines, accurate medication intake, insight into deficits and their everyday consequences).

15 = Essentially unimpaired.

5 = Requires little assistance.

0 = Requires significant assistance.

5. Memory, learning, and orientation

15 = Essentially unimpaired (no further care requirements).

10 = Requires occasional reminders or the use of external memory aids.

5 = Often needs to be reminded.

0 = Disoriented, tendency to wander off.

6. Vision and neglect syndrome

15 = Essentially unimpaired.

10 = Significant reading disorder, but handles familiar and unfamiliar environments without problems (possibly with aids).

5 = Handles familiar, not unfamiliar environments without problems.

0 = Doesn't handle even familiar environments entirely without problems (e.g., can't find their room or department, overlooks obstacles or people, bumps into them).

• Interpretation:

0-15 : severe cognitive impairment

20-65 : moderate cognitive impairment

70-90 : no limitations or mild cognitive impairment

- The patient scored a total of 80 points, indicating no limitations or mild cognitive impairment.

3.3.10 Muscle length test (according to Janda or Kendall)

Table 9 - Muscle length test (initial examination)

Examined muscle(s)	Author	Grade (right - left)	
Trapezius (upper part)	Janda	2	2
Levator scapulae	Janda	2	2
Sternocleidomastoid	Janda	2	1
Pectoralis major (sternal part)	Kendall	*	Shortness (marked)
Pectoralis major (clavicular part)	Kendall	*	Shortness (moderate)
Pectoralis minor	Kendall	*	Shortness (marked)
Medial shoulder rotators	Kendall	*	Shortenss (marked)
Lateral shoulder rotators	Kendall	*	Normal length
Ilioposoas	Janda	1	1
Rectus femoris	Janda	2	2
Tesnor fasciae latae	Janda	2	1
Piriformis	Janda	0	0
Short hip adductors	Janda	1	1

Examined muscle(s)	Author	Grade (right - left)	
Long hip adductors	Janda	1	1
Hamstrings	Janda	2	1
Gastrocnemius	Janda	1	1
Soleus	Janda	1	1

* The limited mobility and feeling pain while executing the tests are limiting the ability to perform an accurate assessment of the full muscle's test.

• Grades expressed by janda:

Grade 0 - No shortness

Grade 1 - Slight (moderate) shortness

Grade 2- Marked shortness

3.3.11 Measurement of ROM (goniometry; SFTR method)

Table 10 - Goniometry of UEE (°) (initial examination)

	Right		Left	
Joint examined	**Active ROM**	**Passive ROM**	**Active ROM**	**Passive ROM**
Shoulder joint	S: 20-0-45 F: 85-0-0 T: 5-0-50 R: 10-0-60	S: 40-0-110 F: 85-0-0 T: 10-0-70 R: 20-0-75	S: 50-0-170 F: 150-0-0 T: 10-0-130 R: 55-0-70	S: 60-0-175 F: 160-0-0 T: 20-0-130 R: 60-0-80
Elbow joint	S: 0-0-55	S: 0-0-105	S: 0-0-110	S: 0-0-120
Radio-ulnar joint	R: 50-0-70	R: 60-0-80	R: 90-0-90	R: 90-0-90
Wrist joint	S: 35-0-45 F: 5-0-10	S: 65-0-70 F: 10-0-25	S: 60-0-70 F: 15-0-30	S: 70-0-80 F: 20-0-30
MCP joint of index	S: x-45-25	S: 0-0-80	S: 20-0-80 F: 15-0-15	S: 25-0-85 F: 20-0-20

	Right		Left	
Joint examined	**Active ROM**	**Passive ROM**	**Active ROM**	**Passive ROM**
IP1 joint of index	S: x-30-60	S: 0-0-80	S: 0-0-90	S: 0-0-100
IP2 joint of index	S: x-20-35	S: 0-0-70	S: 0-0-80	S: 0-0-80
CMC joint of thumb	X	S: 20-0-40 F: 20-0-20	S: 20-0-40 F: 30-0-20	S: 20-0-45 F: 40-0-30
MCP joint of thumb	S: x-15-25	S: 0-0-50	S: 5-0-60	S: 10-0-70
IP joint of thumb	S: x-30-25	S: 0-0-70	S: 5-0-70	S: 10-0-75

- The clenched position of right hand fingers due to spasticity imposes a barrier in making measurements for the joints of the fingers in which the starting position for measuring Active motions (flexion and extension) in the sagittal plane was not at an angle of zero degrees. Furthermore, Motions in frontal plane (abduction and adduction) couldn't be done.
- CMC joint of thumb was immobile actively.
- The MCP, IP1, IP2 joints for the other fingers resemble the findings for the index finger in which right hand fingers were limited and left hand fingers showed no pathological findings.

Table 11 - Goniometry of LEE (°) (initial examination)

	Right		Left	
Joint examined	**Active ROM**	**Passive ROM**	**Active ROM**	**Passive ROM**
Hip joint	S: 10-0-95 F: 25-0-10 R: 35-0-30	S: 15-0-105 F: 30-0-10 R: 45-0-40	S: 15-0-100 F: 35-0-15 R: 40-0-35	S: 30-0-120 F: 45-0-20 R: 45-0-40
Knee joint	S: 0-0-110	S: 0-0-120	S: 0-0-120	S: 0-0-140

	Right		Left	
Joint examined	**Active ROM**	**Passive ROM**	**Active ROM**	**Passive ROM**
Ankle joint	S: 15-0-40 R: 0-0-10	S: 20-0-45 R: 10-0-25	S: 25-0-45 R: 20-0-35	S: 30-0-50 R: 20-0-40
MTP joint of big toe	S: 30-0-20 F: 10-0-10	S: 35-0-30 F: 15-0-15	S: 35-0-30 F: 15-0-15	S: 40-0-40 F: 20-0-20

- IP joint of big toes along with MTP, IP1 and IP2 joint of other toes showed no pathological findings.
- No signs of Hallux valgus.

3.3.12 Anthropometric measurements (in cm)

Table 12 - Anthropometric length of LEE (cm) (initial examination)

Length-Lower extremity	Right	Left
Anatomical	90	91
Functional (from ASIS)	92	93
Thigh	45	45
Middle leg	42	42
Foot	28	28

Table 13 - Anthropometric circumference of LEE (cm) (initial examination)

Circumference-lower extremity	Right	Left
Thigh (15 cm above patella)	53	53
Thigh (10 cm above patella)	48	50
Knee joint	43	43
Tibial tuberosity	38	38

Circumference-lower extremity	Right	Left
Calf	40	38
Ankle joint	27	25
Heel	32	30
Foot	23	22

Table 14 - Anthropometric length of UEE (cm) (initial examination)

Length-Upper extremity	Right	Left
Whole upper extremity	*	84
Humerus	38	38
Forearm	28	28
Hand	*	21

* These measurements were not done because the patient couldn't open his hand fully.

Table 12 - Anthropometric circumference of UEE (cm) (initial examination)

Circumference-Upper extremity	Right	Left
Upper arm (relaxed)	31	34
Upper arm (maximal isometric contraction)	31	36
Elbow joint	30	30
Forearm	28	29
Wrist	18	18
Metacarpal heads	21	21

3.3.13 Joint play examination (according to Lewit)

- During the examination of joint play on the right side, great care was taken to prevent any potential spastic response or discomfort in the patient. Pathological barriers were noted in some joints of upper extremity, including the IP, and MCP joints of all fingers in all directions, as well as the wrist, and elbow. In the lower extremity, limitations were observed in the ankle joint, lisfranc's joint, and chopart's joint.
- On the left side of the body, a blockage was specifically observed in the SI joint, affecting both the upper and lower segments.

3.3.14 Reflex changes (according to Lewit)

Skin:

- Psoriatic changes were observed in specific regions of the patient's body, notably the elbows, shins, heels, and around the medial malleolus. In these areas, the skin exhibited increased warmth and heightened sensitivity, making it more tense and susceptible to discomfort upon contact.
- No abnormalities were detected in other areas of the body.

Subcutaneous tissue:

- Examining with kibler's fold along the spine indicated heightened tension, particularly in the thoracic region, where the fold was challenging to grasp. Nevertheless, the examination was conducted without inducing any pain.
- Kibler's fold was easily graspable and movable on the extremities and the chest with no pain as well.

Fascia:

- It was noted that there was restricted movement bilaterally in deep lumbar fascia caudally and in dorsal fascia cranially. Additionally, limited mobility was observed in the fascia of arm and forearm of the right upper limb.

Muscles:

- Upon palpation, it appeared that the biceps brachii of the right upper limb exhibited hypotonicity. Bilateral hypertonicity was observed in the upper part of the trapezius muscle, along with the indentation of multiple trigger points along its muscle fibers. Additionally, trigger points were noted bilaterally in the levator scapulae mucle.
- Concerning the lower extremities, bilateral hypertonicity was noted in the gastrocnemius and ischiocrural muscles. The quadriceps femoris showed hypertonicity on the left side with identified trigger points. Additionally, bilateral hypotonicity was noted in the gluteal and abdominal muscles.

Periosteal points:

- Tenderness was observed on the periosteal point located over the superior border of the left patella.

3.3.15 Conclusion of initial kinesiological examination

In October 2021, the patient had a hypertensive ICH in the left BG, resulting in right-sided spastic hemiparesis and dysarthria. Subsequently, an ischemic stroke in the same area led to hospitalization from July to August 2022, followed by ongoing rehabilitation. Despite therapy, complications persisted due to the right-sided spastic hemiparesis. Seeking additional rehabilitation support, the patient returned to "Kladno Hospital" in January 2023, expressing dissatisfaction, particularly regarding the functionality of the right upper limb.

The patient showed various neurological signs. Higher cognitive functions were intact, but there was slower memory retrieval and mild dysarthria. Cranial nerve examination revealed slight facial asymmetries and reduced strength in specific muscle groups. Sensory tests showed physiological responses in superficial and deep sensation. Deep tendon reflexes varied between limbs, with hyperreflexia on the right and normal reflexes on the left. Due to limited mobility in the right upper limb, evaluating paretic signs was challenging, but movement indicated pronounced weakness and reduced control on the right side, while the left side showed no significant issues. Spastic signs

were present in the right upper limb, while the lower extremities were unaffected bilaterally. These findings indicate deficits primarily on the right side, consistent with a left-sided brain stroke. Evaluation of cerebellar function and strength on the right side was hindered, with no observable deficits on the left.

The examinations highlighted various challenges. The postural assessment identified differences in weight distribution and alignment between sides, noting anomalies in pelvic tilt, head posture, and muscle variations. Limited range of motion notably impacted balance, particularly on the right side, evident through imbalances on scales and difficulty with specific standing positions. The patient also faced challenges with single-leg standing, emphasizing balance difficulties and limited weight-bearing capacity. Additionally, the gait examination revealed numerous walking difficulties, including asymmetrical movements, altered rhythm, reduced mobility, and signs of fatigue. The patient exhibited a Wernicke-Mann position, a narrow base, outward foot rotation, longer weight-bearing on the left side, and irregular step timing, with shorter steps accentuating asymmetry. This hemiplegic gait affected heel strike and toe-off in the right leg, leading to challenges in changing direction and requiring assistance on stairs, indicating significant stability issues.

The patient demonstrates varying degrees of right-sided spasticity, impacting motor function and movement. This condition also reveals motor control issues, abnormal breathing patterns, and compromised deep stabilization, particularly on the right side, noted by limited chest expansion and intra-abdominal pressure. Assessing muscle length posed challenges due to limited mobility and spasticity, resulting in increased resistance during stretching. Clear differences in range of motion, especially in the right upper limb, were noticeable. The spasticity-induced clenched fingers affected joint measurements, impairing motions in the sagittal and frontal planes, notably in the thumb and fingers. Additionally, restricted joint play was observed in specific hand and wrist joints, while limited mobility in the left SI joint was also noted.

