CHARLES UNIVERSITY IN PRAGUE

FACULTY OF PHYSICAL EDUCATION AND SPORTS

Department of physiotherapy

Case study of physiotherapy treatment of a patient with hemorrhagic stroke

Bachelor's thesis

Supervisor: Mgr. Michaela Stupková

Author: Alexandros ADAMANTIADIS

Prague, April 2022

ABSTRACT

Title: Case Study of Physiotherapy Treatment of Patient with Hemorrhagic Stroke

Aim: The aim of this thesis is to present a case study of a physiotherapy approach to a treatment of a patient with complications after a hemorrhagic stroke. The theoretical part of the thesis will focus on the pathology, risk factors and prevention. On the practical part I will present the case study with the patient's medical history, all the examinations done by me at the start and end of the treatments, day to day therapies and final results.

Methods: The practical section is based on the case of a 51-year-old male, who was diagnosed with a hemorrhagic stroke in 6/7/2017. The study consists of physiotherapeutic approaches for an initial kinesiological examination on the first day, followed by eight therapy sessions lasting half an hour each, and on the last day a final kinesiological examination. All methods used were non-invasive.

Results: The progress was notable during the ten sessions of therapy. The patient's gait has improved significantly in quality and quantity, the spasticity has improved and his ability to control the lower extremity and upper extremity. Although the results have shown great progress in the gait, he is still as dependent as before for his everyday life activities and still needs assistance while walking with the four-point cane.

Conclusions: The patient was motivated and very cooperative during our ten sessions. He was getting fatigued less and less by the exercises and by the gait trainings. He could see the improvement especially in the gait and it gave him confidence. The two weeks of therapies were not enough for this type of patient. He will need more training and therapies for him to gain more independence in his daily life activities.

Keywords: Hemorrhagic stroke, stroke, spasticity, hemiparesis, brain arteriovenous malformation, case study, physiotherapy.

ABSTRAKT

Název: Kazuistika fyzioterapeutické péče o pacienta po CMP

Cíl: Cílem této práce je prezentovat případovou studii fyzioterapeutického přístupu k léčbě pacienta s komplikacemi po hemoragické cévní mozkové příhodě. Teoretická část práce se zaměří na patologii, rizikové faktory a prevenci. V praktické části představím kazuistiku s anamnézou pacienta, všechna mnou provedená vyšetření na začátku a na konci léčby, každodenní terapie a konečné výsledky.

Metodika: Praktická část vychází z případu 51letého muže, u kterého byla 7. 6. 2017 diagnostikována hemoragická cévní mozková příhoda. Studie sestává z fyzioterapeutických přístupů pro vstupní kineziologické vyšetření první den, následuje osm terapeutických sezení v délce každé půl hodiny a poslední den závěrečné kineziologické vyšetření. Všechny použité metody byly neinvazivní.

Výsledky: Pokrok byl znatelný během deseti sezení terapie. U pacienta se výrazně zlepšila kvalita i kvantita chůze, zlepšila se spasticita a jeho schopnost ovládat dolní a horní končetinu. Přestože výsledky ukázaly velký pokrok v chůzi, je stále stejně závislý jako dříve ve svých každodenních činnostech a stále potřebuje asistenci při chůzi se čtyřbodovou holí.

Závěry: Během našich deseti sezení byl pacient motivovaný a velmi spolupracoval. Cvičením a nácvikem chůze byl stále méně unavený. Bylo vidět zlepšení zejména v chůzi a to mu dodalo sebevědomí. Dva týdny terapií byly pro tento typ pacientů málo. Bude potřebovat více školení a terapií, aby získal větší nezávislost ve svých každodenních činnostech.

Klíčová slova: Hemoragická cévní mozková příhoda, cévní mozková příhoda, spasticita, hemiparéza, mozková arteriovenózní malformace, případová studie, fyzioterapie.

DECLARATION

I hereby declare that this bachelor thesis is entirely written by myself and by the instructions of my supervisor Mgr. Michaela Stupkova. The therapies of the hemorrhagic patient chosen for this case study took place at during my practice at the Rehabilitation Hospital of Beroun under the supervision of BSc. Ales Nesvadba, physiotherapist.

I declare that the information in the theoretical as well as the techniques of the practical part are based on my knowledge that I have received during the three years of studying physiotherapy in Charles University in Prague. Other information that I used to write this bachelor thesis is sourced from the list of literature that is found at the last pages of this thesis.

I also declare that no invasive methods were used during the practical approach and thatthe patient was fully aware of the procedures at any given time.

Prague, April 2022 Alexandros Adamantiadis

ACKNOWLEDGEMENTS

I would like to start by thanking my professors during the three years of study. During this pandemic, many challenges were emerging with the teaching in person and the practices.

The way of teaching had to change and I would like to thank them for accommodating us and making it possible for us to keep studying in the best conditions.

I thank my family for being extremely supportive with my choice of moving to Prague and follow my dream of being a physiotherapist.

Finally, I would like to thank my classmates of the bachelor program year 2019-2022 for being a great source of motivation and for supporting each other during the three years of studying.

Alexandros Adamantiadis
Prague, April 2022

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1 Introduction

The physiotherapy clinical work placement took place at the rehabilitation hospital in Beroun. It started on Monday 10th of January 2022 and ended on Friday 4th of February 2022.

The case study that I chose was a patient with complications after hemorrhagic stroke, 4 years ago. I have chosen this patient because of the complexity of his diagnosis and because I wanted to have a better understanding of the neurological conditions and expand my knowledge on how to treat them.

This thesis is divided in two parts; theoretical part and practical part. The theoretical part consists of pathology, epidemiology, risk factors, clinical assessment with diagnostics, kinesiology of stroke, the physiotherapist take and finally the prognostics of stroke patients.

The goal of the theoretical part is to have a better understanding, as a physiotherapist, of the stroke patients, the different kinds of strokes and have a global view of the pathophysiology as well as the diagnostics generally used.

For the main part which is the practical part, a thorough examination and treatment was made during my clinical work placement in Beroun hospital. There is a kinesiologic assessment with initial and final examination, and the day-to-day therapies are also included in the practical part.

My thesis work is based on a patient that I followed for two weeks, with the supervision of BSc Ales Nesvadba in Beroun hospital. My clinical work placement was from January 10th to February 4th 2022. The patient was diagnosed with hemorrhagic stroke and our total sessions together were 10 during the two weeks he was in the hospital.

The goal of the practical part was to have a deep understanding of the patient's complications and how can we improve his condition and autonomy as much as possible. And by the initial and final examination to be able to measure the success of the therapies.

2 Theoretical Part

2.1 Epidemiology of stroke

Stroke is a condition in which poor blood flows into the brain and is causing cell necrosis. Two main types of strokes exist: ischemic stroke and hemorrhagic stroke. The ischemic stroke is caused by blood clotting and the hemorrhagic stroke is caused by bleeding.

Some signs and symptoms of a stroke can include hemiplegia, loss of speech, dizziness, loss of vision on one side, loss of sensation, spasticity and loss of strength. The signs often appear right after the stroke has happened. When the symptoms are lasting less than two hours, it is classified as a transient ischemic attack (TIA) and not a stroke. When a TIA occurs, there is no cell necrosis in the brain. In a hemorrhagic and ischemic stroke in the other hand, there is a cell necrosis with more severe complications and the symptoms can be permanent.

In the 1950's an arbitrary 24-hour limit was dividing the ischemic stroke from transient ischemic attack (TIA). Within 24 hours the symptoms of TIA will self-resolve and do not leave any permanent disability [3]. However, the risk of ischemic strokes is increased after a TIA incident, which can lead to more severe and permanent disability. In the recent years, and with the advancement of the technology we can diagnose through different tests easier. Nevertheless, the difference of TIA diagnosis with a minor ischemic stroke is still difficult to determine as the symptoms and treatments are very similar, and no study so far has been able to clearly demonstrate the difference of outcome [12].

From 1990 to 2019 the deaths from stroke have seen a global substantial increase of 43% [2]. We also observe the absolute number of stroke incidents increased by 70% in just less than 30 years and the fastest-growing risk factor for stroke was a high BMI. [2].

In Czech Republic there are 18'455 strokes per year with a mortality of 13'148 deaths due to stroke per year. The overall healthcare cost of stroke in Czech Republic is 365.8 million euros.

And in the USA more than 795'000 people have a stroke every year, with nearly 1 out of 4 people that have had a previous stroke. The 87% of all strokes are ischemic strokes. The overall healthcare cost of stroke in the USA is nearly 46 billion US dollars between 2014 and 2015 [7].

There is a variance in deaths by race and ethnicity. Black Americans are dying nearly twice as much as white Americans and have the highest rate of death due to stroke.

In a survey 93% of responders recognized sudden numbness on one side as a symptom of stroke. Only 38% were aware of all the main symptoms and knew to call the ambulance when someone was having a stroke. Patients that arrive at the emergency room within 3 hours of their first symptoms often have less disability 3 months after the stroke incident than those that received a delayed care [8].

2.2 Pathology and types of strokes

2.2.1 Overview

Ischemic stroke, also known as embolic stroke, occurs in around 85% of cases. A blood vessel in the brain becomes clogged, most typically as a result of a clot breaking loose elsewhere in the body and traveling to the brain via the bloodstream, blocking oxygen delivery and causing lesions in the unirrigated area. [4]

Stroke is mostly caused by atherosclerosis, a disease characterized by the growth of atherosclerotic plaques in the arteries' walls (a deposit of cholesterol, limestone and cells, which is surrounded by a fibrous cap). These plaques thicken the artery walls as they expand.

In the vast majority of cases, they stay stable and asymptomatic. Nonetheless, the fibrous cap can grow weak and break, releasing its contents into the circulation and causing the clot to form. An ischemic stroke occurs when a blood clot plugs a brain artery.

Hemorrhagic strokes, which originate from the rupture of a cerebral artery, account for the remaining 15% of accidents. The loss of value of specific cerebral arteries causes hemorrhagic stroke. When a cerebral vessel ruptures, causing bleeding (hemorrhage) somewhere in the nervous system, we call it a hemorrhagic stroke. The distinction between a hemorrhagic and an ischemic stroke is that an ischemic stroke occurs when an artery is blocked rather than ruptured.

The most common type of hemorrhagic stroke is intracerebral hemorrhagic stroke, which causes bleeding inside the brain tissue. Subarachnoid hemorrhagic stroke is a type of bleeding that occurs near the surface of the brain, between the brain and the meninges. Hemorrhagic strokes are less common than ischemic strokes, although they are more likely to result in mortality than ischemic strokes.

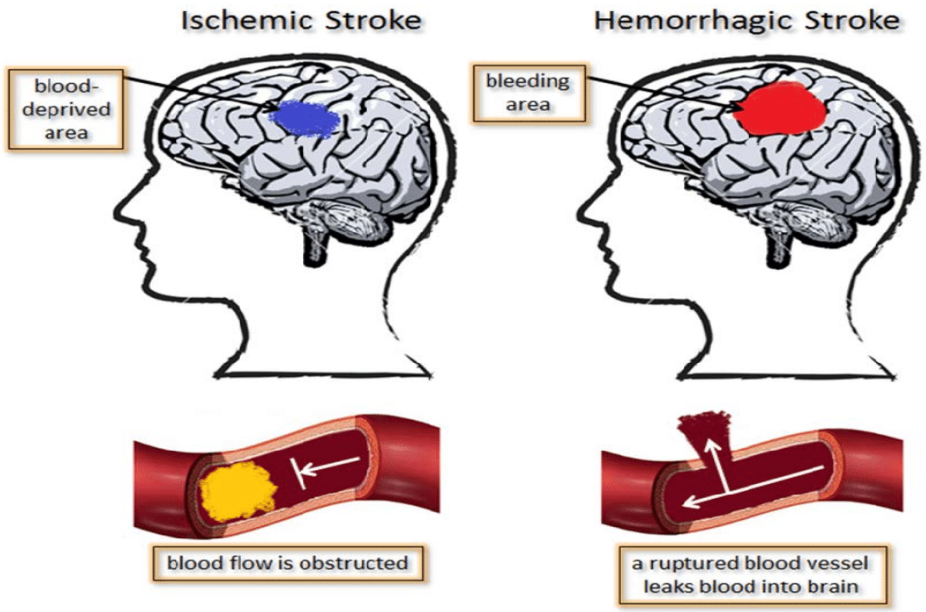

Figure 1: Ischemic versus Hemorrhagic stroke (Rebecca Ann Crouch).

2.2.2 Cerebral arteries and clinical manifestations after stroke

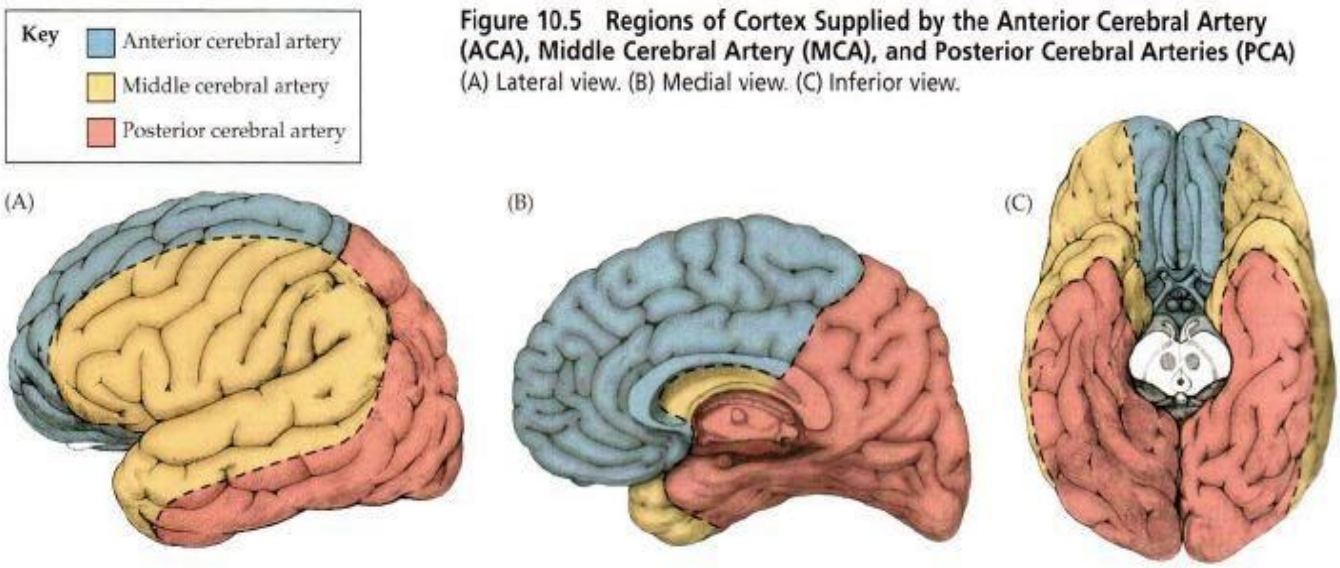

Figure 2: Anterior, Middle and Posterior cerebral artery territory (Stepwards, 2016).

Territory of the anterior cerebral artery

A) Right anterior cerebral artery

A motor deficit in the left lower extremity, sensory disorders of the left lower limb (sensory cortex), the presence of a pathological prehension reaction (grasping reflex), and behavioral and motor activity regulation disorders can all be the result of infarcted cerebral territories on the right side (psychomotor slowing, urination behavior, etc.).

B) Left anterior cerebral artery

A motor deficit of the right lower limb (left motor area of the leg), sensory disorders of the right lower limb (left sensory cortex), the presence of a pathological grasping reaction (grasping reflex), and behavioral and motor activity regulation disorders can all be caused by infarcted cerebral territories on the left anterior side (psychomotor slowing, urination behavior, etc.). Language difficulties may develop on the left side, depending on the magnitude of the infarction (aphasia).

Territory of the middle cerebral artery

Contralateral hemiplegia, hemianesthesia, and homonymous hemianopsia are all clinical symptoms of a blockage near the origin of the middle cerebral artery (reduced visual field). There are language difficulties when the dominant hemisphere (the one with the language center) is harmed (aphasia). There is hemi-negligence (the patient overlooks his left side of body), indifference to the patient's diseases (anosognosia), and apraxia when the minor hemisphere is damaged (impossibility of copying figures, etc.).

A) Superficial territories of the right middle cerebral artery (right superficial Sylvian fissure)

There is left hemiplegia with brachiofacial predominance and hemi-negligence on the left side of the body (variable intensity). When the sensory cortex is affected, these symptoms can be accompanied with sensory problems that are localized to the arm and

face.

B) Superficial territories of the left middle cerebral artery (left superficial Sylvian fissure)

A right hemiplegia with brachiofacial dominance and linguistic difficulties (Broca's aphasia) is present. When the sensory cortex is affected, these symptoms can be accompanied with sensory problems that are localized to the arm and face.

