

**CHARLES UNIVERSITY IN PRAGUE**

**FACULTY OF PHYSICAL EDUCATION AND SPORT**

**DEPARTMENT OF PHYSIOTHERAPY**

Case study of patient with Multiple Sclerosis disease

Bachelor's Thesis

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## **Abstract**

### **Title**

Case study of patient with Multiple Sclerosis disease

### **Thesis aim and clinical findings**

This thesis involves a case study approach for a patient with Multiple Sclerosis. The thesis is divided into theoretical part which describes the background of Multiple Sclerosis . The other part is special part, which contains all the work I have done with my patient, all the examinations, conclusions, therapies and results.

### **Methods**

The practical part took a place in Oblastní nemocnice Kladno, it is based on a female patient, who is suffering from Multiple sclerosis, The patient had one session every day during these two weeks I was there. In total the patient had 5 sessions with me. All the methods applied are from what we have learn and practice during my study in the faculty of physical education and sport, and also all the methods were non-invasive

### **Result**

After the therapy sessions my patient had a slight progress. Range of motion was increased, strength was improved, The therapies have shown to be effective concerning my patient's diagnosis

### **Keywords**

Multiple sclerosis, Neurological, physiotherapy, rehabilitation

## Declaration

I declare that this bachelor thesis was handled by me, under the supervision and instructions of my supervisor Mgr. Helena Vomačková. It is an original research, which refers on practice with patient who suffers from Multiple sclerosis under the supervising of Mgr. Tomáš Modlinger. My practice took place at Oblastní nemocnice Kladno, in Kladno.

I also declare that this work is entirely my own, individual work based on knowledge gained from books, journals, reports and by attending lectures and seminars at FTVS UK.

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

Prague, March 2018

Hussain Alsaud

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## 1. Introduction

This disease has been reported to affect individuals who are mostly 20 years to 40 years old. From the name itself, it is evident that multiple sclerosis refers to multiple scarring or destruction of the white matter of the spinal cord and brain. These defects can severely affect ones' quality of life. There is still no known cure for these diseases; however, few comprehensive treatments have been suggested to delay the progression of the disease. Bearing the definitions of physical activity and exercise in mind and by considering its effectiveness in improving the physical fitness of normal individuals and also having the potential to improve the disabilities in the patients living with MS, it is now clear that physiotherapy is the most effective way to help the patients living with MS to recover from their sufferings due to this disease.

Thus, here in my Bachelor Thesis, I have chosen this disease not only due to its unfortunate widespread and timeliness but also because of the experience that I was gaining due to my surroundings i.e., witnessing a number of cases of MS. Thus, I will be discussing a case study of physiotherapy treatment of my patients who was diagnosed with Multiple Sclerosis, which I performed under the supervision of an experienced physiotherapist from the Department of physiotherapy Bc. Tomas Modlinger in Oblastní nemocnice Kladno during my clinical work placement. During this therapy of my patient, I will be using different physiotherapy strategies, I will not be using any kind of invasive techniques.

My patient was a female with a height of 161 cm, weight of 85 Kgs, BMI of 32.8 with normal cognitive abilities. When I first met her prior to the initiation of her treatment she was dependent on the roll aid walker and ankle foot orthosis on her right side. With a hope and faith on the physiotherapy strategies my main purpose in this case study would be to plan and implement effective physiotherapeutic techniques on my patient so that at the end of her treatment regimen she is able to perform all her activities independently and without the need of any supportive devices. The aim of this rehabilitation will be to improve the overall condition and slow the progression of the disease.

Therefore, I will be dividing this thesis into two parts: theoretical and practical. In the theoretical part, I will be describing the effects of multiple sclerosis, its pathophysiology, etiology, prognosis, treatment available and other latest

available information of multiple sclerosis. Following this, for the practical part, I will be discussing different physiotherapeutic procedures that I will be choosing to treat my patient and finally conclude on the effectiveness of my service to her and the benefits achieved by her post- treatment.

## 2. General Part

### 2.1. Introduction

Multiple sclerosis (MS) is one of the leading causes of neurological disability among the young adult population in all industrialised countries (Compston and Coles, 2008; Myhr et al., 2001). It is chronic neurological disabilities that occur in the central nervous system and there has been no identified cure yet reported. It results in damaged central nervous system, which presents a number of symptoms that might affect one's sensory, motor and autonomic systems in those who are affected by this disability (Compston and Coles, 2008).

The Northern Europe along with Norway are the high-risk areas, where the approximately 5 to 8 individuals per 1,00,000 people are affected and the prevalence is 150 to 170 individuals per 1,00,000 people (Myhr, 2010; Alstadhaug, Olavsen, & Salvesen, 2005). The disease results in a wide range of symptoms that affect one's ability to independently perform his/her daily activities (ADL); of which the disturbances in movement is one of the major issues. Research has shown that rehabilitation interventions such as physical activity and exercise are most beneficial for the management of symptoms of this disease and other associated disabilities in individuals who are victims of MS (National Institute for Clinical Excellence (NICE), 2004). Thus, for such patients, physiotherapy is popular and is recommended widely (European Multiple Sclerosis Platform [EMSP], 2012; National clinical guideline for diagnosis and management in primary and secondary care [NICE], 2004) and is commonly used by people with MS (PwMS) (K. Gottberg et al., 2008; Skovgaard et al., 2012). These two rehabilitative interventions have been shown by various researchers to aid the strength, mobility, cardiovascular fitness, quality of life and endurance (Snook and Motl, 2009; Motl *et al.*, 2008b; Rietberg *et al.*, 2004; Petajan *et al.*, 1996).

Optimising partaking in the ADL through body functions improvement and activities as per the International Classification of Health and Disability 1 (ICF) (World Health Organization [WHO], 2001) are some of the main targets of physiotherapy for patients living with MS in combination with the information and support to self-manage their condition throughout the disease course (Multiple

Sclerosis Society [MSS], 2004; NICE, 2004). The health cares for people living with MS are personified by concurrent long- time use of healthcare services in different healthcare organization and communities (K. Gottberg et al., 2008; Helse Nord, 2007). However, irrespective of the known benefits that are associated with physical inactivity and exercise, patients living with MS are still considered to be inactive (Sandroff et al., 2012; Moti, McAuley, and Snook, 2005), which can pose them to greater risks of acquiring secondary health complications that are associated with inactivity (Moti and Goldman, 2011) such as Type 2 Diabetes, Stroke, and Cardiovascular disorders (Motl, McAuley and Snook, 2005; Stuifbergen and Roberts, 1997).

Inactivity is not explicit to patients living with MS, but is an expression of the activities of the general population all across the world (Lee et al., 2012). The Government in UK has initiated a wide range of schemes in order to address the rising problem of inactivity such as Start Active and Stay Active, Exercise Referral Scheme, etc. (Department of Health (DOH), 2001;DOH, 2011). However, these schemes specifically targeted the healthy population and could not provide any clear evidence about the efficacy of these physical activity and exercise for individuals who live with chronic disabling conditions. Researchers suggest that in order to promote increased physical activity and exercise among patients living with MS, it is essential to include “Blue Prescription”, “Behavioural approaches” and “Self-Management programmes” in the treatment regimen (Barlow et al., 2009b; Plow et al., 2009., McAulley et al., 2007). Blue Prescription is a physiotherapy approach that is designed to promote patients with MS to adhere to regular exercise and increase their physical activity (Mulligan et al., 2013; Smith et al., 2013a; Hale et al., 2012). However, the above- mentioned studies have demonstrated a very limited impact on the increase in exercise and physical activity in patients living with MS. Likewise, other studies have also assessed and investigated the facilitators and barriers of physical activity and exercise in the MS patients (Asano et al., 2013; Kayes et al., 2011a); however, there is still very limited studies present that provides in- depth understanding on the process of translation of these into increased exercise and physical activity.

Physical activity refers to any movement in the body that is produced by the skeletal muscles, which results in loss of energy (Caspersen, Powell and Christenson, 1985 p.126) and would include occupational, sports and domestic-

related activities. While on the other hand, exercise is referred as a subset of planned physical activity that is not only structured but is also repetitive (Caspersen, Powell and Christenson, 1985 p.126) and its objective is to either maintain or improve one's physical fitness. Every health professional plays a major role in promoting both physical activity and exercise. Thus, the role of a physiotherapist is very important as they play a key role in establishing newer and effective ways to help patients with their disabilities and promote increased physical activity and exercise (World Confederation for Physical Therapy (WCPT), 2014; Chartered Society of Physiotherapy (CSP), 2011). However, there is a very little guidance and understanding for physiotherapists when managing patients living with MS with respect to physical activity and exercise in the community. The recent guidelines from the National Institute of Health and Care Excellence (NICE, 2014) recommends the inclusion of physical activity and exercise in the management strategies for MS. However, its centre of attention on exercise is very narrow and thus there is an urgent need to re-evaluate the physical activity component that is a much broader in scale and integrates exercise as an important component to manage the issues in the MS patients in the community.

In different European countries, physiotherapy has been recommended for patients living with MS by the community physiotherapists (cPTs) (Norsk fysioterapeut forbund [NFF], 2012a). The traditional in-patient care has been substituted with treatment in out-patient (OP) clinics, in which most treatments (NICE, 2004; Solari et al., 2007) are provided as multidisciplinary services. Some clinics also provide more systematic follow-up of physiotherapy that starts after the diagnosis and continues throughout the disease course and thus only single sessions are provided on a regular basis that are again complemented by the professional guidance from community physiotherapists.

Based on the needs for information of the patients living with MS and their follow-ups with respect to movement disturbances and collaborations among the different levels of healthcare to secure the quality and continuity of care, it is convenient to understand the gain of the MS patients from these single sessions of physiotherapy in the clinics ((EMSP, 2012; Guthrie, Saultz, Freeman, & Haggerty, 2008; Haggerty et al., 2003; Helse- og omsorgstjenesteloven, 2011; Helse Nord, 2007; NFF, 2012a). Moreover, the lack of competencies of the neurological physiotherapy among the community physiotherapists, the responsibility of the

hospitals for providing guidance to the healthcare workers and an international focus on Continue Professional Development (CPD) raises the concern for further investigation on the impact of professional guidance to the community physiotherapists in these clinics might entail for the ones who are undergoing this service ((Helse- og omsorgstjenesteloven, 2011; Helse-og omsorgsdepartementet [HOD], 2011; French & Dowds, 2008; NFF, 2012b).

## 2.2. Background of Multiple Sclerosis

Multiple Sclerosis (MS) is a chronic neurological disability disorder in which results in the demyelinating condition of the Central Nervous System (CNS) of the patients (Steadman, 2012; Compston and Coles, 2008). It is firmly believed by experts that multiple sclerosis is mainly characterized by an inflammatory process that results in demyelination (gradual deterioration of the myelin sheath) surrounding the axons in the Central Nervous System, thereby, ultimately resulting in the loss of axons (Compston and Coles, 2008). This process is believed to occur over a period of time and is substantiated by the presence of scars or sclerotic plaques along the myelin sheath thereby causing the interruption in the conductivity of electrical impulses along those fibres that are usually used to transfer information or messages between the spinal cord and the brain (Steadman, 2012; Compston and Coles, 2008). This disruption of the electric impulses that occurs as a result of inflammatory processes and degeneration of axons are responsible for the well-known clinical features observed in individuals who are victims of Multiple Sclerosis (Compston and Coles, 2008; Ambler, 2011).

This disease is considered one of the chronic diseases among the autoimmune disorders and its exact pathogenesis is yet undetermined. A number of research studies are still being conducted at present and researchers are yet to present a clear view on its pathogenesis. So far, there are lack of much effective therapies to treat this disorder in patients and completely cure them; however, the available therapeutic options such as certain pharmacological drugs, and physiotherapy allows the healthcare professionals to plan timely and appropriate intervention for patients to help them lead a good quality of life (Mares, 2012).



### 2.3. Epidemiology

Multiple Sclerosis is a very common yet very complex neurological disorder. Approximately 2.5 million individuals in the world are living with this condition while 4,00,000 patients were reported to suffer from this disease in Europe itself (Figure 1) (Flachenecker and Stuke, 2008; Mackenzie *et al.*, 2014).

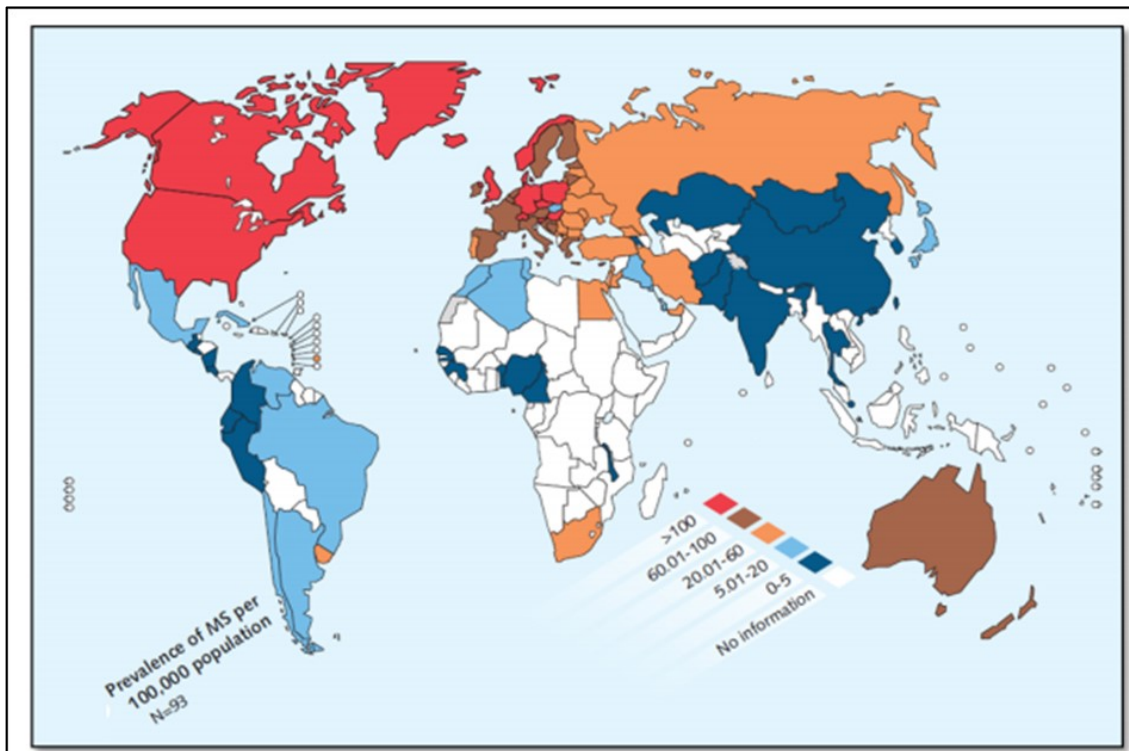


Figure 1 worldwide prevalence of multiple sclerosis

The prevalence rates varies from > 100 to 200 cases/ 1,00,000 in North America to <5 cases/ 1,00,000 in the South America and Asian regions. While in Australia, the rates vary between 11 to 74 cases/ 1,00,000. It usually affects individuals aged 15 to 75 years and the peak onset age is 20 - 40 years (Compston *et al.*, 1998). Mackenzie (2014) have demonstrated in their study that the 5- year difference in the MS peak incidence rate to be between women – 40 years and men – 45 years. Men has been reported to be diagnosed much later in years and they tend to suffer from more aggressive pattern of this disorder (Koch-Henriksen and Sørensen, 2010; Compston and Coles, 2002).

Usually, the women are more susceptible to develop this disease than men and their ratio is 3.2 : 1 while the ration between girls to boys living with this disease is 3:1. This could be because of the difference in the sexes; however, there are no

studies being conducted in this area. The incidence of this disease is uneven all across the world. These differences in its incidence are strictly attributed to different geographical locations, culture and ethnicity (Havrdová 2009; Scolding, Wilkins, 2012).

This disease has been found to be mostly diagnosed among the Indo-European race; especially in individuals who have Scandinavian origin are at higher risk of developing this disorder. In Asia, a special version of multiple sclerosis has been reported to occur, which is commonly known as neuromyelitis optica (Havrdova, 2009; Scolding and Wilkins, 2012). In Czech Republic, the prevalence of this disease has been reported to range from 17,000 to 20,000 individuals who are predominantly are of working age (Horakova, 2011). Even though it is a non-genetic disease, yet there are evidences that 20% of the patients have one or two cases of MS running in their families (Kalib, 2012).

However, the general life span of this patients living with Multiple Sclerosis is similar to that of the general population (Perry, 1994); however, a recent study proved that these patients might have a lower life- span of 5- 10 years than the normal individuals (Hurwitz, 2011). Since the disease mostly affects during the working years of an individual, thus, their social physical and economic implications are huge.

## 2.4. Etiology of Multiple Sclerosis

The cause of this disease is yet to be determined and it is usually said that it occurs as a result of complex interactions between environmental factors and susceptibility genes. The two common environmental factors that have been said to be involved in the disease pathogenesis are viral infection i.e., Epstein- Barr virus and lack of exposure to sunlight. A number of research groups have been trying to decipher the actual etiology behind the disease; however, yet not has been discovered; however, they believe that it occurs due to a number of factors that are associated with it. The studies are under process in the field of epidemiology, immunology, and genetics. Additionally, the infectious agents that might play a crucial role in its development are also being investigated. Understanding the exact

etiology of this disease will help researchers to speed up the process of identifying more effective ways to treat this disease and either prevent its occurrence or totally cure it.

So in summary, Multiple sclerosis (MS) is a neurodegenerative disease of uncertain etiology. In MS, neurodegeneration is thought to be secondary to autoimmune-mediated damage. However, no cohesive explanation yet exists as to how environmental factors interact to induce a neurodegenerative autoimmune response. Insufficient sunlight exposure and chronic viral infections have been proposed as unrelated environmental risk factors for MS. We suggest that these risk factors may act synergistically to enable the pathogenic autoimmune response. Low ultraviolet light (UVL) exposure depletes vitamin D3 stores, and low vitamin D3 levels correlate strongly with high MS risk. The central nervous system converts vitamin D3 into 1,25-dihydroxyvitamin D3 (1,25-(OH)2D3), a biologically active hormone with anti-inflammatory and neuro-protective functions that depend on IL-10-producing regulatory lymphocytes. Herpesvirus infection also correlates with MS risk. Some herpesviruses like Epstein-Barr virus produce an IL-10-like cytokine termed vIL-10. We hypothesize that vIL-10 may induce a dysfunction of IL-10-producing regulatory lymphocytes, thereby undermining the protective functions of sunlight, vitamin D3, and 1,25-(OH)2D3. The vIL-10 could elicit a host immune response capable of neutralizing or depleting IL-10, or the vIL-10 could compete with IL-10 but fail to perform an essential IL-10 function. In either case, the lack of sunlight exposure and the herpes virus infection might synergize to induce a defect in IL-10-producing regulatory lymphocyte function that undermines self-tolerance mechanisms and enables a pathogenic autoimmune response to neural proteins.