The patient shows reflex changes in specific body regions affected by psoriatic alterations, leading to increased warmth, sensitivity, and discomfort in areas like elbows, shins, heels, and around the medial malleolus. Skin issues are confined to these regions, while notable subcutaneous tension is evident along the spine, especially in the

thoracic area. Limited mobility is observed in multiple fascial areas, including the deep lumbar fascia bilaterally and the arm and forearm fascia on the right side. Muscle assessments highlight hypotonicity in the right biceps brachii and bilateral hypertonicity in muscles like upper trapezius, levator scapulae, gastrocnemius, and ischiocrural muscles, with identified trigger points. Tenderness is also noted at the periosteal point over the left patella.

The patient shows mild to moderate mobility impairment based on the TUG test. Scoring 85 points on the Barthel Index indicates mild dependence in daily activities, with challenges stemming from relying on the unaffected left upper limb, causing inefficiencies. However, the Extended Barthel Index indicates no or only mild cognitive impairment. Though the patient can manage daily activities, improving motor skills and reducing reliance on the unaffected limb could significantly enhance independence and task efficiency.

3.4 Short-term and long-term physiotherapy plan

3.4.1 Short-term physiotherapy goals

- Reduce spasticity.
- Improve ROM.
- Enhance balance and stability.
- Improve breathing pattern.
- Optimize gait pattern.
- Improve motor control.
- Stretch shortened muscles.
- Improve movement patterns.
- Restore restricted joint play.
- Reduce tone hypertonic muscles.
- Improve the condition of connective tissues.
- Promote independence in ADLs.

3.4.2 Short-term therapy plan

- Passive stretching.
- AROM exercises.
- Balance and stability training.
- Breathing exercises.
- Gait training.
- Motor control training.
- Neuromuscular re-education, using techniques like PNF, SMS, PIR, and PIR with stretching.
- Mobilization of joints.
- Soft tissue techniques.

3.4.3 Long-term physiotherapy goals

- Improve physical fitness.
- Functional independence.
- Improve postural anomalies and asymmetries.
- Enhance fine motor skills.
- Maintain achieved ROM and potentially further improve it.

3.4.4 Long-term therapy plan

- Breathing exercises.
- Postural correction.
- Utilize therapies and techniques mentioned in short-term plan.
- Patient education and home exercises.

3.4.5 Course of therapy

The patient was admitted to the rehabilitation department at “Kladno Hospital” from January 23rd, 2023, until February 8th, 2023. Throughout this period, the patient received individualized physiotherapy sessions in the outpatient therapy room, conducted twice daily and lasting approximately 30 to 45 minutes per session. When I started overseeing the patient was responsible for leading these sessions under the guidance of my supervisor. I led a single session each day, either in the morning or

afternoon, typically lasting for 1 hour, However, the duration occasionally extended, especially when the session involved both therapy and examinations, depending on its nature.

Throughout the stay, the patient was receiving botulinum toxin (BTX) injections. The patient also participated in speech therapy sessions to address dysarthria, along with focused occupational therapy sessions aimed at improving the functionality of the right upper limb. The therapeutic objectives included reducing spasticity and enhancing fine motor skills.

3.5 Daily record of therapy progress

3.5.1 Therapeutic unit 1

Date: 26.01.2023

Current status

Subj:

- The patient feels generally well but reports stiffness and reduced movement on the right side.

Obj:

- He demonstrated cooperation and independently transitioned from his room to the outpatient therapy area but exhibited signs of and breathlessness upon arrival.
- He maintained orientation in terms of time, place, and personal awareness.
- Limited range of motion in the right side of body was observed along with noticeable spasticity and reduced strength.

Aim of today's therapy:

- Conduct a comprehensive anamnesis and commence the initial kinesiological examination.
- Introducing the patient with the rehabilitation plan.
- Address the discomfort in the right UE through:
- Reduction of spasticity to enhance flexibility and decrease muscle tone, focusing on affected muscles.

- Alleviate restrictions in the fascia of the upper arm and forearm.

Therapy proposed:

- Gather the patient's medical history and perform the examinations pertinent to the case.
- Clarify the rehabilitation plan to the patient.
- Implement passive stretching aimed at spastic muscles of the right UE (shoulder adductors, biceps brachii, triceps brachii, forearm supinators, forearm pronators, wrist flexors, and finger flexors).
- Apply soft tissue manipulation and myofascial release techniques on right UE.

Therapy performed:

- The session began with a detailed interview with the patient to collect medical history. Due to a language barrier, my supervisor assisted in the interview. Additionally, the supervisor provided further details about the patient's current condition, history, and initial findings documented upon arrival at the rehabilitation department. Moreover, the patient was informed of my active involvement in overseeing and managing their case during therapy sessions in the outpatient area.
- I started assessing the patient by carrying out neurological examination , posture examination , gait examination and assessment of spasticity.
- I Engaged in passive stretching for the affected muscles for about 15-20 minutes. The approach emphasized slow, sustained stretches, each held for 20-30 seconds, with gentle pressure to elongate the muscles without inducing discomfort.
- I Initiated releasing the fascia with soft tissue manipulation, employing circular motions to gradually warm up the affected area and relax the muscles. I Increased pressure gradually, considering the patient's tolerance level. Following this, conducted myofascial release to address restricted fascia in the upper arm and forearm using a direct technique. Applied sustained pressure to the affected areas for a few minutes, gradually releasing to promote relaxation. Throughout, I also tried to gently increase pressure as tolerated by the patient.

Self therapy and regimen measures:

- The patient was instructed on self-massage techniques for the affected muscles and fascia. The regimen included gentle circular motions on the upper arm and forearm, focusing on the areas of restricted fascia. Emphasized slow, sustained pressure during self-massage, with the patient encouraged to perform these techniques daily for 10-15 minutes.

Evaluation of therapy's effect:

Subj:

- Following the session, the patient reported a slight reduction in discomfort and muscle tension in the right upper limb.
- The patient expressed satisfaction with the therapy provided and appeared receptive to the self-therapy instructions provided.

Obj:

- All aspects of the medical history were thoroughly addressed during this session.
- Due to the exhaustive nature of assessments and the patient experiencing slight fatigue and discomfort in the right upper limb, the remaining assessments were postponed to the following day. However, The fatigue and discomfort experienced appeared to dissipate gradually during the session.
- Slight relaxation observed in the treated areas.
- Minimal reduction in spasticity levels perceived in the right UE.
- Minimal reduction in muscle tension and improved tissue mobility resulting in decreased discomfort with the affected right UE.

3.5.2 Therapeutic unit 2

Date: 27.01.2023

Current status

Subj:

- The patient expressed slight fatigue but noted reduced stiffness in the right UE compared with the previous day.

Obj:

- The patient was still cooperative, able to independently navigate to the outpatient therapy area, and remained well oriented.
- Signs of fatigue and breathlessness still persist upon arrival to the outpatient therapy area.
- Still limited ROM, noticeable spasticity, and reduced strength in the right UE persisted.

Aim of today's therapy:

- Complete the initial kinesiological examination.
- Continue reducing spasticity in right UE and initiate reduction of spasticity in the right LE.
- Persist in alleviating restrictions in the fascia of the upper arm and forearm of the right UE.
- Enhance activation of deep stabilization system for improved trunk stability and intra-abdominal pressure generation.

Therapy proposed:

- Proceed with the remaining examinations and assessments required to finish the kinesiological examination.
- Apply passive stretching to the previously mentioned spastic muscles of the right UE and also address muscles of the right LE (hip adductors, hamstrings, quadriceps, gastrocnemius, and soleus)
- Apply soft tissue manipulation and myofascial release techniques on right UE.
- Core strengthening along with breathing and diaphragm activation.

Therapy performed

- I resumed the initial kinesiological examination, assessing movement stereotypes , breathing stereotype, muscle length, the deep stabilization system and the timed up and go test. Other examinations including measurement of ROM, anthropometric measurements, joint play examination, and reflex changes, were completed later in the afternoon on the same day.

- I Engaged in passive stretching for the affected muscles for about 15-20 minutes. The approach emphasized slow, sustained stretches, each held for 20-30 seconds, with gentle pressure to elongate the muscles without inducing discomfort.
- I Initiated releasing the fascia with soft tissue manipulation, employing circular motions to gradually warm up the affected area and relax the muscles. I Increased pressure gradually, considering the patient's tolerance level. Following this, conducted myofascial release to address restricted fascia in the upper arm and forearm using a direct technique. Applied sustained pressure to the affected areas for a few minutes, gradually releasing to promote relaxation. Throughout, I also tried to gently increase pressure as tolerated by the patient.
- Core activation breathing exercise:
  - The patient is in supine position.
  - Patient is instructed to perform diaphragmatic breathing focusing on deep inhalation and complete exhalation.
  - I Remind the patient to engage the deep core muscles (transverse abdominis) by drawing the navel navel towards the spine during exhalation.
  - Repeat for several breath cycles , patient was able to perform 5 breath cycles , each cycle is around 5-10 seconds for inhalation and exhalation, totaling for 10-20 seconds per cycle.
  - The patient did a total of 2 sets.
- Ball squeezes exercise:
  - The patient is in supine position with knees bent and feet flat on the therapeutic bed.
  - I placed a small soft ball between the inner thighs of the patient.
  - Patient was guided to gently squeeze the ball using the inner thigh muscles, engaging the deep stabilizing muscles around the pelvis.
  - Patient was able to do 10 squeezes holding each squeeze for 3-5 seconds.
  - He did a total of 2 sets.

Self therapy and regimen measures:

- I instructed the patient to perform the exercises done in the session for 5-10 minutes daily whenever they feel able to.

- Additionally, I reminded them to continue practicing the self-massage techniques taught in the previous session.

Evaluation of therapy's effect:

Subj:

- The patient didn't experience any pain but he felt slight discomfort during passive stretching of gastrocnemius and soleus muscles.
- He expressed satisfaction with the therapy provided and appeared receptive to the self-therapy instructions provided.

Obj:

- The initial kinesiological examination was completed successfully. To prevent patient fatigue and considering time constraints, I conducted some examinations during the session. I then allowed the patient a brief break before commencing therapy. The remaining examinations were carried out in the afternoon.
- During passive stretching of the gastrocnemius and soleus muscles, the patient experienced increased resistance and discomfort. I adjusted the intensity accordingly to avoid further discomfort.
- Minimal reduction in spasticity levels perceived in the right UE and LE.
- Minimal reduction in muscle tension and improved tissue mobility for right UE.
- For the exercises (core activation breathing, and ball squeezes), I initiated with manageable difficulty, focusing on fewer reps, sets, and shorter durations based on the patient's ability and tolerance. Adequate rest periods between sets (approximately 30-60 seconds) were ensured to prevent fatigue. The patient managed the exercises without any issues. Notably, I emphasized the quality of movement and engagement over quantity initially. Gradually with progress, i will be increasing reps, sets, or hold durations based on the patient's tolerance and improvement.

3.5.3 Therapeutic unit 3

Date: 30.01.2023

Current status

Subj:.

- No complaints reported by the patient.
- Feels well rested after the weekend.
- Continues to note progress in reducing stiffness in the right UE.

Obj:

- Same as previous day; well-oriented and independently navigating to the outpatient therapy area.
- Signs of fatigue and breathlessness still persist upon arrival to the outpatient therapy area.
- At the beginning of the session, I conducted a brief neurological examination and made a new observation: the spastic signs in the right UE were no longer positive as they were during the initial assessment. They all tested negative (Juster, Tromner, Hoffman).

Aim of today's therapy:

- Continue reducing spasticity in the right UE and LE.
- Persist in alleviating restrictions in the fascia of the upper arm and forearm of the right UE.
- Sustain efforts in enhancing activation of the deep stabilization system.
- Address breathing pattern concerns by facilitating improved chest expansion, enhancing ribcage mobility, and managing breathlessness during physical activity.