C) Lenticulostriate branches of the right middle cerebral artery (right Sylvian fissure)

On the right side, deep territorial infarction affects the lenticular nucleus, the internal capsule knee, and the caudate nucleus. This infarction causes global and proportional hemiplegia on the left side.

D) Lenticulostriate branches of the left middle cerebral artery (left sylvian softening)

On the left side, deep territorial infarction affects the lenticular nucleus, the internal capsule knee, and the caudate nucleus. It causes right hemiplegia that is both global and proportionate. Language difficulties (aphasia) can occur when a cerebral infarction extends into the cortex.

Territory of the posterior cerebral artery

A) Right posterior cerebral artery

Left hemianopsia can be caused by an infarction in the right occipital lobe's visual cortex (this may be the only clinical sign). The right posterior cerebral artery is involved in the vascularization of the right internal capsule, and its occlusion might result in a left-side motor deficiency. The loss of touch feeling and pricking on the left side of the body can be explained by a lesion of the right thalamus (hypoesthesia).

B) Left posterior cerebral artery

Right hemianopsia can be caused by an infarction in the visual cortex of the left

occipital lobe (this may be the only clinical sign). An infarction that extends to the bead of the corpus callosum might cause a breakdown in communication between the two visual cortices, resulting in reading problems without writing problems in certain cases (alexia without agraphia). The left posterior cerebral artery is involved in the vascularization of the left internal capsule, and its occlusion might result in a right-side motor deficiency. The loss of touch feeling and pricking on the right side of the body can be explained by a lesion of the left thalamus (hypoesthesia).

Territory of the basilar artery

From the meeting of the two vertebral arteries, the basilar trunk emerges. The infero-anterior cerebellar artery and the superior cerebellar artery, as well as perforators that vascularize the pons, arise from this trunk (ventral surface). Two posterior cerebral arteries branch off from the basilar trunk.

The severity of the symptoms is determined by the importance of the infarcted region. A total occlusion of the basilar trunk, for example, can cause motor dysfunction in all four limbs as well as a coma that leads to death.

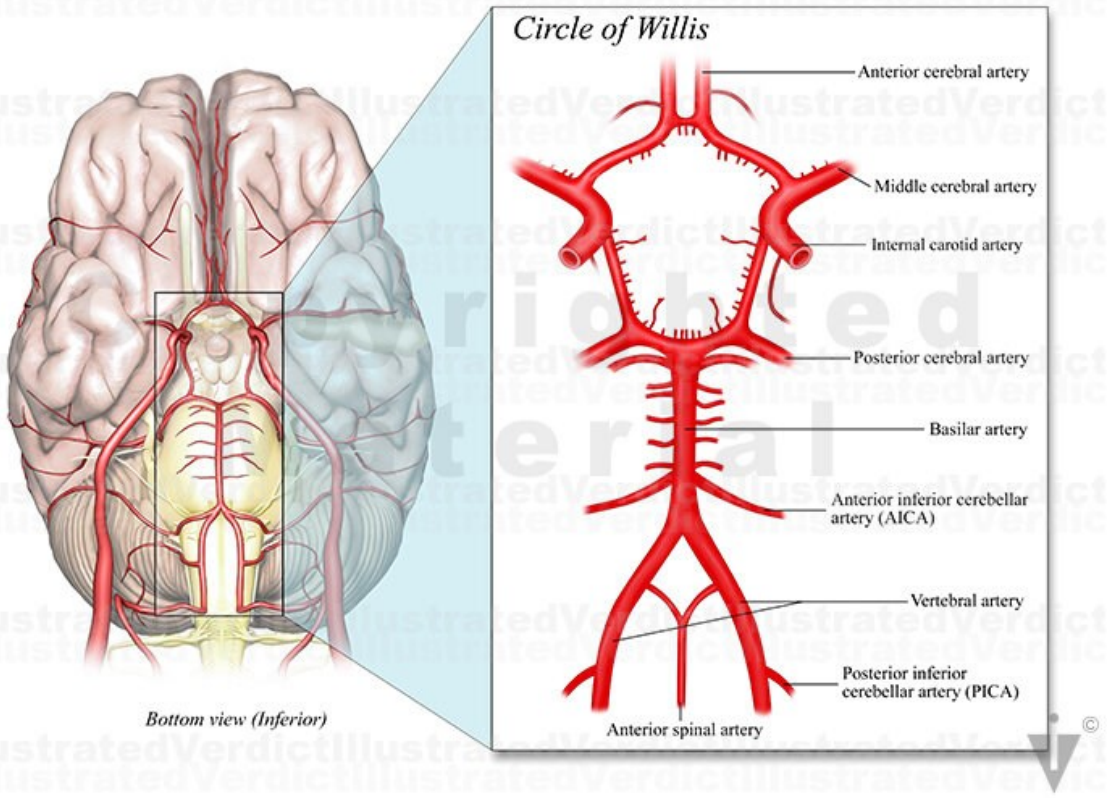

Figure 3: Inferior transversal view of arterial supply of the brain. (Illustrated Verdict, Inc.).

Territory of the vertebral artery

The two subclavicular arteries give rise to the two vertebral arteries. The basilar artery is formed when the two vertebral arteries unite at the medulla/pons. The lower surface of the cerebellum and the lateral half of the bulb are supplied by the posterior-inferior cerebellar artery (PICA), which arises from the vertebral artery. Cerebellar and/or bulbar infarction can result from a clogged artery in this location.

The lateral bulb (or Wallenberg) syndrome is characterized by the presence of posterior headaches, dizziness, nausea, swallowing disorders, facial hypoesthesia, and a cerebellar syndrome (disorders of standing, walking and execution of movements) and Claude-Bernard-Horner syndrome (drooping upper eyelid, contraction of the iris). A thermo-algic hemianesthesia of the upper and lower limbs might be found on the opposite side of the lesion. [33]

2.3 Risk factors

It exists modifiable and non-modifiable risk factors. The aging of the vessels and heredity play a role in the manifestation of a stroke. Yet, more than half of cases are due to atherosclerosis (also called arteriosclerosis). This disease, which affects the large and small arteries, progresses slowly.

Age and hereditary predisposition are two risk factors that cannot be changed. However, there are modifiable factors in which prevention is possible and important such as high blood pressure, smoking, cholesterol, atherosclerosis, diabetes, alcohol overconsumption, stress, physical inactivity, dyslipidemia, heart problems, sleep apnea syndrome.

Another risk factor that has been mentioned in this work is the history of a transient ischemic attack (TIA) incident or a prior incident of stroke.

The two most common causes of modifiable risk factors are hypertension and high blood pressure [21]. Arterial hypertension is generally asymptomatic, making it a silent condition. Regularly measuring blood pressure with a blood pressure monitor (self-measurement arm or wrist blood pressure monitor, or professional manual blood pressure

monitor at the doctor's office) is the best way to identify it.

Cardiovascular disorders are significant stroke risk factors. Hypertension that is too high has negative consequences for the heart. To pump blood through the arteries, it must work harder. As a result, the wall of the ventricle thickens and swells unnaturally. This hypertrophy can lead to heart failure, in which the heart is no longer able to perform its pumping function efficiently, as well as fatigue. Shortness of breath ensues, and the person may develop cardiovascular problems.

High blood pressure or hypertension mixed with diabetes mellitus has been proven as a stroke risk factor and is linked to individuals with atherosclerosis, according to studies and clinical research [17].

Diabetes is a chronic condition in which the body fails to make enough insulin or to utilise it efficiently (type 1 or type 2 diabetes) and it is also a risk factor for stroke. [22]

Insulin is used by the body to digest sugar and regulate blood sugar levels. Sugar, often known as glucose, is a vital source of energy for tissue, muscle, the heart, and the brain. The blood glucose level will be excessively high if the body fails to convert sugar into energy, which can damage organs and blood vessels and raise the risk of thrombotic arteries.

High blood pressure, artery narrowing (atherosclerosis), coronary heart disease, and stroke are all risks associated with diabetes. Diabetic patients are more likely to develop heart disease and stroke, among other illnesses.

A recently published study [18] has shown conclusions with connecting risks between triglyceride-glucose (TyG) and ischaemic stroke. They have concluded that elevated TyG is an independent predictor of ischaemic stroke, and that it might even have association with insulin resistance [18].

As of today in year 2022, the medical consensus on the sugar consumption is very unanimous. There is a general agreement that having too much sugar in the diet is very bad for the health and can lead to various diseases. Obesity and atherosclerosis are some of the diseases but also insulin resistance with diabetes mellitus is another. In fact, the connection between the three main diseases; diabetes, obesity and cardiovascular diseases is known as the “metabolic syndrome”.

Metabolic syndrome, also known as "syndrome X," is a condition that is not a disease in and of itself. Rather, it refers to the existence of a group of physiological markers that

raise the risk of type 2 diabetes, heart disease, and stroke.

2.4 Clinical assessment

2.4.1 Signs and Initial Diagnostic

The American stroke association recommends to the population to use the testing of a potential stroke by acting F.A.S.T. [4]

- **F** is for Face Dropping
- **A** is for Arm Weakness
- **S** is for Speech Difficulty
- **T** is for time to call.

In this order, the person that is next a patient that is having a stroke needs to act fast. The first step is to look at the face of the patient, ask him or her to smile. There is usually one side that is dropping and there is no possibility of control. The second test is to make the person raise their arms, if one of the arms is weak and is not raised it is a second sign of a stroke. The last sign before calling for an ambulance is the speech sign. If the person is not able to repeat and articulate clearly a few words, this is the time to call. Every minute counts

The neurologist orders various tests once arrived at the emergency room to figure out what caused the stroke and where the damaged area is [10].

- **CT scan**: This test, which is similar to an X-ray of the brain, determines whether you've had a stroke. It indicates whether you have had an ischemic stroke caused by a clot or a hemorrhagic stroke (cerebral hemorrhage) caused by bleeding.
- **MRI (magnetic resonance imaging):** this imaging technique employs a magnetic field system to produce images in the form of sections in all planes of space. This aids in the identification of abnormal tissue. MRI can also detect tiny lesions and aid in diagnosis refinement.

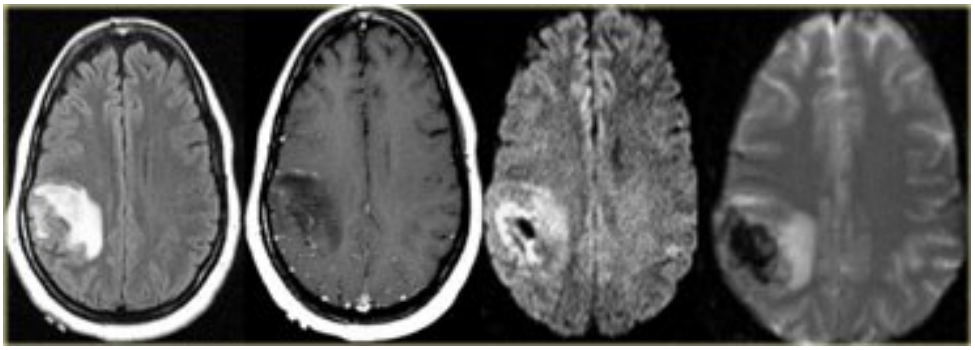

Figure 4: CT of a hemorrhagic stroke (Ashok Srinivasan et alRadioGraphics, 2006)

2.4.2 Additional tests

- **Doppler ultrasound**: During this procedure, ultrasound is used to determine the speed at which blood circulates, allowing doctors to determine whether an artery is narrowed. The arteries in the neck as well as those in the brain are seen.
- **Cardiac ultrasound**: an ultrasound examination that highlights the shape and inside of the heart. The image is viewed on a computer when a probe (sensor) is moved across the chest.
- **The Holter monitor or R-Test**: this test involves recording your heart's activity for 24 hours (or 7 days in the case of the R-Test) in order to discover cardiac rhythm problems. For 24 hours, a tiny box with electrodes is implanted on your chest, and you record your actions on a sheet (walking, meals, sleep, etc.).
- **Neuropsychological examination**: a neuropsychologist or a speech therapist uses tests to assess your language, memory, and understanding in order to pinpoint the nature of your cognitive issues. These tests last an average of two hours and are repeated to track the situation's progress. [10]

2.5 Kinesiophysiology of stroke patients

2.5.1 Kinesiological Diagnostic

Stroke causes a variety of deficiencies (motor, sensory, cognitive, and so on) that are responsible for restricting functions or capacities in everyday physical tasks. This assessment is completed in a multidisciplinary hospital setting, and it must be updated

upon return home, as well as subjected to periodic reassessment, which is coordinated by the attending physician. It addresses the following topics:

● Posture and gait

- a quantitative evaluation of balance and gait

-orthopedic evaluation

●Gestures and grip

● Swallowing and eating

- dynamic radiological study of swallowing (video)

●Vision

- visual field, Lancaster (strabismus), orthoptic evaluation, electronystagmography

● Communications

- Diagnosis of dysarthria, dyslexia, and other language and writing impairments

● Comprehension and expression

● Mood

● Cognitive functions (memory, temporo-spatial orientation, etc.)

- cognitive deficits, memory, attention, and executive function issues, neurovisual disorders...

● Bladder-sphincter control

- Ultrasound of the kidneys

- urodynamic exploration: flowmetry, cystometry and pressure profiling

-instantaneous urinary urethral, pelvic electromyogram (EMG)

● Tiredness

This evaluation should allow you to summarize the patient's shortcomings. He must be accompanied by an assessment of autonomy in everyday activities, with special attention paid to any actions that may be risky (car driving, gas, etc.).

Some strokes leave you completely reliant on others for all of your everyday tasks. These chronic states of full dependence correlate to either the locked-in syndrome (stroke in the basilar trunk territory), or pauci-relational or vegetative states (repeated or very big

strokes). Despite the severity of the trauma, some patients can be treated at home under the supervision of a doctor.

After a stroke, it is common for motor impairments to affect only one side of the body, which can create gait problems by disrupting balance. Because each hemisphere of the brain controls movement on the opposite side of the body, and strokes frequently affect only one hemisphere of the brain, not both, this effect occurs (although it is possible to suffer several strokes that can happen to different hemispheres).

As a result, right strokes have a greater impact on actions on the left side of the body, whereas left strokes have a greater impact on the right side. As a result, hemiparesis and hemiplegia, two illnesses affecting movement on one side of the body, are common stroke after effects.

Hemiparesis is characterized by weakness on one side of the body, whereas hemiplegia is characterized by paralysis that can be localized to the face, arm, or leg, but affects the entire side of the body.

Because all strokes are different, the degree of weakening or paralysis varies from person to person. Even if one has suffered hemiplegia or paralysis as a result of a stroke, recovery is still feasible for the majority of people. [16]

2.5.2 Complications:

Complications occur frequently during the course of a stroke, and their nature might vary greatly. It is the responsibility of the attending physician and the rest of the team to identify them as quickly as possible and treat them according to the specializations involved. [32]

● Neurological and psychiatric complications

- epilepsy
- muscle spasticity
- dementia

– depression

– anxiety

● **Falls**

- Fractures (x-rays)

● **Complications of hypomobility**

- thromboembolism (D-dimers, Venous Doppler ultrasound)

- tendon retractions and skeletal deformities, orthopedic complications (in particular equinus varus foot)

- skin complications : pressure sores, etc.

- constipation

● **Malnutrition or dehydration**

- ionogram, albumin, proteins

● **Pain**

- neurological pain

- shoulder-hand syndrome

- other pains

● **Infectious complications**

- blood count including platelets, CRP (C Reactive Protein)

- swallowing pneumonitis

-chest X-ray

- Urinary tract infection

–Cytobacteriological urinary test

- others: infectious complications of pressure sores, erysipelas, etc.

● **Hemorrhagic syndrome**

- INR, blood count including platelets, renal function depending on the context

2.6 Physiotherapy

The key to regaining the capacity to walk after a stroke is rehabilitation. It works by activating the brain with a variety of workouts and therapies. Physiotherapists are an important resource for regaining gait, posture, grip, and autonomy since they have completed training particularly designed to help people restore movement.

2.6.1 Gait training

Patients who have had a stroke are frequently sent to an inpatient rehabilitation clinic, where they participate in a variety of therapies for a few hours each day. The physiotherapist will lead patients through a series of exercises and activities aimed at restoring movement and coordination, strengthening muscles, and retraining the brain to control body movement.

The most crucial part of regaining gait after a stroke is brain retraining. The brain can rewire itself thanks to a mechanism known as neuroplasticity. It's the process of stimulating neural pathways in the brain to make it more efficient at everyday tasks, as well as the way we learn or relearn skills.

It's all about perseverance when it comes to relearning gait after a stroke. The brain rewires itself to the movement and improves gait by repeating physical therapy activities on a regular basis.