#### **2.4.1. Immunologic Factors**

In Multiple Sclerosis, the responses mediated by the abnormal immune cells tend to attack the coating of the myelin sheath that is present around the nerve fibres in the Central Nervous System (CNS). Several researchers in the recent years were able to determine which particular immune cells are responsible for mounting the attack and also determine those factors that forces them to attack and some of the common receptors

(sites) present on the attacking cells, which appears to get attracted to the myelin sheath so as to begin the destructive process. The ongoing efforts to understand more about the destructive process mediated by the abnormal cells in multiple sclerosis — i.e., what leads to the attacks, how it starts, and how it progresses or ceases — are bringing the researchers quite closer to understand the etiology of this chronic disease.

### 2.4.2. Environmental Factors

Multiple Sclerosis has been found and determined to occur in areas that are away from the equator more frequently. The epidemiologists or the research scientists are putting efforts to study different patterns of the disease. They are focusing on variations in the demographics (i.e., gender, age and ethnic background), geography, infectious causes, genetics and migration patterns so as to understand the exact cause of this disorder.

A number of studies have proved that individuals who are born in the region that has higher risks of developing multiple sclerosis, who later tend to migrate – or move --- to a region with lower risks of developing multiple sclerosis before the age of 15 years presumes the possibility of their new era. These data suggests that an exposure to certain environmental agents/ factors before puberty might predisposes an individual to develop the disease on later stages of their life.

Growing research and their outputs demonstrates that Vitamin D has a crucial role in the development of this disease. Individuals who grow u in the regions closer to the equator are exposed to more sunlight in a year due to which, they tend to have greater levels of Vitamin D in them as it is naturally produced in the body upon exposure to sun. This particular phenomenon is thought to support the functioning of the immune system and it might aid in protecting them against the immune- mediated diseases such as Multiple Sclerosis. The most possible relationship between the exposure to sunlight and multiple sclerosis are being currently studied in different research labs.

Other evidences suggests that smoking might also play a key role in the development of MS as smoking increases an individuals' risks of acquiring the disease and is mostly associated with severe forms of such diseases with a rapid progression.

However, the evidences also suggest that smoking cessation either prior to the onset or post the onset of MS – can slow down the progression of disability.

The multiple sclerosis clusters – i.e., the insight that huge number of MS cases have been reported in a specific time period in a particular region—might present clues to the genetic or environmental factors that might be increasing the risks of this disease. So far, no clear evidence has been produced from the cluster studies for the triggering or the causative factors or other factors associated with Multiple Sclerosis.

### **2.4.3. Infectious Factors**

One is exposed to a number of bacteria, viruses and other microbes during their childhood, and since these viruses are well- recognized as the major causative factors of inflammation and demyelination, thus it is suggested that virus, bacteria or some other infectious agents might be responsible for the triggering factor of multiple sclerosis. More than a dozen of bacteria and viruses—including canine distemper, measles, Chlamydia pneumonia, Epstein Barr virus and human herpes virus- 6—have been investigated by researchers in order to determine whether or not they are involved in the MS development; however, none has been proven yet to responsible for triggering the process.

### **2.4.4. Genetic Factors**

Even though Multiple Sclerosis is not hereditary, yet having a 1<sup>st</sup> degree relative such as a sibling or a parent suffering from multiple sclerosis does considerably increases the risk of that individual to develop this disease. A number of studies have demonstrated that certain genes have higher prevalence in populations that have higher rates of MS. A number of genetic factors have been discovered in some families where more than one individual in the family is affected. Some experts also theorizes that development of MS in such families could be because of the child born has genetic factors which when interacts with some environmental factors, upon exposure, might trigger the immune

response. New sophisticated techniques has been developed now that aids in identifying the genes that are helping to respond to the questions related to the role of different genes involved in the development of MS (NMSS, 2015).

## 2.5. Pathogenesis of Multiple Sclerosis

Multiple Sclerosis is predominantly known as an inflammatory demyelinating disorder; however, it also possesses a significant neurodegenerative component. The myelin sheaths present around the axons enables rapid and efficient promulgation of nerve impulses and provide axons protection (Kotter, Stadelmann, & Hartung, 2011). The lesions or scars predominantly occur in the white matter of the brain and very rarely in the grey matter. These active scars or lesions have been characterized by degeneration of the myelin present around the axons that is accompanied by the peri-vascular inflammations that involves macrophages, hypertrophic astrocytes and T-lymphocytes.

The anticipated major reason for these malfunctions is an individual's defective immune system (Havrdova et al., 2004). At the periphery of the auto-aggressive T-cells are located as a major part of the immune system and these have been found to be responsible for triggering the defense in a living thing against the foreign cells that are entering into the body. Upon erroneous activation of these cells in ones' immune system compels the permeate lymphocytes to pass into the CNS through the impaired blood-brain barrier i.e., through blood to the brain tissue, where these triggers the production of pro-inflammatory cytokines. These cytokines are the protein molecules that are the products of the immune cells, which enable communication between different cell systems. In the CNS, these tend to develop a multiple, irregular distribution of the inflammation foci that are termed as plaques (Seidl, Obenberger, 2004; Ambler 2011).

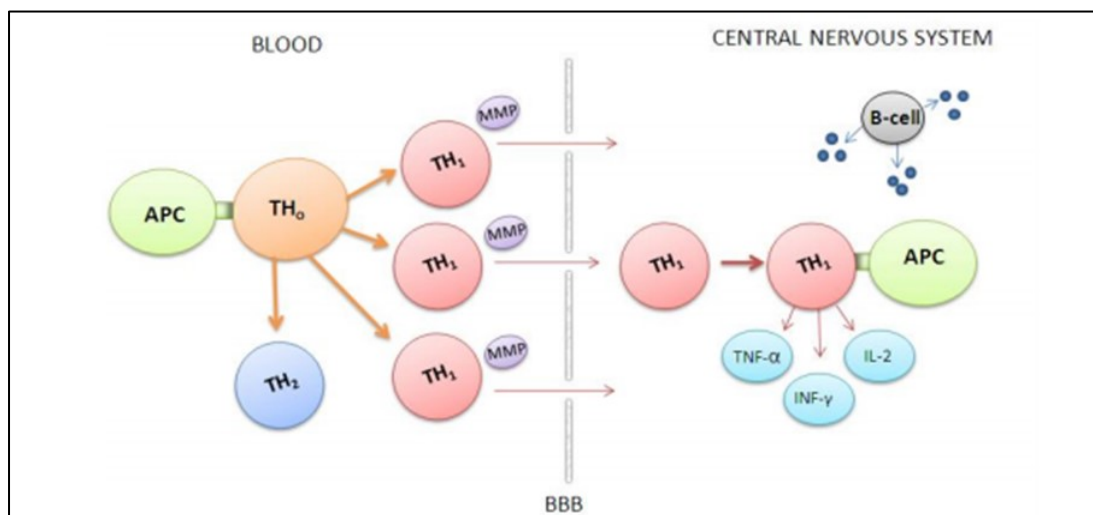
It is perceived that the 1<sup>st</sup> activation of the auto-aggressive T-cells is probably after a brain viral infection. The cytokines bears infiltrate and results in active inflammation that predominantly occurs in the white matter and rarely in the grey matter of the CNS. The second activation results in the enrichment of proliferation of specific cells, which when transferred to the target tissues passing the blood-brain barrier are broken into kindles that triggers the inflammatory mediators (Havrdova, 2009). The antibodies tends to bind to the macrophages along with the cytokines and thereby results in the degeneration of the target tissue. The inflammations foci also damage the axons

and the oligodendrocytes that get disturbed and later get disintegrated. The intact oligodendroglia has the potential to restore the axon myelination functions that describes the remission stage (Kappos, 2007).

This repeated damage results in loss of myelin sheath and its ability to regenerate the axons or the damaged cells and thereby induces development of atrophy in the CNS. The exposed demyelinated fibres then results in disrupted conductivity of the electrical impulses starting from the brain to the periphery and thereby leading to the functional failure. In the chronic phase of this disease, the underway degeneration starts predominately even being independent of the inflammation process (Havrdova, 2009).

The aggressiveness and the sensibility of this disease might be genetically determined. One of the possible reasons could be the organism’s ability to activate certain auto- aggressive cells and some inherited immune system settings. Moreover, various exogenous factors (smoking, vitamin D deficiency, and viral infections) are involved that are known to impact the pathogenesis of the disease.

The blood- brain barrier damage usually occurs resulting in local oedema followed by damage due to inflammation of the myelin sheath via different mechanisms. The damage to the axons then results in ineffective electric impulse conductance. As a result, a number of issues in MS patients arise of which the major one is flow of disturbed



**Figure 2: Multiple sclerosis pathology.** Undifferentiated T-cells (TH<sub>0</sub>) within the periphery are activated by antigen presenting cells (APCs). Once activated the T-cell undergoes clonal expansion producing a greater number of pro-inflammatory T-helper type 1 (TH<sub>1</sub>) cells. Matrix metalloproteinase (MMP) assists the activated T-cells to penetrate and cross the blood-brain barrier (BBB). In the central nervous system (CNS) T-cells are reactivated by APCs and secrete pro-inflammatory cytokines, inducing CNS inflammation via macrophages, B-cells and other T-cells. Macrophages and B-cells subsequently attack the myelin sheath via cytotoxic mediators such as tumor necrosis factor alpha (TNF- $\alpha$ ), Interferon gamma (INF- $\gamma$ ) and interleukin two (IL-

Figure 2 Multiple sclerosis pathology

information within the neuronal networks where the damaged sites are present. However, the re- myelination is promoted by the inflammation itself, where the oligonucleotides and its related precursors play an important function (Kotter et al., 2011). Following this demyelination, the oligonucleotide precursor cells tend to rapidly amplify in the areas of demyelination and causes re- myelination (Kotter et al., 2011).

This phenomenon extensively occurs at an early stage of the disease and is said to be incomplete in the progressive MS cases indicating that loss of some of the cells ability to remyelinate with the progression of the disease. Furthermore, even in the advance multiple sclerosis cases, the oligonucleotides presence have been confirmed indicating the potential of some regeneration. This remission process of the neurons, which occurs between the attacks in addition to the neuroplasticity principles, presents a neurobiological basis of the need for physiotherapy.

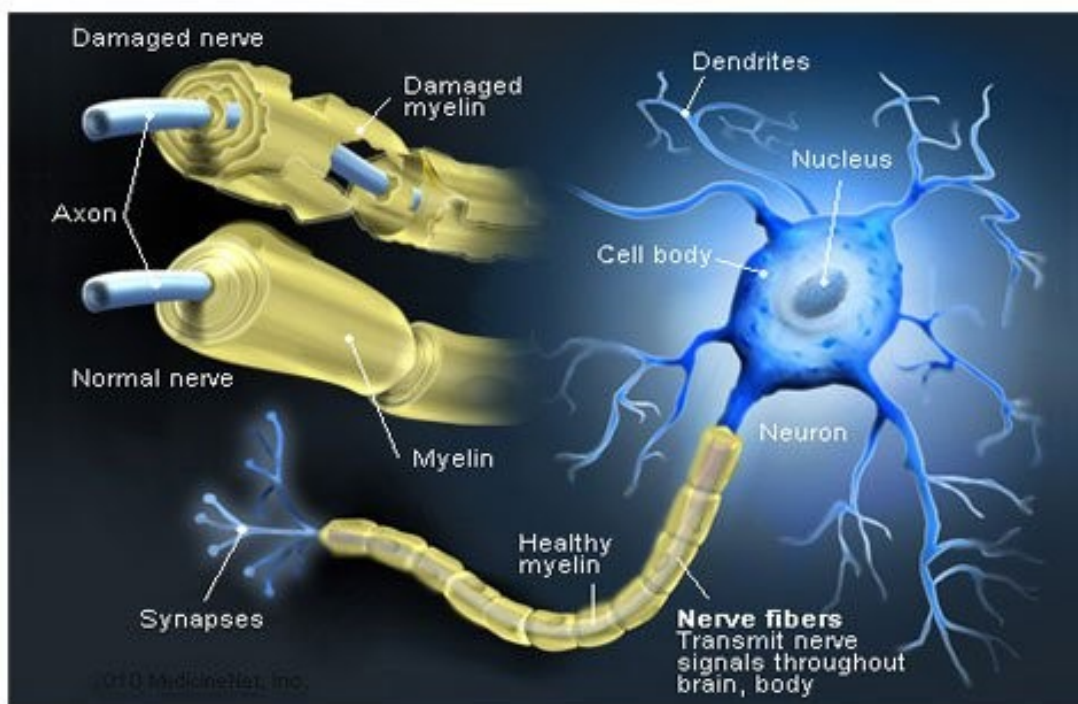


Figure 3 Nerve fibre ( neuron from a healthy individual and person with MS )

The disease pathogenesis can be divided into two phases; where the early phase is characterized by the Central Nervous System (CNS) inflammation that occurs as a result of activated B- cells, T- cells and macrophages (**Figure 2**). The T- cells, macrophages and the antibodies that are secreted from the B- cells tends to attack the



targeted neurons thereby resulting in demyelination. Following the initial phase, this condition tends to gradually progress to the 2<sup>nd</sup> phase that is characterized by neurodegeneration and loss of axons. The disease course significantly varies between the patients and the symptoms presented by them, which are highly dependent upon the affected area of the CNS. The **Figure 3** demonstrates the difference in the structure of the nerve fibre in a normal individual and in patients living with Multiple Sclerosis.

Figure 4 demonstrates the differences in the brain physiology in normal and MS patient.

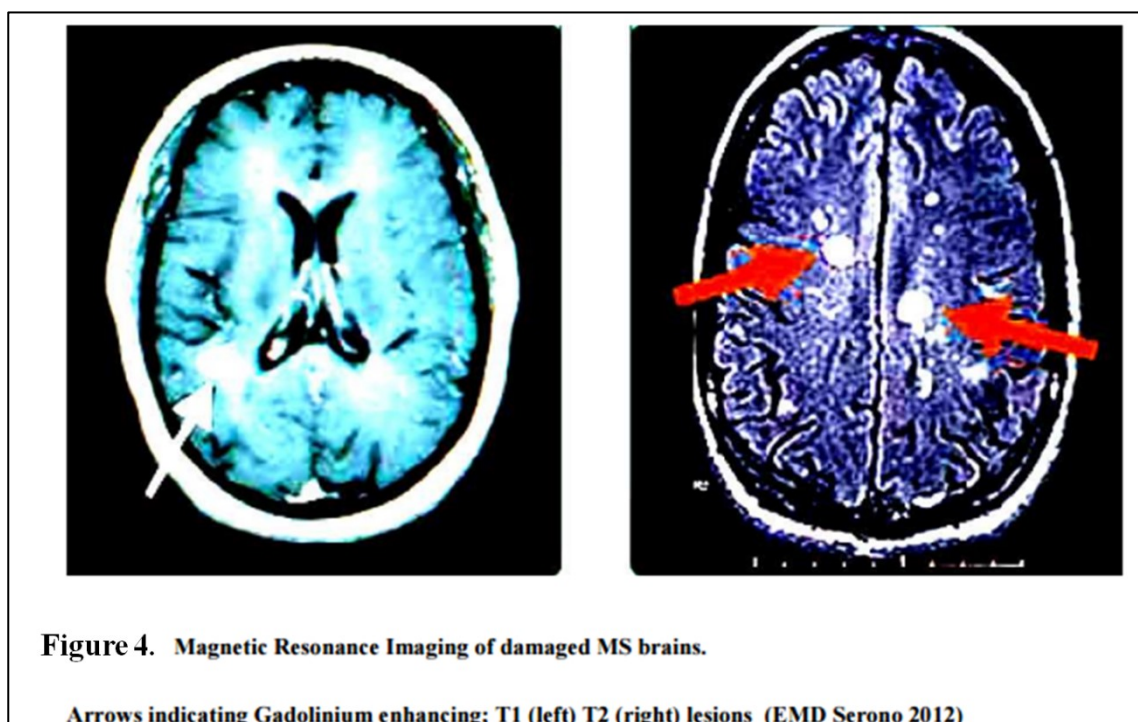


Figure 4 Magnetic Resonance imaging of damaged MS brains

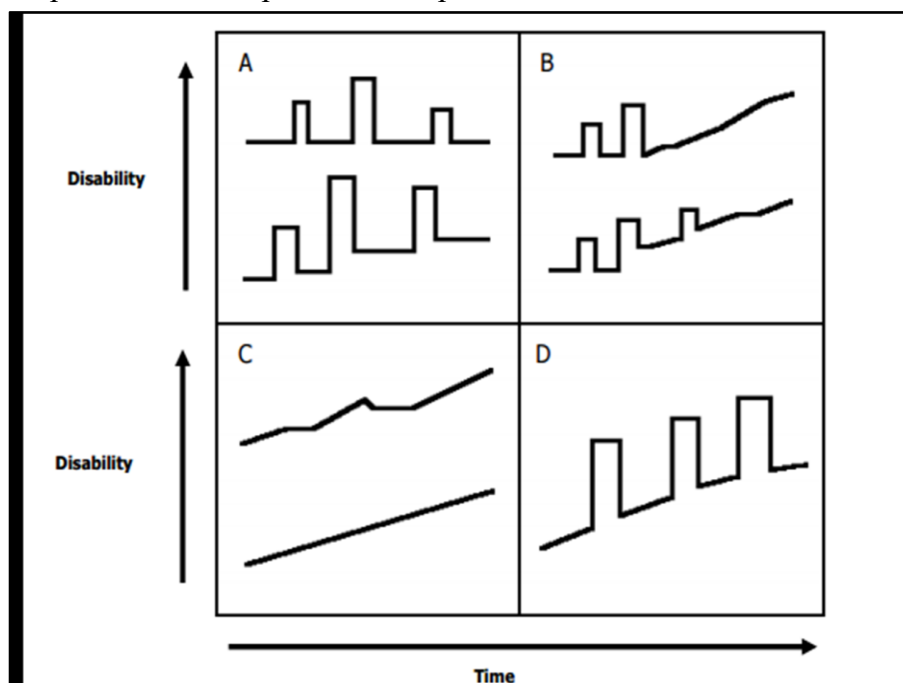
### 2.5.1. Disease Course

Multiple sclerosis has been defined as a long- term chronic auto- immune disease, which usually begins with altering the relapses in the forms of sclerotic attacks and remissions that in most of the cases results post- 10 years to 20 years in to the secondary progression. The ATAC represents the acute inflammation flares, which develops s a result of focal or multi- factorial neurological dysfunctioning and the complications or

symptoms often lasts for a minimum of 24 hours. During the attacks, the patient often experiences symptoms that he/ she has never experienced before or had earlier but the symptoms had disappeared or stabilized sooner. The severity and the extent of these attacks to a certain extent demonstrate the activity of this complex disease; however, it is not a reliable indicator that is used for long- term stabilization. Additionally, 15% of these patients do not experience relapses. In these individuals, experts have suggested the neurological disabilities increases gradually.