Therapy proposed:

- Apply passive stretches to the spastic muscles of the right UE and LE.
- Perform soft tissue manipulation and myofascial release techniques on the right UE. Introduce shifting (stretching) of deep fascia according toWard.
- Incorporate core strengthening exercises alongside breathing and diaphragm activation.
- Manual cueing for chest expansion, and Diaphragmatic Breathing with Leg Lifts.

Therapy performed:

- Performed passive stretching for the affected muscles following the same protocol as the previous day.
- Continued releasing the fascia using the same approach as before. Additionally, initiated soft tissue rotation along a longitudinal axis, employing a wringing movement once the pathological barrier was reached, with both hands moving in opposite directions.
- The patient repeated the two exercises from the previous day following the same protocol (core activation breathing, and ball squeezes).
- Additionally, the patient performed a new exercise, the pelvic tilt with bridge exercise:

- The patient is supine position with knees bent and feet flat on the therapeutic bed
- The patient is guided to perform pelvic tilts by gently pressing the lower back into the therapeutic bed while engaging the abdominal muscles. He did 10 pelvic tilts
- Progress to a bridge exercise where the patient lifts their hips off the ground, focusing on engaging the glutes and core. Hold the bridge briefly, then lower the hips back down. He did 5 bridge lifts while the holding the position for 3-5 seconds.
- He did a total of 2 sets

- Manual cueing for chest expansion

- The patient is in sitting position and I standing facing him maintaining eye contact to provide guidance.
- I placed my hands gently on his lower and upper chest during breathing, my hands were positioned lightly top provide tactile cue without restricting the movement.
- I started giving instructions, asking him to take slow, deep breaths, focusing on expanding the lower and then the upper chest against the resistance offered by my hands. I emphasized inhaling deeply and exhaling completely, encouraging a full breath cycle.
- I was giving visual and verbal cues, by showing him how to expand the chest by lifting my hands as he inhales and gradually lower them as he exhales. Also verbally encouraging him to use their chest to breath, reminding him to expand the area where my hands are placed.
- The patient did a total of 5 breath cycles.

- Diaphragmatic breathing with Leg Lifts:

- The patient is in sitting position.
- I instructed the practice diaphragmatic breathing: Inhale deeply through your nose, allowing your abdomen to expand, and exhale fully through your mouth.
- While maintaining the breathing rhythm, I asked him to add leg movements: Inhale as you slowly lift one leg off the ground, keeping the knee bent if needed. Exhale as you slowly lower the leg back down. Sync your leg movements with your breathing, lift the leg during inhalation and lower it during exhalation.
- He alternated between legs and repeated for several breath cycles.
- The patient a total of 7 breath cycles.

Self therapy and regimen measures:

- the patient was reminded to adhere to the self-therapy protocol provided in previous sessions.
- He was instructed to include the pelvic tilt with bridge exercise
- He was asked to practice the diaphragmatic breathing as much as he can during simple daily tasks or functional movements, keeping in mind to inhale before initiating the movement and exhale during the movement or exertion.

Evaluation of therapy's effect:

Subj:

- The patient didn't report any pain or complaints during therapy.

Obj:

- Progress in reducing spasticity levels in right UE and LE, along with reduced muscle tension improved tissue mobility for the right UE, is ongoing.
- The patient successfully completed the newly added exercises and techniques. However, while performing both Manual Cueing for Chest Expansion and Diaphragmatic Breathing with Leg Lifts, he encountered difficulty maintaining an upright posture.

- I continued keeping a manageable difficulty, focusing on fewer reps, sets, and shorter durations based on the patient's ability and tolerance. Adequate rest periods between sets (approximately 30-60 seconds) were provided to prevent fatigue.

3.5.4 Therapeutic unit 4

Date: 31.01.2023

Current status:

Subj:

- Patient reports no complaints.
- Continues to exhibit progress in reducing stiffness in the right upper extremity.
- Additionally, the patient has begun to experience increased flexibility in the right lower extremity while walking and diminished stiffness in the calf.

Obj:

- Status remains consistent with the previous day; the patient is well-oriented and independently moves to the outpatient therapy area.
- Notably, today he patient displayed higher energy levels compared to previous days. There was an absence of fatigue signs and reduced breathlessness upon arrival at the outpatient therapy area.
- My supervisor assessed spasticity and observed reduced levels in most affected muscles, except for the forearm supinators, and finger flexors where spasticity remained unchanged.

Aim of today's therapy:

- Address joints exhibiting restricted joint play.
- Prioritize reducing stiffness in the spastic muscles that showed no change.
- Address hypertonic muscles and trigger points for release.
- Improve flexibility of shorted muscles.
- Enhance gait stability and efficiency by addressing gait irregularities, improving force and control on the right side.

Therapy proposed:

- Mobilization according to Lewit applied to the right upper extremity, encompassing the IP and MCP joints of all fingers, as well as the wrist, and elbow. On the right lower extremity, focus on the Lisfranc and Chopart joints. And SI joint on the left side.
- Post isometric relaxation (PIR) according to Lewit for right supinator, right finger flexors and upper part of trapezius bilaterally.
- PIR with stretching (janda's stretching) for upper part of trapezius bilaterally.
- Proprioceptive Neuromuscular Facilitation (PNF) according to kabat using a relaxation technique for the upper extremities.
- Gait training and balance exercises, as well as corrective gait techniques.

Therapy performed:

- Wrist IP, and MCP joint mobilization:
  - The patient was seated, with the hand supported on the therapeutic table.
  - Mobilization involved distraction, engagement of the pathological barrier, and repetitive springing.
  - This procedure was done in all directions: dorsal, palmar, laterolateral, and rotation for IP and MCP joints. For the wrist, mobilization involved dorsal, palmar, radial, and ulnar abduction.
- Elbow mobilization:
  - Multiple techniques were utilized.
  - While the patient was in a supine position, distraction and lateral gapping were applied. In a seated position, shaking mobilization was performed.
- lisfranc's and chopart's joint mobilization:
  - The patient is lying down in supine with his heel at edge of therapeutic table , while I was standing medially to his foot.
  - Mobilization comprised distraction, engagement of the pathological barrier, and repetitive springing in a dorsal direction.
- SI joint mobilization (upper and lower parts):
  - Patient is in side-lying position.
  - I sat below the hip level for the upper part and above the hip level for the lower part.

- Mobilization involved repetitive springing.

• PIR of right supinator muscle

- The patient is sitting down with his elbow flexed at a right angle. His forearm was taken into pronation to take up the slack then I instructed him to exert minimal force in the direction of supination for 5-10 seconds and then release. This process was repeated from the newly achieved position, and the cycle was completed 3 times.

• PIR of right finger flexors

- The patient is sitting down, his hand is taken into dorsiflexion and pronation to take up the slack , he resists minimal force toward flexion and supination for 5-10 seconds and then release. This process was repeated from the newly achieved position, and the cycle was completed 3 times.

• PIR of upper part of trapezius muscle (bilaterally) followed by PIR with stretching

- While the patient lay supine, I stabilized their shoulder from above and gently guided the head and neck to one side, asking the patient to look in that direction while breathing in, holding, releasing, and exhaling. Gradually, I increased the side-bending motion, repeating the process 3 times.
- The patient remained in a supine position, taking a brief rest. Following this, I applied PIR with stretching. I used the same instructions as before but with increased resistance and followed it with a more vigorous side-bending motion.

• Execute PNF Contraction-Relaxation technique across all diagonals for both upper limbs, including flexion (I. and II.) and extension (I. and II.).

- Passively move the agonist muscle into a restricted position.
- Isometrically contract the antagonist muscle (the muscle opposing the one being stretched) against resistance.
- Relax the antagonist muscle.
- Passively move the agonist muscle further into the stretch.

• Weight transfer and weight-bearing progression:

- I instructed the patient to stand with feet hip-width apart ensuring a comfortable and stable stance. He was standing in front of the wall ladder for support and safety.
- The asked him to shift his weight from the unaffected side to the affected side and back. Focusing on a slow, controlled movement while maintaining balance.

- Once he was comfortable with weight shifting, I asked him to progress to take controlled steps while ensuring proper weight-bearing on the affected limb during each step and concentrating on maintaining balance and stability throughout the movement.
- While performing controlled steps , I was focusing on improving heel strike , toe-off, and also toe-out gait correction.
- The patient did a total of 3 sets of 10 weight shifts (side to side).
- He also did 10 steps, focusing on weight-bearing on the affected limb.

• Balance and stability drills

- I instructed the patient to stand with one foot in front of the other in a straight line (tandem stance). Again standing in front of the wall ladder for support and safety.
- I was assisting in maintaining balance and stability, and gradually reducing assistance as the patient improves.
- Afterwards, he performed tandem stance on a balance pad , so that the unstable surface will challenge his proprioception and improve control.
- He did a total of 3 sets of 30 seconds in tandem stance.
- He did a total of 2 sets of 10 reps using the balance pad.

Self therapy and regimen measures:

• the patient was reminded to adhere to the self-therapy protocol provided in previous sessions.

• The patient was taught about the self treatment PIR technique for the supinator muscle and finger flexors.

Evaluation of therapy's effect:

Subj:

• The patient expressed satisfaction with experiencing relief in his right UE.

• No pain was reported, but he mentioned slight discomfort in his right UE when I commenced PNF exercises.

• He felt fatigued after completing the balance and stability drills.

Obj:

- Noticeable enhancement in mobility for both the right UE and LE.
- Explaining the necessity of using minimal force during PIR was initially challenging for the patient. However, with guidance from my supervisor, the patient gradually adapted and provided the required force more easily.
- While conducting PNF, encountering difficulty in executing smooth movements on the right upper extremity due to triggered spasticity was notable. My supervisor demonstrated modifications that improved the execution of the technique such as starting with smaller movements within the patient's comfortable range, gentle progression, and slow controlled movements.

3.3.5 Therapeutic unit 5

Date: 01.02.2023

Current status

Subj:

- At the session's onset, the patient felt generally okay.
- However, The patient expressed discomfort in his right upper extremity, particularly around the shoulder area, which disrupted his sleep, resulting in poor rest during the early morning hours.

Obj:

- Status remains consistent with the previous session; the patient is well-oriented and independently moves to the outpatient therapy area.
- While observing the patient walk, improvements were noted. There was better stability and reduced pelvic and trunk asymmetry compared to the initial assessment. However, reduced force and control during heel strike and toe-off persist, noticeable toe-out gait, and diminished arm swinging.

Aim of today's therapy:

- Sustain efforts in enhancing activation of deep stabilization system.
- Address joints exhibiting restricted joint play.
- Continue reducing stiffness in spastic muscles.
- Address hypertonic muscles and trigger points for release.

- Improve flexibility of shorted muscles.
- Enhance gait stability and efficiency by addressing gait irregularities, improving force and control on the right side.

Therapy proposed:

- Incorporate core strengthening exercises alongside breathing and diaphragm activation.
- Mobilization according to Lewit applied to the right upper extremity, encompassing the IP and MCP joints of all fingers, as well as the wrist, and elbow. On the right lower extremity, focus on the Lisfranc and Chopart joints. And SI joint on the left side.
- Post isometric relaxation (PIR) according to Lewit for right supinator, right finger flexors and upper part of trapezius bilaterally.
- PIR with stretching (janda's stretching) for upper part of trapezius bilaterally.
- Proprioceptive Neuromuscular Facilitation (PNF) according to kabat using a relaxation technique for both the upper extremities and lower extremities.
- Gait training and balance exercises, as well as corrective gait techniques.
- Sensory motor stimulation (SMS) according to Janda and Vávrová.

