Multiple Sclerosis: A Literature Review

Jody E. Price
University of North Dakota

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MULTIPLE SCLEROSIS: A LITERATURE REVIEW

by

Jody E. Price
Bachelor of Science in Physical Therapy
University of North Dakota, 1994

An Independent Study
Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota
in partial fulfillment of the requirements
for the degree of
Master of Physical Therapy

Grand Forks, North Dakota
May
1995
This Independent Study, submitted by Jody E. Price in partial fulfillment of the requirements for the Degree of Master of Physical Therapy from the University of North Dakota, has been read by the Faculty Preceptor, Advisor, and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

(Faculty Preceptor)

(Graduate School Advisor)

(Chairperson, Physical Therapy)
PERMISSION

Title Multiple Sclerosis: A Literature Review

Department Physical Therapy

Degree Master of Physical Therapy

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Signature [Handwritten: Judy Price]

Date 3-28-95
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ABSTRACT

Multiple Sclerosis (MS), a demyelinating disease of the Central Nervous System (CNS), is the most common cause of nontraumatic disability affecting young adults in the United States. The resultant lesions lead to a variety of symptoms which include: weakness, sensory disturbances, visual problems, spasticity, fatigue, and paralysis. There are also a number of psychological and emotional issues that the MS patient must face. The cause of MS remains unknown and the diagnosis is often difficult. The course and severity of the disease varies from patient to patient. There is no known cure or prevention.

Current treatments include drug therapy, physical therapy, patient and family education, and other allied health services such as occupational and speech therapies. It is important for the health professional working with MS patients to have a good overall knowledge of the information available in order to provide appropriate and comprehensive treatment.

This paper is a review of the current literature available on the cause, diagnosis, treatments and effects of Multiple Sclerosis. It is intended to aid the physical therapist or any other allied health professional in understanding and gaining additional knowledge about MS in order to better serve their patients.
CHAPTER ONE

Introduction and Overview

Multiple Sclerosis (MS), a demyelinating disease of the Central Nervous System (CNS), is the most common cause of nontraumatic disability affecting young adults in the United States. There are 250,000 existing cases with approximately 8,800 new cases diagnosed each year. The etiology of MS remains unknown. The course and severity of the disease vary from patient to patient. There is no known cure or prevention, and diagnosis is difficult and time consuming. These factors add to the fear and uncertainty felt by the patient. Current treatments include drug therapy, physical therapy (PT), patient education and lifestyle adjustments. The success of any MS treatment varies and depends upon the patient and severity of the disease. Being able to recognize the signs and symptoms, as well as having a basic understanding of the disease process and treatment, is important for a physical therapist not only in direct PT treatment of that patient but also in effective patient education and in establishing a good line of communication with the patient. Because the patient typically sees their therapist more often than their doctor they may feel more comfortable or have more of an opportunity to ask questions of the therapist. A knowledge of MS is also helpful in knowing when to refer a patient to a neurological specialist, as the initial sensory and motor changes of MS may send the patient to PT before the condition is definitively diagnosed.

Multiple Sclerosis (MS) was first identified and described in the late 1800's by Jean Martin Charcot. MS is primarily a disease of young adult white women. It currently affects more than 250,000 individuals in the United States with women affected more than men at a 2:1 ratio, and whites affected more than blacks at a 2:1 ratio. The most frequent age of onset is between 20 and 45 years, with a mean age of onset of 33.
The cause of MS remains unknown, however, studies indicate that it has a multifactorial cause which includes the interaction of an environmental agent with a genetically susceptible individual. The genetic susceptibility theory suggests that a mutation leading to MS arose in the Scandinavian regions and was then spread by the Vikings. Epidemiological studies support this theory by demonstrating a high MS prevalence in areas originally settled by northern Europeans. Family studies have indicated at least one susceptibility factor located in the HLA region of the sixth chromosome. The environmental agent involved is believed to be an unidentified virus which is acquired early in life. Although the specific virus responsible for MS has not yet been identified several viruses have been implicated, these include rabies virus, herpes simplex virus, scapie virus, parainfluenza virus 1, measles virus and coronavirus.

There is a higher occurrence of the disease in northern areas. As a result of the combination of genetically susceptible individuals living in areas with a high environmental risk factor MS is more likely to occur in certain areas of the world than in others. Areas of highest prevalence include the Northern United States, Northern Europe, Canada, Great Britain, Scandinavia and Northern New Zealand.

Studies conducted by Dean and Kurtzke in South Africa and Alter et al in Israel have shown that an immigrant adopts the risk factor of a new country if they migrate to that new country before the age of 15 and retains the risk factor of their home country if they migrate after the age of 15. These studies suggest that the exposure to the environmental factor or virus must occur before the age of 15 in order for the individual to develop MS symptoms. An individual is more resistant to the effects of the virus after the age of 15 and is therefore, less likely to develop symptoms if exposed later in life.

After the initial exposure to the virus it has been suggested that an "MS trait" then develops in genetically susceptible individuals which makes them more susceptible to secondary viral infections, vaccinations or trauma which would then act as trigger events
initiating the immunopathogenesis process of MS. 4 This process begins with an initial viral infection acquired early in life which stimulates the immune system and activates peripheral T lymphocytes. At a later time, after a secondary infection or other trigger, the activated T lymphocytes are triggered to enter the brain. Once in the brain they adhere to blood vessel walls and release vasoactive prostaglandins and other substances that cause a disruption in the blood brain barrier (BBB). The T lymphocytes then cross the BBB and enter the brain resulting in a perivascular inflammatory infiltrate. This infiltrate contains activated T lymphocytes, B cells and macrophages. The B cells cause production of immunoglobulin which results in oligoclonal IgG production in the Cerebrospinal Fluid (CSF) which is characteristic of MS and is used for diagnostic purposes. The end result of this process is the destruction of the myelin sheath of the nerves of the CNS which interrupts the transmission of impulses. 8