2.6.2 Exercising

A physiotherapist will do passive and passive-assistive exercises if the patient is unable to perform any active activities. It entails either using the uninjured side or soliciting the services of a physiotherapist to assist the affected limbs in doing the exercises. Despite the fact that the limbs do not actively perform the movements, these exercises stimulate the brain and promote neuroplasticity, particularly while focusing on their movements. The effects are usually gradual, occasionally preceded by muscle jerks

that indicate progress.

Other therapeutic approaches, such as electrical stimulation, are available. Electrical stimulation involves placing electrodes on the skin and applying a current to induce muscle contractions, which is still quite effective when focusing on the movements.

Functional electrostimulation, if used as soon as possible, will help in "recovery." It will be a matter of using light electrical impulses to artificially solicit muscles that are atrophying in order to restore their tone. All of this happens without any pain or effort.

Self-rehabilitation is achievable with this technique, especially since there are numerous dependable electrostimulation devices on the market, such as Neurotrac Rehab or Neurotrac Multi-Tens, that are well suited for personal usage. [34]

2.6.3 PNF

Definition

It was given its name by Hermann Kabat MD, PhD, Proprioceptive Neuromuscular Facilitation, or PNF. It is a method based on reciprocal inhibition and irradiation (phenomenon triggered by the resistance opposed to the contraction of a muscle resulting in the contraction of other muscles). This approach stimulates the neural system with sensory information from the surface (tactile) and deep (proprioceptive and arthro-kinetic) sources, causing the muscles to react and giving the patient a sense of movement. [19]

This technique is one of a range of techniques known as sensorimotor reprogramming. Through the application of facilitation techniques, it is possible to acquire the activation of muscle contractions. It involves reflexive, automatic, and voluntary motor movements. It's a three-dimensional motor method of active muscle building against manual resistance and tactile stimulation.

Principle

PNF is a treatment that involves making the patient do circular motions called diagonals in order to facilitate the appearance of coordinated and ordered motor activity in response to nervous system stimulation using exteroceptive and proprioceptive inputs.

Each diagonal is arranged using a three-dimensional structure, a direction, and an

execution speed. Each limb has two diagonals: one for the head and one for the trunk. Each diagonal has two kinetic drawings arranged by three components (abduction/adduction – extension/flexion – medial rotation/lateral rotation). The muscles used in kinetic sketching are part of a group of synergistic muscles used in everyday motions.

Facilitation techniques

The manual stimulations of the physiotherapist's hands on the patient's leg or arm are the source of exteroceptive and proprioceptive information that aid in the correct execution of the intended movement. Traction on the limb induces muscle contraction through a reflex stretch phenomenon, permitting a contraction reaction in the inadequate muscles.

The stretching stimuli are more efficient if they are repeated and timed with the patient's voluntary contraction effort. The physiotherapist encourages the patient to actively participate in the exercise by giving him clear and specific commands like "pull," "push," or "hold." The level of the patient's involvement is influenced by the tone of voice. He is encouraged to follow the movement with the eyes.

The resistance to the movement is steadily increased until it reaches its maximum at the end. It is administered with enough force to engage muscles while allowing voluntary movement to occur in all of its amplitude. Through the phenomena of spatial summation, this regulated opposition to movement allows for the recruitment of a large number of motor units. The rise in resistance generates an overflow phenomenon, which manifests itself as irradiation (a contraction overflow) that gradually reaches all of the movement's synergistic muscles. Weak muscles are being radiated by strong muscles.

The PNF concept uses different techniques grouped under two categories.

1) Strengthening techniques

- **Repeated contraction** - Isotonic contraction of the agonist against resistance, in the weakest part of the muscle, isometric contraction of all movement components.

- **Wait for irradiation** - We begin with a resistance-based isotonic contraction of the distal components of movement. Isometric contraction of the proximal movement components. We wait for irradiation from strong muscles to reach weaker muscles. After that, we complete the movement according to the pattern.
- **Hold-relaxation-active movement** - Begin with isometric contractions against the shortened agonist's resistance (finish position of the pattern). The pattern is relaxed and stretched passively. We finish with the agonist's isotonic contraction against resistance.
- **Rhythmic Initiation (pumping effect)** – Repetitive passive movement on agonist muscle, emphasis on distal part. After relaxation, isotonic contraction of agonist with help, without resistance and finally with resistance.
- **Slow reversal** - The antagonist contracts isotonically against resistance, followed by agonist contraction isotonically against resistance.
- **Slow reversal and hold -** isotonic contraction of antagonist with resistance, isometric contraction of antagonist against resistance, isotonic contraction of agonist against resistance, isometric contraction of agonist against resistance.
- **Dynamic Reversals** - Slowly isotonic contraction of agonist against resistance (from stretch to shortened state of muscle), then rapid helpful active movement of agonist back into shortened position, then isometric contraction of agonist against maximal resistance

2) Relaxation techniques

- **Contraction-relaxation** - A passive movement of the agonist into a position of restriction, isometric contraction of the antagonist, relaxation, and then another passive movement of the agonist.
- **Hold-Relaxation** - Active movement of the agonist into a restricted area, antagonist isometric contraction, relaxation, and isotonic contraction of the agonist without resistance
- **Slow reversal – hold – relaxation** - isotonic contraction of the agonist into a limited area (without resistance), antagonistic isometric contraction. Then with resistance, the agonist relaxes and contracts isotonically.

- **Rhythmic Stabilization** - isotonic contraction of the agonist into a limited area, antagonist and agonist contractions are isometric, The antagonist receives the final resistance, relaxation, and isotonic contraction of the agonist with resistance.

2.7 Prognosis and Prevalence of patients after stroke

2.7.1 General prognostics

Because all strokes are different, all stroke prognoses are different as well, resulting in a high level of variability in predicting stroke outcomes. Nonetheless, doctors can utilize several well-known factors to predict what to expect following a stroke.

The prognosis for stroke recovery is greatly affected by how early the treatment started. A stroke that is severe or untreated might be fatal. In recent years, breakthroughs in diagnosis and therapy have lowered the death rate.

Patients who receive treatment within the first three hours after a stroke frequently have less disability after three months than those who receive treatment later [21].

That is to say, time is synonymous with the brain! When it comes to restoring blood flow to the brain, the sooner the better. When it comes to restoring blood flow to the brain, the sooner the better.

The survivor's age, like the timing of stroke therapy, has an impact on the prognosis of a long-term stroke.

Overall, younger stroke survivors have a higher survival rate than older survivors.

2.7.2 Statistics

Cardiovascular diseases are responsible for 160,264 deaths in 2021 in USA. Making it the fifth cause of deaths in USA [21].

To put it into perspective, some statistics are listed below:

- A stroke affects more than 795,000 people in the United States each year. The first or new strokes account for around 610,000 of these. [22]
- Every 40 seconds, someone in the United States gets a stroke and every 4 minutes someone dies from stroke. [22]

- A total of 185,000 strokes occurs in people who have already had a stroke, accounting for approximately one-fourth of all strokes. [22] Ischemic strokes being accounted for about 87 percent of all strokes.
- Black Americans have approximately twice the risk of getting a first stroke as white Americans (2)
- Black Americans have the greatest rate of stroke-related death.
- Despite the fact that stroke death rates have been down for decades across the board, Hispanic Americans have observed an uptick in death rates since 2013 [5]

In Europe we can see also a decline of stroke deaths in the last years. Although the frequency of stroke deaths has decreased over the last 35 years, considerable discrepancies still exist between countries. Even though the total stroke rate is declining, we observe increasing rates in young adults. [1]

According to a study published in 2018 in the European Heart Journal, the number of deaths from cerebrovascular accident (stroke) is reducing in Europe generally, although this decline is slowing in some countries, particularly in the West. Between 1980 and 2016, the study looked at the evolution of mortality from three forms of cerebrovascular illness in 50 nations across Europe, led by Dr Nick Townsend, professor of epidemiology at the University of Bath, United Kingdom.

In 34 nations, the researchers discovered a decreased trend in the number of deaths, mainly in Western Europe [23]. The death rate from cardiovascular diseases has declined by 2.7 percent over the last three decades. This trend is slowing in France, where mortality has dropped by 4.3 points in 36 years. Other nations, such as Austria, Denmark, Germany, Greece, the Czech Republic, and Hungary, are also in this scenario. At the same time, the death rates in those four nations have risen: Azerbaijan, Georgia, Tajikistan, and Uzbekistan [23].

These developments are attributed to an increase in specific risk factors. The substantial rise in the incidence of overweight, obesity, and diabetes in Europe over the last 30 years, as well as the recent stabilization of smoking prevalence and cholesterol levels in several countries after sharp declines.

When the size of the population and age distribution are taken into account, stroke

mortality rates in Western Europe are substantially lower than the rest of the continent. In Western Europe, death rates for men range from 49 per 100,000 in France to 131 per 100,000 in San Marino (a microstate in north-central Italy). Male mortality rates ranged from 110 per 100,000 in the Czech Republic and 391 per 100,000 in. Male mortality rates in Eastern Europe ranged from 82 in Estonia to 331 in Russia per 100,000 people. Finally, they reach 345 deaths per 100,000 people in Azerbaijan, a Central Asian country.

2.7.3 Conclusion of prognosis

In conclusion, for the prognosis of patients with stroke there are multiple factors that need to be taken into consideration. The speed of first response is one of the most important factors that is going to make a big difference in the recovery of the patient and in some cases, it is a matter of life or death if left untreated for long time.

The quality and speed of diagnosis is also crucial as it is imperative to prescribe a correct and useful therapy plan for the patient. Therefore, the location of the patient when having the stroke accident is very crucial because of those two factors mentioned above. If the patient is living in an isolated area with no hospital nearby, the time lost in waiting for the ambulance for example will be crucial time when part of the brain is deprived of oxygen, and therefore making more damage. In contrast, if the patient's location is in the center of a big city and closed to the hospital, he will have better chances of survival and better of recovery due to the time advantage. Time is the most important aspect of prevention and assuring a good prognosis for the patient.

3 CASE study

3.1 Methodology

My Bachelor's clinical work placement took place at the Beroun Rehabilitation Hospital from 10th of January till the 14th of February 2022. Four weeks of practice, from Monday to Friday every morning for a duration 4 hours every day.

During my clinical practice my work was supervised by the physiotherapist BSc. Ales Nesvadba which helped me choose my patient for this bachelor's thesis.

The patient came as inpatient for two weeks in January 19th 2022 until February 2nd 2022. He had a panel of therapies organized for him from ergotherapy to physiotherapy. The physiotherapy sessions were provided by me with the supervision of my supervisor BSc. Ales Nesvadba. The total of sessions we had together were ten sessions.

The therapies used were mostly manual therapy and active-assistive exercises. Instruments were also used such as the goniometer, plumb line and a neurological hammer for testing the patient.

3.1.1 Anamnesis

Student: Alexandros Adamantiadis

Work place: Beroun Hospital

Supervisor name: Ales Nesvadba

Date of first visit: 19 January 2022

Patient's initials: V.S

Date of birth: 1950

Gender: Male

Diagnosis: Left hemiparesis after Hemorrhagic stroke in 2017

Status praesens:

- Height: 1.75 m
- Weight: 100 kg
- Body mass index: 32.0
- Blood pressure: 162/95mmHg
- Temperature: 36.5°C

a) objective: BP: 162/95mmHg, Temp: 36.5°C, Weight: 100kg, Height 175cm BMI: 32
51 year old man, Lucid-Oriented, Jaundice-free, at rest eupnea, afebrile, ameningeal, scar after craniotomy healed, eyes- ears - nose without discharge, isocoria, n.VII left hyperesthesia L ½ of the face
Very mild dysarthria, disorder of orientation and acalculia, mild cognitive deficit, left spastic hemiparesis with maximum on acral parts, respiratory stereotype normal. he is not self-sufficient in walking but can go a small distance with assistance and the 4-point stick
Manages transfers from the wheelchair, for walking with a four-point cane, he needs to be supported by 2nd person when walking (fell 2x), needs help with hygiene, cutting food, but without swallowing or sphincter problems. He doesn't complain of any pain
Afebrile, without angina, shortness of breath

b) **subjective:** He has what it looks like a “mini” epileptic seizure after laying on the table from the wheelchair. He is able to move himself on the table and as soon as he is laying down a few seconds of mini-seizure occurs, and then he comes back to normal again. After a big effort or a more physically demanding exercise, he would also have these epileptic seizures that only lasted for two to three seconds. He is complaining of a lower back pain. Also, he has difficulties with walking and ADL.

3.1.2 Medical history

51years old, hypertensive with hyperlipidemia, admitted for intensive rehabilitation after hemorrhagic stroke from 6-7/2017, Arteriovenous malformation in Posterior Cerebral Artery, hematoma evacuation performed, relieving craniotomy (5/2018)
Clinically severe left-sided spastic hemiparesis (with emphasis on LE), mild dysarthria and mild cognitive deficit, poorer orientation in space.

3.1.3 Previous rehabilitation

Rehabilitation clinic in Janske lazne and Kladruby, outpatient training (no dates provided).
Observed at the RHB ambulance in Nemocnice Tabor

3.1.4 Indication of rehabilitation

One time per day, kinesiological analysis in the beginning and in the end of the stay, PNF, Vojta therapy, Prevention of contractures, Sensomotoric stimulations, strengthening of weakened structures, ADL, Soft Tissue, release spastic muscles, Gait exercising with four-point stick (need at least 1 person), hand motor training and fine motor skills training.

3.2 Initial kinesiological examination

Performed on 19 January 2022

- Postural examination
- Gait examination
- Pelvic palpation
- Anthropometry
- Measurement of Range of Motion
- Manual muscle strength test
- Muscle tone palpation
- Muscle length test by Janda or Kendall
- Dermatome testing
- Deep sensation testing
- Neurological examination

3.2.1 Postural examination

During the examination the patient was not able to stand without the help of an assistive four-point crutch. His body is shifting to the right side and almost no weight is put on the left lower extremity.

a) Plumb line test

- Back view:

  -**Base of support**: it is narrow between the feet

  -**Weight baring**: his body weight is all shifted to the right side, he is holding a four-point cane that is quite far from his feet and it is the only way for him to stay verticalized.

  -**Feet and Ankle joints position and shape**: his right ankle is normal, right foot is slightly inner rotated and flat foot. the left ankle is plantar flexed and everted, the left foot is only touching on the toes with emphasis on the big toe.

  The right foot is more forward than the left

-**Calf muscles**: The left calf muscles are more activated and shortened than the right one.

-**Knee Joint**: Flexion of the left knee

-**Pelvis position**: the pelvis is shifted to the right side and is higher on the right side, also there is a slight left rotation of the pelvis, right side is more forward

-**Paravertebral muscles**: the left side is shorter and more hypertonic, because of the body's shift to the right, the left side of the trunk is shorter.

-**Spine**: there is a spine curvature and shift on the right side, scoliotic

-**Scapulas**: the right scapula is elevated and protracted, the left lower angle of scapula is adducted

-**Shoulder**: Right shoulder protracted and elevated due to the four-point cane he is holding for stability, external rotation of right shoulder

-**Head**: aaashifted to the right side with a slight left lateroflexion and left rotation

- Side view Right:

  -**Ankle joint and foot position**: right foot forwards, flat foot

  -**Knee joints**: the left knee joint is in flexion, right knee fully extended

  -**Pelvis**: Anterior tilt (ASIS is lower than the PSIS), the right side of pelvis is shifted anteriorly (right side forward or left rotation of pelvis)

  -**Spine and trunk**: from the right side the trunk elongated due to the pressure from the four-point cane is stretching the right side of the body, trunk is shifted towards the right side and his weight is shifted to the right side as well

  -**Upper extremities**: extended right elbow and the right hand is griping on the cane, the weight baring is mostly on the right leg and the right upper extremity

  -**Shoulder girdle**: protraction of the right shoulder, elevation and external rotation of the shoulder due to the four-point crutch

  -**Head**: slight protraction of the head and left rotation, there is also a shift laterally towards the right side

- Side view Left:

  -**Ankle joints and foot position**: the right foot is more forward than the left, the

left foot is only touching the ground with the toes. There is a plantar flexion of the left foot as well as an eversion. There is not a lot of weight baring on the left foot. Majority of the weight is distributed in the right lower limb and the four-point cane.

-**Knee joints**: the left knee is flexed, right knee is fully extended

-**Pelvis**: Left rotation of the pelvis, also the pelvis is shifted laterally towards the right

-**Spine and trunk**: the left side of the trunk is shortened, Hip-rib impingement

-**Upper extremities**: the left upper extremity is in a spastic pattern, elbow is in flexion, forearm is pronated and wrist is flexed, the fingers are also in flexion making almost a fist

-**Shoulder girdle**: protraction of shoulder, internally rotated and the shoulder is elevated

-**Head**: the head is in slight left rotation, protracted and laterally shifted on the right side of the body

- Front view:

-**Base of support**: smaller surface between the feet, narrow base, his main support is by the left foot and the four-point crutch.