Therapy performed:

- Ball squeezes exercise:
  - Same protocol previously performed.
  - Patient was able to do 15 squeezes holding for about 10 seconds.
  - He did a total of 3 sets.
- Pelvic tilt with bridge exercise
  - Same protocol previously performed.
  - Patient was able to do 8 bridge lifts holding for about 7 seconds.
  - He did a total of 3 sets.
- Wrist IP, and MCP joint mobilization
- Elbow mobilization
- Lisfranc's and chopart's mobilization

- PIR of right supinator muscle
- PIR of right finger flexors
- PIR of upper part of trapezius muscle (bilaterally) followed by PIR with stretching
- Execute PNF Contraction-Relaxation technique across all diagonals for both upper limbs, including flexion (I. and II.) and extension (I. and II.).
- Execute PNF Contraction-Relaxation technique across all diagonals for both lower limbs, including flexion (I. and II.) and extension (I. and II.).
- Weight transfer and weight-bearing progression:
- Sensory motor stimulation method:

- The patient was instructed to enhance stability while standing by practicing forward and backward half steps. The emphasis was on executing proper foot roll. This involved alternately stepping with one lower limb onto a balance pad while using support from both upper limbs on the wall ladder, holding an isometric position for 2 seconds in the final stance.
- He did it 5 times for a total of 2 sets.

Self therapy and regimen measures:

- Nothing new added, patient was reminded to adhere to the self-therapy protocol provided in previous sessions.

Evaluation of therapy's effect:

Subj:

- He experienced relief after stretching his trapezius
- He encountered difficulty performing the SMS method.

Obj:

- During the SMS method, the physical demand wasn't an issue for the patient like how it was with balance and stability drills previously. However, achieving precise execution, especially in foot rolling, posed a challenge.
- The patient showed improved performance in ball squeezes and pelvic tilt with bridge exercises, demonstrating longer holding positions, increased repetitions, and sets.

3.5.6 Therapeutic unit 6

Date: 03.02.2023

Current status

Subj:

- The patient did not report any pain or discomfort at beginning of the current session.
- Yesterday, he experienced fatigue due to inadequate sleep and felt mentally unwell, particularly in the morning. Consequently, he did not attend any outpatient therapy sessions. However, he underwent an occupational therapy session later in the day when he started feeling somewhat improved.

Obj:

- Due to the patient's condition yesterday, I didn't conduct a session with him.
- Status remains consistent with the previous session; the patient is well-oriented and independently moves to the outpatient therapy area.
- Today, similar to the previous session, I continue to observe improvements in his gait. Additionally, there was a slight enhancement noted during heel and toe-off.
- Improved range of motion was evident in his right extremities.

Aim of today's therapy:

- Sustain efforts in enhancing activation of deep stabilization system.
- Facilitate movement and muscle activation in right UE.
- To improve strength, coordination, and function of the right UE and LE.
- Enhance force and control on the right LE.

Therapy proposed:

- Proprioceptive Neuromuscular Facilitation (PNF) according to kabat with facilitation mechanism.
- Proprioceptive Neuromuscular Facilitation (PNF) using a strengthening technique.
- Dynamic neuromuscular facilitation (DNS) according to Kolář.
- Sensory motor stimulation (SMS) according to Janda and Vávrová.

Therapy performed:

- PNF with facilitation mechanism in I. flexion and I. Extension diagonals:
  - The patient is lying in a supine position.
  - Diagonal movement was performed with a limited range of motion to prevent triggering spasticity.
  - I offered gentle manual assistance to guide his arm through the restricted range of motion.
- PNF with repeated contraction technique , for right UE and LE (I. flexion and I. Extension diagonals):
  - Identify the movement exhibiting weakness.
  - Initiate with isotonic contraction against resistance.
  - Perform isometric contractions, beginning distally and progressing proximally.
  - Apply heightened resistance at the specific point where weakness is observed
  - Continue isotonic contractions, maintaining consistent resistance throughout the entire movement sequence.
  - I started with minimal resistance that the patient can comfortably manage especially for the UE.
  - Moreover, for the UE the movement was broken down into smaller segments.
- DNS in 5th month position:
  - The patient is lying on their side.
  - The hips and knees are slightly bent.
  - The technique was adjusted to manage the spasticity in the right upper extremity by offering sufficient support and avoiding positions that worsen spasticity or induce discomfort in the affected limb.
  - Ensure alignment of the head, neck, and trunk in a neutral position.
  - Then finally I encouraged the patient to do diaphragmatic breathing.
  - It was done when lying down on both sides.
- Sensory motor stimulation method:
  - Same method as previous therapy session
  - The patient was able to hold an isometric position for 5 seconds in the final stance. And also did a total 2 sets.

Self therapy and regimen measures:

- Nothing new added, patient was reminded to adhere to the self-therapy protocol provided in previous sessions.

Evaluation of therapy's effect:

Subj:

- He remained comfortable throughout the entire session.
- No issues or pain were reported.

Obj:

- The patient was fully cooperative.
- My supervisor provided guidance on modifying my technique during PNF and DNS execution, preventing the triggering of spasticity and ensuring the patient's comfort.

3.5.7 Therapeutic unit 7

Date: 06.02.2023

Current status:

Subj:

- The patient is feeling good and experienced an improvement over the weekend.
- He had a restful night's sleep without any discomfort in his right upper extremity.

Obj:

- Status remains consistent with the previous session; the patient is well-oriented and independently moves to the outpatient therapy area.
- Continued significant improvements are observed in the gait and range of motion of the right extremities.
- There's notable increased confidence in utilizing his right upper extremity, particularly evident when supporting himself while getting out of bed and rising onto the therapeutic table.

Aim of today's therapy:

- Facilitate movement and muscle activation in right UE.
- To improve strength, coordination, and function of the right UE and LE.

- Enhance force and control on the right LE.
- Sustain efforts in enhancing activation of deep stabilization system.

Therapy proposed:

- Proprioceptive Neuromuscular Facilitation (PNF) according to kabat with facilitation mechanism.
- Proprioceptive Neuromuscular Facilitation (PNF) using a strengthening technique.
- Dynamic neuromuscular facilitation (DNS) according to Kolář.
- Sensory motor stimulation (SMS) according to Janda and Vávrová.

Therapy performed:

- PNF with facilitation mechanism in I. flexion and I. Extension diagonals.
- PNF with repeated contraction technique , for right UE and LE (I. flexion and I. Extension diagonals)
- DNS in 5th month position:
  - Same protocol as previous session
- Sensory motor stimulation method:
  - Same protocol as previous session

Self therapy and regimen measures:

- Nothing new added, patient was reminded to adhere to the self-therapy protocol provided in previous sessions.

Evaluation of therapy's effect:

Subj:

- Patient remained comfortable during the whole session.

Obj:

- He was fully cooperative.
- He displayed enhanced flexibility in his extremities during therapy, notably evident during PNF techniques.
- Additionally, improved core activation was observed during DNS.

3.5.8 Therapeutic unit 8

Date: 07.02.2023

Current status:

Subj:

- Much like yesterday, he feels good and well-rested.

Obj:

- Status remains consistent with the previous session; the patient is well-oriented and independently moves to the outpatient therapy area.
- I can still see notable increased confidence in utilizing his right upper extremity.

Aim of today's therapy:

- Conduct the final kinesiological examination.
- Facilitate movement and muscle activation in right UE.
- To improve strength, coordination, and function of the right UE and LE.
- Sustain efforts in enhancing activation of deep stabilization system.

Therapy proposed:

- Reassess the evaluations conducted during the initial kinesiological examination.
- Proprioceptive Neuromuscular Facilitation (PNF) according to kabat with facilitation mechanism.
- Proprioceptive Neuromuscular Facilitation (PNF) using a strengthening technique.
- Dynamic neuromuscular facilitation (DNS) according to Kolář.

Therapy performed:

- I began reassessing the evaluations conducted during the initial kinesiological examination to document any new findings following the therapy sessions. This process was split into two parts: some assessments were completed during the current session, and I later resumed with the patient in the afternoon to conclude the remaining examinations.
- PNF with facilitation mechanism in I. flexion and I. Extension diagonals.

- PNF with repeated contraction technique , for right UE and LE (I. flexion and I. Extension diagonals)
- DNS in 5th month position:
- Same protocol as previous session

Self therapy and regimen measures:

- Patient was reminded to adhere to the self-therapy protocol provided in previous sessions.

Evaluation of therapy's effect:

subj:

- He expressed satisfaction with the therapy provided and appeared receptive to the self-therapy instructions provided.

Obj:

- The final kinesiological assessments were successfully conducted on this day. However, due to time constraints and the need to incorporate therapy during the current session, the assessments were finalized later in the afternoon.
- Overall, the patient's condition showed improvement, which was observed during the reassessment.
- This marks my final therapy session with the patient. He will be discharged from the hospital the following day and will be picked up by a family member.

3.6 Final kinesiological examination

Conducted on 07.02.2023.

3.6.1 Neurological examination

Higher functions

- The patient is well oriented; the cognitive sense of his status in time, place and person are not affected.

- The patient has slower memory retrieval (delayed recall) , especially in recalling recent events.
- Signs of mild dysarthria are still present, the patient has imprecise pronunciation of sounds leading to distorted or mumbled speech.

3.6.2 Examination of the cranial nerves

I. Olfactory nerve: intact; patient is able smell different odors.
II. Optic nerve: intact; visual field and visual acuity tests showed no abnormal results.
III. Oculomotor nerve: intact; normal papillary reactions to light and accommodation as wells as no pathological findings for extra-ocular movements (which was tested along with IV and VI cranial nerves).
IV. Trochlear nerve: intact; no pathological findings for extra-ocular movements (which was tested along with III and VI cranial nerves).
V. Trigeminal nerve: intact; No pathological findings in the following: sensation in the face (touch, pain, and temperature perception) , Motor function of temporal and masseter muscles, and corneal reflex.
VI. Abducens nerve: intact; no pathological findings for extra-ocular movements (which was tested along with III and IV cranial nerves).
VII. Facial nerve: Slight drooping of right corner of mouth is observed. However, there is no weakness or asymmetry while performing various facial movements (smiling, frowning, raising eyebrows, closing eyes tightly, and puffing cheeks).
VIII. Vestibulocochlear nerve: hearing is intact, balance is slightly impaired
IX. Glossopharyngeal nerve: it was tested along with X cranial nerve. Taste, swallowing, and gag reflex are intact but the patient's ability to articulate sounds was impaired.
X. Vagus nerve: same results as for the previous one.
XI. Accessory nerve: Reduced strength and size of trapezius and sternocleidomastoid muscles on right side compared with the left one.
XII. Hypoglossal nerve: The tongue is not protruded fully, reduced speed and precision in tongue movements, no deviation of tongue to one side is noticed.

Examination of upper extremities:

Superficial sensation (non-cortical sensory system)

Superficial sensation was examined bilaterally including dermatomes C4-T1 by assessing the following:

- Light touch: Physiological in all dermatomes.
- Pain sensation: Physiological in all dermatomes.
- Temperature perception: Physiological in all dermatomes.

Deep sensation (cortical sensory system)

The following tests were assessed with no visual control (patient was asked to keep his eyes closed).

- Position sense: Physiological bilaterally, the patient was able to identify in which direction his finger was moving (up or down).
- Kinesthesia: Physiological bilaterally, the patient was able to tell when was the beginning and end of movement of his finger.
- Stereognosis: Physiological bilaterally, the patient was able to identify familiar objects placed into his hand like a pen and keys.

Deep tendon reflexes

Table 16 - Deep tendon reflexes of UEE (final examination)

Deep tendon reflex	Right	Left
Biceps	2+	2+
Triceps	2+	2+
Flexors	3+	2+

- The grading system used:

0: Absent reflex

1+: Hyporeflexia (diminished response), indicating a very mild or reduced reflex compared to normal

2+: Normal reflex, indicating a typical or expected response within the normal range

3+: Hyperreflexia (exaggerated response), indicating a brisker or more pronounced response than normal

4+: Clonus, a rhythmic, oscillating series of contractions and relaxations following sustained stretching of the tendon, indicating a significantly exaggerated response.