The areas of demyelination are called plaques. These plaques are found predominantly around the periventricular regions, optic tracts, pons, midbrain and cervical spinal cord. 9 It has been found that, in some cases, MS may remain asymptomatic throughout the life of the individual in spite of the presence of plaques in the CNS. 4 Vost et al 10 and Engell et al 11 found in independent studies that plaques were discovered as incidental findings at autopsy in asymptomatic individuals. The reason for asymptomatic plaques is thought to be due to the "safety margin" which is the absolute minimum conductive capacity necessary for a nerve. If a plaque does not disrupt the conductance of a nerve beyond the "safety margin" then it may remain asymptomatic. 4 Plaques will continue to enlarge or new plaques will continue to be formed as long as the BBB remains permeable, which can be as long as 3.5 months. 12 When these plaques go beyond the "safety margin" they become symptomatic.

MS is characterized by periods of exacerbations and remissions. During the periods of exacerbation the BBB is permeable and new plaques are being formed, it is during this time that symptoms are most acute and progressive. During periods of
remission the BBB has repaired itself, it is no longer permeable and no new plaques are formed. A limited amount of remyelination occurs during remission. Remyelinated axons may then be able to transmit a signal. Symptoms may or may not continue from the exacerbation period to the remitting period, depending upon the degree of severity of the exacerbation, the length of time of the exacerbating period, the number, size, and location of plaque formations. Thus, a patient may be fine for a period of time and then go through a period of varying degrees of handicap and then return to near normal once again.
CHAPTER TWO

Disease Course and Treatment

MS can be classified into 4 specific types: Benign, Exacerbating-Remitting, Remitting-Progressive and Progressive. Benign MS affects 20-30% of MS patients and is characterized by one or two initial attacks with complete or nearly complete remission and little or no lasting disability. Exacerbating-Remitting MS also affects 20-30% of patients and results in sudden onset with partial or complete remission. The difference between Exacerbating-Remitting and Benign is the increased number of attacks that occur with Exacerbating-Remitting. 14 The different types are summarized in Table 1.

Remitting-Progressive type MS differs from Exacerbating-Remitting in that the symptoms do not completely remit and as a result the patient is left with some form of lasting disability. This type affects 40% of patients. Progressive MS affects 10-20% and progresses steadily, be it rapidly or slowly, without remitting, resulting in a chronic debilitating process. A patient may begin in one of the four types and move to any of the other types at any point during the illness. This unpredictable course can hinder diagnosis not to mention create further stress on the patient due to the uncertainty of the disease. 14

The prognosis for MS patients varies greatly depending upon the type and onset. Prognostic factors for a shorter life span include an earlier age of onset, a progressive disease course, and vertigo as an initial symptom. Mortality increases dramatically with severe MS disability. Secondary complications, such as pneumonia, are responsible for over half of MS deaths and suicide is also a significant cause of death among MS patients. The average life expectancy of an individual with MS is 60, which is six to seven years less than the general population. 15
**TABLE 1**

*Types of Multiple Sclerosis*

<table>
<thead>
<tr>
<th>Type</th>
<th>Symptoms</th>
<th>% Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benign</td>
<td>one or two initial attacks&lt;br&gt;complete or nearly complete remission&lt;br&gt;little or no lasting disability</td>
<td>20-30%</td>
</tr>
<tr>
<td>Exacerbating-Remitting</td>
<td>sudden onset&lt;br&gt;increased number of attacks&lt;br&gt;partial or complete remission</td>
<td>20-30%</td>
</tr>
<tr>
<td>Remitting-Progressive</td>
<td>symptoms do not completely remit&lt;br&gt;some lasting disability</td>
<td>40%</td>
</tr>
<tr>
<td>Progressive</td>
<td>progresses steadily, rapidly or slowly&lt;br&gt;no remission&lt;br&gt;chronic debilitating disability</td>
<td>10-20%</td>
</tr>
</tbody>
</table>

*Patient may begin in one type and move to any of the other types at any point during the illness.*
Symptoms

Due to the demyelination, the resulting disruption in nerve conduction and the variability in the size and location of plaque formations throughout the CNS, a variety of symptoms can be seen in MS patients. Common clinical features include: optic neuritis, sensory disturbances, spastic limb paresis, vertigo and balance problems, bowel and bladder disturbance, cerebellar symptoms and cognitive changes. Most patients also suffer from fatigue, heat intolerance, and pain. These symptoms may be present in a variety of patterns and degrees depending on the patient and the type of MS. 9

Lesions of the optic and oculomotor nerves result in visual disturbances, which are common, and can range from total loss of vision to visual field defects, double vision, nystagmus and inflammation of the optic nerve. Sensory disturbances, which can include numbness, tingling, loss of proprioception, headaches, trigeminal neuralgia and pain, result from damage to the spinothalamic tract or sensory nerve roots. When the motor cortex or pyramidal tracts are affected, muscle weakness is seen, usually beginning bilaterally in the lower extremities and may progress to paralysis. Spasticity and increased muscle tone, due to lesions of the pyramidal tracts, are common symptoms. Patients often exhibit hyperactive stretch reflex, positive Babinski sign, Asymmetric Tonic Neck Reflex (ATNR), Symmetric Tonic Neck Reflex (STNR), ankle clonus and spontaneous spasm. Cerebellar disturbances occur when plaques form in the areas of the cerebellum or cerebellar tracts. Cerebellar symptoms include intention tremor, dysmetria, dysdiadochokinesia, ataxia and vertigo. Patients often exhibit problems with bowel and bladder function which include urinary frequency, urgency, incontinence, retention and constipation. Sexual dysfunction and impotence are also a concern for some patients. Bowel, bladder and sexual dysfunction may all result from supra sacral lesions or mechanical outlet obstruction. Emotional instability can occur with cerebral lesions, and symptoms include euphoria or depression and episodes of inappropriate and/or excessive
laughing or crying. If there are cerebral lesions cognitive ability may be affected and is often accompanied by behavioral problems. \(^{14}\)

