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Role of Physiotherapy and Practice of Judo as an Alternative Method of Treatment in Multiple Sclerosis

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Abstract

Multiple sclerosis is a chronic inflammatory-demyelinating disease, which is most frequently diagnosed in young adults. Physiotherapy, mainly kinesiotherapy, plays an important role in supporting the therapeutic process. Research shows that physical activity may delay the progression of the disease and influence its course. Physical exercise can stimulate the secretion of neurotrophic factors that induce neuroplastic processes within the central nervous system, thus contributing to the recovery of motor and cognitive functions. The young age of the patients makes it difficult for them to accept the need to attend rehabilitation sessions on a regular basis. There is a possibility to use alternative forms of rehabilitation based on sports disciplines or other physical activities. A pilot study was conducted, in which judo training was incorporated into the rehabilitation program for MS patients. The benefits of this sport include: development of proprioception, motor coordination, endurance and muscle strength. The study showed a reduction in the symptoms of MS in the participants.

Keywords: multiple sclerosis, physiotherapy, physical activity, alternative rehabilitation, judo, disability

1. Introduction

Multiple sclerosis (MS) as a disease: acquired in young adulthood, chronic and of undetermined etiology is difficult to accept by the patient. Comprehensive therapy based on pharmacological treatment combined with regular rehabilitation is required. Physiotherapy is aimed at maintaining the psychomotor performance of the patient for as long as possible. There are ongoing studies and discussions on determining to what extent the physiotherapy directly affects the regeneration of nervous tissue, and to what extent its satisfactory effects are related solely to the increase in the level of physical activity [1, 2]. A comprehensive rehabilitation program should motivate the patient to live in a dignified and enjoyable way. The pilot studies show that the patients enjoy alternative forms of physiotherapy that influence the locomotor system and engage in them on a regular basis. What is more, this kind of activities helps patients to develop various interests and improves their social relations [3]. Given the high specificity of MS, the physiotherapy should be fully integrated into the treatment program and adapted to the individual needs of the patients, as well as their capabilities and stage of the disease [1, 2]. The following chapter presents recommendations

for alternative forms of rehabilitation used in the comprehensive treatment for multiple sclerosis, such as judo, tai-chi or kick boxing.

2. Role of physiotherapy in the treatment of multiple sclerosis

The most effective non-pharmacological treatment for patients diagnosed with multiple sclerosis include physiotherapy, symptomatic therapy and psychotherapy [4]. The key of the effectiveness of the therapy lays in its all-encompassing character, that is, the cooperation between a doctor, physiotherapist, nurse, social worker, occupational therapist as well as psychologist. In case of some patients, it is not necessary to involve all the specialists listed above. Starting from the diagnosis of the disease and through its development, the patient's situation should be analyzed on an ongoing basis and based on that, they should be under observation of particular specialists. Close cooperation between the physician and the physiotherapist seems to be indispensable in every case of multiple sclerosis [5]. Regular physiotherapy allows patients to maintain independence for longer. The positive effects of the physiotherapy are possible due to the neuroplasticity of the brain. Neuroimaging and electrophysiological examinations show spontaneous and physiotherapy induced changes in the nervous system [6]. Correlation between physical exercise and recovery of motor and cognitive functions in patients is being studied. The studies largely focus on the role of cytokines and neurotrophic factors in these processes, in particular brain-derived neurotrophic factor (BDNF). Increased BDNF levels are observed after regular physical exercise. Brain-derived neurotrophic factor (BDNF) is one of the nerve growth factors. It enhances neuronal regeneration, promotes the survival of nerve cells and influences Schwann cells. Data obtained in several studies show relations between the increased levels of neurotrophins observed after regular physical activity and the induction of neuroplasticity, as well as the recovery of motor and cognitive functions. According to some sources, the plasma cytokine and neurotrophins concentration depends mainly on the type of exercise (light/intense) and not on engaging in a physical activity itself [7, 8]. It is emphasized that patients with multiple sclerosis can tolerate longer training sessions of high and rapidly increasing intensity, which allows them to make a more noticeable progress in less time. In patients with multiple sclerosis, endurance physical activity, in particular short and intense series of exercises, significantly increases cardiorespiratory fitness and leads to an increase in the secretion of brain-derived neurotrophic factor (BDNF) and nerve growth factor (NGF). Sensory symptoms worsening may be observed after kinesiotherapy. However, this is a temporary effect that resolves within half an hour after the exercise session [7].