This particular disease often appears in the benign or malignant forms in patients. The pernicious course, a patient with the malignant form of the disease might represent unrelated symptoms for the first few months; however, later these patients might experience harsh and abundant attacks. This form of disease is found to be common as compared to that of the benign form, where these exhibit minimal neurological deficits (Havrdova et al., 2006).

Based on the frequency and pattern of the symptoms presented, the disease course is classified under 1 of 4 clinically defined MS types (**Figure 5**). The relapsing- remitting multiple sclerosis is one of the commonest forms of MS that accounts over 80% of the new diagnosis made and 55% to 60% of the total affected population. The relapsing-remitting MS patients often experiences relapses,



**Figure 5 Visual representation of the variable disease course in multiple sclerosis.**  
 The lines represent disability. When the line of the figure goes vertically up, it is indicative of a relapse. When the line of the figure goes vertically down, a remission has occurred. A) Figure 5 Visual representation of the variable disease course in multiple sclerosis

followed by the remission periods, where little or no symptoms are present. These attacks tend to occur only in small numbers and disappear completely after sometime and are often dominated by the degenerative processes. Relapses in the MS relapsing-remitting stages have been associated with demyelination and focal areas of inflammation.

Most of the relapsing-remitting MS patients will later develop the secondary-progressive MS. After the relapsing-remitting initial period of MS, the patients tend to experience loss of function progressively. This progressive disability is linked to irreversible damage of the axons within the CNS. It is thus possible for the relapses to either continue or cease with the secondary-progressive MS. At least 20% to 30% of the affected individuals develop the secondary-progressive MS.

When the disease tends to progress from the onset then it is said to be a primary-progressive MS, where patients often experience a stepwise or steady progression in disability without any symptomatic relief. It has been reported to affect approximately 5% to 10% of the MS population. In this form, the patients tend to experience a steady progression of their disability since its initiation along with relapses. This form results in prevailing sphincter and lower spastic paraparesis limb issues and is pathogenically a different form of disease as it represents different histopathology, where it has little or no inflammation present and there is an early loss of oligodendrocytes. However, this type is relatively rare and affects only 5% of the patients. This form of multiple sclerosis is often difficult to be tackled by just using pharmacological drugs (Kaňovský, Herzig et al. 2007).

The relapsing- progressive form is the most complicated forms of all in MS, which often leave a permanent neurological damage without leaving a chance of any medications. The inflammatory activities that this form triggers in the brain tend to faster the progression of the disease process and this result in further deterioration during the disease course. If a patient has experienced this form, it won't be surprising if the patient gets severely crippled over the time. However, most research studies represents that this does occur but occurs in a very small percentages of the patients living with multiple

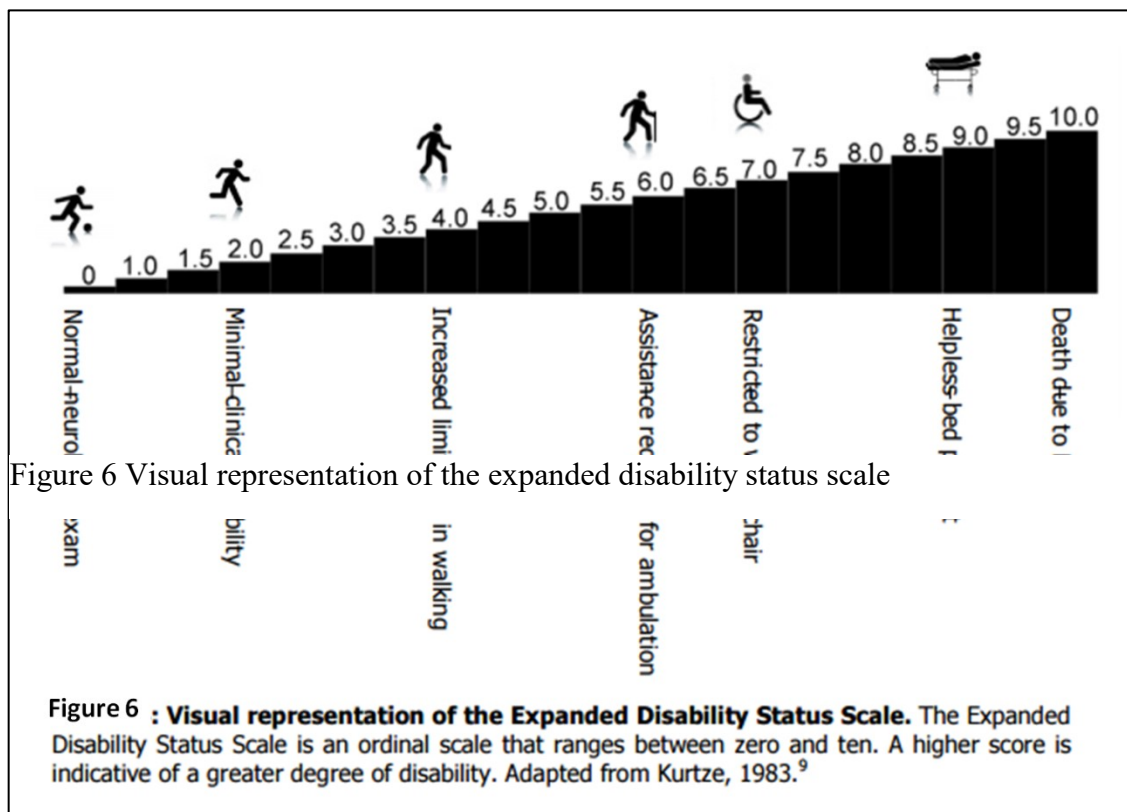


Figure 6 Visual representation of the expanded disability status scale

sclerosis.

### 2.5.2 Disease Severity

The Expanded Disability Status Scale (EDSS) is one of the commonest clinical scales that are used to assess the neurological impairment in multiple sclerosis. The EDSS is known as a neurologist assessed measure, using which the neurologists assesses their patients based on their history and examination of their neurologic factors. Following the assessment, the MS patients are scored based on an ordinary scale ranging between 0 to 10, where the score 0 indicates absence of neurological impairment while score 10

indicates severity leading to death (**Figure 6**). Irrespective of the fact that these are used very commonly to measure the disability in MS patients, yet it has a number of limitations.

This tool has poor reliability because it made up of a large subjective component, especially with respect to the assessment of the bowel/ bladder and ambulation. This can also result in differences in scores when examined by different neurologists. Likewise, the terms such as “mild”, “moderate” and “severe” used in the assessment items might have different meaning to different neurologists, thereby, resulting in differences in scoring. This tool has been also criticised as it uses a non- linear scale where the patient progresses faster from 1<sup>st</sup> to 5<sup>th</sup> step than between 5<sup>th</sup> to 7<sup>th</sup> step. Due to this use of non- liner scales, a number of cross- sectional studies shows a bimodal distribution of the scores. Since, this tool is used only by the neurologists, thus it is not always genuine or is cost- effective to be used in both research and clinical settings.

Even though this tool presents a comprehensive assessment of the severity of the disease, a number of non- specialist neurologists and other healthcare professionals, who have used this tool, often tends to prescribe treatments to the MS patients. Therefore, it is essential to develop a much simpler tool. In order to meet the needs, the Disease Step Scale (DSS) was developed that allowed the researchers and non- speciality healthcare providers to assess the severity of the disease (**Table 1**). The DSS and EDSS have been reported to be highly correlated and DSS has been suggested to have several advantages than the EDSS. This tool is easier to use, shows uniform distribution in patients among different steps and has lower inter- rate variability as compared to EDSS. Thus, DSS is suggested to be a useful alternative tool to EDSS in some clinical and research settings.

Table 1 Disease steps scale

<b>Disease Step Scale score</b>	<b>Description</b>
<b>0: Normal</b>	Functionally normal with no limitations on activity or lifestyle
<b>1: Mild disability</b>	Mild symptoms and/or signs
<b>2: Moderate disability</b>	Main feature is visibility abnormal gait
<b>3: Early cane</b>	Use a cane/unilateral support for greater distances but can walk at least 25 ft (7.62 m) without it
<b>4: Late cane</b>	Unable to walk 25 ft without a cane/unilateral support
<b>5: Bilateral support</b>	Requires bilateral support to walk 25 ft
<b>6: Wheelchair</b>	Essentially confined to a wheelchair
<b>7: Unclassifiable</b>	Used for patients who do not fit above classification

Adapted from Hohol et al.<sup>15</sup>

### 2.5.3. Neuroplasticity

The neuroplasticity helps some of part of the Central Nervous System (CNS) to change their functions and their forms as a result of external or internal changes (Brodal, 2010a, pp. 147-156; Kleim et al., 2002; Nudo, 2003). An internal changes i.e., scars or lesions present in the CNS, tends to promote immediate secretion of the nerve growth factors, followed by cortical re- organization, axonal sprouting and alternative neuronal chain establishment (Comi & al., “Effect of early interferon treatment on conversion to definite multiple sclerosis: a randomised study, 2001). In the early phases of MS, the axonal sprouting is considered to be more extensive as compared to examples such as traumatic head injuries; however are less in the chronic phases of the disease (NMSS, 2015). These neural mechanisms are known to augment due to active use i.e., when active movements are done and thus has been referred to as the “user- pressure” by activity or brodal dependent plasticity. The motor unit activation induces plastic alterations in the alpha motor neurons, the connective tissues, and the innervated muscles (Dahl, 2008). Thus, it this neuromuscular system is adaptable.

## 2.6. Clinical Picture

The clinical picture of this complex chronic disease majorly depends on its prevalence, the brain atrophy rate and on its localization of the inflammatory bearings in the CNS (Havrdova, 2009). Initially most research scientists focused on the sudden emergence of the focal neurological symptoms. This particular condition is described as a clinically isolated syndrome, which is manifested clinical symptoms onset that correspond the demyelinated events with positive lesions visible upon doing a brain MRI and positive outcomes seen in the cerebrospinal fluids. Approximately, 85% of the MS patients results in clinical multiple sclerosis (Mares, 2012). In multiple sclerosis, the neurological symptoms usually occur with a multi- focal distribution in the spinal cord and in the brain's white matter and that keeps on progressing over the time. The biggest issue of this disease is the damage that occurs in the white matter that is present along both the lateral brain stem ventricles and optical nerves of the spinal cord (Seidl, Obenberger, 2004).

The clinical signs comprises of the following:

### **First Symptoms of the Cranial Nerves**

The symptoms might vary from patient- to- patient as the complex disease is associated with a multitude of symptoms. It is dependent upon the type of sub-systems that are affected and on the individuals' with pre-morbid condition. Most patients exhibit clinical manifestations that comprises of sensory, motor, autonomic and visual systems (Compston & Coles, 2008). However, there are few symptoms that are commonly found in all MS patients.

- **Fatigue**

Fatigues are a condition where the patient loses physical or mental energy that in turn interferes with the patients' daily activities. It is one of the commonest symptoms and is reported in almost 90% of the patients. It could be associated with the disease process or with non- disease specific factors such as depression or sleep disturbances. The pathology associated with primary fatigue is complex in MS patients and its mechanism is still undetermined.

- **Spastic Paraparesis Weakness in legs**

Almost all patients during their disease progression exhibit symptoms of gait difficulty (spastic paraparesis or ataxic), urinary incontinence, myelopathy and spasticity or stiffness of the legs. These symptoms can appear all of a sudden, as when there is a presence of transverse myelitis or they tend to develop insidiously during the course of weeks.

In case of transverse myelitis, there is a possibility of rapidly develop syndrome of arm or leg weakness, sensory loss, or bladder involvement along with changes in the cerebrospinal fluid (CSF), most probably a pleocytosis. The research studies that followed- up patients who had presented symptoms of transverse myelitis for longer period demonstrated that clinically definite multiple sclerosis tends to develop in approximately 25% of the patients who have normal MRI scan of their brain during the diagnosis and then the disease tends to progress and after 10 years, 67% of these patients exhibit abnormal MRI scans. In most cases, the transverse myelitis has been suggested to appear after the patients have experienced an episode of optic neuritis, which is also known as the Devic Syndrome that appears to be diverse from that of MS.

- **Sensory Complaints**

Patients with MS often presents Lhermitte signs that comprises of travelling of the electric sensation down the spine of the patient and has been also reported to travel into the arms and legs especially when the patient flexes the neck forward. However this particular symptom is not very specific to MS and its presence in younger patients confirms the presence of this disease.

Most patients often presents constricting band- like paresthesias that are known to imitate small plaques in the spinal cord. These bands are often described as affecting the abdomen, arms, legs, pelvis or thorax and in cases these are not found then the patient is considered to be hysteric. One of four patients often complaints of distressing crawling- and- creeping sensation on their faces, which often come and go. Examination often exhibits slight muscle rippling around their lips, which is also known as facial myokymia.

- **Retrobulbar neuritis**

One of the most frequent initial symptoms of MS is the retrobulbar neuritis in the optic nerve. The demyelination that occurs in the brains tends to



impact almost any part of the optic nerve due to which the patients tends to have impaired color perception, reduced central vision, feeling of pressure or pain behind the eyes that worsens the eye movements and loss of visual field. The inflammation in the ocular nerve might occur several time, yet there are little or no subjective functional defect present (Diblik, Kuthan, Glass, 2011).

- **Nystagmus**

This disability occurs in the oculomotor pathways that results in involuntary jerking of the eye movements, especially in the extreme eye positions and also exhibits inability to capture the images that are clear and double vision. When the nystagmus is at its initial stage or are present in lighter degree, the patients often fail to perceive the issues (Havrdova et al., 2006).

- **Inter- nuclear Ophthalmoplegia**

It is one of the commonest extra- ocular disorders that are seen in MS patients. It occurs in approximately 40% to 76% of the patients. The demyelination has huge impact on the fasciculus longitudinalis medialis, which is a white matter tract and that transverse the majority of the brainstem. This is conjugate lateral gaze disorder where the affected eye presents adduction impairment. In this condition when one tries to gaze contralaterally the effected eye tends to minimally adduct. This occurs majorly due the lesions present in the cerebellar or the brainstem and thereby results in visual fatigue, diplopia, blurred vision and oscillopsia. Upon MRI, posterior fossa lesions are usually found in such patients (Diblik, 2012). A unilateral INO is seldom of vascular origin and it's usually occurs as a result of stroke in older patients.

- **Diplopia**

The binocular diplopia usually tends to occur in MS patients due which they have issues of double vision. This tends to lasts in paients for days to weeks. Due to damage of the nerve pathways that are responsible for eye movements, the eyes get misaligned and the vision messages from each eyes gets dis- coordinated thereby resulting in double vision (Dibik, 2012). Upon examination, often inter- nuclear ophthalmoplegia (INO) is found that restricts

full adduction of one eye while abducting nystagmus results in the horizontal gaze, which often occurs in the other eye.

- **Facial palsy**

The facial paralysis occurs as a result of nerve damage that leads to loss of facial movements. In this case, the facial muscles get weakened. This can result either on one side or on both sides of the face.

- **Cognitive/ behavioural problems**

Most MS patients exhibit mood disorders or cognitive impairment or both. The most common cognitive problems comprises of concentration disability, easy distractibility, impaired verbal fluency, and slowing of psychomotor skills. The development of these issues starts either at early or at later stages during the disease progression process. However, it is to some extent very unusual as some MS patient might present symptoms of dementia as well. The prevalence of the depression among these patients has been reported to be higher as compared to other patient populations. However, it also often remains unrecognized or undetected in patients and thus remain untreated.

A number of studies have reported that greater than one- third of the MS patient population has been detected to suffer from major depressive symptoms. Additionally, approximately, two- thirds of these depressed MS patients were found to be suicidal and have been reported to be devoid of anti-depressant medications, which emphasizes that there is an urgent need for the identification of cure or interventions to treat this kind of depression in such patients.

- **Inco- ordination**

Ataxia has been reported to be very common among MS patients where some patients demonstrated symptoms of truncal ataxia that becomes severe due to which they are unable to sit up independently.

- **Speech**

Most patients with MS demonstrate issues with their speeches, which is further characterized as metered or scanning. Such patient has been seen to frequently use their accents on the wrong word or syllable. However, dysphagia has been frequently accompanied with dysarthria and thus needs to

be screened frequently in order to prevent such complications from occurring and also other complications such as aspiration pneumonia.

- **Bladder Incontinence**

Patients often exhibit urinary tract symptoms as well that eventually tends to develop into severe form in most MS patients. Even though these symptoms usually occur as a result of urinary retention issues, form of urge incontinence, etc. Although, the symptoms of urinary retention is less common, it might have serious medical consequences if remained untreated, such as frequent infections in the urinary tract or hydronephrosis.

- **Hemiparesis**

Even though in majority of the MS cases presenting the problem of hemiparesis occurs as a result of stroke, yet certain presentations appears to trigger the search for MS. In young patients, the hemiparesis often occurs in the insidious form or have a slow onset along with fluctuations that suggests that the patient has MS, especially when there has been already a history of optic neuritis or some other form of neurologic complications.

- **Paroxysmal Symptoms**

A brief or sudden episode of ataxia, dysarthria and so- called spasms can be detected in patients affected with MS. These spasms are also called as tonic seizures; however, they are often considered as a misnomer. Mostly, these spasms are known to comprise of painful twisting of the patients' extremities, which is often elicited by hyperventilation. Experts believe that such paroxysmal symptoms occur from the regions where demyelination has occurred and where the crosstalk between the axons and the neurons takes place.

- **Pain**

In approximately 90% of the patient this is the commonest manifested complication. The most common pain syndromes can be further broadly distinguished into different subtypes: paroxysmal, musculoskeletal and neurogenic.

- ✓ The neurogenic pain represents a characteristic tingling, numbness or burning sensation

- ✓ The prototypical paroxysmal syndrome is a kind of tic douloureux or trigeminal neuralgia that is presented as severe paroxysmal, lancinating pain in the face. The trigeminal neuralgia or tic douloureux tends to occur in the young adults or it bilaterally increases the suspicion of multiple sclerosis in those patients.
- ✓ The musculoskeletal pain can be primary or secondary; similar to hemiparesis which results in musculoskeletal pain that occurs in the compensating stronger side.