**Diagnosis**

Diagnosing MS is complicated by the exacerbating-remitting nature of the disease in addition to the ability of MS symptoms to mimic the symptoms of a variety of other diseases. Patients may exhibit a long delay between the onset of symptoms and diagnoses. A study conducted by the National Institutes of Health demonstrated that there was an average of two years from the onset of symptoms to the time of diagnoses. \(^{5}\)

Symptoms can often mimic stress-related, psychophysiological disorders and as a result patients are often mistakenly referred to psychotherapists for treatment of "conversion disorders". \(^{16}\) Patients may also undergo unnecessary surgical procedures due to misdiagnosis, such as carpal tunnel release and cervical disk explorations and corrections. \(^{5}\)

Although there has been improvement in the use and reliability of objective types of tests for MS, diagnosis remains predominately clinical. Laboratory testing serves mainly to verify the clinical impression and rule out other disease processes. \(^{17}\) Clinical diagnosis includes evidence from history and examination of involvement of at least two sites of the CNS consistent with white matter disease, objective neurological signs, two or more episodes separated by at least a month, or progressive for more than six months. \(^{18}\) Common laboratory tests used to confirm the diagnosis include analysis of CSF, CT scan, evoked response potentials, and MRI. The CSF is withdrawn by lumbar puncture and examined for protein content, the number of white blood cells and especially for the presence of immunoglobulin IgG. Protein electrophoresis is also done on the CSF to detect any oligoclonal banding which occurs in 90% of MS patients. The CT scan is used to determine the presence of plaques, as is the MRI. Evoked response potentials measure the electrical responses of the CNS to various stimuli to determine if conduction has been slowed or distorted by demyelination. \(^{17,18,19}\) In diagnosing MS it is necessary to rule
out several other diseases including: systemic lupus erythematosus, primary Sjogren syndrome, polyarteritis nodosa, Behcet's disease, AIDS, tropical spastic paraparesis, sarcoidosis and Lyme disease. 5

Drug Treatments

Treatment of MS must includes attention to acute exacerbations as well as long term maintenance issues. Acute exacerbations are most commonly treated with a variety of pharmacotherapies. Corticosteroids are the most widely used medications for treatment of acute episodes. These drugs reduce inflammation and edema which can block nerve transmission and they can also help to reduce levels of IgG in the CSF. The most common corticosteroids used in the treatment of MS are ACTH and prednisone. 20 Immunosuppressive drugs are also used in hopes of decreasing the immune systems response to the virus. Some common immunosuppressors used are azathioprine and cyclophosphamide. 9 Patients should also be counseled to avoid situations which may bring on or increase the likelihood of exacerbations, these include exposure to high temperatures, stress, fatigue and trauma. 14 There are a variety of drugs used to treat the symptoms of MS such as spasticity, fatigue, bowel and bladder dysfunction, ataxic conditions, chronic pain and emotional instability. Table 2 is a list of commonly used drugs, the symptoms they treat and some common side effects that the physical therapist and patient should be aware of. 20, 21
**TABLE 2**

Commonly Used Drugs

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Drug used to treat</th>
<th>Side effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spasticity</td>
<td>Balclofen, Dantrolene</td>
<td>confusion, dizziness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>exhaustion, weakness</td>
</tr>
<tr>
<td>Spasms, Seizures</td>
<td>Carbamazepine, Phenytoin</td>
<td>drowsiness, confusion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decreased coordination</td>
</tr>
<tr>
<td></td>
<td></td>
<td>slurred speech</td>
</tr>
<tr>
<td>Bladder dysfunction</td>
<td>Anticholinergic drugs</td>
<td>urinary retention</td>
</tr>
<tr>
<td></td>
<td></td>
<td>confusion</td>
</tr>
<tr>
<td>Ataxia</td>
<td>Balclofen, clonazepam propranolol</td>
<td>drowsiness, weakness</td>
</tr>
<tr>
<td></td>
<td></td>
<td>decreased muscle control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>visual problems</td>
</tr>
<tr>
<td></td>
<td></td>
<td>short term memory loss</td>
</tr>
<tr>
<td>Depression</td>
<td>Tricyclic Antidepressant</td>
<td>weight gain, confusion</td>
</tr>
<tr>
<td>Emotional lability</td>
<td>Amitriptyline</td>
<td>abnormal movement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>blurred vision, anxiety</td>
</tr>
<tr>
<td></td>
<td></td>
<td>weakness</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Amantadine</td>
<td>dizziness, insomnia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nausea</td>
</tr>
<tr>
<td>Pain</td>
<td>Aspirin, Acetaminophen TENS</td>
<td>nausea, GI discomfort</td>
</tr>
</tbody>
</table>
The drugs used to treat MS can have a variety of serious side effects and therefore must be monitored carefully on a regular basis. Other treatments such as special diets, vitamin and mineral therapies, hyperbaric oxygen and removal of dental amalgam have been proposed as beneficial, however, controlled studies have failed to substantiate any real benefit at this time. 

Other treatments may include appropriate amounts of exercise and rest, proper nutrition, avoidance of exacerbation triggers, and treatment of any carryover symptoms from the acute episodes. Appropriate physical therapy techniques should be used to treat symptoms such as weakness, loss of coordination, etc. Treatments will need to be adjusted to the patient's current functional level.