It is difficult to identify a clear cause of disability in patients with multiple sclerosis. It seems that the patient's fitness is reduced not only as a result of the progression of the disease. It may also be a consequence of reduced physical activity in MS patients compared to healthy people. Patients with multiple sclerosis, due to lack of regularity in undertaking physical activity, show a reduction in both the maximum aerobic capacity (maximal oxygen consumption) and muscle strength, which additionally translates into impaired functional capacity and reduced quality of life. The physiological profile of these patients may be a consequence of the irreversible effects of the disease as well as of the inactive lifestyle [4, 9]. The effectiveness of the treatment depends on the stage of the disease and the effects of secondary lack of physical activity. It is not clear to what extent the individual impairments can be reversed, as well as to what extent physiotherapy can boost the remyelination of the nervous system. However, kinesiotherapy carried out on a regular basis can certainly contribute to the improvement of the patient's general condition by reducing

the effects of lack of any physical activity. Therefore, rehabilitation in MS remains the main non-pharmacological strategy that allows to reduce disability and maintain patient's functionality [9].

According to the National Multiple Sclerosis Society based in the US, rehabilitation in MS helps patients to achieve and maintain their maximum physical, psychological, social and professional potential, as well as quality of life in relation to the disease, environment and their life goals. Achieving and maintaining an optimal condition is necessary to accept a life with a chronic illness [9]. Exercising particular functions, improving muscular strength and working on proprioception facilitates the patients' everyday life. In case of patients diagnosed with MS, mental attitude is of an extreme importance. When preparing a rehabilitation and physiotherapy program, attention should be paid to the patients' mental state, as well as to their level of motivation to exercise on a regular basis. The aim of physiotherapy, in addition to the physical aspects, is to improve patient's mental condition. A properly selected program will allow the patient to achieve the intended results. Thanks to such an approach and action, patients gain confidence in themselves and their movements and it is easier for them to accept the disease together with its consequences, while finding their place in the society [1, 4, 7]. The rehabilitation should focus on restoring the functions lost by the patient or properly controlling the compensation processes in order to use the patient's adaptive abilities in the most effective way [5].

Generally speaking, in the case of MS patients, rehabilitation should begin with educating the patients and their relatives. It is important to explain the need for regular rehabilitation and its correlation with the pharmacological treatment. It should be noted that the physiotherapist together with the patient sets rehabilitation goals at each stage of the disease. Education is more effective at the early stages of the disease, because the patient shows lower degree of disability and can be taught the correct pattern of performing particular movements in an effective way, which may be useful in the later stages of MS [10, 11]. Then, the so-called symptomatic and task rehabilitation is introduced. It consists of teaching the patients specific functions that may facilitate their everyday life [4]. The detailed plan of the physiotherapy depends on the dysfunctions presented by the patient, the course of the disease and the patients' needs (including their attitude). Structured therapy should also include the patient's individual work at home [10].