## 2.7. Prognosis

Multiple Sclerosis is progressive auto-immune disease, where the accumulation of the activity of the disease is found in most patients even after years in the form of cognitive and/ or physical impairment (Fisniku & al., 2008). Studied showed that even after follow-up for 2 consecutive years, approximately 50% of the patients living with clinically isolated syndrome fail to meet the diagnostic criteria set for Multiple Sclerosis while after 20 years these becomes more than 80% (Polman, 2006). Even though the majority of the patients are eventually diagnosed with MS, yet a minority of them still continues as clinically isolated syndrome (Comi & al.,2001; Comi & al.,2009). Since the modifying agents of the disease has been repeatedly proven to setback the second relapse, it is often suggested that the disease modifying therapy should be started right after the first relapse. Nevertheless, there have been evidences that indicates that some of the patients experiences little or no progression in their disease in the future after their first relapse and they thus remains clinically isolated syndrome patients even in absence of therapies (Jacobs, 2000; Kappos, 2007). Therefore, it is imperative to identify these patients or patients who experiences progressive disease activity.

## 2.8. Diagnosis

It is very important to diagnose Multiple Sclerosis at an early stage. By early stage, experts mean the clinically isolated syndrome (CIS) and the initial months after being transited into definite multiple sclerosis. Since the starting point, that is, beginning of the disease, the disease starts damaging the neurological system and thereby resulting in permanent neurological deficit. Therefore, injury to the Central Nervous System

(CNS) noted even before the occurrence of first clinical symptom indicates the presence of MS. Additionally, if it is possible to detect and identify the presence of this disease at an early stage then the disease progression can be controlled and the irreversible damage of the CNS can be restricted and thereby the related disabilities (Mares, 2012).

Previously, multiple sclerosis was detected based on the clinical symptoms. However, over the course of time, new diagnostic methods were developed such as examination of the cerebrospinal fluid, visual evoked response (VER) test, magnetic resonance imaging, etc. using which it became each to diagnose this disease. The McDonald criteria was developed by experts as the diagnostic criteria for this disease and in 2010, this criteria was updated, which allows one to detect this disease right after its first clinical attack i.e., when the patient disease is considered as clinically isolated syndrome (CIS) (Josey et al., 2012; Polman et al., 2011) (**Table 2**). In the relapsing remitting course (RR-MS), the diagnosis is done based on the verification of the disseminated illness over the time and localization with no other symptom explanation. The Primary Progressive stage is difficult to diagnose; however, this can be detect after 1 year of the progression when positive outcomes can be expected in the MRI scans, VER tests and cerebrospinal fluid (Josey et al., 2012). The degree of disability and the neurological impairments can be measured by using clinical recording systems. The most commonly used tool for measurement is the Expanded Disability Status Scale (EDSS) (Kurtzke, 1983) (as discussed above). A score “4” in EDSS is defined as the restrictions to walk more than 500 meters while score= 6 indicates the dependency on a crutch to walk even 100 meters, and score= 7 demonstrated the permanent dependency on a wheelchair for ambulation (Kurtzke, 1983). In patients with untreated MS, approximately, 50% experiences restriction in walking distance after 8 years to 10 years, dependency on walking aid even for walking 100 meters after 20 years, and the dependency on a wheelchair after 30 years of the disease (Myhr et al., 2001).

Table 2 Diagnostic criteria for MS

<b>Clinical Presentation</b>	<b>Additional Data Needed for MS Diagnosis</b>
Two or more attacks (relapses) Two or more objective clinical lesions	None; clinical evidence will suffice (additional evidence desirable but must be consistent with MS)
Two or more attacks One objective clinical lesion	Dissemination in space, demonstrated by: MRI or a positive CSF and two or more MRI lesions consistent with MS or further clinical attack involving different site <b>2010 Amendment:</b> Dissemination in Space (DIS) can be demonstrated by the presence of 1 or more T2 lesions in at least 2 of 4 of the following areas of the CNS: Periventricular, Juxtacortical, Infratentorial, or Spinal Cord.
One attack Two or more objective clinical lesions	Dissemination in time, demonstrated by: MRI or second clinical attack <b>2010 Amendment:</b> No longer a need to have separate MRIs run; Dissemination in time, demonstrated by: Simultaneous presence of asymptomatic gadolinium-enhancing and nonenhancing lesions at any time; or a new T2 and/or gadolinium-enhancing lesion(s) on follow-up MRI, irrespective of its timing with reference to a baseline scan; or Await a second clinical attack.
One attack * One objective clinical lesion (clinically isolated syndrome)	<b>2010 Amendment:</b> Dissemination in space demonstrated by: For Dissemination in Space: 1 or more T2 lesion in at least 2 of 4 MS-typical regions of the CNS (periventricular, juxtacortical, infratentorial, or spinal cord); or Await a second clinical attack implicating a different CNS site; and Dissemination in Time: Simultaneous presence of asymptomatic gadolinium-enhancing and nonenhancing lesions; or a new T2 and/or gadolinium-enhancing lesion(s) on follow-up MRI, irrespective of its timing with reference to a baseline scan; or a second clinical attack.
Insidious neurological progression suggestive of MS (primary progressive MS)	One year of disease progression (retrospectively or prospectively determined) and Two or three ( <b>2010 Amendment</b> ) of the following: Positive brain MRI (nine T2 lesions or four or more T2 lesions with positive VEP) Positive spinal cord MRI (two focal T2 lesions) or Positive CSF

Adapted from McDonald et al(2001) and Polman et al (2011).  
MRI – Magnetic Resonance Imaging, CSF – Cerebrospinal Fluid, T2 – Lesion indicating evidence of MS, VEP • Visual Evoked Potentials (evidence on brain activity)

## 2.9. Treatment

The treatment to cure multiple sclerosis in patients is yet to be determined; however, the disease is considerably impacted by using immunosuppressive and immunomodulatory therapies. These therapies aim at influencing the patient's immune system; however, it is important that the therapy is started in a timely manner i.e., it is best to start when clinically isolated syndrome is detected so as to prevent the occurrence of the irreversible CNS damage. The therapeutic approach differs in different stages of the disease such that is when the neurological symptoms are worsening over the time the treatment is aimed at suppressing the acute inflammation while the long-term treatment aims at reducing the total number of attacks and its frequency during the disease progression. The symptomatic treatments majorly impact the number of symptoms during different stages of the disease (Havrdova et al., 2006).

Patients are usually treated at the specialized neurological Multiple Sclerosis centers where the access for treating this disorder is comprehensive, which not only includes pharmacological remedies but also has rehabilitation therapies and physiotherapies. The patients in such centers are also provided with counseling sessions so as to help them and convince them to adhere to their treatment regimen in order to lead a healthy life style (Preiningerova, 2012).

### 2.9.1. Pharmacological treatment

The treatment for acute relapse usually includes intravenous administrations of high doses of corticosteroids such as methylprednisolone without any alternative oral therapy. This drug can be administered even at an out-patient basis in some of the cases depending on the severity of the disease. However, if the patient also suffers from other MS-associated diseases such as diabetes, coronary artery disease, etc. for which they need to be hospitalized usually experiences some major side-effects upon administration of corticosteroids. Thus, to prevent these effects, the patients are often preventively detained. At the end of the therapy, it also becomes important to prevent the rebounds, flares, inflammations, etc. due to withdrawal of corticosteroids. Thus, the expert usually reduces the doses slowly for these patients until withdrawal. If the therapy is stopped

unappreciatively then the clinical symptoms tends to persists over three weeks and one can experience series of plasmapheresis (Mareš, 2012; Meluzínová, 2010).

The long- term treatment on the other hand aids in reducing the inflammatory activity, which in turn reduces the number and intensity of these relapses and slows down the progression of the disease in patients. Patients who experience the relapsing- remittent waveform and exhibits high disease activity are usually treated with drugs as first choice. These patients, however, needs to comply with the indicative drug criteria of the drug of choice. These criteria include diagnosis of the relapsing forms of multiple sclerosis based on the McDonald criteria. The drug of choice belongs to the group of immunomodulatory drugs that modifies the usual course of the disease, which usually comprises the interferon beta (such as Avonex, Rebif, and Extavia Betaferon), glatiramer acetate (i.e., copaxone) and disease modifying drugs (DMD) (Table 3). These different groups of drugs usually have different mechanisms of actions; however, both the drugs aids in reducing the number of relapses. The medicament administration is usually in the form of injection or infusion. In cases, where the patients do not meet the diagnostic criteria for the use of these drugs of first choice or if they hate it being administered intravenously then they are administered with drugs such as immunosuppressants (i.e., azathioprine or methotrexate) or corticosteroids (i.e., Medrol or prednisone) orally. The glatiramer acetate and interferon- beta drugs were approved by the FDA to clinically treat the patients with clinically isolated syndrome (Mares, 2012).

Table 3 Side effects of the interferon- beta agents used to treat MS

Pharmacological agent	Common side effects	Other possible side effects
<b>Avonex®</b>	Flu-like symptoms including myalgia, fever, fatigue, headache, chills, nausea and vomiting.	Paresthesiae, hypertonia, myasthenia, depression, suicidal ideation and new or worsening psychiatric disorders.
<b>Betaseron®</b>	Flu-like symptoms and pain, elevated liver enzymes, lymphopenia, injection-site reaction and asthenia.	Depression, suicidal ideation and injection site necrosis.
<b>Rebif®</b>	Flu-like symptoms, injection-site reaction, elevated liver enzymes and haematological abnormalities.	Depression and suicidal ideation.

Source: Vosoughi & Freedman<sup>150</sup>

The second- line drugs are other alternative methods to treat patients with MS. These drugs are usually used when the treatment of these patients using the first drug of choice fails or is ineffective. However, there are a number of disadvantages of using



second-line drugs. These drugs are known to increase the risks of side-effects in patients as it includes administration of intravenous immunoglobulins, which is a concentrated antibody isolated from the healthy donors. These are used to inhibit the formation of the pathologic antibodies in the patients' body, which are known to damage the CNS. Another alternative drug is the Fingolimod that has the ability to hold the leukocytes and the nodes and can thus effectively prevent them from entering the CNS. These medications can be administered orally. The second option of these drugs usually involves cyclophosphamide and corticosteroids such as cytostatics (Havrdova et al., 2012).

In the recent years, a new drug was discovered, which was "a tested monoclonal antibody" commonly known as the natalizumab (also known as tysabri). This is one of the first biological treatments discovered to treat multiple sclerosis and patients who are at the relapsing-remittent MS stage where the disease activity is considerably high. According to the available evidences, this drug is considered to be twice the efficiency of the already existing drugs of first choice; however, these have a significant risk of developing adverse effects (Mares, 2012).

The symptomatic treatment usually focuses on the impacts of the disease symptoms that the patient experiences, irrespective of the stage of MS the patient are in. One of the most common complications in MS patients is increased muscle tone or spasticity that results in movement restrictions, pain or convulsions. Spasticity is also known to affect the relaxants of the central muscles and thus can be treated with tizanidine, baclofen, thiocochicoside, and myolastan. If these does not work then the patient is subjected to the rehabilitation center. Additionally, in case if these treatments fail or the doses of baclofen are considerably low then baclofen pump can be introduced under the skin of the abdomen near the region of lumbar vertebra 3 and 4 to the patients. This allows the gradual dosing of this drug. Botulinum toxin can also be used for treating local spasticity (Havrdova, 2010).

Patients experiencing sphincter difficulties can be treated with anti-spasmodic, anti-cholinergics, muscle relaxants, etc.; however, experts have suggested that in such cases even exercises can be used to strengthen their pelvic base. Clonazepam can be used for treating cerebellar tremor; however this often results in drowsiness, anxiety, depression, etc. in patients as a side-effect. In such cases, the patients are also administered with anti-depressants and are often subjected to psychotherapy. Paresthesias type neuralgia or neurogenic pain can be effectively treated with

carbamazepine or gabapentin as anti- epileptics (Havrdova, 2010). Fatigues can be dealt with by using pharmacotherapy where drugs such as bupropion, or amantadine modafinil are used (Vachova et al., 2009). Fampyra (oe Ampyra) is a new drug which can be also used to relieve one with their symptom. This drug is known to significantly improve the walking speed in adult patients living with MS. The mode of action of this drug is to improve the impulse conduction across the demyelinated fibre; however, this drug has been proven to be effective only in few patients and not all. This drug has been used as a registered drug in Czech Republic but is very expensive (Preiningerova, 2012).

### 2.9.2 Surgical treatment

For years people have been wondering if the surgical treatment is affective to cure the MS disease or not, just to make it simpler again, the MS disease is not cured yet. But what is the surgical treatment is for when the surgery can not cure the disease? Well, the surgical treatment only occurs when the patient really need it which is mainly “ or mostly known “ in two situations. When the patient have severe tremor affecting the movement or patient with severe spasticity when the medications fail to work on them. The surgery options are (Deep brain stimulation and Implantation of a drug catheter or pump) (Havrdova, 2010).

Deep brain stimulation is a procedure for tremor, which is only done after the conservative treatment and the pharmacotherapy fail to affect on the patient or fail to treat the patient properly. It is implanted on an area in the brain to stimulate any severe or disabling tremor which occurs on the slightest movement of the limbs, The stimulation affects movement by altering the activity in that area of the brain, and on the safe side it does not destroy any brain tissue. It is mostly used on patients who have Parkinson's disease to stop the tremor when medications fail, deep brain stimulation usually is the last choice after all other options have failed to treat MS tremor.

Implantation of a drug catheter of pump, is for patient when have severe spasticity and the medications did not work on resolving the problem, it is used when the patient have pain of suffering from severe spasticity may have catheter pump placed on the lower spinal area, to have some medications constantly delivered such as Baclofen (Lioresal) without suffering from pain when taking the medications

### 2.9.3 Occupational therapy

Occupational therapy plays an important role in improving, and adapting the overall condition for a patient with multiple sclerosis. By using and training the adaptive equipment, occupational therapy could help the patient perform every day's functional with more satisfaction and maintain self-independence. Occupational therapy plays an important role in improving dynamic posture, and the ways of performing daily functional tasks, which spontaneously improves in multiple sclerosis patient.

A study has been applied to a 49 years old female patient who had multiple sclerosis disease for 9 years with no other symptoms to worry about, applying the evidence for intervention from the systematic reviews on MS that were conducted in conjunction with the American Occupational Therapy Association's (AOTA's) Evidence-Based Practice Project, to improve the individual basic life functions, and it came with significant improvement

Table 4 Evaluation for a MS patient before and after OT

Assessment	Evaluation	Final evaluation
Eating	4	6
Bathing	3	4
Upper body dressing	4	5
Lower body dressing	3	5
Toileting	3	6
Transferring from toilet	2	5
Bathing	4	6
Meal preparing	3	5

Scoring according to AOTA's : 1 = total assistance, 2 = maximal assistance, 3 = moderate assistance, 4 = minimal assistance, 5 = supervision, 6 = modified independence, 7 = complete independence.

This improvement has happened in duration of 30 days which is quite significant

Occupational therapy is one of the fundamental treatments which could be used to improve the overall status of patients suffering from Multiple sclerosis disease, in one month period, the patient was in better shape than she was before. Of course as any

therapy the accepting of the therapy would change the result of the therapy, but in this case it for sure was incredibly effective.

## 2.10 Lifestyle Changes

Multiple sclerosis is a threatening disorder because it can systematically progress into permanent disability of the patient. This study is about a male patient diagnosed with multiple sclerosis. This condition has wide-ranging effects on the health of a patient and it can cause depression. Noteworthy is that following this infection, the patient can face health challenges such as lack of muscle control; inability to maintain balance, changes in his thinking capacity, and vision impairments. The patient diagnosed with multiple sclerosis should limit or avoid fatty foods. The health care providers recommend this intervention for him because high-fat diets increase the risk for the condition. The health care providers also advised the patient to avoid sweet foods or consume low-sugar foods to avoid accumulation of blood sugar levels (Wahls et al., 2018). As a result, as opposed to his previous diet whereby the patient used to eat sweet foods, he must now change his diet and consume less or avoid sweet foods and drinks. It is evident that the amounts of sugars contained in the food can to increase the level of blood sugar for this patient.

It is evident that health care providers recommend gluten-free foods. Since the diagnostic outcomes indicated that the patient tested positive for multiple sclerosis, he should rely on gluten-free foods. As a result, the patient should consume much wheat, which is a gluten-free food. Noteworthy is that a Swank diet developed in the 1950s is a common diet modification specifically for people with multiple sclerosis.

The Swank diet is a low-fat diet developed by Dr. Roy Swank. It contains a very small amount of saturated fat. Since this would be an essential diet for the patient, the patient should adhere to the Swank diet should consume lean fish, vegetables, fruits, whole grains, and non-fat dairy products to improve in his health status (Hadgkiss et al., 2015). These are the most common dietary modifications that occur when an individual undergoes multiples sclerosis. Dietary changes became an attractive intervention for several physicians due to the improvements that physicians note in patients that adhere to the dietary recommendations the physicians approve.

Supervised facility-based exercise programs can guarantee this patient a broad support and guidance to enable him to management the symptom of multiple sclerosis. The

patient should perform the exercises to help him to manage the condition and live well. Exercise is a behavioral therapy that expressed promising outcomes regarding the changes in the symptoms for patients with multiple sclerosis (Landro, 2014). Some of the exercises in which this patient should participate include aerobic training, endurance training, aquatics, resistance training, and nontraditional workout modalities of yoga. The latter is now common in most health and fitness centers.

The patient can easily conduct an aerobic exercise because it does not require any sophisticated equipment. It is also accessible because it entails some of the tasks such as community-based walking exercise, which the patient can perform alone or with the aid of a friend. These aerobic exercises can help the patient to develop muscle and strength control. This patient can also allocate in his daily schedule a time in which he can perform press-ups, or arm-curls, wall squats, or leg abduction as opposed to the previous era when he was healthy. The patient should also perform tasks such as calf raises, knee extensions, and sit-to-stand to enhance effective blood circulation across the entire body and to remain physically fit.

As opposed to the previous era, before the patient developed multiple sclerosis, the patient should now perform endurance exercises such as endurance walking around a certain area within the compound at least thrice per week. Ideally, this is essential because it can enable the patient to maintain physical stability in which he can begin to walk for long or short distances (Pearson, Dieberg, & Smart, 2015). A physician would also recommend aquatics exercises for the patient whereby he can play in water bodies. Apart from performing workouts such as yoga, the multiple sclerosis patient can also perform resistance training whereby the patient forces the muscle to contract against an external resistance to enhance tone, strength, mass, and endurance. As opposed to the previous era in which the patient was healthy, the patient must allocate some time daily for these exercises to adhere to the recommended exercise therapy.

Yoga is a set of physical, spiritual, and mental practices that can help multiple sclerosis patients to remain active and manage the symptoms of the condition. A patient diagnosed with multiple sclerosis should participate in yoga training to improve his physical fitness and ensure that he remains physically fit (Pearson, Dieberg, & Smart, 2015). It is evident that the patients tend to undergo muscle weakness and with time, they can begin to struggle to move around. Further, this can limit them from doing most tasks without assistance. Since yoga can improve both physical, spiritual, and

mental wellbeing, the multiple sclerosis patient can achieve much stability when they adhere to the exercise therapy.