Current Treatment Research

There are several new treatments being researched at this time. Two of the most promising are Copolymer-1 and Beta Interferon. Copolymer-1 is a polypeptide synthesized from the amino acids alanine, tyrosine, lysine and glutamate. It is structurally similar to myelin base protein which is found in myelin. Administration of this compound may interfere with the demyelination process. In initial studies by Bornstein et al, Copolymer-1 patients had fewer relapses than did the control group and some had less progressive disability. Beta interferon is presumed to interfere with the effectiveness of the virus. In initial studies patients who received beta interferon had fewer and less serious exacerbations than did the control group. On March 19, 1993 a special advisory panel to the United States Food and Drug Administration recommended that approval be given for the use of beta interferon in mild to moderate relapsing-remitting MS.
CHAPTER THREE

Physical Therapy Management

Rehabilitation Philosophy

In order to develop an optimal plan for therapy the therapist must work together with the patient to identify and address pertinent impairments, disabilities and handicaps faced by the patient. The World Health Organization (WHO) defines impairments as "any loss or abnormality of psychological, physical, or anatomical structure or function". An example of an MS impairment might be spasticity that occurs due to the demyelination of motor pathways. The demyelination cannot be treated but the impairment, spasticity, can be through a variety of therapy techniques. When an impairment interferes with maintenance of personal independence in self-care or other activities of daily living it results in disability. The WHO defines disability as "any restriction or lack of an ability to perform an activity in the manner or within the range considered normal". For example, spasticity may interfere with a normal gait pattern. A handicap will result when a disability interferes with meeting the responsibilities within one's social lifestyle. The WHO states that "a handicap is a disadvantage for a given individual, resulting from an impairment or a disability, that limits or prevents the fulfillment of a role that is normal for that individual". Thus, the gait disturbance can prevent stair-climbing which could result in loss of employment if the patient works in a job that requires stair-climbing. Impairments, disabilities and handicaps will vary widely from patient to patient depending not only on the severity of their symptoms and course of their disease but also on their lifestyle. What may be considered a disability for one patient may be considered an impairment for another. Therefore, the functional status of the patient should be stressed and a treatment plan established accordingly.
Another way to approach treatment planning is to look at MS symptoms as being in one of three categories, primary, secondary or tertiary. Primary symptoms are those that are caused directly by demyelination, such as spasticity weakness, numbness, ataxia and visual disturbances. Secondary symptoms are those that are complications of primary symptoms such as, contractures secondary to spasticity or decubiti secondary to decreased mobility. Tertiary symptoms occur as a result of psychological dysfunction which involves psycho social issues that result from the challenges disabled individuals face in our society as well as interpersonal relationships and self-esteem issues for the patient. Aggressive treatment of the primary symptoms accompanied with the appropriate patient education will decrease not only the primary symptoms but also reduce the likelihood of the development of secondary and tertiary problems.

Multiple Sclerosis is unpredictable not only over the lifetime course of the disease but can also vary from day-to-day. The patient's lifestyle and outlook may have a large impact on the success of any therapy program. The combination and pattern of plaques are unique to each patient giving each patient a unique set of symptoms and goals. Therefore, the rehabilitation approach must be flexible and goals and plans may need to be changed on short notice. Rehabilitation and patient education should begin as soon as possible even if symptoms are mild, in order to improve the patient's general overall condition, prevent future complications and give the patient a sense of taking control of his or her life and treatment.

There are many factors which may complicate the rehabilitation process, such as, income of the patient, family reaction and support, living circumstances, depression and cognitive changes. These factors may need to be addressed in order to ensure further progress in physical therapy treatment. The physical therapist may need to work with a psychologist and or social worker to help the patient resolve some of these issues.

The rehabilitation program should be designed to enable an individual to attain the highest physical, emotional and functional level possible. Goals should address
overall function and independence in self care. To ensure a more successful outcome the patient should be involved in establishing the goals of his or her therapy, however it is important to help the patient establish realistic goals and expectations. The goals set should also be flexible as they will need to change as the patient's condition changes with the progression of exacerbations and remissions, the patient should be educated as to this possibility. 24

Treatment of Specific Symptoms

Spasticity

Spasticity is the result of spinal or supraspinal lesions, it can reduce energy, inhibit motor control and interfere with self-care, sexuality, vocational responsibilities and recreational activities. It can range from mildly bothersome to severe enough to prevent useful motor activity. However, in some instances spasticity may prove to be useful. A weak patient may rely on spasticity to stabilize limbs during transfers or ambulation, in which case treatment of spasticity should be reduced or eliminated, in order to continue to take advantage of the condition. There are several factors which can influence the level of spasticity, these include fatigue, weather conditions, stress, body temperature, medications and exercise. Nociceptive input from the central nervous system can also augment spasticity, therefore prevention of such complications as urinary tract infections, decubitus ulcers, constipation, deep vein thrombosis, contractures and other irritative conditions should be addressed. The most frequently affected muscles are those antigravity muscles responsible for maintaining upright posture, which include gastrocnemius, quadriceps, gluteus maximus, adductor group and erector spinae. In patients with severe spasticity the arm will usually be positioned in a flexed position and the leg in an extended position, there may also be a resultant circumducted gait. Severe spasticity left untreated will eventually result in contractures which will further hinder movement and activities of daily living. 23, 24, 25, 26
There are a number of options available in the treatment of spasticity. The choice will depend upon the patient and therapist preference and how the patient responds to the treatment technique. Treatment techniques include: stretching exercises, cold, pool therapy, electrical stimulation and inhibitive positioning and movement patterns and stroking and pressure techniques. Beyond physical therapy approaches other treatment options include drug therapy, motor point blocks, phenol nerve blocks, phenol root blocks, neurectomy, rhizotomy, tenotomy, myotomy, myelotomy and chordectomy. This is referred to as the pyramidal approach to management of spasticity, it begins with the most easily administered and non invasive modalities and uses interventions with greater potential risk as they become necessary. 23, 24