-**Feet position and weight distribution**: left foot in extreme eversion and plantar flexion, only the toes are touching the ground on the left foot. The right foot is taking most of the load and there is a visible flatfoot on the right side. The weight is also distributed in the right upper extremity with the help of the four-point cane.

-**Ankle joints position and shape**: Right ankle is ideal, left ankle in eversion and plantar flexion

-**Knee joint:** The left knee is in inner rotation and slightly bent

-**Pelvis position:** There is a pelvic shift to the right side, the right side is also higher than the left

-**Abdominal line and thorax:** there is a curve of convexity in direction of the right side giving an impression of scoliotic spine, the thorax is shifted to the right side

-**Clavicle**: The right clavicle is higher than the left, the pressure on the cane is pushing the clavicle up.

-**Shoulder**: The left shoulder is in protraction and slight internal rotation, the right shoulder is higher due to the pushing on the cane

-**Upper extremity position**: His left arm is in a spastic position, inner rotation of shoulder, protracted, flexion of elbow, pronation of forearm, flexion of wrist and fingers. The right side is holding on the cane.

-**Head**: The head is shifted to the right side as is all his body due to the right-side weight baring. His neck is slightly laterally flexed on the left side and rotated to the left.

3.2.2 Gait examination

The patient has a general instability in standing position as well as walking. He can only stand with a crutch with four points of contact. He also needs the support of at least one person.

- Width of the base of support is very narrow
- Walking type is hemiplegic gait
- Walking speed is slow
- Stride length, in both legs it is short but in the left side the strides are shorter than the right leg. The right leg going forwards and leading the gait, the left leg is following behind and does not swing.
- Movement of the foot on the right side it is normal, on the left side there is a very big stiffness in plantar flexion, the left foot doesn't touch in its entirety but only touches the ground with the toes and especially the hallux due to the eversion and plantar flexion of the foot
- Movement of the knees are not optimal. There is almost no flexion in the right knee as for the left knee it is in flexion position and does not extend.
- Movement of the hip joints: the right hip is moving more forward (left rotation of pelvis) than the left in such way that it is leading the gait, the left side is hanging and making a slight circumduction
- Movement of the trunk is quite big and it is moving a lot in the frontal plane. He is

trying to shift his weight from one leg to another but also, he is using the four-point cane and the center of balance is getting much more outside of the body. Therefore, he has to move much more from side to side.

- The paravertebral muscles and the muscles of the back are asymmetrically activated. The left side is more contracted and shortened than the right side, the fact that he is putting almost all his weight on the right side and that his whole body is shifting to the right the paravertebral muscles on the right side are going to be automatically less active
- The abdomen muscles are hard to determine besides that he is in the obese side of the spectrum. When walking he is using a lot the right leg swing technique and not so much his deep muscles. The right hip is moving and the rest of the body follows.
- The position of the head is shifting on the right but going in a slight left lateroflexion in every right leg swing.
- His stability is very poor, he is quite unstable even with the four-point crutch but he is able to walk on his own without further assistance. Of course, he needs a person to be next to him in case he falls or missteps or even when he is feeling tired.
- He cannot walk for a very long distance (approximately 20meters); he gets easily fatigued and needs a rest.

Gait modification:

- His instability is great and the confidence of the patient is very low. We did not perform any modification gait as it would increase dramatically the chances of him falling. Having the patient with a level of 32 BMI, even without the hemiparesis, it can be very challenging to make gait modifications. Therefore, for these reasons we decided with the not to examine that.

3.2.3 Pelvic examination

- Iliac crest: right side higher
- Posterior superior iliac spines (PSIS): higher on the right side

- Anterior superior iliac spines (ASIS): higher on the left side
- ASIS and PSIS (right side): The ASIS is lower than the PSIS
- ASIS and PSIS (left side): The ASIS is in a slightly lower level than the PSIS

3.2.4 Anthropometry

Lower Extremity									
	Length (cm)				Circumference (cm)				
	Anatomical	Thigh	Mid-Leg	Foot	Thigh	Knee	Calf	Ankle	Foot
Right	81.5	48	39	26	68	45	39.5	30	31
Left	81.5	48	39	26	68	45	39	30	31
Upper Extremity									
	Length (cm)				Circumference (cm)				
	Anatomical	Humerus	Forearm	Hand	Upper arm Relaxed	Upper Arm Flexed	Elbow	Forearm	Metacarpal
Right	75	31	27	20	34.5	35.5	27	26.5	21
Left	75	31	27	20	34	34	27	26	21
Other (cm)									
Height	Arm Spam	Head	Thorax Middle	Thorax Xiph.	Middle Max. Ins	Middle Max Exp	Xiph. Inspirat	Xiph. Expirate	Cir. Waist
175	X	69	100	103	107	102	106	101	125
Cir.Hips	Biacromial	Bicristal	Bispinal	Bitrochant.					
105	46	65	51	70					

Table 1: The anthropometry results of the lower extremity and upper extremity were taken during the initial examination.

3.2.5 Assessment of stereotype (pattern) or breathing (in various positions)

- Standing: Upper thoracic when breathing in, then abdominal. And during the expiration the abdominal goes first and then the middle and then upper thoracic,
- Sitting: Abdominal, diaphragmatic breathing
- Supine: We can see a full abdominal breathing pattern in the supine position, diaphragmatic breathing

3.2.6 Measurement of Range of Motion (According to Janda, STFR method)

	Shoulder					
	Extension	**Flexion**	**Abduction**	**Adduction**	**External Rot**	**Internal Rot**
Passive ROM	Left **S:** 10-0-150		Left **F**: 110-0-120		Left **R**: 30-0-90	
	Right **S**: 40-0-175		Right **F**: 170-0-120		Right **R**: 75-0-90	
Active ROM	Left **S**: 0-0-25		Left **F**: 15-0-105		Left **R**: 0-0-90	
	Right **S**: 30-0-170		Right **F**: 165-0-125		Right **R**: 70-0-90	
Norm Janda	***0-30/60***	***0-160/180***	***0-90/180***	***0-120/130***	***0-55/95***	***0-45/90***
	Elbow					
	Extension	**Flexion**	**Supination**	**Pronation**		
Passive ROM	Left **S**: 0-0-145		Left **R**: 70-0-90			
	Right **S**: 0-0-150		Right **R**: 85-0-90			
Active ROM	Left **S**: 0-75-145		Left **R**: 0-45-90			
	Right **S**: 0-0-150		Right **R**: 85-0-90			

Norm Janda	***0-0/10***	***0-145/150***	***0-80/90***	***0-80/90***		
	Wrist		**Radial-Ulnar**		**Metacarpal joints**	
	Extension	**Flexion**	**R-duction**	**U-Duction**	**Extension**	**Flexion**
Passive ROM	Left **S**: 70-0-90		Left **F**: 05-0-35		Left **S**: 10-0-90	
	Right **S** : 80-0-80		Right **F** : 15-0-35		Right **S** : 15 -0-90	
Active ROM	Left **S**: 0-85-85		Left **F** : 0-20-30		Left **S**: 0-85-85	
	Right **S** : 75-0-80		Right **F** : 10-0-30		Right **S** : 05-0-90	
Norm Janda	***0-70/85***	***0-80/90***	***0-15/20***	***0-30/35***	***0-10/45***	***0-90***
	Thumb CMC		**Thumb MCP**		**Thumb IP**	
	Extension	**Flexion**	**Extension**	**Flexion**	**Extension**	**Flexion**
Passive ROM	Left **S**: 0-30-40		Left **S**: 0-0-80		Left **S**: 0-0- 90	
	Right **S**: 10-0-30		Right **S**: 0-0-60		Right **S**: 0-0- 90	
Active ROM	Left **S**: 0-30-35		Left **S**: 0-65-75		Left **S**: 0-80-90	
	Right **S**: 15-0-35		Right **S**: 0-0-50		Right **S**: 0-0-90	
Norm Janda	***0-0/20***	***0-15/45***	***0-0/10***	***0-50/80***	***0-0/10***	***0-80/90***
	Hip Joint					
	Extension	**Flexion**	**Abduction**	**Adduction**	**External R**	**Internal R**

Passive ROM	Left **S**: 10-0-125		Left **F**: 25-0-30		Left **R**: 25-0-30	
	Right **S**: 25-0-125		Right **F**: 30-0-35		Right **R**: 50-0-35	
Active ROM	Left **S**: 0-10-10		Left **F**: 5-0-30		Left **R**: 0-0-20	
	Right **S**: 20-0-120		Right **F**: 30-0-40		Right **R**: 40-0-30	
Norm Janda	***0-10/30***	***0-120/135***	***0-10/30***	***0-30/50***	***0-45/60***	***0-30/45***
	Knee		**Ankle**			
	Extension	**Flexion**	**Dorsal Flex**	**Plantar Flex**	**Eversion**	**Inversion**
Passive ROM	Left **S**: 0-0-155		Left **S**: 0-10-50		Left **R**: 30-5-0	
	Right **S**: 0-0-150		Right **S**: 15-0-45		Right **R**: 20-0-35	
Active ROM	Left **S**: 0-15-150		Left **S**: 0-40-45		Left **R**: 25-25-0	
	Right **S**: 0-0-150		Right **S**: 10-0-45		Right **R**: 15-0-35	
Norm Janda	***0-0/10***	***0-125/160***	***0-10/30***	***0-45/50***	***0-15/30***	***0-35/50***
	Toe MTP I		**Spine**			
	Extention	**Flexion**	**Ext Cervical**	**Flex Cervical**	**Lat Flx Left**	**Lat Flx Right**
Passive ROM	Left **S**: 45-0-50		**S :** 45-0-45		**F :** 45-0-30	
	Right **S**: 85-0-50					
Active ROM	Left **S**: 0-40-40		**S :** 40-0-40		**F :** 40-0-15	
	Right **S**: 75-0-45					

Norm Janda	*0-40/90*	*0-40/50*	*0-45/75*	*0-40/45*	*0-0/45*	*0-0/45*
	Cervical Spine		**Thoracic + Lumbar Spine**			
	Rotation L	**Rotation R**	**Lat Flx Left**	**Lat Flx R**	**Rotation L**	**Rotation R**
Passive ROM	T : 60-0-55		30-0-25		25-0-20	
Active ROM	T : 50-0-55		35-0-20		20-0-15	
Norm Janda	*0-50/60*	*0-50/60*	*0-35/40*	*0-35/40*	*0-20/45*	*0-20/45*

Table 2: The Range of motion results of the lower extremity, upper extremity and trunk were taken during the initial examination.

3.2.7 Manual muscle strength test (according to Kendall)

	Origin / Insertion	**Grade L**	**Grade R**
Upper Extremity			
ADD pollicis	MCP / Phalanx	4+	5
ABD pollicis brevis	Trapezium Scaphoid/Phalanx	0	5
Opponens pollicis	Trapezium/ 1st MC	5	5
Flexor pollicis longus FLEXOR pollicis brevis	M epicondyle/ Phalanx Carpal B./Phalanx	1	5
EXTENSOR pollicis longus Extensor pollicis brevis	Ulna / Phalanx Radius /Phalanx	0	5
ABDUCTOR POLUCIS LONGUS	Radius, Ulna/ MCP	0	5
ABDUCTOR DIGITI MINIMI	Pisiform / Phalanx	0	5
OPPONENS DIGITI MINIMI	Hamate / 5th MCP	4	5
FLEXOR DIGITI MINIMI	Hamate / Phalanx	4+	5
DORSAL INTEROSSEI	2-4 MC / Phalanx	0	4
PALMAR INTEROSSEI	1-5 MC / Phalanx	4	5
LUMBRICALES	Flx profundus Tendon / MCP	5	5
PALMARIS LONGUS	M.Epicond/ Palmar Aponevrosis	4	5
PALMARIS BREVIS	Palm Apon/ skin ulnar border	4	5
EXTENSOR INDICIS	Ulna / Ext.dig.Long.	0	5
EXTENSOR DIGITI MINIMI	Lat Epi / Ext. Exp 5th finger	0	5
EXTENSOR DIGITORUM	Lat epi/ 2-5 prox, med, dist. Phalanx	0	5
FLEXOR DIGITORUM SUPERFICIALIS	Med Epi / Med phal	5	5

FLEXOR DIGITORUM PROFUNDUS	Ulna / distal Phal	5	5
FLEXOR CARPI RADIALIS	Med Epi / MC 2-3	4	5
Flexor carpi ulnaris	Med Ep / Pisiform	5	5
EXTENSOR CARPI RADIALIS LONGUS	Lat Supracond/ 2nd MCP	0	5
EXTENSOR CARPI RADIALIS BREVIS	Lat Epi / 3rd MCP	0	5
EXTENSOR CARPI ULNARIS	Lat Epi / 5th MCP	0	5
PRONATOR TERES PRONATOR QUADRATUS	Med Epi / Radius Ulna / Radius	5	5
SUPINATOR	Lat Epi / Radius	0	5
BRACHIORADIALIS	Humerus / Radius	5	5
Coracobrachialis	Coracoid / Humerus	4	5
BICEPS BRACHII	CoracoidSupraglenoid /Radius	5	5
BRACHIALS	Humerus / Ulna	5	5
TRICEPS BRACHII	Infraglenoid / olecran	1	5
SUPRASPINATUS	Supraspinatus fossa / Humerus	4	5
DELTOID	Clavicle-Acrom-Spina scap / Humerus	1	5
ANTERIOR DELTOID		2-	5
POSTERIOR DELTOID		1	5
Pectoralis major	Clav Stern / Humerus	4+	5
PECTORALIS MINOR	3-5 ribs / Coracoid	4	5
LATISSIMUS DORSI	Th-Lumb-sacr/Hume.	5	5
INFRASPINATUS TERES MINOR	Infrasp fossa / Gr tub Infrasp fossa / Gr tub	0	5
mm.RHOMBOIDEI	Th1-5 /Med Scapula	1	5
LEVATOR SCAPULAE TRAPEZIUS Upper	C1-4 / Sup angle Scap C1-Th12 /Clav Scap Acr	4	5
SERRATUS ANTERIOR	1-9 ribs / Med Scapul	4	5

Lower extremity

GLUTEUS MAXIMUS	Illium / iliotibial tract	1	3+
PSOAS ILIACUS	Lumb /lessTrochanter Iliac fossa / less troch	2-	4
SARTORIUS	ASIS / tibia	1	4
TENSOR FASCIAE LATAE	ASIS / iliotibial tract	1	4
QUADRICEPS FEMORIS	ASIS,Troch /Tibia Patella	1	5
PECTINEUS ADDUCTOR MAGNUS GRACILIS ADDUCTOR LONGUS ADDUCTOR BREVIS	Pubis / femur Pubis ramus / linea aspera Symphysis Pubis/Tibia Pubis / Linea aspera Pubis/ Linea aspera	2+	4+
GLUTEUS MINIMUS	Gluteal line / Gr Trochanter	1	5

GLUTEUS MEDIUS	Iliac / greater trochanter	1	5
External Hip Rotators (QUADRATUS FEMORIS, OBTURATOR INTERNUS AND EXTERNUS, GEMELLUS SUPERIOR AND INFERIOR, PIRIFORMIS)	Sacrum, ischium, pubic bone, iliac crest / Greater trochanter of the femur	0	5
Internal Hip Rotators (TENSOR FASCIAE LATAE, GLUTEUS MINIMUS AND GLUTEUS MEDIUS)	ASIS / iliotibial tract, trochanter	2+	5
SEMITENDINOSUS, SEMIMEMBRANOSUS – medial hamstrings	Ischium / Medial condyle of tibia	4	5
BICEPS FEMORIS – lateral hamstrings	Ischium linea aspera / fibula, tibia	2	5
GASTROCNEMIUS	Condyle femur / calcaneus	5	5
SOLEUS	FibulaTibia /Achilles tendon	4	5
PLANTARIS	LatSupracondyl / Calcaneus	5	5
PERONEUS LONGUS, PERONEUS BREVIS	Tibia, fibula / MT cuneiform	1	5
TIBIALIS POSTERIOR	Tibia, fibula / 2-4 MT, Tarsal	5	5
TIBIALIS ANTERIOR	Tibia / cuneiform, 1st MT	0	5
EXTENSOR HALLUCIS LONGUS	Fibula / distal phalanx 1st	0	5
EXTENSOR HALLUCIS BREVIS	Calcaneus / prox Phal.1st	0	5
EXTENSOR DIGITORUM LONGUS	Lat condyle tibia/ Dist Phal	0	5
EXTENSOR DIGITORUM BREVIS	Calcaneus / ext tendons	0	5
FLEXOR HALLUCIS LONGUS	Fibula / distal Phal 1st	5	5
FLEXOR HALLUCIS BREVIS	Cuboid, cunei / Prox. Phal	5	5
FLEXOR DIGITORUM LONGUS	Tibia / 2-5 distal Phal	5	5
FLEXOR DIGITORUM BREVIS	Calc / Middle Phal 2-5	5	5
Quadratus Plantae	Calcaneus / Tendon Dig Lon	5	5
PLANTAR INTEROSSEI	MT 3-5 / Proximal Phal 3-5	4	5
DORSAL INTEROSSEI	MT 2-4 / Prox Phal 2-5	0	5
LUMBRICALES	Flex dig Long Tend / 2-5 Ph	5	5
ABDUCTOR HALLUCIS	Calcaneus/ Proximal 1st Ph	0	5
ADDUCTOR HALLUCIS	2-4 MT / Prox Phal 1st	4+	5

Trunk, Spine

Scalenus Ant Med Post	C2-C7 / 1-2nd ribs	5
Longus Colli	Ant surf C3-T3 / C1-C6	4
Longus Capitis	Transv C3-6 / Occiput	4
Sternocleidomastoid	Sternum,Clavicle/Mastoid	4
Iliocostalis cervicis	Sacr, iliac crest, Th / Ribs	4
Longissimus capitis	Th4-5, C5-7/ Mastoid	4

Longissimus cervicis	T1-5 / C2-6	4	
Spinalis cervicis	C4-C6 / C2-C4	4	
Cervicis	Spin Pr T3-6/ Trans C1-3	4	
Rectus abdominis (Flexion) Obliquus Ext-Int Abdominis	Pubic symph / xiph, ribs Ribs 5-12 / pubic tub, iliac	3+	
Iliocostalis (extension) Spinalis (extension)	Ribs 3-12 sacr iliac/ C4-L4 Th spinous pr/ C2-C5	3+	
Quadratus Lumborum	Iliac, lumbar v / Last rib	5	4+

Table 3: The Muscle strength test results of the lower extremity, upper extremity and trunk were taken during the initial examination.