Each patient may show different symptoms, which may hinder their everyday life to a varying degree. Physiotherapy aims at choosing a method that can treat several ailments at the same time [11]. Depending on the patient's needs, the emphasis is put on different types of exercise: exercises that increase muscle strength, improve proprioception and coordination or the aerobic exercises. A combination of various types of training is used in order to obtain better results. For instance, a combination of endurance and resistance training improves mobility, balance and coordination [4, 12]. Due to the early age of the diagnosis, the progressive nature of the disease, symptoms that hinder normal functioning and are often embarrassing and may contribute to depression, alternative forms of physical rehabilitation are increasingly being considered. Many types of physical activity can be adapted for therapeutic purposes. Therapy derived from a specific type of sport has a positive effect on the level of motivation to undertake the effort as well as the patient's well-being and self-esteem. This approach allows patients to feel that their goal is not limited to preventing the effects of the disease – the dysfunctions they present – but it is an opportunity to learn new skills, develop new interests or maintain the previous ones. In particular, at the initial stages of MS, it is beneficial to introduce unconventional forms of rehabilitation, which have therapeutic effects, but at the same time may become an alternative way of spending free time. It may support the process of accepting progressing disability. A person who

notices his or her limitations often tends to isolate oneself from society and shows a fear of learning something new. The use of unconventional methods of rehabilitation is aimed at: helping the patient overcome fear, building self-confidence, motivating them to spend time with other people, and encouraging them to adopt a more open attitude, thus facilitating a conversation about their disability. Different activities can be used for therapeutic purposes, including: aerobic training, cycling, judo, tai chi, kickboxing, bicycle ergometer, yoga, aqua spinning and other water exercises [4, 7, 12, 13].

3. Judo: an alternative form of physiotherapy in the treatment of multiple sclerosis

An experiment was conducted, in which a program of physiotherapy for patients with relapsing–remitting (RR) multiple sclerosis was developed on the basis of judo elements. The study involved 4 women aged from 32 to 49 years who had been suffering from MS for several years (from 3 to 7 years). Before being qualified into the study, their physical activity was varied. Prior to the beginning of the study, the patients did not undergo any supervised physiotherapy. In the functional assessment, they presented different levels. However, all of them were able to move independently. They reported the following problems related to the disease: urinary incontinence, chronic fatigue, balance disorders and sensory disturbances. In addition, 3 respondents reported a sense of social isolation despite being active professionally. None of the women had practiced a sport like judo before. Unconventional therapy involving judo elements lasted for 8 weeks. All patients fully executed the plan they were provided with. The women participated in judo training supervised by a physiotherapist twice a week, in 45-minutes sessions and performed exercises at home twice a week, in 20-minutes sessions. The number of classes and their duration were determined based on the guidelines of physical activity for patients with MS developed by the Canadian Society for Exercise Physiology, which received a recommendation from the Multiple Sclerosis Society of Canada [14]. The participants exercised barefoot in sportswear in a room with a relatively low temperature (around 15°C). The program of classes included the following: learning about history and philosophy of the discipline, demonstration of throws and combat by professional sportsmen, coordination exercises (alternating arm circles, etc.), learning falling techniques from various positions (*ukemi*), ways of moving on the mat, body turns and body rotations, special judo exercises aimed at strengthening the stabilizing muscles of the torso, the so-called central stabilizers (moving: sitting straight forward and backward, lying back and forward, lying backwards with alternate right and left bends of the body, in a standing position with bent lower limbs, taut torso and bent upper limbs, etc.), learning 3 basic holds (*osaekomi - waza*) and getting out of them, performing individual throwing techniques without a partner (*tandoku - renshu*), responding to sound and visual signals, exercises and games aimed at throwing the partner (*uke*) off balance (including: pulling/pushing an *obi* with one's hands, pulling with the left upper limb and thrusting with the right, and vice versa, pushing the partner while approaching him), taking defensive positions on the ground (*ne - waza*) and trying to maintain them, training fights on the ground (*randori ne - waza*), adjusting one's own movements to the partner's movements, moving around the mat with your partner, entering different techniques with the partner (*uchi - komi*) in a spot or in movement, *tandoku - renshu* with closed eyes and overcoming the partner's resistance. Each class began with warm-up exercises and ended with breathing and relaxation techniques on the basis of post-isometric muscle self-relaxation. The tasks to be performed at home correlated

with the current stage of the rehabilitation program. Therefore, the plan included: coordination exercises (alternating forward and backward arms rotations), stabilization exercises, the so-called CORE (starting positions: point kneeling and lying on the back), falling on the mattress/bed, *tandoku - renshu* (also outdoor), simulation of exits from holds without a partner and breathing and relaxation exercises.