Stretching exercises are highly beneficial and can be performed passively by the therapist or caretaker or the patient can be taught to perform them independently. These exercises should be performed through the full range of motion and repeated several times daily, this will not only relieve spasticity and stiffness but will also prevent contractures and joint ankylosis. 2 Stretching should be gentle and sustained and held at a level of discomfort but not pain for 1-2 min in order to allow the muscles to elongate and relax. Stretching the muscle to rapidly will produce muscles spasm. Patients can and should be taught to perform these exercises independently if at all possible, they should be taught the proper technique and position for each exercise. 24 Some generalized relaxation of all spastic muscles can be obtained by first stretching the muscles of the calf. An ankle slant board can be constructed to aid in the stretching of calf muscles, the board is positioned at the desired angle and placed against the wall, the patient then stands on the board and receives a sustained stretch to the muscles of the calf. 25

The use of cold packs or ice massage prior to stretching may aid in muscle relaxation. Cold should be applied for 5 to 20 minutes and contraindications include poor circulation and patient intolerance. 24
Pool therapy is also very helpful in the treatment of spasticity. Exercises in the pool should be easy, rhythmic and slow calisthenics performed in lukewarm water at approximately 75 degrees Fahrenheit. Swimming is an excellent form of exercise for individuals with MS. The cooling effect of the water not only helps to reduce spasticity but the exercise increases endurance and a sense of well-being. This is often the only non fatiguing option in hot, humid weather.  

Functional electrical stimulation may provide some relief for patients with mild to moderate spasticity and may help improve non ambulatory patients ability to control their lower extremities and torso during transfers. It can also aid in releasing hip adductor spasms which will improve the patient's ability to perform self care activities. The stimulus should provide palpable or visual muscle contraction with an intensity within the limits of patient tolerance.

Spasticity responds differently depending on the type of position, handling and movement used and the baseline level of CNS excitability (i.e. patient's ability to relax). Sidelying is a reflex-inhibiting position and therefore a patient can achieve more relaxation in this position and decrease spasticity. Exercises for patients who have difficulty exercising in prone or supine positions should therefore be modified so that they can be performed in a sidelying position. Different positions affect muscle tone in different ways and can be very helpful in reducing spasticity so range of motion exercises and other therapeutic activities can be performed. In prone with head raised and arms extended above head, spine in extension, this position facilitates extension of hips and legs. If combined with horizontal abduction it facilitates extension of the dorsal spine and opening of the fingers and abduction of the legs. In supine, abduction, external rotation and extension of the hips and knees inhibits both flexor and extensor spasticity in the legs. In sitting, flexion of the hips, forward flexion of the trunk and abduction of the legs facilitates extension of the spine and raising of the head. Sidelying, as mentioned before normalizes tone when supported in a neutral position. In general, the supine
position facilitates extensor tone and inhibits flexor tone and the prone position facilitates flexor tone and inhibits extensor tone. 24

As with positioning, different movement patterns may also alter tone and can be incorporated into treatment programs as needed. Reflex-inhibiting movement patterns inhibit abnormal postural reactions and facilitate active automatic and voluntary movements. Following the NDT approach, key points of control include the head and spine, shoulder and pelvic girdles, toes and ankles and fingers and wrist. Extension of the head and shoulder in prone, sitting or standing inhibits flexor spasticity and facilitates extensor tone. Flexion of the head and shoulders inhibit extensor spasticity. Horizontal abduction and external rotation of the shoulder with supination and extension of the elbow inhibits flexor spasticity and facilitates opening of the hand and fingers. A downward pressure through the shoulder and arms helps with extension of the spine. Abduction of the thumb combined with supination of the wrist facilitates extension of the spine. Hip flexion facilitates abduction and external rotation of the hip, ankle dorsiflexion and inhibits extensor spasticity. Dorsiflexion of the toes facilitates ankle dorsiflexion, external rotation and abduction of the leg. 24

Movement techniques can be used to modulate spasticity and allow a sense of normal and voluntary movement. They include rhythmic rotation, systemic rolling and slow rhythmical rocking. Rhythmic rotation should be done slowly and passively on an individual extremity holding at the end range for 10 seconds then gently moving into the new range. Systemic rolling involves moving slowly and systematically from supine to sidelying in order to reduce spasticity. Slow rhythmical rocking can be done in any of the developmental positions or patterns and can be combined with quadreped or ball activities. The incorporation of weight bearing activities with slow rhythmical rocking enhances the decrease in spasticity. 24

Slow stroking massage can decrease overall tone and relax muscles. Firm maintained pressure applied to certain areas, such as the upper leg, palms of the hand,
soles of the feet and the abdominal area can also decrease spasticity. Pressure applied by
the therapist or the patient is also helpful in decreasing tone, therefore weight bearing
positions are very desirable and should be incorporated into the treatment program and
couraged whenever possible. 24

Balance and Coordination

The cerebellum is involved in balance and the coordination of movement, lesions
in this area may result in ataxia with incoordination and tremor of the extremities or head.
Lesions of the posterior columns in the spinal cord, which transmit sensory information
from the extremities to the brain, result in a loss of position sense which can also result in
balance problems. Loss of visual input will also cause problems with balance and
coordination. 24

Ataxia or incoordinaiton of the lower extremities interferes with gait. The gait
becomes broad-based and the patient weaves from side to side or, if only one side is
involved, drifts to the side of the lesion. 2 Tremor is the oscillating movement of one or
more extremities or occasionally of the head. Tremors may be wide or fine and can occur
at rest or within movement. They may be fast or slow and may or may not be disabling
depending upon their severity. Ataxia and tremors frequently occur together and may be
exaggerated by stress, fatigue or certain activities.