3.2.8 Facial Muscles Strength Test (According to Kendall)

	Action	**Left**	**Right**
Frontalis	Raise the eyebrows	5	5
Corrugator Supercilii	Draw eyebrows together	5	5
Nasalis	Widen apertures of nostrils	5	5
Depressor Septi	Draw point of nose downward	5	5
Procerus	Agry face, skin of nose upward	5	5
Levator Anguli Oris	Angle of mouth upward	4	5
Risorus	Fake smile	4	5
Zygomaticus	Genuine smile	4	5
Levator Labii Superioris	Raise and protrude upper lip	5	5
Depressor Labii Inferioris Platysma	Lower lip downward and outward	5	5
Orbicularis Oris	Kiss motion	5	5
Buccinator	Blow air in mouth and keep the tension	5	5
Mentalis	Raise skin of chin, lower lip protruding	5	5

Depressor Anguli Oris	Sad face, angles of mouth downwards	5	5
Pterygoideus Medialis and Lateralis	Protrude lower jaw, show lower teeth	5	5
Temporalis Masseter Pterygoideus medialis	Bite firmly	5	5
Orbicularis Oculi	Close eye	5	5
Suprahyoid Muscles	Depress lower jaw, open mouth	5	5
Infrahyoid Muscles	Depression of hyoid bone	5	5
Rectus Medialis Oculi	Look horizontaly inward towards the nose	5	5
Rectus Lateralis Oculi	Look horizontaly outward away from nose	5	5
Levator Palpabrae Superioris	Raise upper lid	5	5
Rectus superior Oblicus inferior	Look up	5	5
Rectus inferior Oblicquus superior	Look down	5	5

Table 4: The results of the facial muscle strength examination were taken during the initial examination.

3.2.9 Muscle tone palpation

	Left	**Right**
Scaleni	Hypertonic	Normal
Sternocleidomastoid	Hypertonic	Hypertonic
Trapezius	Hypertonic	Hypertonic
Biceps brachii	Hypertonic	Normal
Triceps Brachii	Hypotonic	Hypertonic
Extensors carpi	Hypotonic	Hypertonic
Flexors Carpi	Hypertonic	Normal
Pectoralis minor	Hypertonic	Hypertonic

Pectoralis Major	Hypertonic	Hypertonic
Latissimus Dorsi	Hypertonic	Hypertonic
Quadratus lumborum	Hypertonic	Normal
Abdominal muscles	Normal	Normal
External Oblique	Normal	Normal
Psoas	Hypertonic	Hypertonic
Rectus Femoris	Hypotonic	Hypertonic
Vastus lateralis	Normal	Normal
Vastus medialis	Hypotonic	Normal
Biceps Femoris	Hypertonic	Hypertonic
Tensor Fascia Lata	Normal	Hypertonic
Gluteus maximus	Hypotonic	Normal
Adductors	Hypertonic	Normal
Gastrocnemius	Hypertonic	Hypertonic
Tibialis anterior	Normal	Normal

Table 5: The muscle tone palpation of the lower extremity, upper extremity and trunk were taken during the initial examination.

3.2.10 Muscle Length test (according to Janda or Kendall)

	M.Gastro	M.Soleus	Hip-Fl One joint	Hip-Fl Two joint	Adductors One joint	Hamstring	Piriformis	Quadratus lumborum	Levator scapula
	Janda	**Janda**	**Kendal**	**Kendal**	**Janda**	**Kendal**	**Janda**	**Janda**	**Janda**
Right	Grade 0	Grade 0	0cm	80°	Grade 0	70°	Grade 1	3cm	Grade 0
Left	Grade 2	Grade 0	5cm	95°	Grade 2	55°	Grade 1	X	Grade 0
Norm	Grade 0	Grade 0	0cm	80°	Grade 0	80°	Grade 0	>5cm	Grade 0

	Pectoralis Major	Pectoralis Minor	Shoulder IR	Shoulder ER	M. Trapezus	Paravertebrals
	Janda	**Janda**	**Kendal**	**Kendal**	**Janda**	**Janda**
Right	Short	Short	90°	15°	Grade 1	20 cm (Grade 2)
Left	Short	Short	90°	60°	Grade 2	
Norm	Normal Length	Normal Length	90°	<20°	Grade 0	0-10 cm

Table 6: Initial examination of muscle length test on lower and upper extremity.

3.2.11 Neurological tests

Dermatomes:

	Left	**Right**
Upper Limb dermatomes		
C4 (Shoulders)	Normal sensation	Normal sensation
C5 (upper lateral)	Normal sensation	Normal sensation
C6 (lateral forearm + thumb)	Loss of sensation in the thumb	Normal sensation
C7 (middle palm and fingers)	Complete loss of sensation on palm	Normal sensation
C8 (5^{th} finger)	Complete loss of sensation	Normal sensation
T1 (inner forearm)	Normal sensation	Normal sensation
Lower Limb dermatomes		
L1 (anterior Iliac crest line)	Normal sensation	Normal sensation
L2 (front of both thighs)	Normal sensation	Normal sensation
L3 (vastus medialis direction, to medial side of knee)	Normal sensation	Normal sensation
L4 (anterior part of knee, medial side of calf, medial part of hallux)	Loss of sensation on the hallux, half medial side of calf, normal feeling in the knee	Normal sensation

L5 (lateral anterior part of thigh and calf, middle of plantar and dorsal part of foot)	Loss of sensation on foot dorsal and plantar part.	Normal sensation
S1 (5th toes, lateral dorsal part of LE)	Loss of sensation on lower half dorsal part of calf and 5th toe	Normal sensation
S2 (medial dorsal part of LE)	Normal sensation	Normal sensation

Table 7: Initial examination of dermatomes on lower and upper extremity.

Signs and tests:

	Left	**Right**
Lower extremity		
Spastic signs		
Babinski (lateral side of sole and under heads of MTT bones)	Positive	Negative
Siccard (flex the big toe with leg elevation)	Negative, although the LE can't be raised enough due to hamstring shortness.	Negative
Chaddock's (Lateral malleolus)	Positive	Negative
Paretic signs		
Mingazzini sign (30sec, 90 degrees flexion knees and hips)	Positive, his left knee drops after a few seconds of holding it in 90°	Negative
Barré sign (prone, flexion 90°knees)	Positive	Negative
Upper Extremity		
Spastic signs		
Juster's sign (antithenar and heads of MC bones)	Positive	Negative

Hoffman's sign (flick 3rd finger dorsal side)	Negative	Negative

Paretic signs

Dufour sign (full supination, extended fingers)	Patient could not perform the test; he can't raise his left shoulder/LE	Negative
Mingazzini (arms forward in pronation, eyes closed)	Patient could not perform the test; he can't raise his left shoulder/LE	Negative
Retardation phenomenon	He was not able to perform voluntary movements on the left side	Negative

Table 8: Initial examination of neurological signs and tests on lower and upper extremities.

Deep Tendon Reflexes:

	Grade Left	Grade Right
Biceps C5	4	2
Radialis C6	4	2
Triceps C7	3	3
Finger flexors C8	2	2
Patellar L2-4	4	2
Achilles L5-S2	5	2

Medioplantar L5-S2	3	1

Table 9: Initial examination of tendon reflexes on lower and upper extremity.

Grading scale:

0: Absent

1: Hypoactive or present only with reinforcement

2: Readily elicited with a normal response

3: Brisk with or without evidence of spread to the neighboring roots

4: Associated with a few beats of unstained clonus

5: Sustained clonus

Spastic or Rigid Muscle Testing (left side):

	Spastic	**Rigid**	**Normal**
Elbow flexors -Brachialis -Biceps humeri -Brachioradialis	X	X	
Wrist and finger extensors -Extensor carpi radialis longus -Extensor carpi radialis brevis -Extensor digitorum -Extensor digiti minimi -Extensor carpi Ulnaris -Extensor indicis			X
Wrist and finger flexors -Flexor carpi radialis -Flexor carpi ulnaris -Palmaris longus -Flexor Digitorum superficialis	X	X	

-Flexor Digitorum profundus -Flexor policis longus			
Forearm supinator -Supinator muscle			X
Forearm Pronator -Pronator teres -Pronator quadratus		X	
Finger flexors UE -Flexor digitorum profundus -Flexor longus pollicis -Palmaris longus	X	X	
Shoulder Flexors **-**Deltoid anterior -Pectoralis major -Coracobrachialis	X	X	
Shoulder extensors -Deltoid posterior -Latissimus dorsi			X
Shoulder ER -Teres minor -Infraspinatus			X
Shoulder IR -Teres major -Pectoralis major -Subscapularis -latissimus dorsi	X	X	
Hip Flexors -Iliac -Psoas -Rectus femoris		X	
Hip extensors -Gluteus maximus -Hamstring muscles			X

Hip ER -Piriformis -Gemellus inferior -Gluteus Medius -Obturator internus -Obturator externus			X
Hip IR -Gluteus medius (ant. part) -Gluteus minimus -Piriformis -Tensor fascia latae -Adductor longus -Adductor Brevis -Gracilis	X	X	
Knee flexors -Biceps femoris -Semitendinosus -Semimembranosus		X	
Knee extensors -Quadriceps femoris	X		
Ankle flexors -Triceps surae	X	X	
Ankle extensors -Tibialis anterior -Extensor digitorum longus -Extensor hallucis longus			X

Table 10: Initial examination of spasticity and rigidity on lower and upper extremity.

3.2.12 Conclusions of the initial examination

The patient is a 51-year-old male with left hemiparesis after hemorrhagic stroke in 2017. Diagnosed with arteriovenous malformation in posterior cerebral artery, as well as mild dysarthria, mild cognitive deficit and poor orientation in space.

During the initial kinesiologic examination there have been some conclusive information about the patient.

First of all, we can observe multiple asymmetries on his body. His left side of the body is hemiplegic with result of him shifting his weight on the right lower extremity. His left ankle is in plantar flexion and eversion resulting in a bad stability. Also, his left knee is slightly bent and in inner rotation along with the hip joint. His left upper extremity is also affected with the posture of flexion in wrist, fingers, elbow and with inner rotation of the shoulder with protraction.

His ability to verticalize has been affected and he can only stand upright with the help of a four-point crutch and the help of a therapist, to avoid falling. His gait is also affected as his right leg is talking most of the load. The left ankle flexion is causing an increase in instability and cannot be used correctly for walking. The fact that he is obese is also an extra challenge as he is getting fatigued very fast and can walk only small distances.

On the pelvic examination the results showed that the patient has a pelvic distortion with the right side of the pelvis being anteriorly tilted. We also observe that there is a shift to the right of his center of gravity and therefore the pelvis as well.

For the anthropometric measurements there is a small difference in the circumference of the upper and lower extremities. The right side is a bit bigger and this is due to the fact that he is using his right side a lot as a compensation while walking, with both his lower and upper extremity using the four-point crutch. The main characteristic of this examination shows the obesity problem that is indicated in the anamnesis and is confirmed here in this examination. The circumference of the waist is 125cm. The obesity measurement for men starts at 102cm, that means that the patient has exceeded the minimum limit of obesity by 23cm. This is definitely a contributing factor as to how well he can recover and exercise during our sessions.

The measurement of the range of motion has shown very different results when comparing the right side to the left side. We can see that on the left side the active movements were very limited and for some movements impossible to perform any motion. External rotation, extension, abduction eversion and supination in the upper and lower left extremity were not possible to control.

The measurements for range of motion were very difficult to make, especially on the left side of the body. The positioning was not always optimal and some measures may have been altered. Although it was not fully accurate for some measurements, it shows a very good general picture of the situation of the patient.

We can see the same pattern of the inability to control certain muscles of the left side with the muscle strength test (Kendall). He was unable to contract almost every extensor, supinator, external rotator and abductor on his left side. His facial muscle strength test (Kendall) showed that he has a normal functioning of his facial muscles.

The muscle length testing (Janda and Kendall) showed a Grade 2 in the following muscle groups on the left side: Gastrocnemius and Adductors. The left hamstrings were at 55° out of the norm of 80° and the pectoral muscles in both sides were shortened. And finally, the shoulder external rotation was at 60° from the table which is shortened too.

The neurological tests have shown that there is a spasticity and rigidity on the left side of the body as well as loss of sensation on the left upper and lower extremities. The spasticity has been confirmed by the muscle spasticity testing that measures the tension based on the velocity. It has also been confirmed by the specific testing such as Babinski and Juster's sign.

There is overall a neurological deficit in the left side of the body, with spasticity, loss of sensation and paretic muscles with loss of voluntary contractions in most of the movements on the left side of the body.

3.2.13 Goals of therapy

- Improve verticalization (from bed to standing)
- Gait improvement
- Improve ROM of the left lower extremity and upper extremity
- Improve stability
- Improve muscle strength and movement control on the paretic muscles
- Improve self-sufficiency
- Improve fine motor skills on affected side
- Improve ADL
- Find better shoes (orthotic shoes)
- Walking up and down the stairs

3.2.14 Short term plan

- PNF on upper and lower extremity, facilitating voluntary muscle contraction and muscle strength
- Sensomotoric stimulation on the acral parts of LE and UE, Kenny method on paretic muscles (Extensors, ER, Abductors, supinator and evertors)
- PIR, RI and Stretching on shortened muscles of left UE and LE
- Gait exercising
- Active movements with focus on the left upper and lower extremity
- Exercise from laying to bed into sitting position and then into standing

3.2.15 Long term plan

- Gait exercising (without plantar flexion of the left foot)
- Stairs exercising
- Exercise with fine motor skills, grabbing objects with the left hand
- Sitting and standing exercises

- Sensomotoric stimulation on the acral parts of LE and UE, Kenny method, PNF
- Left shoulder, elbow, wrist, ankle, knee and hip muscle active movements
- Stretching exercises on shortened muscles, emphasis on the fingers, wrist and ankle
- Exercises to regain normal ROM on all the restricted joints in upper and lower extremity

3.2.16 Therapy progress (Day to day therapy)

Every therapy session was performed by me with the supervision of my supervisor BSc. Ales Nesvadba. One session per day for a total of 10 sessions in a period of time of two weeks.

Date: 19/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: Before we started the therapy, he was complaining of lower back pain.

Goal of today's therapy:

- Perform a complete kinesiological examination
- -Improve the ROM of left upper and lower extremity
- -Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- -Stimulate the paretic muscles

Therapy:

- Stretching of flexors on the left hand and wrist: Flexor carpi radialis, Flexor carpi ulnaris, Palmaris longus, Flexor digitorum profundus, Flexor longus pollicis, Flexor Digitorum superficialis, Flexor Digitorum profundus and Flexor policis longus.