On the same note, to improve on his body balance, the patient can conduct balance exercise using balanced boards and ball work. The patient can also perform activities such as the salsa dancing that keep the entire body active including soothing the mind. Since these exercises are offering an alternative way of managing multiple sclerosis, the health care providers recommend that the patient should be able to access healthy living centers, fitness centers, conduct health walks, and attend swimming pools to improve his muscles strength through physical aerobic exercises.

### 3. Special Part

#### 3.1. Methodology

My bachelor practice took place at RHB oddělení, Nemocnice Kladno a.s. from 16.01.2017 to 27.01.2017.

During these two weeks I was there for 8 hours every day, in total it was 40 hours, each session with my patient lasts for 45 minutes to 1 hour

I had 7 days in total with my patient, two of these days she was tired and did not want to do any exercise, so my practice with her were 5 days

My clinical work placement was supervised by Bc. Tomas Modlinger.

My patient was informed from the beginning about the examination, therapy and my work there, and signed the informed consent. The Ethics committee at FTVS Charles University, Prague approved my bachelor work at RHB oddělení, Nemocnice Kladno a.s. with the approval number 047/2017

### 3.2. Anamnesis (medical history)

#### Status presents

##### 3.2.1 objective

Height: 161cm

Weight: 85kg

BMI: 32.8

Glasses: no

Cognition: ok

Communication: she can communicate with the people and physiotherapists normally

Assistive devices: roll aid walker, and ankle foot orthosis on the right side

##### 3.2.2 subjective

Chief complaint: Patient have multiple sclerosis, patient can not walk properly or do normal activities, the patient have problems mainly in the right side of her body, it's harder for her to control her right side more than the left side, however she is using aid walker when walking or standing as she can not stand or walk without it

Personal anamnesis: the beginning of the patient problems occurred in the fall of 2011. Around six years ago the patient had flue for four times in a very short time in between, then she started to have pain in her ear on her right side, slowly in the next two months “ in the beginning of 2012 “ she started to have hemiparesis, it was getting worse and worse, until she could not catch properly in the spring of 2012, after that she have been getting worse for the next 4 months, she couldn't rise her right leg and she was sliding when she was walking, and since then, she has been getting better and worse, so basically until now she is not in a stable condition

Injuries anamnesis: No past injuries.

Past medical and surgical history: No past surgeries.

Functional anamnesis :

-Mobility activity



She has been using roll aid walker as an assistive device for her to walk, and also she is using ankle foot orthosis on the right side for better dorsiflexion of the foot

-ADL

Table 5 activities of daily living

<u>Function</u>	<u>Ability of the patient</u>
Bathing	Patient is able to bath be herself with the usage of special equipment in the bath
Dressing	She can manage dressing the upper part easily while struggling in wearing the pants and right shoe
Oral care	Patient can handle it by her self
Toileting	Patient can handle it by her self
Transferring	She can transfer from one place to another using the walking aid, but she can not uses the stairs
Walking	She can walk using the aid walker
Climbing the stairs	Not able to
Eating	She can eat by herself with no help
Cooking	It's hard for her to handle cooking and working in the kitchen
Managing medications	She can manage medications and she aware of the medications she uses
Using phone	Able to uses her phone normally
House work	Not able to

Medications, pharmacological anamnesis:

Letrox – for thyroid

Prestrarium – for blood pressure

Agen – for blood pressure as well

An silan – muscle relaxation “ every other day “

Allergic anamnesis: corticoids

Diet: she’s not following diet plan

Family anamnesis: Father died because of head stroke when she was 17 years old, mother is heathy, sister is healthy as well

Social anamnesis: She lives in a small apartment alone, she has been hospitalized for two months in the hospital

Occupation anamnesis, vocation: she is not working, she has been taking money from the government, as she it not able to work

Hobbies: working in the garden, reading books

### **3.3. Prior rehabilitation**

In the spring of 2012, she used to go to massage therapy because of neck pain she used to have

### **3.4. Excerpt from patient’s health care file**

### **3.5. RHB indications**

Doctor indicated the patient to be under physiotherapy supervision for 3 months before she goes back for him, and maily indications is about muscle strengthening, breathing pattern correction and

### 3.6. Examination by physiotherapist

#### 3.6.1 Postural examination

“ with roller “

- Postural examination :

Posterior view :



- Plumb line test :  
the plumb line is between the heels, the right leg seemed to be closer to the plumb line than the left one, plumb line goes slightly to the left of the intergluteal line, trunk is shifted to the right from the plumb line, from her lower part of the Lumbar and the shift to the right side increases as we go cranially, until it's goes to the left side of the head

Figure 7 Postural examination (patient from posterior view)

Aspection

- narrow base of support
- left ankle joint is in inversion
- calf muscles of the right side are in atrophy
- knee valgusity is present in both right and left sides
- hip is elevated in left side

- no scoliosis curve, the trunk is shifted to the right side, starting from lower Lumbar “ around L4-5” there is a shift to the right side and it’s increasing more as we go cranially
- left shoulder is more elevated than the right one

Lateral view : “ right side “



- Plumb line test :  
Slightly anterior to the lateral malleolus, on the axis of knee joint, passes through the axis of hip joint, slightly anterior to the bodies of the lumbar vertebrae, passes through the shoulder joint and slightly anterior to the external auditory meatus

Figure 8 Postural examination (patient from lateral view) right side

Aspection

- right foot is supinated and in planter flexion, while the left is in while left one is well positioned, with no hyper planter flexion nor supination
- hyperextension of the right knee
- pelvis in anteversion

- slight rotation of the body to the left side as the left part of body of the patient looks visible
- posture of the spine from this side looks good except the hypokyphotic in the thoracic spine

Lateral view : “ left side “



- Plumb line test :  
Slightly anterior to the lateral malleolus, slightly posterior to the axis of knee joint, slightly posterior to the axis of hip joint, passes slightly behind the bodies of the lumbar vertebrae, passes behind the shoulder joint and the external auditory meatus and the entire head

Figure 9 Postural examination (patient from lateral view) left side

Aspection

- left foot is in planter flexion, it's also in inversion
- knee joint is in hyperextension
- pelvis is in anteversion
- rotation of the body to the left side as the right side of the body is not slightly visible from this side
- there is hypolordosis of the upper part of the Lumbar spine

Anterior view



Figure 10 Postural examination (patient from anterior view)

- left foot is in inversion and planter flextion
- right foot is more supinated and planter flexion
- knees valgusity are present
- umbilicus is slightly of shifted to the right side more than the left side
- right breast is more depressed
- left shoulder is higher than the right one

### 3.6.2 Gait analysis

“ with the aid walker “

- wide base of support when walking due to the ABD of the right hip that happens during the gait
- right foot is in supination during the walking
- the walking rhythm is non periodic
- the length of the strides are different from one leg to another, length of the stride on left side is in normal while the right one is swinging laterally
- foot movement is present in the left side, in proper way, heel strike, flat foot, heel off, toes off, while in the right foot the movement is initiated from the right hip, and the foot is swinging as it is elevated from the hip and abducted then swings forward, and it is kind of hard for the patient to lift it up from the ground
- the movement of the trunk is actually obvious when the patient is elevating the right hip to swing her entire leg forward, due to the elevation of the right hip, the right side of the patient is completely elevated, “ the shoulder, the hand and the trunk “
- right pelvis is elevated and it is actually initiating the movement of the lower extremity when the patient is walking

#### Conclusion:

Walking pattern of the patient is one of her essential problems, right side being affected more by her disease plays important role in the gait pattern of the patient. The patient can't walk without the air walker, the gait of the patient is affected by weakness of the right side lower extremity which created compensatory movement which is created by right hip elevation, and that for sure affected the muscles which elevate the hip and put the muscles that elevate the hip in hypertone. The left side is better in walking rhythm. But movement in general is done slowly, the patient needs so much time to move from her room to the training room

**3.6.3 Anthropometric measurement (length, circumferences)**

Table 6 Initial anthropometric measurement UE

UPPER EXTREMITIES	RIGHT (cm)	LEFT (cm)
Length of upper limbs	76	75
Length of humerus	35	34
Length of forearm	30	30
Length of hands	19	19
Circumference of upper hand	35	35
Circumference of forearm	30	30

Table 7 Initial anthropometric measurement LE

LOWER EXTREMITIES	RIGHT (cm)	LEFT(cm)
Anatomical length	79	80
Functional length	88	88
Length of thigh	22	22
Length of middle leg	41	41
Length of foot	23	23.5
Circumference of thigh	57.5	56.5
Circumference of knee	43	41.5
Circumference of calf	40	40
Circumference of ankle	27	27
Circumference of foot	22	22.5

**3.6.4 Goniometry**

( two-arm goniometer - finger’s goniometer )

AROM:

Table 8 Initial active range of motion

<u>Name of Joint</u>	<u>Right</u>	<u>Left</u>
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<u>Shoulder joint :</u>	S: 40-0-180 F: 170-0-0 R:65-0-50 T: 35-0-100	S: 30-0-150 F: 110-0-0 R:50-0-45 T: 25-0-85
<u>Elbow joint :</u>	S: 0-0-125 R: 70-0-80	S: 0-0-130 R: 75-0-75
<u>Wrist joint :</u>	S: 50-0-80 F: 10-0-30	S: 50-0-80 F: 10-0-30
<u>Fingers (MCP):</u>	S: 20-0-95 F: 5-0-10	S:30-0-95 F:5-0-20
<u>Fingers (IP1):</u> ( finger's goniometer )	S: 0-0-90	S: 5-0-90
<u>Fingers (IP2):</u>	S: 0-0-90	S: 0-0-90
<u>Thumb (CMC):</u>	S: 5-0-25 F:40-0-35	S:10-0-35 F:45-0-35
<u>Thumb (MCP) :</u>	S: 0-0-70	S: 0-0-70
<u>Thumb (IP) :</u>	S: 5-0-90	S: 5-0-90
<u>Hip joint :</u>	S: 5-0-10 F: 30-0-20 R: 15-0-10	S:10-0-100 F: 35-0-20 R:25-0-15
<u>Knee joint :</u>	S: 0-0-120	S:5-0-125
<u>Ankle joint:</u>	S: 20-15-15 R: 0-0-10	S:30-10-15 R:10-0-20
<u>Toes (MTP) :</u>	S: 60-0-55	S: 60-0-55
<u>Toes (IP)big toe :</u>	S: 0-0-60	S: 0-0-55
<u>C spine :</u>	S: 55-0-45	
<u>Lateroflexion of C spine :</u>	50	50
<u>Rotation of C spine :</u>	55	50
<u>Rotation Th and L spine :</u>	35	35

PROM

Table 9 Initial passive range of motion

<u>Name of Joint</u>	<u>Right</u>	<u>Left</u>
<u>Shoulder joint :</u>	S: 40-0-180 F: 170-0-0 R:65-0-50 T: 35-0-100	S: 30-0-150 F: 170-0-0 R:55-0-50 T: 30-0-90
<u>Elbow joint :</u>	S: 0-0-145 R: 90-0-90	S: 0-0-155 R: 90-0-90
<u>Wrist joint :</u>	S: 80-0-90 F: 15-0-35	S: 80-0-90 F: 15-0-35
<u>Fingers (MCP):</u>	S: 35-0-95 F: 20-0-25	S:40-0-95 F:20-0-30
<u>Fingers (IP1):</u>	S: 5-0-95	S: 5-0-95
<u>Fingers (IP2):</u>	S: 0-0-95	S: 0-0-95
<u>Thumb (CMC):</u>	S: 10-0-40 F:50-0-55	S: 10-0-40 F:50-0-55
<u>Thumb (MCP) :</u>	S: 0-0-70	S: 0-0-70
<u>Thumb (IP) :</u>	S: 5-0-90	S: 5-0-90
<u>Hip joint :</u>	S: 20-0-130 F: 40-0-20 R: 55-0-35	S: 25-0-130 F: 40-0-25 R: 55-0-35
<u>Knee joint :</u>	S:0-0-155	S:0-0-155
<u>Ankle joint:</u>	S: 30-0-15 R: 15-0-25	S:30-0-20 R:20-0-30
<u>Toes (MTP) :</u>	S: 70-0-60	S: 70-0-60
<u>Toes (IP)big toe :</u>	S: 0-0-70	S: 0-0-70
<u>C spine :</u>	S: 60-0-45	
<u>Lateroflexion of C spine :</u>	60	55
<u>Rotation of C spine :</u>	60	60
<u>Rotation Th and L spine :</u>	45	45

3.6.5 Hypermobility

Table 10 Initial hypermobility examination

	Left	Right
<b>Lumber spine</b>		
Retroflexion “ Sachse “	Grade B	
Anterioflexion “ Sachse “	Grade A	
<b>Thoracic spine</b>		
Rotation “ Sachse “	Grade A	Grade A
<b>Cervical spine</b>		
Rotation “ Sachse “	Grade A	Grade A
<b>Metacarpal joints</b>		
Dorsal Flexion “ Janda “	Hypermobility	Hypermobility
<b>Metacarpal joints</b>		
Dorsalflexion “ Sachse “	Grade C	Grade C
<b>Wrist joint</b>		
Dorsal flexion“ Janda “	Hypermobility	Hypermobility
<b>Elbow joint</b>		
Extension “Sachse “	Grade C	Grade C
<b>Shoulder joint</b>		
High cross arm“ Sachse “	Grade B	Grade B
Touch the hands behind the back “ Sachse “	Grade C	Grade C
<b>Glenohumeral joint</b>		
Abduction “ sachse “	Grade B	Grade B
<b>Knee joint</b>		
Extension “ sachse “	Grade B	Grade B
<b>Hip joint</b>		
Rotation “ sachse “	Grade B	Grade B

Conclusion :

The joints of the patient is hypermobile in general, which could leads to instability of the joints and muscles weakness, and it is could be physiological as the patient is a woman, in general the patient is hypermobile which could indicate lower muscle tone

**3.6.6 Muscle length test**

(according to Janda or Kendall)

-length of ankle flexor muscles (gastrocnemius- soleus): “ Kendall “

“gastrocnemius ”: R - Dorsiflex 10° “ normal “ L - Dorsiflex 10° “ normal “

“ soleus ” : R – dorsiflex 20 “normal” L – dorsiflex 20 ” normal “

-length of hip flexor muscles : “Kendall“

R: Both one and two joints muscles are normal length

L: Both one and two joints muscles are normal length

-length of hip adductor muscles : “ Janda “

R: grade 0 L: grade 0

-length of hamstring muscles : “ Kendall “

R: normal L: normal

-length of paravertebral muscles : “ Janda “

grade 0

-length of m. quadratus lumborum : “ Janda “

R: grade 0

L: grade 0

-length of piriformis muscles : “ Janda “

R: grade 0

L: grade 0

-length of pectoralis major (upper and lower part) “Kendall“

R: upper part – normal. Lower part – normal

L: upper part – slight shortness. Lower part – slight shotness

-length of pectoralis minor : “ Kendall “

R: slight shortness

L: slight shortness

-length test for teres major – latissimus dorsi – rhomboid major and minor muscles : “

Kendall “

R: normal length

L: normal length

-length of medial and lateral shoulder rotators : “ Kendall “

R: lateral shoulder rotators - normal length

    medial shoulder rotators – normal length

L: lateral shoulder rotators – normal length

    medial shoulder rotators – slight shortness

-length of carnial part of trapezius : “ Janda “

R: grade 0      L: grade 0

-length of levator scapulae : “ Janda “

R: grade 0      L: grade 0

-length of SCM : “ Janda “

R: grade 0      L: grade 0

-length of scalene muscles : “ Janda “

R: grade 0      L: grade 0

**3.6.7 Muscles strength test**

“ according to Kendall “

Table 11 Initial muscle strength test

Name of muscle	Right	Left
ADD POLLICIS	3	4
ABD POLLICIS BREVIS	3	4
FLEXOR POLLICIS LONGUS	3	4
FLEXOR POLLICIS BREVIS	3	4
EXTENSOR POLLICIS LONGUS	3	4
EXTENSOR POLLICIS BREVIS	3	4

ABD POLIICIS LONGUS	3	4
OPPONENS DITI MINIMI	3	4
FLEXOR DIGITORUM SUPPERFICIALIS	3	4
OPPONENS DITI MINIMI	3	4
FLEXOR CARPI RADIALIS	5	2-
FLEXOR DIGITORUM SUPPERFICIALIS	4+	4
FLEXOR CARPI ULNARIS	5	4
EXTENSOR CARPI RADIALIS (LONGUS AND BREVIS):	4	3+
EXTENSOR CARPI ULNARIS	4+	4
PRONATOR TERES AND QUADRATUS	5	4
SUPINATOR AND BICEPS	5	3+
BRACHIORADIALIS	5	4+
CORACOBRACHIALIS:	5	5
TRICEPS AND ANCONIUS	4-	4+
DELTOID (ANTERIOR)	5	5
DELTOID (POSTERIOR)	5	5
DELTOID (MEDDLE)	3+	3+
TERES MAJOR	5	4
PECTORALIS MAJOR: “UPPER AND LOWER “	5	4-
PECTORALIS MINOR	5	4
LATISSIMUS DORSI	5	5
MEDIAL SHOULDER ROTATION	5	4+

LATERAL SHOULDER ROTATION	5	5
INFRASPINATUS	5	5
TERSE MINOR	5	5
RHOMBOIDE AND LEVATOR SCAPULA	4	4
TRAPIZIUS UPPER PART	5	4
TRAPIZUS MIDDLE PART:	4	4
TRAPZUS LOWER PART	4+	3
SERRATUS ANTERIOR	5	5
ABD HALLUCIS	2	3+
EXTENSOR DIG. LONGUS AND BREVIS	2	4+
EXTENSOR HALLUCIS LONGUS AND BREVIS	3+	5
TIBIALIS ANTERIOR	3	4
TIBIALIS POSTERIOR	2+	4
PERONEI mm:	0	4
SOLEUS	3-	4
HAMSTRING (LATERAL, MEDIAL)	2	4-
QUADRICEPS FEMORIS:	3-	4
HIP FLEXORS AND ILLIOPSOAS	1+	3+
TENSOR FASCIA LATAE	2	3+
MEDIAL HIP ROTATION	2	3+
LATERAL HIP ROTATION	2	3
GLUTEAUS MINIMUS	2	3
GLUTEAUS MIDEUS	2	3
SARTURIOS	2	4
GLUTEAUS MAXIMUS	4	3