Prior to the start of the rehabilitation program and at the end of the program, patients completed the Multiple Sclerosis Impact Scale (MSIS - 29) questionnaire. The results showed that in the assessment of patients, the physiotherapy contributed to the decrease in the degree of their disability, both physically and mentally. Each of the women, after eight weeks of judo practice, in response to the questions contained in MSIS-29, emphasized that the intensity of the dominant and most bothersome symptoms significantly decreased compared to the baseline assessment. This proves that judo classes had a positive effect on the functional status of the patients (**Table 1**).

Before and after the study, the following tests were also performed: Lovett (for muscles: rectus femoris, biceps femoris, rectus abdominus, deltoideus), Time Walking (10mTW), Functional Reach Test and body posture assessment. The comparison of the results showed an improvement in all the areas after the completion of the program. One of the patients initially showed significant lack of balance that negatively affected her stability and movement. Prior to the physiotherapy, her gait was abnormal: small steps, slightly spastic and shaky, with wider base. She also reported fear of falls, which occurred regularly. Each time, she feared possible injury and a sore body. After therapy, however, she showed a more stable body posture when moving. Her gait improved and was closer to physiological one. In addition, the feeling of fear of uncontrolled falls decreased significantly, as during therapy she learned how to fall in a way that cushioned her fall to the ground.

All the patients who participated in the study stressed that they gained self-confidence, felt less muscle tension, acquired control and inner peace, while their well-being improved. They reported much higher levels of concentration and observed that they were able to perform daily activities faster than before. In addition, they estimated that the level of depression they felt decreased within these two months.

On the basis of the pilot studies, the following conclusions can be drawn:

1. Practicing judo by people with multiple sclerosis improves all motor skills (speed, strength, endurance, coordination). Judo exercises allow to reduce the fatigue. Based on the results obtained in this study, it cannot be clearly stated whether the therapy had a direct effect on the chronic fatigue or only increased the level of tolerance for physical efforts, thus indirectly reducing this symptom.

Patient	MSIS-29 before starting the judo program points/%	MSIS -29 after completion of the judo program points/%
1.	63/43%	48/33%
2.	92/63%	60/41%
3.	67/46%	45/31%
4.	98/68%	58/40%

Points - number of points obtained, % - number of points obtained x 100% /maximum number of points (maximum number of points = 145).

Table 1.
Analysis of the MSIS -29 questionnaire before and after the 8-week judo program.

2. MS patients, who performed specialized judo exercises, show improvement in term of balance, because those exercises require a constant activation of a large number of joints (both in the lower and upper extremities), which causes stimulation of deep sensation receptors. Constant stimulation of the muscle of the abdomen, pelvis and lumbar spine promotes maintaining a stable body posture.
3. Specialized judo exercises increase muscle strength within the abdominal muscles and pelvic floor, thus reducing urinary incontinence.
4. Judo is a contact sport. During the practice, frequent stimulation of mechanoreceptors in the skin occurs, especially when the exercising person is dressed in sportswear of normal thickness such as shorts and a T-Shirt. This can have a direct effect on improving surface and deep sensation. Pressure and precise touch (in judo they are continuously triggered by the embrace/compression of the body to perform a given technique) are transmitted along the same pathways as information from proprioceptors. As a result, proprioception is also improved.
5. Acquiring the ability to fall safely results in: more stable body posture, more confident and determined gait, more complex movements and actions that the patient previously tended to avoid. It also reduces the risk of suffering mechanical trauma as a result of a fall.
6. Performing complex movements in an open kinematic chain (throwing techniques), which require high concentration, precision, correlation of two hemispheres and motor coordination, improves cognitive functions. It may suggest that judo can have indirect beneficial effect on the process of regeneration of neural tissue.
7. Conducting physiotherapy based on a specific sport contributes to increased motivation and conscientiousness during exercise.
8. Working on correcting the patient's impaired functions is easier if combined with acquiring new skills, such as learning judo techniques. The patient then participates in the training more willingly and consciously.
9. The patient's attitude to achieve a specific goal, in the form of learning to perform previously unknown activities, increases self-confidence, promotes better and more open interpersonal relations and has a positive effect on the patient's attitude.
10. The positive results obtained in this pilot study suggest that it may be worth conducting a study involving a larger population.