  A variation of PIR (Lewit 2009) with no voluntary contraction was performed in combination with the stretching. The patient was instructed to breathe in slowly, hold for 5 seconds and then breathe out and relax.

  Patient lying supine on the table, starting from the fingers, slow stretching in the direction of extension until reaching a neutral position of the fingers. Then stretching on the wrist in dorsiflexion while keeping the tension on the fingers.

- Passive and active-assistive ROM exercises of the left hand. We start with repetitions of passive movements in direction of wrist dorsiflexion and fingers

extension. Then instructing the patient to perform the movements while assisting him.

- Kenny method for the treatment of paretic muscles on the left hand was also performed in combination with the ROM exercises. Verbal instruction of patient to extend his fingers and wrist. Tactile stimulation on the paretic muscles: Extensor carpi radialis longus, Extensor carpi radialis brevis, Extensor digitorum, Extensor digiti minimi, Extensor carpi Ulnaris. Followed by movement stimulation.

Results (of today's therapy unit):

We had very little time for the therapy session, most of the time was spent on the initial examination. The stretching on the left hand made the spastic muscles more relaxed. No visible change in the flexion position of the fingers and wrist of the patient while at rest.

The patient was not able to activate the paretic muscles even after the Kenny method therapy.

Self-therapy:

For the self-therapy I instructed the patient to use his right hand and stretch his left fingers and wrist. A variant of a passive stretching also with the help of the wheelchair's arm rest. Perform the stretching as frequently as possible 5 repetitions of 30 seconds each.

Date: 20/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.
Status praesens Subjective: No pain today.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint

- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Stretching of flexors on the left hand and wrist: Flexor carpi radialis, Flexor carpi ulnaris, Palmaris longus, Flexor digitorum profundus, Flexor longus pollicis, Flexor Digitorum superficialis, Flexor Digitorum profundus and Flexor policis longus.

  A variation of PIR (Lewit 2009) with no voluntary contraction was performed in combination with the stretching. The patient was instructed to breathe in slowly, hold for 5 seconds and then breathe out and relax.

  Patient lying supine on the table, starting from the fingers, slow stretching in the direction of extension until reaching a neutral position of the fingers. Then stretching on the wrist in dorsiflexion while keeping the tension on the fingers.

- Passive and active-assistive ROM exercises of the left hand. We start with repetitions of passive movements in direction of wrist dorsiflexion and fingers extension. Then instructing the patient to perform the movements while assisting him.

- Kenny method for the treatment of paretic muscles on the left hand was also performed in combination with the ROM exercises. Verbal instruction of patient to extend his fingers and wrist. Tactile stimulation on the paretic muscles: Extensor carpi radialis longus, Extensor carpi radialis brevis, Extensor digitorum, Extensor digiti minimi, Extensor carpi Ulnaris. Followed by movement stimulation.

- Passive and active-assistive ROM exercises of the left shoulder. Starting with repetitions of passive movements in direction of flexion of the shoulder. Then instructing the patient to perform the movements while assisting him. We then repeat the process for the abduction.

- Stretching of flexors on the left ankle and knee: Biceps femoris, Semitendinosus, Semimembranosus, Tibialis anterior, Extensor digitorum longus, Extensor

hallucis longus

- Passive and active-assistive ROM exercises of the left ankle and knee. Starting with repetitions of passive movements in direction of extension of the ankle. Then instructing the patient to perform the movements while assisting him. We then repeat the process for the flexion of the knee.
- Kenny method for the treatment of paretic muscles on the left ankle was also performed in combination with the ROM exercises. Verbal instruction of patient to extend his fingers and wrist. Tactile stimulation on the paretic muscles:
  Tibialis anterior, Extensor digitorum longus, Extensor hallucis longus
- Gait training with the four-point crutch. Training at standing up with the help of the crutch and walk through the corridor. Me, my supervisor and my class mate were assisting the patient as little as possible to allow him to be as autonomous as possible. One of us would always have the wheelchair nearby in case he is tired and needs to have a break.

Results (of today's therapy unit):

Very little change as for the stretching and stimulation therapy. His muscles are very stiff and it is very hard to stretch them. Also, when the stretching is done, the position of the extremities is back to full flexion.

The gait training was a great success, he was able to walk a small distance from the therapy table to the entrance of the physiotherapy department. It is approximatively 20meters distance. He was putting his weight on the right side of the body using the crutch. A problem was the left ankle that is fixed in the plantar flexion position in combination with his shoes not being the optimal ones. In fact, his left heel would come of the shoe as he was trying to take a step.

He got very tired quickly at the end of the therapy and especially after the walking.

Self-therapy:

Same therapy with the stretching of the fingers. Adding to this self-therapy a visualization of him voluntarily extending his fingers. While he is performing the stretching, he needs to focus and try to actively extend his fingers and wrist.

Date: 21/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: No pain today.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

Again, very little change as for the stretching and stimulation therapy. His muscles are very stiff and it is very hard to stretch them. Also, when the stretching is done, the position of the extremities is back to full flexion.

The gait is improving, he was able to walk a bit further this time. He was putting his weight on the right side of the body using the crutch. His shoes is still not being the optimal ones. His left heel come of the shoe as he was trying to take a step.

He gets tired very quickly but he was able to sustain a bit more this time. He feels a bit more secure by us being around and making sure that he is not falling.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 24/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: No pain today.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

The stretching is easier to perform, it seems that his muscles are not as tight as in the beginning. His muscles are still very stiff but it is easier to stretch them. He is able to stretch them on his own too, which was not possible in the beginning.

The gait is improving again, he was able to walk a bit further this time. He got some other shoes that are much better, he can walk better with them and the ankle stays in the shoe. His plantar flexion is getting better as he walks, it is hard for him to extend it consciously but during the walk and the gravity he is able to release a bit of tension on the ankle joint. The eversion is also causing issue during walking as he cannot load correctly the left foot without losing stability.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 25/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: No pain reported today.

Goal of today's therapy:

- Same as previous day

Therapy:

- Same as previous day
- PNF technique in the 1st diagonal - extension pattern. Starting position is in flexion of fingers, thumb and wrist, forearm in supination, elbow extended, shoulder in flexion adduction and external rotation. The direction of the movement is in the extension of fingers, wrist shoulder, with external rotation of the shoulder and abduction and pronation of forearm. The main goal of this therapy is to stretch the flexors of the shoulder, wrist and fingers and to activate the contraction of the antagonist extension muscles of the fingers, wrist and shoulder.

Results (of today's therapy unit):

Today he was able to activate his finger and wrist extensors. There was a trace of activity when he was trying to perform the movement. The left shoulder active ROM is now also improving with a ROM on the Sagittal plane 5-0-40.

The gait is better now with the other shoes. He is getting more confident and is progressing in his balance. He is able to make bigger strides while walking, he needs to slow down to be able to correct the form of his walk. His ankle is still in flexion but he is able to extend it a bit more while he's walking. Shifting the weight completely to the left is still not easy for him, he can't do it without losing balance.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 26/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: No pain reported today.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

Today we added the PNF technique, it was difficult for him to understand the movements but after a few passive repetitions, he was able to slightly contract the extensors of the wrist, fingers and shoulder. During the last therapies he was not able to contract simultaneously every extensor like this therapy session, so it is an improvement.

Improvement also was visible on the stretching of the flexors. He was able to relax more easily the spastic muscles and allowing the stretching to be easier on the upper and lower extremity. Although the position of his extremities goes back to the same spastic position, there is an improvement on the motion and more elastic feeling of the stretching.

As for the gait no visible improvements, he is still using the crutch for the balance and his right ankle is still in eversion and plantar flexion while walking.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 27/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: He feels tired today, no pain reported.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

The patient is getting tired after all the exercising, today we performed more passive movements to keep his energy for the walking. The gait training today was shorter as he was tired quicker than previous sessions. The PNF therapy seems to work nicely on the stretching of the spastic muscles. The first movements are hard but after a few repetitions his muscles get more and more relaxed overtime.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 28/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: The patient has more energy today. He slept well last night. No pain reported today.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

Today the session was more focused on active exercising and making the patient move his upper extremity to grab objects. There is an improvement on the range of the motion and the activation of the muscles but he was not able to extend his fingers enough to grab an object, he needed help with that.

The gate is getting better, he is more confident and the fact that he had more energy today, he was able to go a bit further this time and with less swinging the body to the right side.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 31/01/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: No pain reported today.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

His transfers have been improving from sitting to standing. He still has difficulty in laying on his back on the table. He is having "mini-seizures" when he is going to lay on the bed. These seizures are only lasting 2-3 seconds and then he comes back to normal. The doctor said this is not something to be worried about and that it can happen that his brain gets overloaded and needs a few seconds to "cool-down".

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 01/02/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: No pain reported today.

Goal of today's therapy:

- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

The gait was a lot better than yesterday. He was able, after a small break, to make the trip back to the table. It is overall twice the distance that he did yesterday.

His left ankle is more flexible and we can observe it during the gait how the gravity is pulling the foot into dorsiflexion. Therefore, helping a lot with his gait pattern, he is more stable and less shaking of the spastic muscles.

As for the fingers and wrist, the difference is small but visible. He is able to almost grab the stick we use to exercise. The patient still needs the help of the therapist or his own right hand to grab something.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

Date: 02/02/2022

Status praesens Objective: Patient was able to communicate clearly. No visible cognitive deficit.

Status praesens Subjective: No pain reported today.

Goal of today's therapy:

- Final kinesiological examination
- Improve the ROM of left upper and lower extremity
- Relax and reduce the shortness on spastic muscles of the left hand, wrist and ankle joint
- Stimulate the paretic muscles
- Improve transfers from sitting to standing
- Gait improvement

Therapy:

- Same as previous day

Results (of today's therapy unit):

Today's therapy was shortened due to the fact that it is our last session and we spent more time on the final examination. We still did the same therapy as daily but less repetitions and went quickly into the testing part.

He is feeling less tired when performing the exercises than the beginning. He has improved a lot his stamina by exercising daily and with gait training.

Self-therapy:

Same therapy with the stretching of the fingers and active movement.

3.3 Final kinesiological examination

Performed on 2nd of February 2022

- Postural examination
- Gait examination
- Pelvic palpation
- Anthropometry
- Measurement of Range of Motion
- Manual muscle strength test
- Muscle tone palpation
- Muscle length test by Janda or Kendall
- Dermatome testing
- Deep sensation testing
- Neurological examination

3.3.1 Postural examination

The postural examination was made with the patient holding on the four-point crutch for stability. He is not able to stand without the crutch.

b) Plumb line test

- Back view:

  -**Base of support**: slightly narrow

  -**Weight baring**: There is a shift of his whole body to the right lower extremity.

  -**Feet and Ankle joints position and shape**: The left ankle joint is in a slight plantar flexion and eversion, the toes and medial side of the foot has contact on the floor. His left heel does not touch.

  -**Calf muscles**: The left calf muscles are more active and prominent

  -**Knee Joint**: Slight flexion of the left knee

  -**Pelvis position**: The right side of pelvis is higher and anteriorly shifted

  -**Paravertebral muscles**: the left side is shorter and more hypertonic

-**Spine**: there is a spine curvature and shift on the right side, slightly scoliotic

-**Scapulas**: Right scapula is abducted and inferior angle in external rotation

-**Shoulder**: Right shoulder elevation, inner rotation and protraction

-**Head**: The head is shifted to the right side with a slight left lateroflexion.

- Side view Right:

  -**Ankle joint and foot position**: the right foot is forwards

  -**Knee joints**: the left knee joint is in flexion, right knee fully extended

  -**Pelvis**: The right side of pelvis is shifted anteriorly and in anteversion

  -**Spine and trunk**: The right side of the body is elongated due to the holding of the crutch

  -**Upper extremities**: the right UE is extended and placed forward due to the crutch

  -**Shoulder girdle**: protraction of the right shoulder, elevation and external rotation of the shoulder

  -**Head**: The head is in slight protraction

- Side view Left:

  -**Ankle joints and foot position**: the left foot is slightly positioned more posteriorly than the right, left ankle joint is in plantar flexion and eversion. Slight weight baring on the left foot.

  -**Knee joints**: left knee slightly flexed

  -**Pelvis**: Left rotation of the pelvis and right shift

  -**Spine and trunk**: the trunk and upper body leaning slightly forward

  -**Upper extremities**: left UE is in wrist and elbow flexion

  -**Shoulder girdle**: abduction of left shoulder girdle and external rotation of anguli inferioris

  -**Head**: Slight protraction

- Front view:

  -**Base of support**: narrow base of support

-**Feet position and weight distribution**: The weight distribution is more on the right foot, left foot is in plantar flexion and eversion.

-**Ankle joints position and shape**: Right ankle lack of medial longitudinal arch, left ankle in eversion and plantar flexion

-**Knee joint:** The left knee is slightly bent

-**Pelvis position:** the right side is higher than the left and there is a shift on the right side

-**Abdominal line and thorax:** the abdomen is lower on the left side.

-**Clavicle**: Right higher than left

-**Shoulder**: Left shoulder internally rotated, right shoulder is higher

-**Upper extremity position**: Left upper extremity in spastic position, flexion of fingers, wrist and elbow with pronation of forearm, slight adduction on left shoulder

-**Head**: Slight shift to the right and lateroflexion to the left

3.3.2 Gait examination

The patient has a general instability in verticalization. He can only stand with a crutch with four points of contact. He also needs the support of at least one person.

- Width of the base of support is moderately narrow
- Walking type is hemiplegic gait
- Walking speed is slow
- Stride length, short but in the left side the strides are shorter. The right leg going forwards and leading the gait, the left leg is following behind and does not stride.
- Movement of the foot on the right side it is normal, the plantar flexion on the left side is still present but a lot better than the initial examination. The left foot is more flexible when it touches the floor, compared to the very stiff plantar flexion initially examined.
- Movement of the knees are not optimal. The left knee is still slightly in flexion, the extension is more visible than in the initial examination.
- Movement of the hip joints: the right hip is in left rotation and the right side is

leading the gait, the left side is hanging and making a slight circumduction

- Movement of the trunk is less present on the frontal plane. His trunk is much more stable and less movements in the frontal plane.
- The paravertebral muscles are still asymmetrical. He is putting most of the weight on his right side, resulting in a scoliotic spine (right side convexity).
- The position of the head is moving to the left lateroflexion at every right leg swing, as a compensation for weak deep stabilizing muscles.
- His stability is better, he still needs the four-point crutch but he is much more stable than in the beginning. His feet and movements are more fluid and there is less shaking of the extremities.
- His walking stamina has increased, he can now walk approximately 60meters without break (3 times more than in the initial examination).

Gait modification:

- Not examined.

3.3.3 Pelvic examination

- Iliac crest: right side higher
- Posterior superior iliac spines (PSIS): higher on the right side
- Anterior superior iliac spines (ASIS): higher on the left side
- ASIS and PSIS (right side): The ASIS is lower than the PSIS
- ASIS and PSIS (left side): The ASIS is in a slightly lower level than the PSIS

3.3.4 Anthropometry

Lower Extremity									
	Length (cm)				Circumference (cm)				
	Anatomical	Thigh	Mid-Leg	Foot	Thigh	Knee	Calf	Ankle	Foot
Right	81.5	48	39	26	67	45	39	29	30
Left	81.5	48	39	26	66	45	38	29	30
Upper Extremity									
	Length (cm)				Circumference (cm)				
	Anatomical	Humerus	Forearm	Hand	Upper arm Relaxed	Upper Arm Flexed	Elbow	Forearm	Metacarpal
Right	75	31	27	20	33	35	27	26	21
Left	75	31	27	20	33	34.5	27	26	21
Other (cm)									
Height	Arm Spam	Head	Thorax Middle	Thorax Xiph.	Middle Max. Ins	Middle Max Exp	Xiph. Inspirat	Xiph. Expirate	Cir. Waist
175	X	69	100	103	107	102	106	101	122
Cir.Hips	Biacromial	Bicristal	Bispinal	Bitrochant.					
102	46	65	51	69					

Table 11: The anthropometry results were taken during the final examination.