Examination of paretic signs

Table 17 - Paretic signs of UEE (final examination)

Paretic sign	Right	Left
Mingazzini	Positive	Negative
Dofour	Positive	Negative
hanzal	Positive	Negative
barré	Positive	Negative
Rusecké	Positive	Negative
Retardation phenomenon	Positive	Negative

- The patient showed improved performance during the test, yet execution remained somewhat limited. However, this improvement made it easier to assess and determine the test result.

Examination of spastic (irritation) signs

Table 18 - spastic signs of UEE (final examination)

Spastic sign	Right UE	Left UE
Juster	Negative	Negative
Trömner	Negative	Negative
Hoffmann	Negative	Negative

Examination of Cerebellum functions

- The patient was able to reach his nose with his right index finger, and there was a reduction in the oscillating tremor during this task. However, dysmetria was detected due to undershooting observed in the movement.
- In an alternate test requiring the patient to touch their umbilicus with the right index finger, the patient was still able to do it successfully and no cerebellar signs were present.
- The standard assessment for disdiadochokinesis was still challenging due to the patient's limited ability to fully supinate his right arm, within his manageable range, it was absent.
- No cerebellar signs were observed while assessing the left upper extremity.

Precision and strength of grips

The patient continues to exhibit compromised fine motor skills and grip strength in the right hand. While unable to execute various precision grips such as pinch, tripod, and lateral grips, this time, the patient managed to perform a pad-to-pad grip. Similarly, power grips like cylindrical and hook grips remained challenging, although this time, the patient was able to perform a spherical grip. However, both the pad-to-pad and spherical grips were executed poorly, lacking smoothness and the ability to sustain them comfortably for an extended period.

Examination of lower extremities:

Superficial sensation (non-cortical sensory system)

Superficial sensation was examined bilaterally including dermatomes L2-S2 by assessing the following:

- Light touch: Physiological in all dermatomes.
- Pain sensation: Physiological in all dermatomes.
- Temperature perception: Physiological in all dermatomes.

Deep sensation (cortical sensory system)

The following tests were assessed with no visual control (patient was asked to keep his eyes closed):

- Position sense: Physiological bilaterally, the patient was able to identify in which direction his toe was moving (up or down) with eyes closed.
- Kinesthesia: Physiological bilaterally, the patient was able to tell when was the beginning and end of movement of his toe.

Deep tendon reflexes

Table 19 - Deep tendon reflexes of LEE (final examination)

Deep tendon reflex	Right	Left
Patellar	2+	2+
Achilles	3+	2+

Examination of paretic signs

Table 20 - Paretic signs of LEE (final examination)

Paretic sign	Right	Left
Mingazzini	Positive	Negative
Barré	Positive	Negative
Retardation phenomenon	Positive	Negative

Examination of spastic (irritation) signs

Table 21 - Spastic signs of LEE (final examination)

Spastic sign	Right	Left
Babinski	Negative	Negative
Siccard's	Negative	Negative
Chaddock's	Negative	Negative
Oppenheim's	Negative	Negative
Rossolimo's	Negative	Negative

Examination of Cerebellum functions

- The patient performed the heel to shin test, aimed to touch the examiner's finger with his big toe, and execute rapid alternating movements, moving the feet up and down.
- Still no abnormal findings were observed bilaterally.

Examination of Abdominal reflexes

- The Epigastric, Mesogastric, and Hypogastric reflexes were evaluated, still bilateral hyporeflexia in all of them.

3.6.2 Postural Examination

The patient was able to stand independently throughout the whole examination of posture.

Static postural examination:

Posterior view:

- Base of support - slightly narrow width of stance between heels. He has a wider stance on right leg (affected side) while left leg is closer to the centre of the body.
- Weight distribution - Greater load of body weight is on the left lower extremity.
- Heels - spherical shape of both heels. Both heels appear to be in neutral position.
- Feet - the right foot is slightly in front of the left one.
- Ankle joint - right foot is externally rotated.
- Achilles Tendon - thicker on left and deviated laterally on right.
- Calf muscles - the calf muscles on the left side appear more prominent, while they appear flatter and less defined on the right side.
- Knee joints - right knee looks slightly flexed and shows signs of valgus alignment.
- Popliteal line - deeper on the right side.
- Thigh muscles - more tense and contracted appearance on the right side.
- Thoracobrachial triangles - slightly larger on the left side.
- Position of pelvis - lateral pelvic tilt to the right.

• Paravertebral muscles - appear to be more contracted on right lumbar area.
• Spine - the curvature is prominent in the lumbar and thoracolumbar areas, slight kyphosis is visible in thoracic area.
• Scapula - higher on left side.
• Shoulder - both shoulders are protracted, left one is higher.
• Trapezius muscle - larger on the left side.
• Upper limb - slightly flexed elbow, slightly pronated forearm, and fingers held in moderate clenched position.
• Head - moderate anterior tilt.

Right side view:

• Weight distribution - Reduced weight bearing on right side.
• Ankle joint - slight plantar flexion.
• Knee joint - semiflexed and in valgus position.
• Pelvis - slight anterior tilt.
• Lumbar vertebrae – slight lordosis.
• Thoracic vertebrae - slight Kyphosis.
• Cervical vertebrae - slight lordosis.
• Shoulder - protracted and depressed.
• Upper limb - elbow slightly flexed, forearm slightly pronated and fingers held in moderate clenched position.
• Head - moderarte anterior tilt.

Left side view:

• Weight distribution - more weight shift to the left side (increased contact along the lateral border of the left foot).
• Ankle joint - neutral position.
• Knee joint - neutral position.
• Pelvis - slight anterior tilt.
• Lumbar vertebrae - slight lordosis.
• Thoracic vertebrae - slight Kyphosis.

• Cervical vertebrae - slight lordosis.
• Shoulder - protracted and elevated.
• Upper limb - elbow slightly flexed.
• Head - moderate anterior tilt.

Anterior view:

• Base of support - slightly narrow width of stance between heels. He has a wider stance on right leg (affected side), while left leg is closer to the centre of the body.
• Feet - the right foot is slightly in front of the left one.
• Ankle joint - right foot is externally rotated and slightly in plantar flexion (toes slightly curled).
• Weight distribution - Greater load of body weight is on the left lower extremity.
• Tibialis anterior muscle - signs of atrophy on the right side.
• Knee joints- right knee is slightly semi-flexed while left one is neutral.
• Patella - Right patella appears rounded , slightly higher and is pointing outwards.
• Thigh muscles - more defined on the left side.
• Position of pelvis - lateral pelvic tilt to the right.
• Navel - slightly deviated to the left side.
• Thoracobrachial triangles - slightly larger on the left side.
• Chest - appears more tense on right side and right nipple is slightly higher than left one.
• Shoulder - both shoulders are protracted , left shoulder is moderately higher than right one which is depressed.
• Trapezius muscle - larger on the left side.
• Upper limb - slightly flexed elbow , slightly pronated forearm, and fingers held in moderate clenched position.
• Head - moderate anterior tilt.

Palpation of the pelvis:

• height and symmetry of the iliac crest - left side is higher than right side.

- height and symmetry of the Posterior superior iliac spine (PSIS) -Not Symmetrical, slightly higher on left side.
- height and symmetry of the Anterior superior iliac spine (SIAS) - Not Symmetrical, slightly higher on left side.
- So overall the pelvis is laterally tilted to the right.
- No signs of torsion.
- Slight anterior tilt.

Dynamic spine examination:

Flexion:

- The overall range of motion remains incomplete, yet the patient managed to reach further, extending halfway down the thighs.
- Some spreading of the thoracic spine was observed, primarily in the upper segment, but none noted in the cervical spine.
- The return to an upright position is still not fluent.

Lateral flexion:

- Still Asymmetrical, the ROM was bigger to the left side.
- In both lateral to the right and left, the functional curve is missing at the thoracic and cervical spine and the patient couldn't keep an upright posture towards the end of the movement excursion.
- In lateral flexion to the left side the patient was rotating his trunk in a clockwise direction.
- No fluency when returning back to upright position.

Extension :

- The overall range of motion is incomplete.
- The flattening of thoracic spine is not present.
- No fluency when returning back to upright position.

Specific Testing

1. Romberg test I, II , III:

- Romberg I: Stable.
- Romberg II: Relatively stable but with a bit difficulty maintaining balance.

- Romberg III: Unstable stance with compensatory movements.

2. Trendelenburg sign test:

- Standing on right leg: He managed to stand on his right leg, but maintaining the test position was challenging, making it difficult to assess the outcome accurately.
- Standing on left leg: The test was negative, he was able to maintain balance for few seconds without pelvis drop to the right side, but compensatory movements to maintain balance were still visible, like leaning with trunk towards left side and rotating in clockwise direction.

3. Vele test:

- The left foot exhibits normal stability (grade 1), while the right shows slight impairment indicated by pressed toes (grade 2).

4. Standing on two scales:

- The patient weighs 92kg, his weight was distributed into 38 kg on the right and 54 kg on the left.
- So the patient loads more weight on the left side with a 17% of body weight.
- The difference is still greater than the tolerated range (10% - 15%) which indicates impaired balance.

Modification of standing

1. Standing on tiptoes:

- The patient managed it briefly with less weight on his right foot. However, with support from the wall ladder, he achieved better balance and sustained the position longer.

2. Standing on heels:

- He held he position longer, but reduced dorsiflexion was noticeable on the right side.

3. Single-leg stance test:

- Patient could maintain the test for less than 10 seconds without support on his right foot.
- On the left, he sustained it for over 10 seconds without support, although he leaned towards the left side, showing reduced tendon activity in the left foot.

- With eyes closed, he briefly balanced on his left leg but hasn't attempted it yet on the right.

3.6.3 Gait Examination

Patient walked independently during the examination and he didn’t report any pain.

- Width of base of support - slightly narrow.
- Position of feet - reduced external rotation of the right foot.
- Walking rhythm - refined rhythm with a slight increase in right side weight-bearing and better step timing.
- Walking speed - moderately increased walking speed, notable improvement in right foot push-off power.
- Stride length - more consistent gait, with a noticeable increase in stride length on the right side.
- Position and movement of the lower limb - enhanced initiation of the swing phase on the right, but limited knee flexion and hip extension persist. Some improvement in force during heel strike and toe-off, though not fully restored.
- Position and movement of pelvis - reduced lateral pelvic tilt during stance.
- Centre of gravity - slightly shifted less to the left but not entirely centered.
- Position and movement of the trunk - maintained upright posture without leaning forward, yet trunk asymmetries persist, with more lateral flexion and rotation on the left.
- Position and movement head - improved head position, though still slightly tilted to the left in alignment with the trunk.
- Position and movement of the upper limb - enhanced right arm swing, yet symmetry with the left arm is not entirely achieved. Improved upper extremity position but fingers remain clenched.
- Gait Endurance - improved endurance, displaying reduced signs of fatigue during extended walking.
- Other observations - potentially smoother turning and changing direction, but some caution remains. Patient is able to go up and down the stairs independently.

3.6.4 Assessment of spasticity

- The assessment of spasticity was conducted using the Modified Ashworf Scale (MAS).
- Specifically, testing was limited to the right upper and lower extremities, as no signs of spasticity were observed in the left side.
- While assessing the soleus muscle, no clonus was observed anymore.