4. Why was judo selected for rehabilitation in MS?

Judo is a sport that develops all motor skills, that is, speed, strength, endurance and coordination. In addition, it promotes proprioception, as well as increases mobility in the joints and improves muscle stretching. The practice consists of making the opponent lose his or her balance while, at the same time, trying to control one's body posture in different planes. It is widely believed that

the main determinant of success in judo is the efficiency and effectiveness of the postural control system. Therefore, when performing different exercises, techniques (*nage - komi*) as well as free practice (*randori*) the participant learns to feel the body movements and the position of the opponent (*uke*) and use unstable and dynamic situations on his or her favor. Constant stimulation of mechanoreceptors and proprioceptors and the liberation of adequate tension of stabilizing muscles within the trunk occurs constantly in the participant's body. A correct correlation between the central nervous system and the locomotor system (musculoskeletal system) is very important. In addition, judo is trained barefoot. The feet have the control over the transmission of information received both from the outside (position on the ground) and from the inside (adopted position) [15, 16]. Superficial mechanoreceptors located on the plantar side of the foot provide the CNS with information on the position of the body in relation to the vertical reference, based on gravitational forces, load-bearing surface reaction forces and shear forces, which plays an important role in maintaining a stable vertical position [17, 18].

Making unexpected moves imposed by the opponents can have a beneficial effect on improving the movement coordination of judokas in unexpected situations. The training enables them to develop their sensorimotor adaptation that also influences the control of body posture in other situations. During the judo practice, the central nervous system – thanks to available sensory information as well as biomechanical constraints – controls the position of the center of gravity of the body in relation to the feet and creates posture patterns that allows to maintain balance in a given position. Improving postural control as a result of practicing judo seems to be a consequence of improving motor coordination (postural strategy), primarily based on somatosensory information received from one's body.

It is worth paying attention to learning falling techniques in the context of falling to the ground in a safely way. Maintaining control prevents injuries and reduces the discomfort during the fall. A fall is an unintended change in the body position, which consists of losing the balance when walking or performing other activities. As a result of the fall, a person unexpectedly finds oneself on the ground or other low-lying surface. The probability of injury to various tissues increases at the moment when the speed of the person who falls rapidly drops to zero, as a consequence of the collision with the ground. From the biomechanical point of view, a fall can be broken into four phases. **The first phase** of adaptation to the repositioning of the body occurs unconsciously. Reaction that occurs in the upper part of the trunk creates increased muscle tension. **In the second phase**, still in an unconscious way, vestibular system reacts stimulating the lower kinetic chain. **The third phase** occurs consciously and aims to protect the spine from injury. The person who falls bends the body, with the simultaneous reduction of cervical and lumbar lordosis and rounding of the back. **The fourth phase** consists of a rapid energy dissipation and a reduction in the reaction force of the ground by hitting the outer edge of the upper limb against the mat (**Figure 1**) [20].

Judo is among sports commonly practiced by people with intellectual and motor disabilities. It is one of the disciplines included in the Paralympic Games. This sport is practiced, among others, by: blind or visually impaired people, people with impaired hearing, Down's Syndrome and with Cerebral Palsy [18, 21–23]. Judo elements were also used in the physiotherapy of patients after stroke [24]. The positive effects of the alternative methods of rehabilitation (such as tai-chi, kickboxing and yoga) among MS patients, as well as the many benefits of judo and its high therapeutic effectiveness demonstrated in groups with disabilities was one of the reasons why practice of judo by MS patients was considered.