HIP ADD	2	3+
ANTERIOR NECK FLEXOR	3	3

**3.6.8 Muscle tone palpation**

- M. sternocleidomastoid

In supine position, symmetrical in the left and right side

The muscles were in hypotone

No pain was felt during the palpation

- Mm. scalene

In sitting position, was really hard to palpate the right muscles

Muscles are in hypotone, especially the right side

No pain was felt during the palpation

- M.trapezius ( upper, middle,lower parts )

Upper part : sitting position, left is normal tone while the the right one is in hyper tone

Middle part : prone position, symmetrical in both sides, normal tone

Lower part : prone position, hypertonic in right and normal tone in left side

No pain was felt during the palpation for the upper, middle, or the lower parts

- M.deltoid (anterior, middle,posterior)

Upper part: sittin position, the right side was more hypotone than the left one

Middle part: sittin position, both sides were in hypotone,

Lower part: sittin position, right side is more in hypotone than the left side

Trigger point were palpated and the patient was uncomforted

- M.pectorales major

In supine positon, Hypertonic in the left side and normal tonic in the right side, trigger point was palpated in the incertion of the muscle on the Humerus on the left side.

painful at the left side when the patient was doing more than 120 degree flexion,

Pateint was not comforted while palpating the trigger point on the left side other than that the patient didn't feel anypain

- M.pectorales minor



Supine position, both sides where in normal tone, but trigger point was found in the left side near the insertion “coracoid process “ , but no pain was felt during the palpation, the patient was just feeling uncomfortable while touching the trigger point

- M.serratus anterior

In supine position, muscles where in hypontone in both sides

No pain was felt during the movement

- M.biceps brachii

sitting position, symmetrical in both sides

The muscle was in normal tone in both sides

No pain was felt during the palpation

- M.triceps brachii

Prone position, symmetrical in both sides

The muscle was in normal tone in both sides

No pain was felt during the palpation

- Quadratus Lumborum

Prone position, hypertone in the right side and normal tone on the left side

A little pain was felt by the patient while palpating the right side

- M. rectus abdominis

Supine position,

Muscle was in hypotone, trigger point was palpated

Nopain was felt during the palpation of the muscle

- M.quadriceps femoris

Supine position, in left side the muscle is in hypertone while hypotone in the right side,

No pain was felt during the palpation

- Mm.adductors

Supine position, more tonic in the left side than the right side, left is normal tonic while right is hypo tonic

No pain was felt during the palpation

- M.tibialis anterior

In sitting position, hypertonic muscle in the left side, normal in the right side

No pain was felt during the palpation

- M. fibularis longus and bervis

In sitting position, right side is more hypotonic than the hypotonic left side,

No pain was felt during the palpation

- M. supraspinatus

In sitting position, the muscle was normal tonic in the left side and hypo in the right side

No pain was felt during the palpation

- M. infraspinatus

In sitting position, symmetrical in both sides

In both sides the muscles were hypotonic

No pain was felt during the palpation

- M. latissimus dorsi

In prone position, symmetrical in both sides

In both sides the muscles were hypotonic

No pain was felt during the palpation

- M. gluteus max

In prone position, normal in right and hypo tone in left side

No pain was felt during the palpation

- M. gluteus mid

In prone position, normal tone in left side, and hyper tone in right side

No pain was felt during the palpation

- Hemstrings

In prone position, the right is a bit more hypotonic than the left one

No pain was felt during the palpation

- M. triceps surae

In prone position, right muscle is in hypotone, while the left one is also in hypotone but it's still better than the right one,

no pain was felt during the palpation

### **3.6.9 Pelvis palpation**

- height and symmetry of cristae iliacae

left is higher

- height and symmetry of SIPSs

left is higher

- height and symmetry of SIASs

right is higher

Conclusion :

Elevation of the left hip in both anterior and posterior sides and the iliac crest, resulted because the imbalance of the muscles around the hip, and the weakness of the right side muscles which will lead to depression in general of the right side of the body and mainly the inability of the patient to stand still and have her weight in the middle and depending on the left side in maintain balance

**3.6.10 Romberg Test**

Romberg Test I

Test is positive

Since Test I is positive, no need to proceed to next ones

\*\*\* As for the stability, the patient have no stability by herself, she needs a support for standing and sitting

**3.6.11 Breathing pattern**

The breathing pattern of the patient was noticed when standing sitting and lying down

There is maximum activation of lower thoracic breathing and minimum of abdominal breathing when the patient is standing and sitting

But when the patient is lying down, she's using both lower and upper thoracic and abdominal breathing

3.6.12 Neurological Examinations

Table 12 Initial neurological examination

	Upper extremity	lower extremity
Reflexes	<p><b>The biceps brachii reflex</b> Same in both sides, the reflex was present and it wasn't either, hyper or hypo was just normal</p> <p><b>The triceps reflex</b> Same in both sides, the reflex was present and it wasn't either, hyper or hypo was just normal</p> <p><b>Finger flexors</b> Same in both sides, the reflex was present and it wasn't either, hyper or hypo was just normal</p>	<p><b>The knee reflex</b> No reflexes on either side</p> <p><b>Achilles tendon reflex</b> Hypo reflex on the left side while no reflex on the right side</p>
Superficial sensation	<p>Normal touch was applied to the patient with his eyes closed on his upper extremity</p> <p>“ anterior – lateral – medial and posterior sides “ both right and left extremity</p> <p>The patient felt them both, but when compared the right and left sides, the patient felt the left side more than the right side</p>	<p>Normal touch was applied to the patient with his eyes closed on his upper extremity</p> <p>“ anterior – lateral – medial and posterior sides “ both right and left extremity</p> <p>The patient felt them both, but when compared the right and left sides, the patient felt the left side more than the right side</p>

<p>Deep sensation</p>	<ul style="list-style-type: none"> <li>- An item was placed in the patient’s hand, and the patient was able to identify it</li> <li>- Patient was also asked to identify a passive movement “flexion of small finger” which have been done to her passively with her eyes closed, she was able to identify the movement in both sides</li> <li>- Then the patient have been asked to do the same previous movement which have been done passively in the other side, and the patient was able to do it correctly</li> </ul>	<ul style="list-style-type: none"> <li>- An extension movement was done to the patient big toe both sides, and the patient was asked to identify the movement, the patient was able to identify it correctly</li> <li>- Then the patient was asked to do the same movement “ extension of the big toe “ on her other leg, she was able to do the movement correctly on the left side, but not very good on the right side, but that is probably because of muscle weakness on right side</li> </ul>
<p>Pyramidal sign</p>	<p><b>Mingazzini</b>                  Negative both sides                  *fingers flexion right side</p> <p><b>Rusecky</b>                  Negative both sides</p>	<p><b>Babinski</b>                  Negative on left side                  Positive on right side</p> <p><b>Chaddock</b>                  Negative on left side                  Positive on right side</p> <p><b>Openheim</b>                  Positive on left side                  Positive on right side</p>

		<p><b>Mingazzini</b>                  Right leg fell down after 3 seconds                  “ positive in right side “</p>
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**2.6.13 Examination of facia**

lumbar fascia caudally

Restriction were found in both sides

lumbar fascia cranially

No restriction in either side

fascia on both sides of the trunk

No restriction in either side

shifting of the fascia around the thorax

No restriction in either side

The scalp

No restriction

Fascia at the neck and the extremities

No restriction

**2.6.14 Segmental examination**

Cervical spine

No restriction in any segment in either direction

Thoracic spine

No restriction in any segment in either direction

Ribs

There were no restriction

Lumbar spine

There was restriction in L4 segment into flexion direction only

Sacroiliac joint

No restriction in sacroiliac joint

Upper extremity

Left shoulder restriction is present in cranial direction

Right and left elbows are restricted

Lower extremity

Restriction were found in the right knee

### 3.7. Examination's conclusion

The patient has her main problem on the right side, she can not control it properly, there is weakness of the muscles on the right side, which indicates imbalance and weakness of the muscles, she can not maintain static position without support, her body is dropped on the right side, Quadratus lumborum is hypertonic and hyper active because of the gait pattern she has, as she has a compensatory movement created by elevating the right hip and swing her leg forward, and that would create imbalance on the hip area. ROM of the shoulder on left side indicated a problem which turned to be higher tension and trigger points located on her left pectoral muscles, which could be because she is generally weaker in her right side, so she mainly uses her left side to maintain balance and get support, one of the most important problems of her is the peroneal muscles and hip flexors of the right side, it is mostly affected because of the right side of her is more effected neurologically which led to muscle weakness and then the compensatory movement of her right hip appeared and then she stopped using these muscles, the hypo-tonicity of the patient muscles is mainly because of the medications she started to use, and that could be affecting the hypermobility of the patient, weakness of muscles of her right side is obvious in general, patient is hypermobile, she is not suffering from any restriction of the joints, although she has restriction in the fascia of lumbar spine in caudal direction

### 3.8. Differential balance

Patient has Multiple sclerosis, affecting her mainly on the right side, lack of movement and exercises resulted in muscles weakness and postural problems, the right side being more affected by the disease created very poor walking pattern, which affected the muscles which pull up the whole right lower extremity, knowing what disease she has, the patient is also affected mentally, giving her less motivation in exercising and moving, the patient has many problems during my first session with her, but in my opinion she needs mostly the motivation, neurologically the patient does not really look well, she needs support when standing or sitting.



### 3.9. The goal of short - term therapeutic plan

- Maintain self satisfaction and improve mental condition
- Improve fascia and blood circulation
- Passive exercises to avoid possible contractures
- Relax over hypertonic muscles, especially muscles around the right hip
- Improve the fascia of the back in caudal direction
- Increase muscle activation and strengthening the muscles which are weakened
- Mobilize restricted joints
- Correct and improve gait pattern
- Improve breathing pattern

### 3.10. Proposed therapy

- Soft tissue technique to improve the fascia and prepare the patient for exercises
- Post Isometric Relaxation “ PIR” for right Quadratus Lumborum and left Pectoral major
- Stretching lumbar fascia in caudal direction in both sides
- Strengthening hip flexors muscles with active and passive movements, hip flexors, hip ABD and hip ADD
- Facilitate Peronei mm. in the right side
- Mobilization techniques involved in Lumber spine, left shoulder joint, knee joints, and the hand precisely unspecific mobilization for the hand
- Gait training, with walker aid
- Breathing exercises to increase muscle activation of the abdomen and thorax

### 3.11 Goals of long-term therapeutic plan

- Maintain and increase ROM of the lower extremities and upper extremities and mainly the right side of the patient
- Correct gait and walking pattern, and start training on climbing and going down of the stairs
- Improve breathing pattern of the patient in standing and sitting position, by activating the abdominal muscles
- Improve sensomotoric feeling
- Increase postural stability and increase muscles strength of whole body and mainly right side by doing neuromuscular stimulation exercises
- Decrease the progression of the disease

### 3.12 Therapy proposal

- Passive movement to avoid contractures, maintain and increase ROM of upper and lower extremities
- Isometric and isotonic exercises to strengthening the weakened muscles
- Facilitation of Peronei mm., strengthening muscles involved in walking
- Strengthening the muscles of abdomen, improve breathing pattern, and activate muscles involved in breathing
- Sensorimotoric exercises to improve sensomotoric feeling
- General and conditional exercises to strengthening the whole body, which will help in decrease the progression of the disease

**3.13 Day by day therapy**

*Day 1 : 19.01.2017*

Subjectively :

Patient was not feeling good because of some personal and emotional issues she was devastated

Objectively :

Patient uses walking aid, and she wears ankle foot orthosis in her right side, due to the drop foot

Goal:

- Maintain self satisfaction and improve mental condition
- Improve facia and blood circulation
- Unspecific mobilization of the hand
- Passive exercises in the right leg, in hip, and knee joints
- Release restricted fascia
- Strengthening exercises
- Breathing exercises to activate abdominal muscles and improve breathing pattern

Proposed therapy :

- Soft tissue technique to improve the fascia and prepare the patient for exercises
- Passive exercises of the muscles in right side of the hip joint and knee joint to avoid possible contractures
- Unspecific mobilization for the hand according to Lewit
- Release fascia of lumbar spine in caudal direction
- Strengthening the weak muscles from both sides of upper and lower extremities, with active, passive and also isometric contractions
- Breathing exercises to increase muscle activation of the abdomen

Implementation of the therapy :

The patient was kind of tired because some personal problems, so the exercises was easy for her she didn't want to do something too hard,

- Started with soft tissue technique, to release fascia of the anterior, lateral and medial sides of the right thigh and lower right leg, from caudal to cranial

directions to increase the stimulation, and improve blood circulation in according to Lewit

- Unspecific mobilization to both hands were followed in both ventral and dorsal directions, according to Lewit
- Passively, the patient was lying supine, I had the patient right hip and knee flexed to maximum the patient could, then abducted and adducted the hip joint, done the repetition 5 times each, in slow movement, to keep the range of motion and avoid possible contraction.
- Isometric strengthening exercises were done after that to right quadriceps femoris muscle 5 times repetition, while patient was supine, by placing a ball under her leg, asking her to press on it, with dorsiflexion of the ankle joint, and extension of knee joint
- The patient then was in prone position, I asked her to actively extend and rise her whole leg off the treatment table, keep position for 2 seconds, then relax, she repeated this exercise 3 times in each side
- After the active exercise, we asked the patient to take the position for releasing fascia of lower back in caudal direction while prone according to Lewit, repeated the same procedure 3 times in each side
- And lastly we finished with breathing exercises for the patient while she was lying supine and sitting on the treatment table, to better function the abdominal muscles, the exercises were done while the patient in supine and sitting position and focusing on breathing in her abdominal part

#### Subjective result :

After therapy the patient was tired, and depressed as she feels that she does not improve at all and she asked to finish the therapy session

#### Objective results:

Released of fascia of lumbar in caudal direction in both sides, activation of abdominal muscles while breathing are more obvious

#### Self-therapy :

Non-were given to the patient in first day

*Day 2 : 20.01.2017*

Subjectively :

Patient was better than day before, but still not in very good mental condition

Objectively :

Patient uses walking aid, and she wears ankle foot orthosis in her right side, due to the drop foot, fascia of lumbar spine in caudal direction were restricted again in both sides, activation of abdominal muscles while breathing were not visible

Goal:

- Improve fascia and blood circulation
- Unspecific mobilization of the hand
- Passive exercises in the right leg, in hip, and knee joints
- Release restricted fascia
- Strengthening exercises
- Mobilize restricted joints
- Breathing exercises to activate abdominal muscles and improve breathing pattern

Proposed therapy :

- Soft tissue technique to improve the fascia and prepare the patient for exercises
- Unspecific mobilization for the hand
- Passive exercises of the muscles in right side of the hip joint and knee joint to avoid possible contractures
- Strengthening the weak muscles from both sides in upper and lower extremities, with active, passive and also isometric contractions
- Facilitation of Peronei mm. according to Kenny method
- Strengthening abdominal muscles
- Release fascia of lumbar spine in caudal direction
- Mobilization of the Lumbar spine
- Breathing exercises to increase muscle activation of the abdomen

Implementation of the therapy :

- Started with soft tissue technique, to release fascia of the anterior, lateral and medial sides of the right thigh and lower right leg, from caudal to cranial directions to increase the stimulation, and improve blood circulation in according to Lewit

- Unspecific mobilization according to Lewit to both hands were followed in both directions, ventrally and dorsally
- Passively, while the patient was lying supine, I have done maximum flexion of the right hip and knee, slowly, then back to the starting position, and hip adduction and abduction, and then again to maximum flexion, repeated the same procedure 3 times
- Isometric strengthening exercises for the Quadriceps femoris, by placing a small ball under her knee, then ask the patient to press on the ball down, raise her lower leg, with dorsiflexion of the foot, and then relax to the starting position “5 times”
- Then exercises to the adductor group of the lower extremity muscles, by placing a medicine ball in between the patient’s knees, and asked her to press on it hold, repeat 3 times, and then moved the ball under her heels and asked her to roll it backward until 90 degrees of flexion is done on the hip and knees joints
- Kenny method were applied to the Peronei mm. on the right side the patient was lying supine and I applied the technique by stretching the Peronei mm, muscle, doing the movement of the muscle passively with vibration during the movement, then gently with my hand I facilitated the muscle by touching it, and finally I asked the patient to do the motion actively, but she was not able to, so I had to give her assistance
- We have done bridging exercise after that to strength core,” rectus abdominus, erector spinae, hamstrings and hip adductors” while the patient was lying supine we asked her to put her soles on the treatment table, flex her knees, elevate her hips and hold for few seconds, and then go back to starting position, I asked her to do the exercise 5 times
- After the exercises, we asked the patient to take the position for releasing fascia of lower back in caudal direction while prone according to Lewit, repeated the same procedure 3 times in each side
- Followed by a special technique for mobilization L4 according to Lewit, in anteflexion direction, in side lying position
- And lastly we finished with breathing exercises for the patient while she was sitting, we have done a breathing exercise according to Dr.Weil for relaxing breathing knowing as 4-7-8 breathing exercise, the patient shall breath out through the mouth, making the whoosh sound, then breathing in quietly through

the nose, counting to 4, hold the breath and count to 7, and then breathing out completely while counting to 8, repeated the procedure 3 times

Subjective result :

Patient was in better mental and emotional condition from the day before, she have done more exercises than the day before, tired she was, but she was able to do the exercises I asked her to do better than the day before

Objective result :

Released of fascia of lumbar in caudal direction in both sides, activation of abdominal muscles while breathing are more obvious, and no evidence of activation of Peronei mm. on the right side

Self-therapy :

Isometric contraction of the right quadriceps femoris, with a small ball under her ankle, press on the ball, with knee extension, and ankle is dorsiflexed, hold for 3 seconds , 5 times every 8 hours

*Day 3 :23.01.2017*

The patient was tired and she told the supervisor she would prefer some rest and not exercising

Theoretically, what I was planning to do is

Goal:

- Improve facia and blood circulation
- Relax hypertonic muscles
- Strengthening exercises in the upper and lower extremities
- Stability exercises
- Correct and improve gait pattern

Proposed therapy :

- Soft tissue technique, to release fascia, improve blood circulation in the right leg, and thigh, according to Lewit

- PIR for the right Quadratus femoris and left Pectorals major
- Strengthening the hip flexors, hip adductors and abductors muscles with active and passive exercises
- Increase postural stability and increase muscles strength of whole body and mainly right side
- Facilitation of the Peronei mm. according to Kenny method
- Gait training, with walker aid

*Day 4 : 24.01.2017*

Subjectively :

The patient was in her best mental condition, she was feeling really good and she was excited for the therapy

Objectively :

Patient uses walking aid, and she wears ankle foot orthosis in her right side, due to the drop foot, fascia of lumbar spine in caudal direction were restricted again in both sides, activation of abdominal muscles while breathing were not visible

Goal:

- Improve fascia and blood circulation
- Strengthening exercises in the upper and lower limbs
- Breathing exercises
- Improve sensomotoric stimulation
- Increase postural stability and increase muscles strength of whole body and mainly right side

Proposed therapy :

- Soft tissue technique to improve the fascia and prepare the patient for exercises
- Strengthening abdominal muscles
- Strengthening the weak muscles from both sides of the upper and lower extremities, with active, passive and also isometric contractions
- Facilitating the Peronei mm. in the right side using Kenny method technique



- Breathing exercises to increase muscle activation of the abdomen
- Sensomotoric exercises to improve sensomotoric stimulation
- Stability exercises

Implementation of the therapy :

- Started with soft tissue technique, to release fascia of the anterior, lateral and medial sides of the right thigh and lower right leg, from caudal to cranial directions to increase the stimulation, and improve blood circulation in according to Lewit
- Isometric exercises for the quadriceps femoris were done 5 times, patient was supine, placing a ball under her knee and ask her to press it in downward direction, making an extension of the knee, and dorsiflexion of the ankle joint
- Active exercise were done after that, while the patient was lying supine we asked her to put a medicine ball under her legs and roll it to maintain flexion, that is to target the hip and knee flexors, asked the patient to repeat the exercise 7 times, in slow motion
- Strengthening exercises for the upper extremities, pectoral muscles in both sides, asking the patient who have her hand 90 flexed in shoulder, extended elbow, to abduct both shoulders together while holding a rubber band in both her hands
- Then she was asked to again so same exercise but instead of abducting both shoulders together, she had to abduct one and stand still the other shoulder, so it will have an isometric contraction
- Kenny method were applied to the Peronei mm. on the right side the patient was lying supine and I applied the technique by stretching the Peronei mm, muscle, doing the movement of the muscle passively with vibration during the movement, then gently with my hand I facilitated the muscle by touching it, and finally I asked the patient to do the motion actively, but she was not able to, so I had to give her assistance
- We have done bridging exercise after that to strength core,” rectus abdominus, erector spinae, hamstrings and hip adductors” while the patient was lying supine we asked her to put her s soles on the treatment table, flex her knees, elevate her hips and hold for few seconds, and then go back to starting position, I asked her to do the exercise 5 times

- Long foot exercise was done to the patient on both sides, while patient was sitting I have done it passively 4 times, then 4 times the patient have done it with my assistance, and then she has done it by herself on the left side, not on the right side as the exercise was done to both sides, so I had to help her while she was doing it on the right foot
- Stability increasing exercises the patient was asked to do, one was asking the patient to sit with no back support neither hands support, the patient was hardly able to do it by herself, we asked her to hold until she is not able to, that lasted around 15 seconds, the second exercise was by asking her to stand up, hold a bar which is into the wall, lower one hand and hold standing position with the support of one hand only, in both sides she did it, better stability was when she was holding the bar with her right hand while the left one was lowered

Subjective result :

Patient was tired but satisfied and really happy as she have done so much work on this day, she was feeling relieved after we finished the therapy session

Objective result :

Higher flexion in hip joint right side is obvious, relaxed quadratus lumborum muscle

Self-therapy :

Same exercises she was given last session

*Day 5 : 25.01.2017*

Subjectively :

The patient was in good mental condition, she was feeling good and a bit tired from last day exercises

Objectively :

Patient uses walking aid, and she wears ankle foot orthosis in her right side, due to the drop foot, facia of lumbar spine in caudal direction were free in both sides, activation of abdominal muscles while breathing are visible

Goal:

- Improve facia and blood circulation
- Strengthening exercises in the upper and lower limbs
- Relax hypertonic muscles

- Mobilization of restricted joints
- Increase postural stability and increase muscles strength of whole body and mainly right side
- Breathing exercises to activate abdominal muscles and improve breathing pattern

Proposed therapy :

- Soft tissue technique to improve the fascia and prepare the patient for exercises
- Strengthening the weak muscles from both sides of upper and lower extremities, with active, passive and also isometric contractions
- Facilitating the Peronei mm. in the right side using Kenny method technique
- PIR technique for left pectoralis major muscle and right quadratus lumborum muscle
- Mobilization of Lumbar spine in ante-flexion direction
- Stability exercises
- Breathing exercises to increase muscle activation of the abdomen

Implementation of the therapy :

- Started with soft tissue technique, to release fascia of the anterior, lateral and medial sides of the right thigh and lower right leg, from caudal to cranial directions to increase the stimulation, and improve blood circulation in according to Lewit
- Isometric exercises for the quadriceps femoris were done 5 times, patient was supine, placing a ball under her knee and ask her to press it in downward direction, making an extension of the knee, and dorsiflexion of the ankle joint
- Active exercise were done after that, while the patient was lying supine we asked her to put a medicine ball under her legs and roll it to maintain flexion, that is to target the hip and knee flexors, asked the patient to repeat the exercise 7 times, in slow motion
- Isometric exercises for the ADD group by placing a ball between the patient knees, while the knees are 45 degrees bent, and feet are on the table, she squeeze the ball between her knees and hold for 4 seconds, repeat the exercise 5 times,
- ABD group were actively trained, on both sides by asking the patient to lie on her side, raise her leg to the upward “ into ABD “ , and hold it for 5 seconds and then

let it go back, did this exercise 4 times on each side, Triceps sura of both sides were also exercised by asking the patient who is lying supine to press against my hand into planter flexion with my hand on her sole applying resistance

- Kenny method were applied to the Peronei mm. on the right side the patient was lying supine and I applied the technique by stretching the Peronei mm, muscle, doing the movement of the muscle passively with vibration during the movement, then gently with my hand I facilitated the muscle by touching it, and finally I asked the patient to do the motion actively, but she was not able to, so I had to give her assistance
- Stability increasing exercises the patient was asked to do, one was asking the patient to sit with no back support neither hands support, the patient was hardly able to it by herself, we asked her to hold until she is not able to, that lasted around 15 seconds, the second one was by asking her to stand up, hold a bar which is into the wall, lower one hand and hold standing position with the support of one hand only, in both sides she did it, better stability was when she was holding the bar with her right hand while the left one was lowered
- PIR technique according to Lewit, for hypertonic quadratus lumborum on the right side of the patient, 3 times repetition
- Followed by a special technique for mobilization L4 according to Lewit, in anteflexion direction, in side lying position
- And lastly we finished with breathing exercises for the patient while she was lying supine and sitting on the treatment table, to better function the abdominal muscles, the exercises were done while the patient in supine and sitting position and focusing on breathing in her abdominal part

#### Subjective result :

Patient was tired but satisfied and really happy as she have done so much work on this day, she was feeling relieved after we finished the therapy session

#### Objective result :

Released of fascia of lumbar in caudal direction in both sides, activation of abdominal muscles while breathing are even more obvious than the day before, higher flexion in hip joint right side is obvious, relaxed quadratus lumborum muscle

Self-therapy:

Same as the day before, and we also asked her to do the bridge exercise once every 8 hours, 2-3 repetitions each time

*Day 6 : 26.01.2017*

The patient had an appointment with the doctor and she could not do exercises because she will have to do some tests

Theoretically, what I was planning to do is

Goal:

- Improve facia and blood circulation
- Strengthening exercises in the upper and lower extremities
- Improve sensomotoric stimulation
- Correct and improve gait pattern

Proposed therapy :

- Soft tissue technique, to release fascia, improve blood circulation in the right leg, and thigh, according to Lewit
- Strengthening the hip flexors, hip adductors and abductors muscles with active and passive exercises
- Facilitation of the Peronei mm. according to Kenny method
- Sensomotoric exercises to improve sensomotoric stimulation
- Gait training, with walker aid

*Day 7 : 27.01.2017*

Subjectively :

The patient did not want to do exercises this day, she was moody and emotional

Objectively :

Patient uses walking aid, and she wears ankle foot orthosis in her right side, due to the drop foot, facia of lumbar spine in caudal direction were free in both sides, activation of abdominal muscles while breathing are visible

Goal:

- Relax hypertonic muscles
- Release restricted fascia

- Mobilize restricted joint

Proposed therapy :

- PIR technique for left pectoralis major muscle and right quadratus lumborum muscle
- Release lumbar fascia in caudal direction according to Lewit
- Unspecific mobilization of the hands according to Lewit was applied in ventral and dorsal directions
- Mobilization of the Lumbar spine in ante flexion according to Lewit

Implementation of the therapy :

Because of the patient was not feeling good, and did not want to do exercises, I have just applied techniques for relaxing and then started with the final kinesiological examination

- Unspecific mobilization to both hands were followed in both ventral and dorsal directions, according to Lewit
- PIR technique according to Lewit, for hypertonic quadratus lumborum on the right side of the patient, 3 times repetition and left Pectoralis major
- I asked the patient to take the position for releasing fascia of lower back in caudal direction while prone according to Lewit, repeated the same procedure 3 times in each side
- And finally, Lumbar spine mobilization into flexion for L4 was applied to the patient who was in side lying

And then I started to do the final kinesiological examinations to the patient as it is the last day

Subjective result :

Patient was in good mental condition, not too much exercises were given to her, but she was relaxed after the therapy session

Objective result :

Activation of abdominal muscles while breathing are even more obvious now than the day before, higher flexion in hip joint right side is obvious, relaxed quadratus lumborum muscle

Self-therapy:

Same as the day before, and we also asked her to do the bridge exercise once every 8 hours, 2-3 repetitions each time, breathing exercises 1-2 times a day, by putting her hands on her abdomen, she try to move her hands up and down just by moving her abdomen breathing

### 3.14 Final Kinesiological Examination

#### 3.14.1 Postural examination

“ with roller “

##### Postural examination :

Posterior view :

- Plumb line test :

the plumb line is between the heels, the right leg seemed to be closer to the plumb line than the left one, plumb line goes slightly to the left of the intergluteal line, trunk is shifted to the right from the plumb line, from her lower part of the Lumbar and the shift to the right side increases as we go cranially, until it's goes to the left side of the head

Aspection

- narrow base of support
- left ankle joint is in inversion
- calf muscles of the right side are in atrophy
- knee valgusity is present in both right and left sides
- hip is elevated in left side
- no scoliosis curve, the trunk is shifted to the right side, starting from lower Lumbar “ around L4-5” there is a shift to the right side and it's increasing more as we go cranially
- left shoulder is more elevated than the right one

Lateral view : “ right side “

- Plumb line test :

Slightly anterior to the lateral malleolus, on the axis of knee joint, passes through the axis of hip joint, slightly anterior to the bodies of the lumbar vertebrae, passes through the shoulder joint and slightly anterior to the external auditory meatus



Aspection

- right foot is supinated and in planter flexion, while the left is in better position
- hyperextension of the right knee
- pelvis in anteversion
- slight rotation of the body to the left side as the left part of body of the patient looks visible
- posture of the spine from this side looks good except the hypokyphotic in the thoracic spine

Lateral view : “ left side “

- Plumb line test :

Slightly anterior to the lateral malleolus, slightly posterior to the axis of knee joint, slightly posterior to the axis of hip joint, passes slightly behind the bodies of the lumbar vertebrae, passes behind the shoulder joint and the external auditory meatus and the entire head

Aspection

- left foot is in planter flexion, it's also in inversion
- knee joint is in hyperextension
- pelvis is in anteversion
- rotation of the body to the left side as the right side of the body is not slightly visible from this side
- there is hypolordosis of the upper part of the Lumbar spine

Anterior view

- left foot is in inversion and planter flexion
- right foot is more supinated and planter flexion
- knees valgusity are present
- umbilicus is slightly of shifted to the right side more than the left side
- right breast is more depressed

- left shoulder is higher than the right one

**3.14.2 Gait analysis**

“ with the aid walker “

- wide base of support when walking due to the ABD of the right hip that happens during the gait
- the walking rhythm is non periodic
- the length of the strides are different from one leg to another, length of the stride on left side is in normal while the right one is swinging laterally
- foot movement is present in the left side, in proper way, heel strike, flat foot, heel off, toes off, while in the right foot the movement is initiated from the right hip, and the foot is swinging as it is elevated from the hip and abducted then swings forward, and it is kind of hard for the patient to lift it up from the ground
- the movement of the trunk is actually obvious when the patient is elevating the right hip to swing her entire leg forward, due to the elevation of the right hip, the right side of the patient is completely elevated, “ the shoulder, the hand and the trunk “
- right pelvis is elevated and it is actually initiating the movement of the lower extremity when the patient is walking

**3.14.3 Anthropometric measurement (length, circumferences)**

Table 13 Final anthropometric measurement UE

UPPER EXTREMTITIES	RIGHT (cm)	LEFT (cm)
Length of upper limbs	76	75
Length of humerus	35	34
Length of forearm	30	30
Length of hands	19	19

Circumference of upper hand	35	35
Circumference of forearm	30.5	30

Table 14 Final anthropometric measurement LE

LOWER EXTREMITIES	RIGHT (cm)	LEFT(cm)
Anatomical length	79	80
Functional length	88	88
Length of thigh	22	22
Length of middle leg	41	41
Length of foot	23	23.5
Circumference of thigh	57.5	56.5
Circumference of knee	43	42
Circumference of calf	40	40
Circumference of ankle	27	27
Circumference of foot	22	22.5

**3.14.4 Goniometry**

AROM:

Table 15 Final active range of motion

<u>Name of Joint</u>	<u>Right</u>	<u>Left</u>
<u>Shoulder joint :</u> ( <u>two-arm goniometer</u> )	S: 40-0-180 F: 170-0-0 R:65-0-50 T: 35-0-100	S: 35-0-165 F: 130-0-0 R:50-0-50 T: 30-0-90
<u>Elbow joint :</u> ( <u>two-arm goniometer</u> )	S: 0-0-130 R: 70-0-80	S: 0-0-130 R: 75-0-75
<u>Wrist joint :</u> ( <u>two-arm goniometer</u> )	S: 50-0-80 F: 10-0-30	S: 50-0-80 F: 10-0-30

<u>Fingers (MCP):</u> ( <u>finger's goniometer</u> ) and ( <u>two-arm goniometer</u> )	S: 20-0-95 F: 5-0-10	S:30-0-95 F:5-0-20
<u>Fingers (IP1):</u> ( <u>finger's goniometer</u> )	S: 0-0-90	S: 5-0-90
<u>Fingers (IP2):</u> ( <u>finger's goniometer</u> )	S: 0-0-90	S: 0-0-90
<u>Thumb (CMC):</u> ( <u>two-arm goniometer</u> )	S: 5-0-25 F:40-0-35	S:10-0-35 F:45-0-35
<u>Thumb (MCP) :</u> ( <u>finger's goniometer</u> )	S: 0-0-70	S: 0-0-70
<u>Thumb (IP) :</u> ( <u>finger's goniometer</u> )	S: 5-0-90	S: 5-0-90
<u>Hip joint :</u> ( <u>two-arm goniometer</u> )	S: 5-0-25 F: 30-0-20 R: 15-0-10	S:10-0-100 F: 35-0-20 R:25-0-15
<u>Knee joint :</u> ( <u>two-arm goniometer</u> )	S: 0-0-120	S:0-0-125
<u>Ankle joint:</u> ( <u>two-arm goniometer</u> )	S: 20-15-15 R: 0-0-10	S:30-10-15 R:10-0-20
<u>Toes (MTP) :</u> ( <u>finger's goniometer</u> ) and ( <u>two-arm goniometer</u> )	S: 60-0-55	S: 60-0-55
<u>Toes (IP)big toe :</u> ( <u>finger's goniometer</u> )	S: 0-0-60	S: 0-0-55
<u>C spine :</u> ( <u>two-arm goniometer</u> )	S: 55-0-45	
<u>Lateroflexion of C spine :</u> ( <u>two-arm goniometer</u> )	50	50

<u>Rotation of C spine :</u> ( <u>two-arm goniometer</u> )	55	50
<u>Rotation Th and L spine :</u> ( <u>two-arm goniometer</u> )	35	35

**PROM**

Table 16 Final passive range of motion

<u>Name of Joint</u>	<u>Right</u>	<u>Left</u>
<u>Shoulder joint :</u> ( <u>two-arm goniometer</u> )	S: 40-0-180 F: 170-0-0 R:65-0-50 T: 35-0-100	S: 40-0-170 F: 170-0-0 R:55-0-55 T: 30-0-90
<u>Elbow joint :</u> ( <u>two-arm goniometer</u> )	S: 0-0-145 R: 90-0-90	S: 0-0-155 R: 90-0-90
<u>Wrist joint :</u> ( <u>two-arm goniometer</u> )	S: 80-0-90 F: 15-0-35	S: 80-0-90 F: 15-0-35
<u>Fingers (MCP):</u> ( <u>finger's goniometer</u> ) and ( <u>two-arm goniometer</u> )	S: 35-0-95 F: 20-0-25	S:40-0-95 F:20-0-30
<u>Fingers (IP1):</u> ( <u>finger's goniometer</u> )	S: 5-0-95	S: 5-0-95
<u>Fingers (IP2):</u> ( <u>finger's goniometer</u> )	S: 0-0-95	S: 0-0-95
<u>Thumb (CMC):</u> ( <u>two-arm goniometer</u> )	S: 10-0-40 F:50-0-55	S: 10-0-40 F:50-0-55
<u>Thumb (MCP) :</u> ( <u>finger's goniometer</u> )	S: 0-0-70	S: 0-0-70
<u>Thumb (IP) :</u> ( <u>finger's goniometer</u> )	S: 5-0-90	S: 5-0-90

<u>Hip joint :</u> ( two-arm goniometer )	S: 20-0-130 F: 40-0-20 R: 55-0-35	S: 25-0-125 F: 40-0-25 R: 55-0-35
<u>Knee joint :</u> ( two-arm goniometer )	S:5-0-155	S:5-0-155
<u>Ankle joint:</u> ( two-arm goniometer )	S: 30-0-15 R: 15-0-25	S:30-0-20 R:20-0-30
<u>Toes (MTP) :</u> ( finger’s goniometer ) and ( two-arm goniometer )	S: 70-0-60	S: 70-0-60
<u>Toes (IP)big toe :</u> ( finger’s goniometer )	S: 0-0-70	S: 0-0-70
<u>C spine :</u> ( two-arm goniometer )	S: 60-0-45	
<u>Lateroflexion of C spine :</u> ( two-arm goniometer )	60	55
<u>Rotation of C spine :</u> ( two-arm goniometer )	60	60
<u>Rotation Th and L spine :</u> ( two-arm goniometer )	45	45

**3.14.5 Hypermobility**

Table 17 Final hypermobility

	Left	Right
<b>Lumber spine</b>		
Retroflexion “ Sachse “	Grade B	
Anterioflexion “ Sachse “	Grade A	
<b>Thoracic spine</b>		
Rotation “ Sachse “	Grade A	Grade A