There are several techniques available to treat balance problems. In retraining
balance any weakness or spasticity should be addressed before treatment of balance
begins. It is important that the patient has normal pelvic motion and alignment in order
to achieve and maintain good balance, therefore the pelvis is treated first. The
Neuromuscular Developmental Technique (NDT) is very useful in the treatment of
balance and coordination problems and is used frequently in the treatment of MS patients.
In NDT treatment the patient begins by relearning how to achieve and maintain the
neutral position and then learns to move in and out of this position and into new
positions. The patient is aided by the therapist through visual, verbal and tactile cueing.
Joint approximation and weight bearing activities will increase sensory feedback and allow for co-contraction of muscles around joints which will increase stability. The patient may need to learn to use alternative sensory feedback, such as substituting vision for the loss of proprioceptive input. In the NDT progression component parts of an activity are practiced with the aid of sensory cues. Activities advance from simple to more challenging as the patient progresses.²⁴ Frenkles exercises have been recommended for the treatment of ataxia.² This series of exercises of increasing difficulty improves lower extremity proprioceptive control. The exercises are performed in each of four positions: lying, sitting, standing, and walking, they incorporate total patterns, righting reflexes and stabilization mechanisms while stressing prime movements.² Visual cues may be added to compensate for loss of proprioception.²

There are four general categories in the treatment of tremor: patterning, immobilization, weighting and vestibular stimulation. Patterning is the tracing and repeating of basic movement patterns. It is based on the theory that certain muscles can be trained to move in a coordinated fashion by repeatedly using the nervous system circuit involved in the movement. Normal movements are guided and assisted by the therapist until they become automatic, then minor resistance is added and removed while the patient repeats the patterns independently. The muscles gradually appear to develop an increased endurance for the learned movements and are able to retain control when patterns are applied to functional tasks.²⁵

Immobilization involves placing a rigid brace across the joint in a fixed position. This decreases the random movement of tremor and is most helpful for the foot and ankle although it can also be used for the arm and hand. Adding weight to the extremities decreases tremor and increases sensory feedback. Increasing the amount of vestibular stimulation received by the balance centers allows the brain to function more normally. Rocking, swinging and the incorporation of ball therapy are excellent ways to provide vestibular stimulation.²⁵
The patient may need to be taught to compensate for tremor by providing as much stability for the limbs as possible. He or she may need to develop postural adjustments, such as learning to use his or her arms close to the body. Assistive devices may be helpful in performing activities of daily living by making it easier to grasp or stabilize things. Tremors of the head, neck and torso are more difficult to manage and the patient may need to be stabilized with a neck brace. Tremors of the lips, tongue and jaw may affect speech, in which case the patient will need to be referred to speech therapy for treatment. 25

Weakness

Weakness is a common problem in Multiple Sclerosis. It can be caused by a variety of factors: demyelination of the pyramidal tracts, spasticity, fatigue, apraxia, impaired sensation and disuse. 23, 24 Demyelination of the pyramidal tracts results in upper motor neuron dysfunction and may be manifested as weakness. 23 In some instances spasticity may simulate weakness; the muscle not only has to move against gravity but also against the resistance of the spasticity. 24 Decreasing spasticity will make muscles less stiff and easier to move which can help to improve strength. 25 Fatigue, one of the most common complaints of MS patients, can also be manifested as weakness, therefore decreasing fatigue will in turn increase strength. 24, 25 Apraxia may also mimic weakness. Impaired sensation, especially proprioception, decreases feedback to the brain about what the muscles are doing and thus decreases efficiency which produces fatigue. Weakness in MS can also be caused simply from disuse. The patient may be less active because of more challenged mobility, a decreased tolerance to activity or from depression and their strength decreases from inactivity. 24

The most common pattern of weakness in MS patients is in the muscles of the lower extremity, the dorsiflexors and evertors of the foot, hip flexors and abductors. 2 Spasticity and fatigue should be treated first, if there is still no improvement in strength then a strengthening program may be appropriate. The benefit and safety of
strengthening programs for MS patients is somewhat controversial. Excessive muscle fatigue can result in increased paresis, increased body temperature, and ataxia. The increased body temperature may also further impair nerve conductance causing an exacerbation of current symptoms. However, it is generally accepted that a carefully planned and monitored muscle strengthening program that does not lead to appreciable fatigue or increases in body temperature is beneficial. In fact, Smith and Scheinberg state that "all patients should be maintained on an exercise program commensurate with their physical capabilities". Many therapists believe that high-resistance, low-repetition exercises develop both strength and endurance. Some general principles to consider in developing a strengthening program include:

1) Unaffected muscle groups should also be strengthened in order to allow them to be used in necessary compensation techniques.

2) Assistive devices should be used when necessary in order for the patient to remain ambulatory for as long as possible. This will decrease the incidence of disuse atrophy.

3) Exercises must be safe and the patient should be taught to balance exercise with periods of rest.

4) Exercises should be progressed slowly, increasing 1-2 repetitions every 2-3 weeks, when adding weights increase 1-2# and decrease the number of repetitions to begin the progression over.

5) Exercising should be done in a cool atmosphere.

6) Patient should be taught to stretch before exercising in order to decrease spasticity, increase flexibility and increase blood flow.

7) Exercises should be done at sub maximum resistance with frequent repetitions.

8) An emphasis should be placed on proximal strength in order to decrease energy consumption during ADL's.
9) Patient should be taught to use large fluid movements in order to enhance coordination.

10) Light weights may help to stabilize significant tremors.

11) Combine strengthening with aerobic, balance and or spasticity exercises.

12) Avoiding fatigue is important, 1 to 5 minute rest periods should occur throughout the session in order to facilitate recovery of neurotransmission.

13) Set realistic goals and expectations, be creative, realistic and simplistic. 

A comprehensive exercise program should include cardiovascular exercises as well as muscle strengthening. These principles should be included in a comprehensive home program that will need to be monitored and adjusted as the patient's condition changes.

Exercise Prescription

When carefully prescribed by a health professional, proper exercise can increase overall fitness and decrease fatigue. Exercise can also improve self image and functional abilities. It also gives the patient a sense of control over their life and treatment. This is very important in MS because many patients may begin to feel a sense of helplessness because of the unpredictability of the disease.