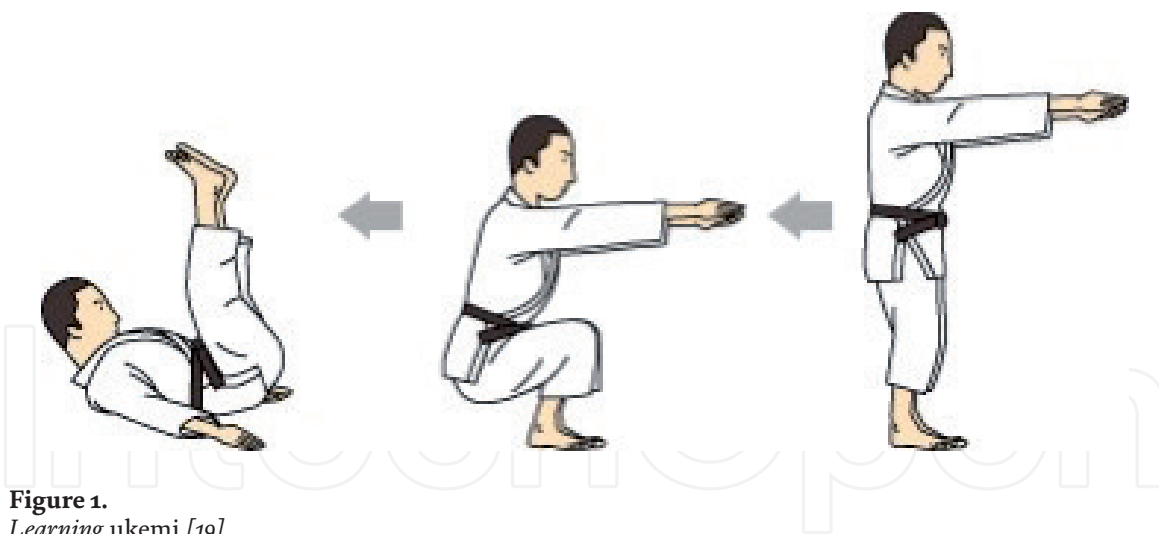


Figure 1.
Learning ukemi [19].

5. Conclusions

Regular rehabilitation is very important for patients with multiple sclerosis. First of all, physical activity reduces the existing dysfunctions and allows to maintain the independence for longer. Development of the disability in MS patients can be caused not only by the progression of the disease but also by reduced physical activity compared to healthy people. It is suggested that rehabilitation may delay the progression of MS. Physical activity can stimulate changes in neuroplasticity of the brain. The role of cytokines and neurotrophic factors, in particular brain-derived neurotrophic factor (BDNF), in these processes is stressed.

The type of therapy undertaken and its effectiveness in eliminating the resulting dysfunctions depend on many factors, but above all on the stage of the disease, the effects of secondary physical inactivity and the patient's motivation. Kinesiotherapy conducted on a regular basis can help to improve the general condition of the patient, both physically and mentally.

Comprehensive rehabilitation should be introduced as soon as MS is diagnosed. Physiotherapy should begin with education, that is, explaining the patient the reason behind the regular physical activity and preparing him or her for the progressive nature of the disease. Most patients are diagnosed with MS at a young age and the correct patterns should be taught to them at the initial stage, as they may be useful when his or her condition deteriorates. When treating MS patients, it is important to bear in mind that they are losing functions that used to be natural to them. Therefore, alternative form of rehabilitations are worth considering. It is necessary to plan a therapeutic program in such a way that the patient, despite the prospect of the increasing number of dysfunctions, is willing in undertake physical activity. Physiotherapy cannot become a cause of mental suffering of the patient, resulting from the awareness of the progression of the disease. It is worth implementing a therapy based on the patient's previous interests or a method that requires the patient to learn new skills. Judo can be an attractive form of rehabilitation for patients with multiple sclerosis.

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