<b>Cervical spine</b>		
Rotation “ Sachse “	Grade A	Grade A
<b>Metacarpal joints</b>		
Dorsal Flexion “ Janda “	Hypermobility	Hypermobility
<b>Metacarpal joints</b>		
Dorsalflexion “ Sachse “	Grade C	Grade C
<b>Wrist joint</b>		
Dorsal flexion“ Janda “	Hypermobility	Hypermobility
<b>Elbow joint</b>		
Extension “Sachse “	Grade C	Grade C
<b>Shoulder joint</b>		
High cross arm“ Sachse “	Grade B	Grade B
Touch the hands behind the back “ Sachse “	Grade C	Grade C
<b>Glenohumeral joint</b>		
Abduction “ sachse “	Grade B	Grade B
<b>Knee joint</b>		
Extension “ sachse “	Grade B	Grade B
<b>Hip joint</b>		
Rotation “ sachse “	Grade B	Grade B

### 3.14.6 Muscle length test

(according to Janda or Kendall)

- length of ankle flexor muscles (gastrocnemius- soleus): “ Kendall “  
 “gastrocnemius ”: R - Dorsiflex 10° “ normal “ L - Dorsiflex 10° “ normal “  
 “ soleus ” : R – dorsiflex 20 “normal” L – dorsiflex 20 ” normal “
- length of hip flexor muscles : “Kendall“  
 R: Both one and two joints muscles are normal length  
 L: Both one and two joints muscles are normal length
- length of hip adductor muscles : “ Janda “  
 R: grade 0    L: grade 0

-length of hamstring muscles : “ Kendall “

R: normal

L: normal

-length of paravertebral muscles : “ Janda “

grade 0

-length of m. quadratus lumborum : “ Janda “

R: grade 0

L: grade 0

-length of piriformis muscles : “ Janda “

R: grade 0

L: grade 0

-length of pectoralis major (upper and lower part) “Kendall“

R: upper part – normal. Lower part – normal

L: upper part – slight shortness. Lower part – slight shotness

-length of pectoralis minor : “ Kendall “

R: slight shortness

L: slight shortness

-length test for teres major – latissimus dorsi – rhomboid major and minor muscles : “ Kendall “

R: normal length

L: normal length

-length of medial and lateral shoulder rotators : “ Kendall “

R: lateral shoulder rotators - normal length

    medial shoulder rotators – normal length

L: lateral shoulder rotators – normal length

    medial shoulder rotators – normal length

-length of carnial part of trapezius : “ Janda “

R: grade 0      L: grade 0

-length of levator scapulae : “ Janda “

R: grade 0      L: grade 0

-length of SCM : “ Janda “

R: grade 0      L: grade 0

-length of scalene muscles : “ Janda “

R: grade 0      L: grade 0



**3.14.7 Muscles strength test**

“ according to Kendall “

Table 18 Final muscle strength test

Name of muscle	Right	Left
ADD POLLICIS	3	4
ABD POLLICIS BREVIS	3	4
FLEXOR POLLICIS LONGUS	3	4
FLEXOR POLLICIS BREVIS	3	4
EXTENSOR POLLICIS LONGUS	3	4
EXTENSOR POLLICIS BREVIS	3	4
ABD POLIICIS LONGUS	3	4
OPPONENS DITI MINIMI	3	4
FLEXOR DIGITORUM SUPPERFICIALIS	3+	4
OPPONENS DITI MINIMI	3	4
FLEXOR CARPI RADIALIS	5	2+
FLEXOR DIGITORUM SUPPERFICIALIS	4+	4
FLEXOR CARPI ULNARIS	5	4
EXTENSOR CARPI RADIALIS (LONGUS AND BREVIS):	4	3+
EXTENSOR CARPI ULNARIS	4+	4
PRONATOR TERES AND QUADRATUS	5	4

SUPINATOR AND BICEPS	5	3+
BRACHIORADIALIS	5	4+
CORACOBRACHIALIS:	5	5
TRICEPS AND ANCONIUS	4-	4+
DELTOID (ANTERIOR)	5	5
DELTOID (POSTERIOR)	5	4+
DELTOID (MIDDLE)	4-	4
TERES MAJOR	5	4+
PECTORALIS MAJOR: “UPPER AND LOWER “	5	4+
PECTORALIS MINOR	5	4+
LATISSIMUS DORSI	5	5
MEDIAL SHOULDER ROTATION	5	4+
LATERAL SHOULDER ROTATION	5	5
INFRASPINATUS	5	5
TERES MINOR	5	5
RHOMBOIDE AND LEVATOR SCAPULA	4	4
TRAPIZIUS UPPER PART	5	4
TRAPIZUS MIDDLE PART:	4	4
TRAPZUS LOWER PART	4+	3
SERRATUS ANTERIOR	5	5
ABD HALLUCIS	2+	3+
EXTENSOR DIG. LONGUS AND BREVIS	2+	4+
EXTENSOR HALLUCIS LONGUS AND BREVIS	3+	5
TIBIALIS ANTERIOR	3	4
TIBIALIS POSTERIOR	3	4

Peronei mm	1	4
SOLEUS	3-	4
HAMSTRING (LATERAL, MEDIAL)	2	4-
QUADRICEPS FEMORIS:	3+	4
HIP FLEXORS AND ILLIOPSOAS	2+	4-
TENSOR FASCIA LATAE	2	3+
MEDIAL HIP ROTATION	2	3+
LATERAL HIP ROTATION	2	3
GLUTEAUS MINIMUS	2+	4-
GLUTEAUS MIDEUS	2	3
SARTURIOS	2+	4
GLUTEAUS MAXIMUS	4	3+
HIP ADD	2+	4
ANTERIOR NECK FLEXOR	3	3

**3.14.8 Muscle tone palpation**

- M. sternocleidomastoid

In supine position, symmetrical in the left and right side

The muscles were in hypotone

No pain was felt during the palpation

- Mm. scalene

In sitting position, was really hard to palpate the right muscles

Muscles are in hypotone, especially the right side

No pain was felt during the palpation

- M.trapezius ( upper, middle,lower parts )

Upper part : sitting position, left is normal tone while the the right one is in hyper tone

Middle part : prone position, symmetrical in both sides, normal tone

Lower part : prone position, hypertonic in right and normal tone in left side

No pain was felt during the palpation for the upper, middle, or the lower parts

- M.deltoid (anterior, middle,posterior)

Upper part: sittin position, the right side was more hypotone than the left one

Middle part: sittin position, both sides were in hypotone,

Lower part: sittin position, right side is more in hypotone than the left side

No trigger point were palpated

- M.pectorales major

In supine positon, both sides where in normal tone, no trigger point were palpated

No pain was felt during the palpation

- M.pectorales minor

Supine position, both sides where in normal tone, no trigger point were palpated

No pain was felt during the palpation

- M.serratus anterior

In supine position, muscles where in hypontone in both sides

No pain was felt during the movement

- M.biceps brachii

sitting position, the muscle was in normal tone in both sides

No pain was felt during the palpation

- M.triceps brachii

Prone position, symmetrical in both sides

The muscle was in normal tone in both sides

No pain was felt during the palpation

- Quadratus Lumborum

Prone position, hypertone in the right side and normal tone on the left side

A little pain was felt by the patient while palpating the right side

- M. rectus abdominis

Supine position, Muscle was in hypo tone, trigger point was palpated

No pain was felt during the palpation of the muscle

- M.quadriceps femoris

Supine position, normal tone in right side and hyper tone in left side

No pain was felt during the palpation

- Mm.adductors

Supine position, more tonic in the left side than the right side, left is normal tonic while right is hypo tonic

No pain was felt during the palpation

- M.tibialis anterior

In sitting position, hypertonic muscle in the left side, normal in the right side

No pain was felt during the palpation

- M. fibularis longus and bervis

In sitting position, right side is more hypotonic than the hypotonic left side

No pain was felt during the palpation

- M. supraspinatus

In sitting position, both sides the muscles were in hypo tone

No pain was felt during the palpation

- M. infraspinatus

In sitting position, both sides the muscles were in hypo tone

No pain was felt during the palpation

- M. latissimus dorsi

In prone position, both sides the muscles were in hypo tone

No pain was felt during the palpation

- M.gluteus max

In prone position, normal tone in right and hypo tone in left side

No pain was felt during the palpation

- M.gluteus mid

In prone position, normal tone in both sides

No pain was felt during the palpation

- Hemstrings

In prone position, the right is a bit more hypotonic than the left one

No pain was felt during the palpation

- M.triceps surae

In prone position, both muscles are in hypotone

no pain was felt during the palpation

**3.14.9 Pelvis palpation**

- height and symmetry of cristae iliacae  
left is higher
- height and symmetry of SIPSs  
left is higher
- height and symmetry of SIASs  
right is higher

**3.14.10 Romberg Test**

Romberg Test I  
 Test is positive  
 Since Test I is positive, no need to proceed to next ones

**3.14.11 Breathing pattern**

The breathing pattern of the patient was noticed when standing sitting and lying down  
 The breathing is more divided into the abdominal and thoracic parts when the patient is sitting, standing and lying down

**3.14.12 Neurological Examinations**

Table 19 Final neurological examination

	Upper extremity	lower extremity
Reflexes	<p><b>The biceps brachii reflex</b>                      Same in both sides, the reflex was present and it wasn't either, hyper or hypo was just normal</p>	<p><b>The knee reflex</b>                      No reflexes on either side  <b>Achilles tendon reflex</b></p>

	<p><b>The triceps reflex</b> Same in both sides, the reflex was present and it wasn't either, hyper or hypo was just normal</p> <p><b>Finger flexors</b> Same in both sides, the reflex was present and it wasn't either, hyper or hypo was just normal</p>	<p>Hypo reflex on the left side while no reflex on the right side</p>
<p>Superficial sensation</p>	<p>Normal touch was applied to the patient with his eyes closed on his upper extremity</p> <p>“ anterior – lateral – medial and posterior sides “ both right and left extremity</p> <p>The patient felt them both, but when compared the right and left sides, the patient felt the left side more than the right side</p>	<p>Normal touch was applied to the patient with his eyes closed on his upper extremity</p> <p>“ anterior – lateral – medial and posterior sides “ both right and left extremity</p> <p>The patient felt them both, but when compared the right and left sides, the patient felt the left side more than the right side</p>
<p>Deep sensation</p>	<ul style="list-style-type: none"> <li>- An item was placed in the patient's hand, and the patient was able to identify it</li> <li>- Patient was also asked to identify a passive movement “flexion of small finger” which have been done to her passively with her eyes</li> </ul>	<ul style="list-style-type: none"> <li>- An extension movement was done to the patient big toe both sides, and the patient was asked to identify the movement, the patient was able to identify it correctly</li> <li>- Then the patient was asked to do the same movement “ extension</li> </ul>

	<p>closed, she was able to identify the movement in both sides</p> <p>- Then the patient have been asked to do the same previous movement which have been done passively in the other side, and the patient was able to do it correctly</p>	<p>of the big toe “ on her other leg, she was able to do the movement correctly on the left side, but not very good on the right side, but that is probably because of muscle weakness on right side</p>
<p>Pyramidal sign</p>	<p><b>Mingazzini</b>                  Negative both sides                  *fingers flexion right side</p> <p><b>Rusecky</b>                  Negative both sides</p>	<p><b>Babinski</b>                  Negative on left side                  Positive on right side</p> <p><b>Chaddock</b>                  Negative on left side                  Positive on right side</p> <p><b>Openheim</b>                  Positive on left side                  Positive on right side</p> <p><b>Mingazzini</b>                  Right leg fell down after 3 seconds                  “ positive in right side “</p>



**3.14.13 Examination of fascia**

lumbar fascia caudally

No restriction in either side

lumbar fascia cranially

No restriction in either side

fascia on both sides of the trunk

No restriction in either side

shifting of the fascia around the thorax

No restriction in either side

The scalp

No restriction

Fascia at the neck and the extremities

No restriction

**3.14.14 segmental examination**

Cervical spine

No restriction in any segment in either direction

Thoracic spine

No restriction in any segment in either direction

Ribs

There were no restriction

Lumbar spine

There was restriction in L4 segment into flexion direction only

Sacroiliac joint

No restriction in sacroiliac joint

Upper extremity

Left shoulder restriction is present in cranial direction

Right and left elbows are restricted

Lower extremity

Restriction were found in the right knee

**4. Conclusion**

**4.1 Effect of the therapy**

My aim of this rehabilitation will be improve the overall condition and slow the progression of the disease, although, in this amount of time I have seen some changes, regarding the muscle strength, the range of motion, the fascia in lumbar spine, the situation of the L4 vertebra, and the breathing pattern

Coming to over all conclusion, I have had 5 days of therapy with my patient, there was noticeable changes and some improvement, so in general I can say that my therapy had its satisfactory effect and showed its improvement on my patient.

I have made a table for the most noticeable changes for my patient condition from the first day to the last day of the therapy

Table 20 Effect of the therapy

	Initial	Final
Muscle strength tests	Pectoral muscles R: 5            L: 4- Quadriceps Femoris R: 3-            L: 4 Hip Adductors R: 2            L: 3+ Hip Abductors R: 2            L: 3 Gluteus muscles R: 4            L: 3 Peroneal mm. R: 0            L: 4	Pectoral muscles R: 5            L: 4+ Quadriceps Femoris R: 3+            L: 4 Hip Adductors R: 2+            L: 4 Hip Abductors R: 2            L: 3+ Gluteus muscles R: 4            L: 3+ Peroneal mm. R: 1            L: 4
Range of motion	Shoulder joint L: S: 30-0-150 F: 110-0-0 R:50-0-45	Shoulder joint L: S: 35-0-165 F: 130-0-0 R:50-0-50

	T: 25-0-85 Hip joint R: S: 5-0-10 F: 30-0-20 R: 15-0-10	T: 30-0-90 Hip joint R: S: 5-0-25 F: 30-0-20 R: 15-0-10
Gait pattern	Walking with aid walker, the movement of the right side starts with elevation of the hip, with no flexion of the hip joint, swinging the elevated right leg to move it forward	** Less right hip elevation when moving forward, slight hip flexion is present, abduction of the hip helps moving the leg forward, no extension of the knee
Breathing pattern	Activation of lower thoracic muscles and minimum activation of abdominal	The breathing is more divided into the abdominal and thoracic parts
Segmental examination	L4 segment restricted in flexion direction	The vertebra was mobilized
Fascia	Restriction were found in both sides in the Lumbar fascia in caudal direction	Restriction were released

\*\* meaning the changes are not permanent, only after PIR of Quadriceps lumborum, otherwise the walking is the same as the initial

#### 4.2 Conclusion of the therapy

My patient has Multiple sclerosis. In total I had five sessions with her, that was quite short time to work with a patient who has a neurological disease, I have not used any invasive methods during my therapy, and all the therapy plan and implementation were done according to what I have learned during my studies and under the supervision of Mr. Tomas Modlinger.

My patient has a multiple sclerosis disease, which is not only effecting her physically, but also mentally, she was sensitive and emotional during my therapy with her, so the emotional motivation was essential during my therapy, I had to increase her motivation from time to time, tell her how hard she work and that she have improved from the previous day. Apart form that, I have used several techniques during my therapy, active, passive exercises, isotonic and isometric strengthening exercises, mobilization techniques, releasing of the fascia, exercises for breathing Kenny method, mobilization of lumbar spine, relaxation techniques, sensorimotoric training and stability increasing exercises, in a different bases, based on the patient ability on every individual day, I have focused on active exercises to increase muscle activity mainly, thus will increase the overall condition and the stability. The exercise I have done with the patient did not provoke any pain for the patient.

## 5. Conclusion of the work

I have chosen this patient in Kladno because it was interesting case to me, something not common, too much work to do with, too much things to learn from, a lot of practice, also the patient was too kind and helpful, I learned a lot during these 2 weeks and I appreciate the guidance, supervising and support I got at RHB oddělení, Nemocnice Kladno a.s.

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## 7. Appendix

### 7.1 Ethics committee approval

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

#### Application for Approval by UK FTVS Ethics Committee

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

**The title of a project:** Case study of a patient with diagnosis of multiple sclerosis  
**Project form:** Bachelor  
**Period of realization of the project:** January 2017  
**Applicant:** Hussain Alsaud  
**Main researcher:** Hussain Alsaud  
**Supervisor (in case of student's work):** Mgr. Helena Vomáčková

**Project description:** Case study of physiotherapy treatment of a patient with diagnosis of multiple sclerosis is conducted under the expert supervision of an experienced physiotherapy to the rehabilitation department in Oblastní nemocnice Kladno. The methods which are used are in line with the hospital rules for patients with neurological diseases the methods that are used from the researcher are based to the knowledge which they are earned from bachelor program in physiotherapy in UK FTVS Prague.  
**Ensuring safety within the research:** For that particular research the researcher doesn't use any invasive methods. All the precautions and risk preventions are followed according to the specific rules, policies and procedures signed documentation. The rehabilitation regimes are designed, prescribed and approved from the responsible physician and under all of the implemented procedures including assessment, discussions and any kind of communication with the patient were under the responsible supervision of Mgr. Tomáš Modlinger.  
**Ethical aspects of the research:** All the members and, or participants in the research project are adults and non-vulnerable. All the personal data are anonymized and will be stored in anonymous form.  
**Informed Consent:** attached

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

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

In Prague, January 27, 2017

Applicant's signature:



#### Approval of UK FTVS Ethics Committee

**The Committee: Chair:** doc. PhDr. Irena Parry Martínková, Ph.D.  
**Members:** prof. PhDr. Pavel Slepíčka, DrSc.  
 doc. MUDr. Jan Heller, CSc.  
 Mgr. Pavel Hráský, Ph.D.  
 Mgr. Eva Prokešová, Ph.D.  
 MUDr. Simona Majorová

The research project was approved by UK FTVS Ethics Committee under the registration number: 044/2014

Date of approval: 31.1.2014

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.

Stamp of UK FTVS  
**UNIVERZITA KARLOVA**  
 Fakulta tělesné výchovy a sportu  
 José Martího 31, 162 52, Praha 6  
 – 20 –

  
 Signature of the Chair of  
 UK FTVS Ethics Committee

## 7.2 Informed consent

## 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 na ....., 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 názvem .....

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 poučení<sup>3</sup> .....

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 zástupce .....

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

.....



### 7.3 List of Abbreviations

1. CNS = Central Nervous System
2. cPTs = Community Physiotherapists
3. DSS = Disease Step Scale
4. INO = Inter- nuclear ophthalmoplegia
5. CSF = Cerebrospinal fluid
6. EDSS = Expanded Disability Status Score
7. CIS = Clinically isolated syndrome
8. VER = Visual evoked response test
9. IFN = Interferon
10. RR- MS = Relapsing Remitting course
11. MS = Multiple Sclerosis
12. MRI = Magnetic Resonance Imaging
13. ROM = range of motion

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