Table 22 - Spasticity assessment using MAS (final examination)

Muslce(s) tested	Grade
Shoulder adductors	1
Biceps brachii	0
Triceps brachii	2
Forearm supinators	1+
Forearm pronators	1
Wrist flexors	1
Finger flexors	1+
Hip flexors	0
Hip adductors	0
Hamstrings	0
Quadriceps	0
Gastrocnemius	1
Soleus	1+

- The grading system is as follows:

0: No increase in muscle tone

1: Slight increase in muscle tone, with a catch and release or minimal resistance at the end of the range of motion when an affected part is moved in flexion or extension

1+: Slight increase in muscle tone, manifested as a catch, followed by minimal resistance through the remained (less than half) of the range)

2: A marked increase in muscle tone throughout most of the range of motion, but affected parts are still easily moved

3: Considerable increase in muscle tone, passive movement difficult

4: Affect part(s) rigid in flexion or extension

3.6.5 Examination of movement stereotypes by janda

Hip extension

On right side:

- Movement is still initiated in the ipsilateral paravertebral muscles.
- Enhanced activation of the ipsilateral gluteus maximus and ischiocrural muscles, leading to better coordination of movement.
- Movement is still not smooth with reliance on turning pelvis to left side to lean on and straight lift the right leg into extension.

On left side:

- Exhibits coordinated and normal timing of activation of ipsilateral gluteus maximus muscle and the ischiocrural muscles.
- Increased activity of contralateral paravertebral muscles.
- Smoother with a greater range of motion.

Hip abduction

On right side:

- Improved activation of the gluteus medius, gluteus minimus, and tensor fasciae latae muscles, leading to better initiation and coordination of movement.
- Less noticeable compensatory activation of the quadratus and tensor mechanism

On left side:

- Improved coordination
- Diminished but still slightly visible quadrates and tensor mechanism

Trunk flexion

- Better initiation from the trunk muscles rather than relying primarily on pelvic movement or excessive activation of the iliopsoas muscle.
- Potential improvement in attempting the movement.
- He was only able to lift the superior angle of scapula.

Neck flexion

- The head is still protracted, although there's improved activation of the deep neck flexors when attempting to flex the neck; however, the movement remains unsmooth.

Shoulder Abduction

On right side:

- Reduced hyper-activation of the upper trapezius muscle, allowing for better initiation of movement.
- Still not fluent, with slight side bending to the left.
- Still not coordinated scapular movement, but with reduced hyper- activation of lower scapula fixators ipsilaterally.

On left side:

- Initiated the movement by less elevation of shoulder (hyper-activation of upper part of trapezius muscle).
- More fluent, with greater range of motion.
- More coordinated scapular movement.

3.6.6 Breathing pattern assessment

- Potential improvement in balancing abdominal and chest breathing, reducing over-reliance on abdominal breathing.
- Increased ribcage mobility and improved chest expansion. It was noticeable in various positions (standing, sitting, and lying down)
- Improved breathing control, enabling the patient to manage physical activities more efficiently and with decreased breathlessness.

3.6.7 Examination of deep stabilization system (According to prof. Kolář)

1. Extension test:

- Better activation of lateral abdominal muscles.
- Still higher activity of paravertebral muscles, particularly on the right side.
- Better ability to maintain a stable pelvis during the test.

- Still increased activity of ischiocrural muscles.

2. Trunk diaphragm test:

- Increased capacity to expand the lower chest laterally and dorsally against resistance.
- Cranial migration of ribs was slightly noted.
- There was better lateral expansion of the chest on the right side.

3. Intra-abdominal pressure test:

- Increased ability to generate sufficient intra-abdominal pressure.
- Increased activity in the upper abdominal muscles still slightly persist.
- The navel still moves upward.

3.6.8 Special Tests

Timed up and go test (TUG):

- It is used as an assessment to evaluate a person's mobility, balance, and risk of falling. It measures the time taken for an individual to stand up from a standard armchair, walk a short distance (about 3 meters or 10 feet), turn around, walk back, and sit down again.
- The procedure is as follows:

Setup:

- Place a chair with a standard seat height and armrests in an open area.
- Instruct the participant to sit with their back against the chair, arms resting on the armrests, and feet flat on the floor.

Instructions:

- Explain the task to the participant: They will stand up from the chair, walk to a marked spot about 3 meters away, turn around, walk back, and sit down again.
- Use a stopwatch or a timer to record the time taken for the complete task.

Execution:

- On the signal, the participant rises from the chair, walks to the designated spot at a comfortable pace (without running), turns around, walks back, and sits down.

Scoring:

- Record the time taken in seconds. Shorter times generally indicate better mobility and lower fall risk.

• The interpretation is as follows:

- <10 seconds: Typically indicates normal mobility.
- 10-20 seconds: Suggests mild to moderate mobility impairment.
- >20 seconds: Indicates significant mobility issues or an increased fall risk.

• The patient completed the test in 11 seconds which still suggests mild to moderate mobility impairment.

Barthel index (BI):

• It was used to assess the patient's level of independence in performing basic activities of daily living (ADLs).

Table 23 - Barthel index (final examination)

Activity	Execution of activity	Score points
Food and fluid intake	Independently without assistance	10
	With assistance	**5**
	Unable to perform	0
Dressing	Independently without assistance	10
	With assistance	**5**
	Unable to perform	0
Bathing	independently or with assistance	**5**
	Unable to perform	0
Personal hygiene	independently or with assistance	**5**
	Unable to perform	0

Activity	Execution of activity	Score points
Urinary continence	Fully continent	**10**
	Occasionally incontinent	5
	Permanently incontinent	0
Bowel continence	Fully continent	**10**
	Occasionally incontinent	5
	Permanently incontinent	0
Toilet use	Independently without assisstance	**10**
	With assistance	5
	Unable to perform	0
Transfer from bed-chair	Independently without assistance	**15**
	With little assistance	10
	Able to sit	5
	Unable to perform	0
Walking on flat surfaces	Independently for >50 meters	**15**
	With assistance for 50 meters	10
	On a wheelchair for 50 meters	5
	Unable to perform	0
walking on stairs	Independently without assistance	**10**
	With assistance	5
	Unable to perform	0

- Proposed guidelines for interpreting the scores are as follows:

0-40 : highly dependent

45-60 : moderate dependence

65-95 : mild dependence

100 : Independent

- The patient scored a total of 90 points, indicating mild dependence in his abilities. The only activity with a different score was stair walking; the patient is now independent in this task. Moreover, I observed the patient frequently attempting to utilize his right upper extremity.

Extended Barthel Index (EBI):

- It helps to assess the need for assistance in managing daily activities, where cognitive abilities are a prerequisite.

1. Understanding

15 = Unimpaired (not including patients who only understand written language).

10 = Understands complex factual content, but not abstract concepts.

5 = Understands simple requests.

0 = Doesn't understand.

2. Communication

15 = Able to express almost everything.

5 = Able to express simple factual content.

0 = Unable or almost unable to express themselves.

3. Social interaction

15 = Unimpaired.

5 = Occasionally uncooperative, aggressive, lacks appropriate distance, withdrawn.

0 = (Almost) uncooperative.

4. Daily problem solving (Planning the course of various actions, adapting to changes, meeting deadlines, accurate medication intake, insight into deficits and their everyday consequences).

15 = Essentially unimpaired.

5 = Requires little assistance.

0 = Requires significant assistance.

5. Memory, learning, and orientation

15 = Essentially unimpaired (no further care requirements).

10 = Requires occasional reminders or the use of external memory aids.

5 = Often needs to be reminded.

0 = Disoriented, tendency to wander off.

6. Vision and neglect syndrome

15 = Essentially unimpaired.

10 = Significant reading disorder, but handles familiar and unfamiliar environments without problems (possibly with aids).

5 = Handles familiar, not unfamiliar environments without problems.

0 = Doesn't handle even familiar environments entirely without problems (e.g., can't find their room or department, overlooks obstacles or people, bumps into them).

- Interpretation:

0-15 : severe cognitive impairment

20-65 : moderate cognitive impairment

70-90 : no limitations or mild cognitive impairment

- The patient again scored a total of 80 points, indicating no limitations or mild cognitive impairment.

3.6.9 Muscle length test (according to Janda or Kendall)

Table 24 - Muscle length test (final examination)

Examined muscle(s)	Author	Grade (right - left)	
Trapezius (upper part)	Janda	1	0
Levator scapulae	Janda	1	1

Examined muscle(s)	Author	Grade (right - left)	
Sternocleidomastoid	Janda	1	0
Pectoralis major (sternal part)	Kendall	*	Shortness (moderate)
Pectoralis major (clavicular part)	Kendall	*	Shortness (moderate)
Pectoralis minor	Kendall	*	Shortness (moderate)
Medial shoulder rotators	Kendall	*	Shortenss (moderate)
Lateral shoulder rotators	Kendall	*	Normal length
Ilioposoas	Janda	1	1
Rectus femoris	Janda	1	1
Tesnor fasciae latae	Janda	1	1
Piriformis	Janda	0	0
Short hip adductors	Janda	1	1
Long hip adductors	Janda	1	1
Hamstrings	Janda	2	1
Gastrocnemius	Janda	0	0
Soleus	Janda	0	0

* The limited mobility and feeling pain while executing the tests are limiting the ability to perform an accurate assessment of the full muscle's test.

- Grades expressed by Janda:

Grade 0 - No shortness

Grade 1 - Slight (moderate) shortness

Grade 2- Marked shortness

3.6.10 Measurement of ROM (goniometry; SFTR method)

Table 25 - Goniometry of UEE (°) (final examination)

	Right		Left	
Joint examined	**Active ROM**	**Passive ROM**	**Active ROM**	**Passive ROM**
Shoulder joint	S: 25-0-60 F: 90-0-0 T: 5-0-70 R: 20-0-65	S: 40-0-120 F: 90-0-0 T: 10-0-80 R: 20-0-80	S: 50-0-170 F: 150-0-0 T: 10-0-130 R: 55-0-80	S: 60-0-180 F: 160-0-0 T: 20-0-130 R: 65-0-80
Elbow joint	S: 0-0-90	S: 0-0-115	S: 0-0-120	S: 0-0-130
Radio-ulnar joint	R: 70-0-80	R: 75-0-80	R: 90-0-90	R: 90-0-90
Wrist joint	S: 50-0-65 F: 15-0-30	S: 65-0-75 F: 15-0-30	S: 60-0-70 F: 15-0-30	S: 70-0-80 F: 20-0-30
MCP joint of index	S: 0-30-25 F: 5-0-5	S: 0-0-80 F: 10-0-10	S: 20-0-80 F: 15-0-15	S: 25-0-85 F: 20-0-20
IP1 joint of index	S: 0-20-65	S: 0-0-80	S: 0-0-90	S: 0-0-100
IP2 joint of index	S: 0-15-35	S: 0-0-70	S: 0-0-80	S: 0-0-80
CMC joint of thumb	X	S: 20-0-40 F: 20-0-20	S: 20-0-40 F: 30-0-20	S: 20-0-45 F: 40-0-30
MCP joint of thumb	S: 0-15-30	S: 0-0-50	S: 5-0-60	S: 10-0-70
IP joint of thumb	S: 0-30-30	S: 0-0-70	S: 5-0-70	S: 10-0-75

- The clenched position of right hand fingers due to spasticity imposes a barrier in making measurements for the joints of the fingers in which the starting position for measuring Active motions (flexion and extension) in the sagittal plane was not at an

angle of zero degrees. However, motions in frontal plane (abduction and adduction) were manageable to measure this time.

- CMC joint is slightly mobile actively, but the patient is unable to differentiate between individual movements.
- The MCP, IP1, IP2 joints for the other fingers still resemble the findings for the index finger in which right hand fingers were limited and left hand fingers showed no pathological findings.