3.3.5 Assessment of stereotype (pattern) or breathing (in various positions)

- Standing: upper thoracic and mid thoracic when in inspiration, in expiration also upper and mid thoracic
- Sitting: Mid thoracic breathing
- Supine: Abdominal breathing

3.3.6 Measurement of Range of Motion (According to Janda, STFR method)

	Shoulder					
	Extension	**Flexion**	**Abduction**	**Adduction**	**External Rot**	**Internal Rot**
Passive ROM	Left **S:** 20-0-160		Left **F**: 125-0-120		Left **R**: 35-0-85	
	Right **S**: 40-0-170		Right **F**: 165-0-120		Right **R**: 75-0-90	
Active ROM	Left **S**: 0-0-35		Left **F**: 45-0-110		Left **R**: 5-0-90	
	Right **S**: 30-0-170		Right **F**: 165-0-125		Right **R**: 65-0-90	
Norm Janda	***0-30/60***	***0-160/180***	***0-90/180***	***0-120/130***	***0-55/95***	***0-45/90***
	Elbow					
	Extension	**Flexion**	**Supination**	**Pronation**		
Passive ROM	Left **S**: 0-0-155		Left **R**: 75-0-90			
	Right **S**: 0-0-155		Right **R**: 85-0-90			
Active ROM	Left **S**: 0-60-145		Left **R**: 0-30-85			
	Right **S**: 0-0-150		Right **R**: 90-0-85			
Norm Janda	***0-0/10***	***0-145/150***	***0-80/90***	***0-80/90***		
	Wrist		**Radial-Ulnar**		**Metacarpal joints**	
	Extension	**Flexion**	**R-duction**	**U-Duction**	**Extension**	**Flexion**

Passive ROM	Left **S**: 80-0-90		Left **F**: 5-0-35		Left **S**: 10-0-90	
	Right **S** : 90-0-85		Right **F** : 10-0-30		Right **S** : 15 -0-90	
Active ROM	Left **S**: 0-65-85		Left **F** : 0-15-30		Left **S**: 0-75-90	
	Right **S** : 85-0-80		Right **F** : 10-0-30		Right **S** : 5-0-90	
Norm Janda	***0-70/85***	***0-80/90***	***0-15/20***	***0-30/35***	***0-10/45***	***0-90***
	Thumb CMC		**Thumb MCP**		**Thumb IP**	
	Extension	**Flexion**	**Extension**	**Flexion**	**Extension**	**Flexion**
Passive ROM	Left **S**: 0-0-40		Left **S**: 0-0-80		Left **S**: 0-0- 90	
	Right **S**: 5-0-35		Right **S**: 0-0-60		Right **S**: 0-0- 90	
Active ROM	Left **S**: 0-25-35		Left **S**: 0-60-75		Left **S**: 0-75-90	
	Right **S**: 15-0-35		Right **S**: 0-0-50		Right **S**: 0-0-90	
Norm Janda	***0-0/20***	***0-15/45***	***0-0/10***	***0-50/80***	***0-0/10***	***0-80/90***
	Hip Joint					
	Extension	**Flexion**	**Abduction**	**Adduction**	**External R**	**Internal R**
Passive ROM	Left **S**: 15-0-125		Left **F**: 25-0-35		Left **R**: 30-0-35	
	Right **S**: 25-0-125		Right **F**: 30-0-35		Right **R**: 50-0-35	
Active ROM	Left **S**: 0-0-60		Left **F**: 10-0-30		Left **R**: 5-0-25	

	Right **S**: 20-0-120		Right **F**: 30-0-40		Right **R**: 35-0-35	
Norm Janda	***0-10/30***	***0-120/135***	***0-10/30***	***0-30/50***	***0-45/60***	***0-30/45***
	Knee		**Ankle**			
	Extension	**Flexion**	**Dorsal Flex**	**Plantar Flex**	**Eversion**	**Inversion**
Passive ROM	Left **S**: 0-0-160		Left **S**: 0-05-50		Left **R**: 30-0-15	
	Right **S**: 0-0-150		Right **S**: 15-0-45		Right **R**: 20-0-35	
Active ROM	Left **S**: 0-5-150		Left **S**: 0-30-45		Left **R**: 30-20-0	
	Right **S**: 0-0-150		Right **S**: 10-0-45		Right **R**: 15-0-35	
Norm Janda	***0-0/10***	***0-125/160***	***0-10/30***	***0-45/50***	***0-15/30***	***0-35/50***
	Toe MTP I		**Spine**			
	Extention	**Flexion**	**Ext Cervical**	**Flex Cervical**	**Lat Flx Left**	**Lat Flx Right**
Passive ROM	Left **S**: 50-0-50		**S :** 45-0-50		**F :** 50-0-35	
	Right **S**: 85-0-50					
Active ROM	Left **S**: 0-35-40		**S :** 40-0-45		**F :** 45-0-25	
	Right **S**: 75-0-45					
Norm Janda	***0-40/90***	***0-40/50***	***0-45/75***	***0-40/45***	***0-0/45***	***0-0/45***
	Cervical Spine		**Thoracic + Lumbar Spine**			
	Rotation L	**Rotation R**	**Lat Flx Left**	**Lat Flx R**	**Rotation L**	**Rotation R**

Passive ROM	T : 60-0-55		35-0-30		35-0-30	
Active ROM	T : 55-0-50		30-0-25		25-0-20	
Norm Janda	***0-50/60***	***0-50/60***	***0-35/40***	***0-35/40***	***0-20/45***	***0-20/45***

Table 12: Final examination of the Range of motion.

3.3.7 Manual muscle strength test (according to Kendall)

	Origin / Insertion	**Grade L**	**Grade R**
Upper Extremity			
ADD pollicis	MCP / Phalanx	5	5
ABD pollicis brevis	Trapezium Scaphoid/Phalanx	1+	5
Opponens pollicis	Trapezium/ 1st MC	5	5
Flexor pollicis longus FLEXOR pollicis brevis	M epicondyle/ Phalanx Carpal B./Phalanx	1	5
EXTENSOR pollicis longus Extensor pollicis brevis	Ulna / Phalanx Radius /Phalanx	1+	5
ABDUCTOR POLUCIS LONGUS	Radius, Ulna/ MCP	1	5
ABDUCTOR DIGITI MINIMI	Pisiform / Phalanx	0	5
OPPONENS DIGITI MINIMI	Hamate / 5th MCP	4	5
FLEXOR DIGITI MINIMI	Hamate / Phalanx	4+	5
DORSAL INTEROSSEI	2-4 MC / Phalanx	1+	4
PALMAR INTEROSSEI	1-5 MC / Phalanx	4	5
LUMBRICALES	Flx profundus Tendon / MCP	5	5
PALMARIS LONGUS	M.Epicond/ Palmar Aponevrosis	4	5
PALMARIS BREVIS	Palm Apon/ skin ulnar border	4	5
EXTENSOR INDICIS	Ulna / Ext.dig.Long.	2-	5
EXTENSOR DIGITI MINIMI	Lat Epi / Ext. Exp 5th finger	2-	5
EXTENSOR DIGITORUM	Lat epi/ 2-5 prox, med, dist. Phalanx	2-	5
FLEXOR DIGITORUM SUPERFICIALIS	Med Epi / Med phal	5	5
FLEXOR DIGITORUM PROFUNDUS	Ulna / distal Phal	5	5
FLEXOR CARPI RADIALIS	Med Epi / MC 2-3	4	5
Flexor carpi ulnaris	Med Ep / Pisiform	5	5
EXTENSOR CARPI RADIALIS LONGUS	Lat Supracond/ 2nd MCP	2-	5

EXTENSOR CARPI RADIALIS BREVIS	Lat Epi / 3rd MCP	2-	5
EXTENSOR CARPI ULNARIS	Lat Epi / 5th MCP	2-	5
PRONATOR TERES PRONATOR QUADRATUS	Med Epi / Radius Ulna / Radius	5	5
SUPINATOR	Lat Epi / Radius	2-	5
BRACHIORADIALIS	Humerus / Radius	5	5
Coracobrachialis	Coracoid / Humerus	4	5
BICEPS BRACHII	CoracoidSupraglenoid /Radius	5	5
BRACHIALS	Humerus / Ulna	5	5
TRICEPS BRACHII	Infraglenoid / olecran	2-	5
SUPRASPINATUS	Supraspinatus fossa / Humerus	4	5
DELTOID	Clavicle-Acrom-Spina scap / Humerus	1	5
ANTERIOR DELTOID		2-	5
POSTERIOR DELTOID		1	5
Pectoralis major	Clav Stern / Humerus	4+	5
PECTORALIS MINOR	3-5 ribs / Coracoid	4	5
LATISSIMUS DORSI	Th-Lumb-sacr/Hume.	5	5
INFRASPINATUS TERES MINOR	Infrasp fossa / Gr tub Infrasp fossa / Gr tub	1	5
mm.RHOMBOIDEI	Th1-5 /Med Scapula	0	5
LEVATOR SCAPULAE TRAPEZIUS Upper	C1-4 / Sup angle Scap C1-Th12 /Clav Scap Acr	4	5
SERRATUS ANTERIOR	1-9 ribs / Med Scapul	4	5

Lower extremity

GLUTEUS MAXIMUS	Illium / iliotibial tract	2-	3+
PSOAS ILIACUS	Lumb /lessTrochanter Iliac fossa / less troch	2-	4
SARTORIUS	ASIS / tibia	1	4
TENSOR FASCIAE LATAE	ASIS / iliotibial tract	1	4
QUADRICEPS FEMORIS	ASIS,Troch /Tibia Patella	1	5
PECTINEUS ADDUCTOR MAGNUS GRACILIS ADDUCTOR LONGUS ADDUCTOR BREVIS	Pubis / femur Pubis ramus / linea aspera Symphysis Pubis/Tibia Pubis / Linea aspera Pubis/ Linea aspera	2+	4+
GLUTEUS MINIMUS	Gluteal line / Gr Trochanter	1	5
GLUTEUS MEDIUS	Iliac / greater trochanter	1	5
External Hip Rotators (QUADRATUS FEMORIS, OBTURATOR INTERNUS AND EXTERNUS, GEMELLUS	Sacrum, ischium, pubic bone, iliac crest / Greater trochanter of the femur	1	5

SUPERIOR AND INFERIOR, PIRIFORMIS)			
Internal Hip Rotators (TENSOR FASCIAE LATAE, GLUTEUS MINIMUS AND GLUTEUS MEDIUS)	ASIS / iliotibial tract, trochanter	2+	5
SEMITENDINOSUS, SEMIMEMBRANOSUS – medial hamstrings	Ischium / Medial condyle of tibia	4	5
BICEPS FEMORIS – lateral hamstrings	Ischium linea aspera / fibula, tibia	2	5
GASTROCNEMIUS	Condyle femur / calcaneus	5	5
SOLEUS	FibulaTibia /Achilles tendon	4-	5
PLANTARIS	LatSupracondyl / Calcaneus	5	5
PERONEUS LONGUS, PERONEUS BREVIS	Tibia, fibula / MT cuneiform	1	5
TIBIALIS POSTERIOR	Tibia, fibula / 2-4 MT, Tarsal	5	5
TIBIALIS ANTERIOR	Tibia / cuneiform, 1st MT	1	5
EXTENSOR HALLUCIS LONGUS	Fibula / distal phalanx 1st	1	5
EXTENSOR HALLUCIS BREVIS	Calcaneus / prox Phal.1st	1	5
EXTENSOR DIGITORUM LONGUS	Lat condyle tibia/ Dist Phal	1	5
EXTENSOR DIGITORUM BREVIS	Calcaneus / ext tendons	1	5
FLEXOR HALLUCIS LONGUS	Fibula / distal Phal 1st	5	5
FLEXOR HALLUCIS BREVIS	Cuboid, cunei / Prox. Phal	5	5
FLEXOR DIGITORUM LONGUS	Tibia / 2-5 distal Phal	5	5
FLEXOR DIGITORUM BREVIS	Calc / Middle Phal 2-5	5	5
Quadratus Plantae	Calcaneus / Tendon Dig Lon	5	5
PLANTAR INTEROSSEI	MT 3-5 / Proximal Phal 3-5	4	5
DORSAL INTEROSSEI	MT 2-4 / Prox Phal 2-5	0	5
LUMBRICALES	Flex dig Long Tend / 2-5 Ph	5	5
ABDUCTOR HALLUCIS	Calcaneus/ Proximal 1st Ph	0	5
ADDUCTOR HALLUCIS	2-4 MT / Prox Phal 1st	4	5

Trunk, Spine

Scalenus Ant Med Post	C2-C7 / 1-2nd ribs	4
Longus Colli	Ant surf C3-T3 / C1-C6	4
Longus Capitis	Transv C3-6 / Occiput	4
Sternocleidomastoid	Sternum,Clavicle/Mastoid	4
Iliocostalis cervicis	Sacr, iliac crest, Th / Ribs	4
Longissimus capitis	Th4-5, C5-7/ Mastoid	4
Longissimus cervicis	T1-5 / C2-6	4
Spinalis cervicis	C4-C6 / C2-C4	4

Cervicis	Spin Pr T3-6/ Trans C1-3	4	
Rectus abdominis (Flexion) Obliquus Ext-Int Abdominis	Pubic symph / xiph, ribs Ribs 5-12 / pubic tub, iliac	3+	
Iliocostalis (extension) Spinalis (extension)	Ribs 3-12 sacr iliac/ C4-L4 Th spinous pr/ C2-C5	3	
Quadratus Lumborum	Iliac, lumbar v / Last rib	4	4

Table 13: Final examination of the muscle strength.

3.3.8 Muscle tone palpation

	Left	**Right**
Scaleni	Hypertonic	Normal
Sternocleidomastoid	Hypertonic	Hypertonic
Trapezius	Hypertonic	Hypertonic
Biceps brachii	Hypertonic	Normal
Triceps Brachii	Hypotonic	Hypertonic
Extensors carpi	Hypotonic	Hypertonic
Flexors Carpi	Hypertonic	Normal
Pectoralis minor	Hypertonic	Hypertonic
Pectoralis Major	Hypertonic	Hypertonic
Latissimus Dorsi	Hypertonic	Hypertonic
Quadratus lumborum	Hypertonic	Normal
Abdominal muscles	Normal	Normal
External Oblique	Normal	Normal
Psoas	Hypertonic	Hypertonic
Rectus Femoris	Hypotonic	Hypertonic
Vastus lateralis	Normal	Normal
Vastus medialis	Hypotonic	Normal
Biceps Femoris	Hypertonic	Hypertonic
Tensor Fascia Lata	Normal	Hypertonic

Gluteus maximus	Hypotonic	Normal
Adductors	Hypertonic	Normal
Gastrocnemius	Hypertonic	Hypertonic
Tibialis anterior	Normal	Normal

Table 14: Final examination of the muscle tone palpation.

3.3.9 Muscle Length test (according to Janda or Kendall)

	M.Gastro	**M.Soleus**	**Hip-Fl One joint**	**Hip-Fl Two joint**	**Adductors One joint**	**Hamstring**	**Piriformis**	**Quadratus lumborum**	**Levator scapula**
	Janda	**Janda**	**Kendall**	**Kendall**	**Janda**	**Kendall**	**Janda**	**Janda**	**Janda**
Right	Grade 0	Grade 0	0cm	80°	Grade 0	75°	Grade 1	4cm	Grade 0
Left	Grade 2	Grade 0	3.5cm	90°	Grade 2	65°	Grade 1	X	Grade 0
Norm	Grade 0	Grade 0	0cm	80°	Grade 0	80°	Grade 0	>5cm	Grade 0

	Pectoralis Major	**Pectoralis Minor**	**Shoulder IR**	**Shoulder ER**	**M. Trapezus**	**Paraverterbrals**
	Janda	**Janda**	**Kendall**	**Kendall**	**Janda**	**Janda**
Right	Short	Short	90°	10°	Grade 1	20 cm (Grade 2)
Left	Short	Normal	90°	40°	Grade 1	
Norm	Normal Length	Normal Length	90°	<20°	Grade 0	0-10 cm

Table 15: Final examination of muscle length.

3.3.10 Neurological tests

Dermatomes:

	Left	**Right**
Upper Limb dermatomes		
C4 (Shoulders)	Normal sensation	Normal sensation
C5 (upper lateral)	Normal sensation	Normal sensation
C6 (lateral forearm + thumb)	No sensation in the thumb	Normal sensation
C7 (middle palm and fingers)	No sensation on palm and fingers	Normal sensation
C8 (5^{th} finger)	No sensation in 5^{th} finger	Normal sensation
T1 (inner forearm)	Normal sensation	Normal sensation
Lower Limb dermatomes		
L1 (anterior Iliac crest line)	Normal sensation	Normal sensation
L2 (front of both thighs)	Normal sensation	Normal sensation
L3 (vastus medialis direction, to medial side of knee)	Normal sensation	Normal sensation
L4 (anterior part of knee, medial side of calf, medial part of hallux)	No sensation of hallux, half medial side of calf, normal sensation of the knee	Normal sensation

L5 (lateral anterior part of thigh and calf, middle of plantar and dorsal part of foot)	No sensation of foot dorsal and plantar part.	Normal sensation
S1 (5th toes, lateral dorsal part of LE)	No sensation on lower half dorsal part of calf and 5th toe	Normal sensation
S2 (medial dorsal part of LE)	Normal sensation	Normal sensation

Table 16: Final examination of dermatomes on lower and upper extremity.