Recommendations to patients about exercise should be based on a detailed medical and physical examination. The patient's current physical and medical status, as well as their current functional level should be identified. An objective baseline should be obtained in order to document changes and aid in making further recommendations. The program should be modified frequently as changes in physical and medical status warrant. A complete exercise program should include: goals, purpose and objectives, recommendations of specific exercises, principles of training including intensity, frequency, duration, progression, what apparatus to use, assistance needed, and recuperation. The patient should be taught how to monitor and avoid excessive fatigue and should exercise in rooms with cooler temperatures to avoid overheating.
Some examples of aerobic exercises useful for MS patients include: walking, biking, swimming, yoga and low impact aerobics. Stationary machines are useful for those patients who have problems with balance or coordination. Stationary bikes with contralateral leg/arm movements are very good especially for patients with paresis or paralysis. Swimming is also an excellent choice because spastic muscles can be relaxed more easily in the water. Balance and coordination can be practiced more safely and the water provides resistance which will improve strength and endurance. The temperature can be kept cooler (80-85°F) which will prevent overheating, therefore a greater level of exercise can be tolerated in the water. Yoga exercises help to increase flexibility, strength and coordination and may help with relaxation. Group exercises can help to motivate patients and offer a sense of camaraderie and support. 24

The optimal level of frequency and duration for aerobic exercise is 30 minutes 3-4 times per week, however, this should be adjusted for each patient and the current state of the disease. Some patients may need to start with shorter duration time within their tolerance level and slowly build up, even 5 to 10 minutes of exercise can be beneficial. 24 For a holistic program aerobic exercises should be combined with strength training.

Fatigue

Fatigue is one of the three most disabling symptoms of MS. It is often severe enough to prevent a patient from carrying out duties and responsibilities and interferes with work, family or social life. 2, 27 It is also difficult for the patient because it is an "invisible" symptom and family and friends have trouble understanding why the individual with MS cannot perform normal activities. Fatigue can range from a bothersome tiredness after effort to apparently spontaneous and overwhelming exhaustion. It seems to adopt a clinical cycle, being greatest in the afternoon and least in the morning. It is worsened by physical activity and increases in temperature both internal and external (2, 22).
Fatigue can be divided into four specific types. The first type, natural fatigue, is the tired feeling that occurs after hard work and can be handled by a good night's sleep. Type two is a "worn out" feeling that occurs when someone is depressed and is accompanied by poor appetite, sleep disturbances and feeling of poor self worth. This type of fatigue may best be treated by counseling or antidepressants. The third type of fatigue is very common in MS patients, an example of how this type of fatigue occurs is as follows: as an MS patient walks three blocks during the first block he experiences a slight limp, during the second block he begins to drag a leg and during the third block he has to stop to rest because he is too tired to continue. This happens because the nerves that carry impulses to the leg have been worked beyond their capacity. Type four fatigue or "MS fatigue" can be described as an overwhelming feeling of fatigue that can come at any time of the day without warning. The patient will suddenly feel extremely sleepy.

Treatment of fatigue consists mainly of education for both the patient and family and "economy of effort" training. Patients must learn to organize their schedule around their pattern of fatigue in order to permit periods of rest when fatigue is most common. Highly fatiguing activities such as grocery shopping, laundry and house cleaning should be scheduled for time of the day when fatigue is less likely. Large projects, such as house cleaning, should be spread over several days and workspace and utensils should be organized so that tasks can be carried out with the minimum of time and energy. The patient should be taught to sit, slide and toss rather than stand, lift and carry. An onsite assessment of the home or workplace to determine how best to organize for the most efficiency may be helpful. Intervals of rest should be interspersed throughout activities and high temperatures should be avoided. Some principles of energy conservation that are helpful to keep in mind include: 1) Balance activity with rest, rest meaning doing nothing at all. Stop and rest as soon as fatigue sets in. 2) Learn to plan ahead by making a daily and/or weekly schedule, spreading heavy and light tasks throughout the day. 3) Pace activity and rest before becoming exhausted. 4) Break down activities into smaller
tasks and/or have others assist. 5) Set priorities, learn to let go of guilt associated with not finishing tasks. 6) Accept that it is ok to say no. 2, 23, 25

Ambulation and Ambulation Aids

MS may affect ambulation through weakness, spasticity, impaired sensation and proprioception, decreased balance, fatigue, vision problems and vertigo. 24 In the National Multiple Sclerosis Survey Study, 60% of patients reported the need for assistance with ambulation. 28 Ambulation is typically very important to most patients, however its importance should be kept in perspective and the PT should help the patient understand that it does not necessarily measure independence or define ones physical image of being healthy. Patients should be counseled that assistive devices are important aids to their independence and function and do not reflect negatively on the person using them. 24

Key areas in ambulation treatment include trunk control, flexibility, strength, balance, endurance and body awareness. Good trunk control is essential for improving gait and should be attained first before working on other areas. Adequate truncal stability is necessary to maintain balance and correct posture. Flexibility in the trunk, pelvis and major muscles of the lower extremity is important to inhibit spasticity which can interfere with gait. Gait is more functional when strength is improved. The muscles first weakened by MS include those muscles of the lower extremity involved in gait; hip flexors, hip abductors, dorsiflexors and ankle evertors invertors. Strengthening exercises should begin as soon as weakness is first detected. Strength of the upper extremities is also important, especially if assistive devices such as canes, crutches or walkers are being used. Balance is obviously an important component in ambulation and should be addressed in gait training. Some suggestions for balance activities were given earlier in this chapter. Fatigue and lack of endurance often limits functional gait. The patient should be taught moderation in gait and the proper utilization of rest periods. Endurance can be increased in a slow progression similar to that discussed in strength training, i.e.
begin with 1 block for 3-4 weeks and increase to 1 and 1/2 to 2 blocks for 2-3 weeks. Visual and tactile cues, mirrors and other sensory feedback will increase body awareness and help the patient avoid accidents such as tripping or bumping into objects. The NDT facilitation technique is very useful in ambulation training.\textsuperscript{2, 24}