Table 26 - Goniometry of LEE (°) (final examination)

	Right		Left	
Joint examined	**Active ROM**	**Passive ROM**	**Active ROM**	**Passive ROM**
Hip joint	S: 15-0-105 F: 25-0-10 R: 40-0-30	S: 15-0-105 F: 30-0-10 R: 45-0-40	S: 20-0-100 F: 35-0-15 R: 40-0-35	S: 30-0-120 F: 45-0-20 R: 45-0-40
Knee joint	S: 0-0-120	S: 0-0-120	S: 0-0-120	S: 0-0-140
Ankle joint	S: 20-0-45 R: 10-0-20	S: 25-0-50 R: 20-0-30	S: 25-0-45 R: 20-0-35	S: 30-0-50 R: 20-0-40
MTP joint of big toe	S: 30-0-20 F: 10-0-10	S: 35-0-30 F: 15-0-15	S: 35-0-30 F: 15-0-15	S: 40-0-40 F: 20-0-20

- IP joint of big toes along with MTP , IP1 and IP2 joint of other toes showed no pathological findings.
- No signs of Hallux valgus.

3.6.11 Anthropometric measurements (in cm)

Table 27 - Anthropometric length of LEE (cm) (final examination)

Length-Lower extremity	Right	Left
Anatomical	90	91
Functional (from ASIS)	92	93

Length-Lower extremity	Right	Left
Thigh	45	45
Middle leg	42	42
Foot	28	28

Table 28 - Anthropometric circumference of LEE (cm) (final examination)

Circumference-lower extremity	Right	Left
Thigh (15 cm above patella)	53	53
Thigh (10 cm above patella)	49	50
Knee joint	43	43
Tibial tuberosity	38	38
Calf	38	38
Ankle joint	26	25
Heel	30	30
Foot	22	22

Table 29 - Anthropometric length of UEE (cm) (final examination)

Length-Upper extremity	Right	Left
Whole upper extremity	84	84
Humerus	38	38
Forearm	28	28
Hand	21	21

Table 30 - Anthropometric length of UEE (cm) (final examination)

Circumference-Upper extremity	Right	Left
Upper arm (relaxed)	32	34
Upper arm (maximal isometric contraction)	33	36
Elbow joint	30	30
Forearm	28	29
Wrist	18	18
Metacarpal heads	21	21

3.6.12 Joint play examination (according to Lewit)

- There are no more observed pathological barriers on the right side. Physiological barriers were noticed in the joints of the right upper extremity, including the IP and MCP joints of all fingers in all directions, as well as the wrist and elbow. The same was observed for the Lisfranc's joint and Chopart's joint of the right lower extremity.
- However, the SI joint on the left side, both upper and lower segments, still remain blocked.

3.6.13 Reflex changes (according to Lewit)

Skin:

- Psoriatic changes were still observed in specific regions of the patient's body, notably the elbows, shins, heels, and around the medial malleolus. In these areas, the skin exhibited reduced warmth and heightened sensitivity.
- Still no abnormalities detected in other areas of the body.

Subcutaneous tissue:

- Examining with kibler’s fold along the spine still indicated heightened tension, particularly in the thoracic region, the fold was easier to grasp. And the examination was conducted without inducing any pain.
- Kibler’s fold was still easily graspable and movable on the extremities and the chest with no pain as well.

Fascia:

- There's bilateral improvement noted in both deep lumbar fascia caudally and dorsal fascia cranially, showing no restrictions. Movement and flexibility in the fascia of the arm and forearm of the right upper extremity have improved but remain slightly limited.

Muscles:

- Upon palpation of the right upper extremity, normal muscle tone is observed in the biceps brachi muscle.Although hypertonicity persists in the upper part of the trapezius and levator scapulae muscles, there is some alleviation and no presence of trigger points in either muscle.
- Reduction in hypertonicity is noted in the gastrocnemius bilaterally, along with the ischiocrural muscles bilaterally and the left quadriceps femoris, all displaying normal tone.
- There's an enhancement in muscle tone observed in the gluteal muscles bilaterally, showing normal tone. While the abdominal muscles are still considered hypotonic.

Periosteal points:

- Reduction in tenderness was observed on the periosteal point located over the superior border of the left patella.

3.6.14 Conclusion of final kinesiological examination

The overall functionality of the right upper limb has improved, facilitating a smoother conduction of numerous examinations. This was previously hindered during the initial examination by weakness and limited mobility. Functionality also improved for right LE. The improvement was evident through increased range of motion observed during goniometry measurements, notably in the shoulder, elbow, wrist, and small joints of the hand. Additionally, enhancements were noted in the hip, knee, and ankle joints.

Neurological examination continues to reveal persistent signs, with the left upper extremity and both lower extremities displaying consistent findings. However, there's an exception observed in the deep tendon reflexes for the right lower extremity. The deep tendon reflexes for the right upper extremity display a reduction, resulting in normal reflexes for the biceps and triceps, similarly seen in the patellar reflex. Nonetheless, hypereflexia persists for the flexors, though without clonus, as observed in the Achilles reflex. Stereognosis testing exhibited a physiological response, while paretic signs showed positive results across all assessments. Notably, spastic signs now register as negative. During cerebellar function testing, the patient displayed improved control with reduced intention tremor and no indication of other cerebellar impairments. However, assessing disdiadochokinesis remained challenging, but an absent result was noted when testing within a manageable range.

The final assessments indicate improvements in various aspects of posture, such as enhanced alignment of the right LE, spine, right UE, and head. Improved performance of the right LE was noted, although the Romberg and Vele tests yielded similar results. However, the patient managed to stand on his right leg during the single-leg stance and Trendelenburg sign test, though with some difficulty maintaining the test position. Notably, improvements in balance, weight distribution, strength, and control were observed. The patient put 11% less body weight on the left side when standing on two scales. Additionally, he demonstrated an improved ability to stand on tiptoes and heels for an extended period. These enhancements were also reflected in his gait, characterized by a narrower base of support, reduced external rotation of the right foot, refined walking rhythm, improved step timing with a longer stride length on the right

side, and enhanced initiation of the swing phase and increased force during heel strike and toe-off. Furthermore, the gait examination revealed improved pelvic and trunk symmetry and increased right arm swinging.

Significant reductions were observed in both spasticity and muscle shortness on the right side, with most muscles exhibiting noticeable improvements, and some showing no spasticity or shortening anymore. These enhancements in mobility and flexibility were evident in improved coordination and activation of movements during tested movement stereotypes. Additionally, better motor control was observed in the assessment of the deep stabilization system, characterized by enhanced activation of lateral abdominal muscles, improved trunk diaphragm function, and an increased ability to generate intra-abdominal pressure. Moreover, optimization of the breathing pattern was noted, indicated by increased chest expansion and ribcage mobility, along with reduced breathlessness during physical activity.

There is no longer restricted joint mobility on the right side, although there is still slight restriction observed in the fascia of the arm and forearm. Muscle tone increased on biceps brachii exhibiting normal muscle tone. Muscle tonicity has decreased in the gastrocnemius and ischiocrural muscles bilaterally, as well as in the left quadriceps femoris, all now exhibiting normal muscle tone upon palpation. Conversely, there's increased tonicity noted in the bilateral gluteal muscles. However, hypertonicity persists in the right trapezius and levator scapulae, although trigger points have been released. Hypotonicity still persists bilaterally in the abdominal muscles.

The patient completed the TUG test 3 seconds faster than the initial attempt, although the result still indicates mild to moderate mobility impairment. Additionally, there was a 5 points increase in the Barthel Index, attributed to the newfound ability to independently navigate stairs, but still signifying mild dependence in activities. However, observing the patient revealed increased utilization of the right UE in daily activities, reducing dependence on the left one. No changes were observed in the Extended Barthel Index, indicating no limitations or mild cognitive impairment.

3.7 Evaluation of the effect of therapy

To assess the therapy's impact, it's crucial to highlight that our physiotherapy plan targeted enhancing the functionality of the uncomfortable and dissatisfactory right UE for the patient, focusing primarily on reducing spasticity. Following the therapy sessions, assessments revealed a significant reduction in spasticity levels, as demonstrated in the forthcoming chart. Additionally, our goal was to enhance the strength of the right UE, evident in the improved active range of motion, which will be portrayed in table 31. However, despite reduced reliance on the left UE, the patient still exhibits some hesitation in fully engaging the right UE in daily activities.The neurological function of the right UE displayed improvement, with decreased deep tendon reflexes as shown by table 32 and a transition of spastic signs from positive to negative as shown by table 33. Techniques like PIR, PNF, and passive stretching were all effective in enhancing the functionality of the right UE. Notably, occupational therapy and botulinum injections played integral roles in achieving these improvements.

Chart no.1 - Spasticity levels of right UE before and after therapy

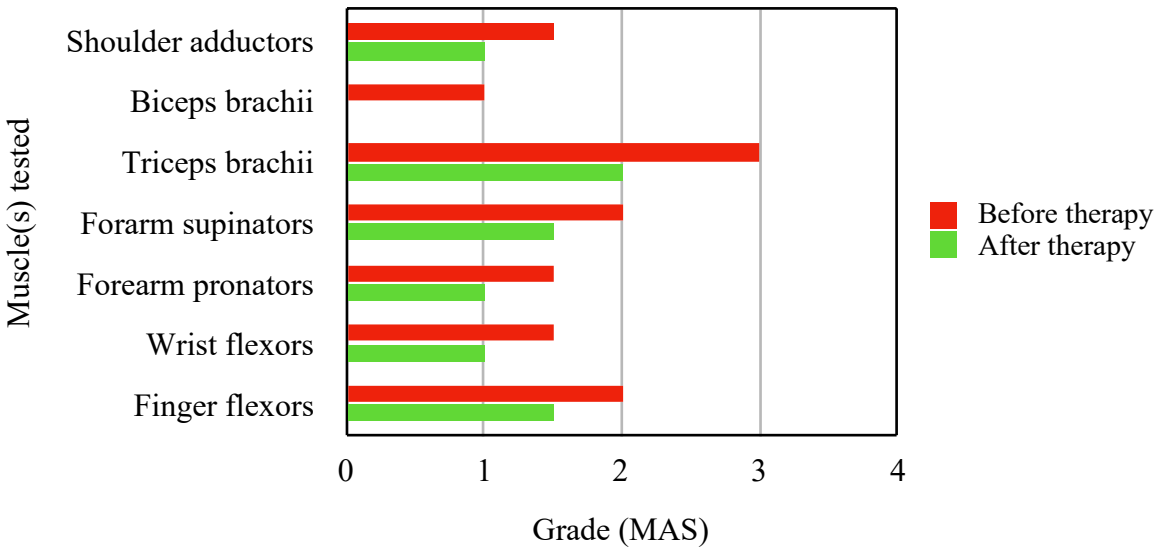


Table 31 - Goniometry of UEE (°) (before and after therapy)

Joint examined	Before therapy	After therapy
Shoulder joint	S: 20-0-45 F: 85-0-0 T: 5-0-50 R: 10-0-60	S: 25-0-60 F: 90-0-0 T: 5-0-70 R: 20-0-65
Elbow joint	S: 0-0-55	S: 0-0-90
Radio-ulnar joint	R: 50-0-70	R: 70-0-80
Wrist joint	S: 35-0-45 F: 5-0-10	S: 50-0-65 F: 15-0-30
MCP joint of index	S: x-45-25	S: 0-30-25 F: 5-0-0
IP1 joint of index	S: x-30-60	S: 0-20-65
IP2 joint of index	S: x-20-35	S: 0-15-35
MCP joint of thumb	S: x-15-25	S: 0-15-30
IP joint of thumb	S: x-30-25	S: 0-30-30

Table 32 - Deep tendon reflexes of UEE (before and after therapy)

Deep tendon reflexes	Before therapy	After therapy
Biceps	3+	2+
Triceps	3+	2+
Flexors	4+	3+

Table 33 - spastic signs of UEE (before and after therapy)

Spastic sign	Before therapy	After therapy
Juster	Positive	Negative
Trömner	Positive	Negative
Hoffmann	Positive	Negative

4 Discussion

The short-term therapeutic plan has been successfully executed, resulting in the attainment of our primary objective: enhancing the functionality of the patient's right upper extremity, as elaborated in the therapy evaluation. Nevertheless, as the patient has not yet fully relied on their right upper extremity, exploring additional therapeutic approaches outlined in the latest interventions could be beneficial.