Signs and tests:

	Left	**Right**
Lower extremity		
Spastic signs		
Babinski (lateral side of sole and under heads of MTT bones)	Positive	Negative
Siccard (flex the big toe with leg elevation)	Negative	Negative
Chaddock's (Lateral malleolus)	Positive	Negative
Paretic signs		
Mingazzini sign (30sec, 90 degrees flexion knees and hips)	Positive, he can keep the position for 10seconds	Negative
Barré sign (prone, flexion 90°knees)	Positive	Negative
Upper Extremity		
Spastic signs		
Juster's sign (antithenar and heads of MC bones)	Positive	Negative

Hoffman's sign (flick 3rd finger dorsal side)	Negative	Negative

Paretic signs

Dufour sign (full supination, extended fingers)	Patient could not perform the test; he can't fully raise his left shoulder/UE	Negative
Mingazzini (arms forward in pronation, eyes closed)	Patient could not perform the test; he can't raise his left shoulder/LE	Negative
Retardation phenomenon	Positive, he was not able to perform quick voluntary movements on the left side	Negative

Table 17: Final examination of neurological signs and tests on lower and upper extremities.

Deep Tendon Reflexes:

	Grade Left	Grade Right
Biceps C5	5	2
Radialis C6	4	1
Triceps C7	4	2
Finger flexors C8	3	1
Patellar L2-4	4	2
Achilles L5-S2	4	2
Medioplantar L5-S2	3	1

Table 18: Final examination of tendon reflexes on lower and upper extremity.

Grading scale:

0: Absent

1: Hypoactive or present only with reinforcement

2: Readily elicited with a normal response

3: Brisk with or without evidence of spread to the neighboring roots

4: Associated with a few beats of unstained clonus

5: Sustained clonus

Spastic or Rigid Muscle Testing (left side):

	Spastic	**Rigid**	**Normal**
Elbow flexors -Brachialis -Biceps humeri -Brachioradialis	X	X	
Wrist and finger extensors -Extensor carpi radialis longus -Extensor carpi radialis brevis -Extensor digitorum -Extensor digiti minimi -Extensor carpi Ulnaris -Extensor indicis			X
Wrist and finger flexors -Flexor carpi radialis -Flexor carpi ulnaris -Palmaris longus -Flexor Digitorum superficialis -Flexor Digitorum profundus -Flexor policis longus	X	X	
Forearm supinator -Supinator muscle			X

Forearm Pronator -Pronator teres -Pronator quadratus		X	
Finger flexors UE -Flexor digitorum profundus -Flexor longus pollicis -Palmaris longus	X	X	
Shoulder Flexors **-**Deltoid anterior -Pectoralis major -Coracobrachialis	X	X	
Shoulder extensors -Deltoid posterior -Latissimus dorsi			X
Shoulder ER -Teres minor -Infraspinatus			X
Shoulder IR -Teres major -Pectoralis major -Subscapularis -latissimus dorsi	X	X	
Hip Flexors -Iliac -Psoas -Rectus femoris		X	
Hip extensors -Gluteus maximus -Hamstring muscles			X
Hip ER -Piriformis -Gemellus inferior -Gluteus Medius			X

-Obturator internus -Obturator externus			
Hip IR -Gluteus medius (ant. part) -Gluteus minimus -Piriformis -Tensor fascia latae -Adductor longus -Adductor Brevis -Gracilis	X	X	
Knee flexors -Biceps femoris -Semitendinosus -Semimembranosus		X	
Knee extensors -Quadriceps femoris	X		
Ankle flexors -Triceps surae	X	X	
Ankle extensors -Tibialis anterior -Extensor digitorum longus -Extensor hallucis longus			X

Table 19: Final examination of spasticity and rigidity on lower and upper extremity.

3.3.11 Conclusion of the final examination

During the final examination, we can observe a few patterns that are related to the patient's hemorrhagic stroke accident.

His posture is affected with a visible weakness on the left side. He is using mostly his right side of the body to keep himself in standing position and needs to use a four-point crutch for stability. The position of his left UE is in flexion of wrist, hand and fingers with pronation. As for the left LE, his ankle is in plantar flexion with eversion and the knee in slight flexion.

For the gait examination, there were a few observations. The base of support being narrow and with a poor control and strength of the left LE, the patient has a gait that is mostly supported by the right side of the body. His right UE is helping a lot with the crutch and therefore his center of gravity is shifted to the right side. He gets tired quite easily while walking as every step is a hard work for the patient. The stability is also poor and he needs assistance of at least one person to walk with confidence.

In the pelvic examination, the conclusion is that the pelvis is in a left rotation with a left lateral tilt (right side higher).

In the anthropometric measurements there is a very slight difference of circumference between the right and left side. In some areas like the circumference of the upper arm flexed is 1.5cm bigger and this might be because of the loss of strength on the left side. The rest of the circumference in upper and lower extremities there is in certain cases difference of 0.5cm which is not much. And for the length testing the measures were symmetrical on both sides.

In the measurement of range of motion there are a few conclusive points. The first is that the left UE and LE are restricted in passive as well as in active movement. The passive movement is freer due to the relaxation of the spastic muscles. In the active movements he is able to make movement to the extension of the elbow (for example) but not in full motion. He goes from flexion of 155° to a final position of the elbow in flexion of 60°.

We can conclude by the ROM measurement that there is an activation of

muscles but not in the full ROM of the joints on the left UE and LE.

It is confirmed with the test of muscle strength, there is an activation of the left side muscles: Abductor pollicis brevis, flexor pollicis brevis/longus, abductor pollicis longus, extensor carpi radialis, extensor carpi ulnaris, supinator, triceps brachii, gluteus maximus, psoas, tensor faciae latae, Adductors (LE). Those muscles all scored less than Grade 3 (according to Kendall), which means that full range of motion was not reached against gravity, but there was a sign of movement or partial ROM of the muscle.

The muscle tone palpation showed that there are hypertonic muscles mostly on the left side, especially in the spastic muscles such as biceps humeri, flexors carpi, biceps femoris and gastrocnemius. The hypotonicity was more present on the antagonistic muscles such as triceps brachii, vastus medialis, rectus femoris, extensor carpi.

For the muscle length testing the following muscles were shortened on the left side: Gastrocnemius (grade 2 according to Janda), Hip flexors one joint (3.5cm according to Kendall), Piriformis (Grade 1), hamstrings, shoulder ER, trapezius and pectoralis major. The shortening of those muscles is one symptom of the spasticity on the body that is preventing the patient to fully extend certain joints and to have full ROM actively but also passively.

Finally, in the neurological examination the patient has no dermatome sensation in the left extremity in the acral parts of the body. The spastic signs were mostly positive on the left side in the UE and LE with for example Babinski and Juster's sign both being positive. Also, in the paretic signs on the left side the Mingazzini was positive on the LE and UE. There is also a hyperreflexia on the left UE and LE comparatively with the right side that is normal. Lastly, spasticity and rigidity testing were positive on the left side of the body. With emphasis on the knee, elbow, wrist, shoulder flexors and hip IR being spastic and rigid. And in contrast with the extensors and external rotators being normal.

3.3.12 Therapy effects

The effects of the therapy were very positive in some areas and less effective in others. The posture has been improved as he is standing with better base of support and the patient is much more stable. The plantar flexion of the foot and knee has been improving slightly at every session. Resulting in a much better position of the foot while standing but also during the gait.

The general stability and balance of the patient has improved a lot, although he is still dependent on the four-point crutch, he has been able to walk more distance and with better quality of gait. This part of the therapy I believe was the most important and most beneficial for the patient. The fact that the patient is putting his whole body in motion is very helpful for the improvement of his general fitness and it's psychologically motivating. He has been very passive before his visit to the clinic; therefore, the gait exercising was not the easiest part for him.

The anthropometric measurements were very interesting to compare between the initial and final examination. We can see slight reduction in almost every circumference measurement. Especially with the hips and waist measurements, he has lost 3 centimeters in his waist and 3 in his hip circumference. The result of the daily training with a combination of a different diet during his stay has been probably beneficial for his weight loss. We did not measure his weight as it is difficult to put him on a regular scale. The question now is if he is going to keep exercising at home with his wife and have a better diet. This is definitely something that is going to be beneficial for his overall recovery.

For the Range of motion and muscle strength we can see very good results. On the active ROM he has been able to improve slowly every session, from not being able to activate the muscles to moving in a small ROM. The left shoulder, elbow, wrist, hip and ankle having the most significant improvements. He is able now to make greater flexion in the hip joint as well as the shoulder. The active extension is also better in the elbow, ankle and wrist.

In the muscle strength I have highlighted the biggest differences in the active movement. Mostly the extensors that were Grade 0 are now in Grade 2-, which represents an activation of muscles with partial ROM without gravity. This is a big change since he was not able to contract at all the muscles listed in the table above.

Finally, the muscle length testing was also interesting to see that the therapies have been

helping the patient with the range of motion as well as the muscle length. The fact that his muscles are more relaxed and the constant stretching and relaxation techniques have been very helpful for his gait as well. In fact, he is able to extend better the ankle and the knee, therefore he is more stable while walking.

Bellow this text you will find a table with the most significant changes during our two weeks of therapies:

Initial Examination	Final Examination
Postural Examination	
Base of support: it is narrow between the feet **Feet and Ankle:** the left foot is only touching on the toes with emphasis on the big toe **Knee Joint**: Flexion of the left knee **Head**: slight protraction of the head and left rotation, there is also a shift laterally towards the right side	**Base of support**: slightly narrow **Feet and Ankle:** left ankle joint is in a slight plantar flexion and eversion, the toes and medial side of the foot has contact on the floor. His left heel does not touch **Knee Joint**: Slight flexion of the left knee **Head**: The head is in slight protraction
Gait examination	
Width of the base of support is very narrow **Stride length**: the left leg is following behind and does not swing **Movement of the foot:** left side there is a very big stiffness in plantar flexion, only touches the ground with the toes and especially the hallux **Movement of the trunk** is quite big and it is moving a lot in the frontal plane **His stability** is very poor, he is quite unstable	**Width of the base of support** is moderately narrow **Stride length:** the left leg is following behind but has a small swing phase **Movement of the foot:** The left foot is more flexible compared to the very stiff plantar flexion initially examined **Movement of the trunk** is less present on the frontal plane His trunk is much more stable and less movements in the frontal plane. **His stability** is better, movements are more fluid and there is less shaking of the extremities

Anthropometry	
Thigh circumference: L 68cm – R 68cm **Calf** circumference: L 39cm – R 39.5cm **Forearm** circumference: L 26- R26.5 **Upper arm** circumference: L 34cm – R 34.5cm **Hips** circumference: 105cm **Waist** circumference: 125cm	**Thigh** circumference: L 67cm – R 67cm **Calf** circumference: L 39cm – R 39cm **Forearm** circumference: L 26cm- R 26cm **Upper arm** circumference: L 33cm- R 33cm **Hips** circumference: 102cm **Waist** circumference: 122cm
Active Range of motion (Left)	
Shoulder S: 0-0-25 / **F**: 15-0-105 / **R**: 0-0-90 **Elbow : S**: 0-75-145 / **R**: 0-45-90 **Wrist: S**: 0-85-85 **Hip: S**: 0-10-10 / **F**: 5-0-30 / **R**: 0-0-20 **Ankle: S**: 0-40-45 / **R**: 25-25-0	**Shoulder S**: 0-0-35 / **F**: 45-0-110 / **R**: 5-0-90 **Elbow: S**: 0-60-145 / **R**: 0-30-85 **Wrist: S**: 0-65-85 **Hip: S**: 0-0-60 / **F**: 10-0-30 / **R**: 5-0-25 **Ankle: S**: 0-30-45 / **R**: 30-20-0
Muscle Strength test (according to Kendall)	

Upper Extremity	Upper Extremity
Extensor digitorum – Grade 0	**Extensor digitorum** – Grade 2-
Extensor digiti minimi – Grade 0	**Extensor digiti minimi** – Grade 2-
Extensor indicis– Grade 0	**Extensor indicis**– Grade 2-
Extensor carpii– Grade 0	**Extensor carpii**– Grade 2-
Supinator – Grade 0	**Supinator** – Grade 2-
Infraspinatus, Teres minor – Grade 0	**Infraspinatus, Teres minor** – Grade 1
Lower extremity	Lower extremity
Tibialis anterior – Grade 0	**Tibialis anterior** – Grade 1
Extensor hallucis longus/brevis – Grade 0	**Extensor hallucis longus/brevis** – Grade 1
Extensor digitorum – Grade 0	**Extensor digitorum** – Grade 1
External hip rotators – Grade 0	**External hip rotators** – Grade 1
Muscle length test (according to Janda and Kendall)	
Hip Flexors (One joint): 5cm	**Hip Flexors (One joint):** 3.5cm
Hamstrings: 55°	**Hamstrings**: 65°
Pectoralis minor: Short	**Pectoralis minor:** Normal
Shoulder External Rotation: 60°	**Shoulder External Rotation:** 40°
Trapezius muscle: Grade 2	**Trapezius muscle:** Grade 1

Table 20: Main differences between initial and final examinations

3.3.13 Prognosis

The patient will go back home after our two weeks of sessions. He has improved a lot during this time and it is reflecting on the final examination. I do not know if he is going to continue with therapies after this, in my opinion he should be having a physiotherapist at home regularly so he can improve further.

The motivation of the patient will have to be there as well. I am not sure if he will be fully motivated to continue doing exercises at home. Although he has been improving a lot, he is still dependent in his every day activities. Even though he can see himself that he made progress, his daily living has not changed, he is still dependent of a person to help him with almost everything. And to gain autonomy in his daily living can seem for him very far away or impossible to achieve. If he understands that by continuing the exercising and therapies for longer than just 2 weeks, he will be able to improve his quality of life significantly in my opinion.

4 Conclusion

From the day-to-day therapy till the end of the sessions the patient has shown good improvements. With his cooperation we were able to improve his gait, posture, range of motion, muscle shortness and muscle voluntary activation. He even has gained confidence in his walking which was also an improvement from the initial examination.

I have learned a lot during this period of following this patient. In the beginning I could not see how we could help significantly someone after 4 years he had a hemorrhagic stroke. The therapies have shown that he is capable of progressing and this is a very good indication that he should continue with the therapies. Slow progress and staying constant in the therapy sessions is a great tool for improvement for these types of patients. I have learned more about the neurological patients and this will be also very beneficial for me for my future job as a physiotherapist.

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6 Supplements

Supplement 1

List of tables

Supplement 2

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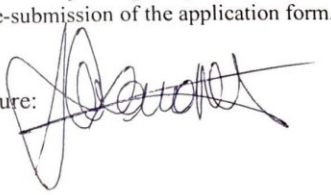
6.1 Ethics committee approval

CHARLES UNIVERSITY
FACULTY OF PHYSICAL EDUCATION AND SPORT
José Martího 31, 162 52 Prague 6-Veleslavín

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, 18.01.2022 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. Prof. MUDr. Jan Heller, CSc.
PhDr. Pavel Hráský, Ph.D. Mgr. Eva Prokešová, Ph.D.
Mgr. Tomáš Ruda, Ph.D. MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 104/2022
Date of approval: 18. 1. 2022

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
-- 20 --
Stamp of UK FTVS

Signature of the Chair of
UK FTVS Ethics Committee

6.2 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 vyšetření a průběhu terapie v bakalářské práci nebo svůj souhlas kdykoli odvolat bez represí, a to písemně zasláním Etické komisi UK FTVS, která bude následně informovat řešitele.

Místo, datum .....
Jméno a příjmení pacienta ..... Podpis pacienta:.....
Jméno a příjmení zákonného zástupce4 .....….
Vztah zákonného zástupce k pacientovi ..... Podpis: .....

6.3 List of abreviations

TIA: Transient Ischemic Attack
BMI: Body Mass Index
US: United States
USA: United States of America
ACA: Anterior Cerebral Artery
MCA: Middle Cerebral Artery
PCA: Posterior Cerebral Artery
PICA: Posterior Inferior Cerebellar Artery
TyG: Triglyceride-glucose
FAST: Face Arm Speech Time
CT: Computerized Tomography
MRI: Magnetic Resonance Imaging
EMG: Electromyogram
CPR: C Reactive Protein
INR: International Normalized Ratio
PNF: Post Neurological Facilitation
CDC: Centers for Disease Control and Prevention
Kg: Kilogram
Cm: Centimeters
BP: Blood Pressure
LE: Lower Extremity
UE: Upper Extremity
ADL: Activities of Daily Living
ROM: Range of Motion
PSIS: Posterior Superior Iliac Spine
ASIS: Anterior Superior Iliac Spine
Cir.: Circumference
SFTR : Sagittal Frontal Transversal Rotation
ABD : Abduction
ADD : Adduction
M. : Musculus
ER: Internal Rotation
IR: External Rotation
PIR: Post Isometric Relaxation