One potential avenue involves employing virtual reality therapy to further augment motor function (Karkhaneh & Ghasemi, 2017). Beyond the primary goal, substantial improvements have been observed across various facets. Notably, advancements in the patient's walking ability and enhanced stability and balance have been evident, underscoring the efficacy of methodologies such as SMS, as per Janda and Vávrová, in conjunction with active exercises and gait training.

Furthermore, considering complementary interventions like Electromechanical-Assisted Gait Training (Elsisi, Zayed, & Mosaad, 2021) and techniques focused on enhancing stride length and gait speed (Das & Biswas, 2016) may also prove advantageous in our holistic approach to therapy.

5 Conclusion

The completion of my bachelor's thesis has been an enriching journey, unveiling a plethora of insights into a prevailing and profoundly debilitating diagnosis in today's world. It has underscored the pivotal role of physiotherapists in post-illness rehabilitation and emphasized the paramount importance of collaborative efforts within a multidisciplinary team, be it in immediate or ongoing care.

Exploring into the theoretical domain of this diagnosis has offered me a comprehensive understanding of its anatomical and physiological underpinnings, shedding light on its onset and progression. It's become evident that public education plays a pivotal role in curbing the impact of the disease and facilitating the patient's reintegration into normal life. Time becomes a critical factor from the illness's onset, potentially shaping the patient's trajectory. Moreover, this exploration has fortified my grasp of diverse diagnostic methods, while also providing an in-depth understanding of prevalent physiotherapeutic approaches, their efficacy, and the latest advancements in professional research and studies.

The practical application of this knowledge during my practice allowed me firsthand experiences in testing and validating various methods, especially in the domain of neurological diagnoses. Observing these conditions in patients and engaging in collaborative discussions about their progress and treatment with a team of specialists proved immensely beneficial. I anticipate that these experiences and the wealth of newfound knowledge will serve as a wellspring for my future pursuits.

In the context of intensive rehabilitation, I've realized the pivotal role of the patient's motivation and their belief in the rehabilitation process, alongside the trust cultivated between therapist and patient. I was fortunate to work with a patient who exhibited genuine cooperation and amiability, consistently displaying determination to attend sessions. This collaboration significantly contributed to the achievement of our predefined objectives within the short therapeutic plan.

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7. Attachments

Annex 1: Ethics committee approval

Annex 2: Consent form

Annex 3: List of tables and figures

UNIVERZITA KARLOVA V PRAZE
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

Application for Approval by UK FTVS Ethics Committee

of a research project, thesis, dissertation or seminar work involving human subjects

The title of a project: Case study of physiotherapy treatment of a patient after ischemic stroke in basal ganglia with right sided spastic hemiparesis

Project form: Bachelor Thesis

Period of realization of the project: January 2023 - February 2023
The research will be carried out in accordance with the valid epidemiological measures of the Ministry of Health of the Czech Republic.

Applicant: Husam Aldin Naser Barakat, UK FTVS department of physiotherapy

Main researcher: Husam Aldin Naser Barakat, UK FTVS department of physiotherapy

Place of work: Oblastní Nemocnice Kladno

Supervisor (in case of student's work): Mgr. Ilona Kučerová

Financial support:

Project description: Writing Bachelor's thesis based on my patient diagnosis. My patient has an ischemic stroke in basal ganglia with right sided spastic hemiparesis. The goals of the rehabilitation process is to increase range of motion, facilitate muscles of affected side, prevent secondary complications, also increase his ability and independence in performing activities of daily living.

The project starts with a theoretical part followed by a Study case reporting the complete initial and final assessment including neurological, kinesiological examinations and other tests needed according to his diagnosis.

The study case also displays the day to day therapy which focused on techniques such as DNS, PNF, PIR. Along with soft tissue techniques, manual methods and joint mobilizations. Moreover, training exercises in which some equipment was used such as overall and some stability aids.

All the methods and techniques used were taught to me in FTVS during my bachelor degree program.

Characteristics of participants in research: The involved participant is one. The participant is male and 58 years old who has been assigned to me at OMN in Rehabilitation department for my Bachelor's thesis. The participant had an ischemic stroke in basal ganglia on left side on 10.10.2021. He was hospitalized before in the rehabilitation department of OMN in the period of 12.07.2022 to 02.08.2022. The patient's condition now is better but he was admitted to the same rehabilitation department again mainly to improve the state right sided limbs. Patients with acute (especially infectious) diseases do not participate in therapy.

Ensuring safety within the research: I ensure that my therapy does not include any invasive methods and the patient will not be put at any risk. The implementation is safe with respecting the conditions and rules of the hospital and also under the control and supervision of Bc. Tomáš Modlinger. Risks of therapy and methods will not be higher than the commonly anticipated risks for this type of therapy.

Ethical aspects of the research: Data will be collected in line with the rules given by European Union no. 2016/679 and the Czech Act no. 110/2019 Coll. – on personal data processing.
The collected data will be anonymized within one week after the end of working with the patient. I understand that anonymization means that the text does not use any item of information or combination of Items that could lead to the identification of a person. I will be careful not to enable recognition of a person in the text of the thesis, especially within the anamnesis. After the text has been anonymized, any personal data still kept elsewhere will be deleted.
All collected data will be safely stored on a PC safeguarded by a keyword in a locked room, any data in paper form will be kept safely under lock and key in a locked room. The data will be processed, safely retained and published in an anonymous way in the bachelor thesis.

Photographs: Photographs of the participant will be anonymized within one week after being taken by blurring the face, parts of the body or any characteristics that could lead to identification of the person. After anonymization any non-anonymized photographs will be deleted by the end of the study. The non-anonymized photographs will be accessed only by the main researcher and supervisor.

UNIVERZITA KARLOVA V PRAZE
FAKULTA TĚLESNÉ VÝCHOVY A SPORTU
José Martího 31, 162 52 Praha 6-Veleslavín

No audio recordings or video recordings will be taken during the research.

I shall ensure to the maximum extent possible that the research data will not be misused.

Informed Consent: attached

It is a duty of **all participants of the research team** to protect life, health, dignity, integrity, the right to self-determination, privacy and protection of the personal data of all research subjects, and to undertake all possible precautions. Responsibility for the protection of all research subjects lies on the researcher(s) and not on the research subjects themselves, even if they gave their consent to participation in the research. All participants of the research team must take into consideration ethical, legal and regulative norms and standards of research involving human subjects applicable not only in the Czech Republic but also internationally.

I confirm that this project description corresponds to the plan of the project and in case of any change, especially of the methods used in the project, I will inform the UK FTVS Ethics Committee, which may require a re-submission of the application form.

In Prague, 27.01.2023

Applicant's signature:

Approval of UK FTVS Ethics Committee

The Committee: Chair: Doc. PhDr. Irena Parry Martínková, Ph.D.
Members: Prof. PhDr. Pavel Slepička, DrSc.
PhDr. Pavel Hráský, Ph.D.
Mgr. Tomáš Ruda, Ph.D.
Prof. MUDr. Jan Heller, CSc.
Mgr. Eva Prokešová, Ph.D.
MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 063/2023

Date of approval: 27. 1. 2023

UK FTVS Ethics Committee reviewed the submitted research project and **found no contradictions** with valid principles, regulations and international guidelines for carrying out research involving human subjects.

The applicant has met the necessary requirements for receiving approval of UK FTVS Ethics Committee.

UNIVERZITA KARLOVA
Fakulta tělesné výchovy a sportu
José Martího 31, 162 52, Praha 6

Stamp of UK FTVS

– 20 –

Signature of the Chair of
UK FTVS Ethics Committee

Annex 2:

INFORMOVANÝ SOUHLAS

Vážená paní, vážený pane,

v souladu se Všeobecnou deklarací lidských práv, zákonem č. 101/2000 Sb., o ochraně osobních údajů a o změně některých zákonů, ve znění pozdějších předpisů, Helsinskou deklarací, přijatou 18. Světovým zdravotnickým shromážděním v roce 1964 ve znění pozdějších změn (Fortaleza, Brazílie, 2013) a dalšími obecně závaznými právními předpisy Vás žádám o souhlas s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie prováděné v rámci praxe na1 ……., kde Vás příslušně kvalifikovaná osoba seznámila s Vaším vyšetřením a následnou terapií. Výsledky Vašeho vyšetření a průběh Vaší terapie bude publikován v rámci bakalářské práce na UK FTVS, s názvem2 ……

Získané údaje, fotodokumentace, průběh a výsledky terapie budou uveřejněny v bakalářské práci v anonymizované podobě. Osobní data nebudou uvedena a budou uchována v anonymní podobě. V maximální možné míře zabezpečím, aby získaná data nebyla zneužita.

Jméno a příjmení řešitele .....

Podpis:.....

Jméno a příjmení osoby, která provedla poučení3.....

Podpis:.....

Prohlašuji a svým níže uvedeným vlastnoručním podpisem potvrzuji, že dobrovolně souhlasím s prezentováním a uveřejněním výsledků vyšetření a průběhu terapie ve výše uvedené bakalářské práci, a že mi osoba, která provedla poučení, osobně vše podrobně vysvětlila, a že jsem měl(a) možnost si řádně a v dostatečném čase zvážit všechny relevantní informace, zeptat se na vše podstatné a že jsem dostal(a) jasné a srozumitelné odpovědi na své dotazy. Byl(a) jsem poučen(a) o právu odmítnout prezentování a uveřejnění výsledků Místo, datum .....

Jméno a příjmení pacienta Podpis pacienta:

.....

Jméno a příjmení zákonného zástupce4 .....….

Vztah zákonného zástupce k pacientovi ..... Podpis: .....

Annex 3:

Table 1 - Deep tendon reflexes of UEE (initial examination)

Table 2 - Paretic signs of UEE (initial examination)

Table 3 - spastic signs of UEE (initial examination)

Table 4 - Deep tendon reflexes of LEE (initial examination)

Table 5 - Paretic signs of LEE (initial examination)

Table 6 - Spastic signs of LEE (initial examination)

Table 7 - Spasticity assessment using MAS (initial examination)

Table 8 - Barthel index (initial examination)

Table 9 - Muscle length test (initial examination)

Table 10 - Goniometry of UEE (°) (initial examination)

Table 11 - Goniometry of LEE (°) (initial examination)

Table 12 - Anthropometric length of LEE (cm) (initial examination)

Table 13 - Anthropometric circumference of LEE (cm) (initial examination)

Table 14 - Anthropometric length of UEE (cm) (initial examination)

Table 15 - Anthropometric length of UEE (cm) (initial examination)

Table 16 - Deep tendon reflexes of UEE (final examination)

Table 17 - Paretic signs of UEE (final examination)

Table 18 - spastic signs of UEE (final examination)

Table 19 - Deep tendon reflexes of LEE (final examination)

Table 20 - Paretic signs of LEE (final examination)

Table 21 - Spastic signs of LEE (final examination)

Table 22 - Spasticity assessment using MAS (final examination)

Table 23 - Barthel index (final examination)

Table 24 - Muscle length test (final examination)

Table 25 - Goniometry of UEE (°) (final examination)

Table 26 - Goniometry of LEE (°) (final examination)

Table 27 - Anthropometric length of LEE (cm) (final examination)

Table 28 - Anthropometric circumference of LEE (cm) (final examination)

Table 29 - Anthropometric length of UEE (cm) (final examination)

Table 30 - Anthropometric length of UEE (cm) (final examination)

Table 31 - Goniometry of UEE (°) (before and after therapy)

Table 32 - Deep tendon reflexes of UEE (before and after therapy)

Table 33 - spastic signs of UEE (before and after therapy)

Chart 1 – Spasticity levels of right UE before and after therapy

Figure 1- Anatomical structure of Basal Ganglia. (TeachMeAnatomy, n.d.)