Walking needs to be as efficient as possible in order for the patient to remain ambulatory as long as possible. Ambulatory aids will increase safety and endurance and decrease energy costs. The use of assistive devices may be an emotional issue for some patients who may think of them as a sign of disability or dependence. The physical therapist needs to emphasize these devices as tools of function and help to ensure continued independence.\textsuperscript{24}

There are a variety of options to chose from when an assistive device becomes necessary. These include canes, crutches and walkers.\textsuperscript{2} Canes offer the least amount of support and walkers the most. Patients may use one or two canes depending upon their needs and quad canes are available for those who need more stability. Crutches may be either axillary or nonaxillary (forearm). Forearm crutches are more often prescribed because they do not apply pressure in the axillary region which can lead to damage to the nerves of the brachial plexus. They also offer greater stability and do not require as much upper extremity strength. Walkers provide the most support, at the cost of very slow and awkward gait. They are of particular use for patients with poor balance. Once the assistive device has been prescribed the patient should be instructed on how to use it properly, gait training is not complete until the patient can demonstrate the ability to negotiate stairs, inclines, and curbs.\textsuperscript{2, 24, 25}

Orthotics may also be used to assist with and improve gait. For orthotics to be best utilized by the patient, the patient must understand the purpose and benefit of the device, it must be comfortable, relatively easy to don and doff, and reasonably cosmetic. Lower extremity orthotics often prescribed for MS patients are ankle foot orthosis (AFO) to prevent foot drop and mediolateral ankle instability and knee ankle foot orthosis.
(KAFO) to prevent genu recurvatum. There are many different types and styles of orthosis and each patient should be examined by someone trained in orthotics in order to determine which device would be most appropriate for them. ², ²⁴

When assisted walking becomes unsafe or impossible, a wheelchair may be necessary. Wheelchairs may be either manual or motorized and require proper prescription and fitting. Often wheelchairs are used as a supplementary means of transportation at times of fatigue or exacerbation. Frequently patients may be able to ambulate with a cane or crutches in the mornings but may need a wheelchair in the afternoons when they are tired and the temperature may be warmer. Wheelchairs are excellent for non ambulatory patients and for those instances when ambulatory patients may require another option for mobility, however, some patients may rely too heavily on their chair. Patients should understand that walking, even with an aid, is the preferred option whenever possible. ², ²⁵

Musculoskeletal Dysfunction

A variety of musculoskeletal problems can arise secondary to MS symptoms. For example, hammer toes, foot inversion and increased plantarflexion can occur secondary to spasticity. Decreased control and sensation may result in overuse syndromes. Muscle imbalances and incoordination may result in chronic hyperextension, especially of the knee, and may result in ligament and joint damage. Muscle imbalances may also cause malignment of the hip and sacral joints causing pain and gait problems. The most common musculoskeletal complaint is that of low back pain which may be due to poor posture, paraspinal spasticity, inappropriate walking pattern, or loss of lumbar lordosis due to muscle weakness or imbalance. There may also be a radicular pattern associated with low back pain from demyelination adjacent to the dorsal root ganglia, which may give the appearance of a herniated disc. ²⁴

Because musculoskeletal problems associated with MS are frequently secondary problems, appropriate treatment and monitoring of the primary symptoms can prevent
them. When they do occur it is important to not only treat the dysfunction itself but also the primary symptom that caused it. ²⁴

Pain

Although MS is generally painless, 20% of MS patients report having significant pain. ²⁵ Some experience severe, lancinating neuralgic pains in the limbs or elsewhere; others a more, persistent, intolerable dysesthesias, frequently with burning quality. ²⁷

Chronic pain may be the result of the demyelination itself or it may be secondary to other MS symptoms such as spasticity or occasionally it may be an illusionary pain caused by demyelination in the area of the brain that registers pain. Ankle, knee and hip pain due to degenerative joint changes, may occur secondary to abnormal gait, weakness, spasticity and incoordination. ²⁶

Acute pain may be caused by infection or injury which may or may not be associated with MS. In this case the area of pain should always be thoroughly examined in order to determine the exact cause of pain. Joints may suffer traumatic injuries such as dislocations from muscle imbalance, weakness, spasticity, sever spasms or falls. Fractures may occur more easily if the patient is taking steroids as a part of his or her treatment because one of the side effects of steroid therapy is osteoporosis. ²⁶

Facial pain or trigeminal neuralgia is relatively common in MS patients. It is described as severe stabbing pain in the face or shock like spasms of the facial muscles. It may be triggered by chewing, tooth brushing, shaving or just touching the face. ²⁵,²⁶

Low back pain is also common and is often caused by a pinched nerve or other problem secondary to poor posture or dysfunctional gait pattern. Paraspinal muscle spasms are also a common cause. Poor lifting procedures and body mechanics will compound the problem and may need to be addressed in some patients. Spinal manipulations are contraindicated in MS patients because these manipulations may irritate the spinal cord and increase neurological symptoms. ²⁵
Treatments used for pain include drugs which calm sensory nerves or block pain signals from registering in the brain. However, traditional analgesics such as aspirin or codeine are usually not effective, therefore stronger drugs are used and often have unwanted side effects including addiction. Sometimes mood altering drugs such as tranquilizers and antidepressants can be effective by altering the interpretation of the pain message. Physical Therapy treatments for pain control include TENS, massage, ultrasound and exercise. The use of TENS in the treatment of MS pain is somewhat controversial, some believe that it increases pain and therefore should not be used, while others feel that it can be effective in some cases and an individual patient's experience is a more important measure than the general rule. Some other techniques used in pain management include acupuncture, steroid injection into nerves, relaxation therapy and biofeedback.

In examining an MS patient who's subjective complaints include pain, it is important to remember that the patient may have a painful musculoskeletal or neurologic condition that is unrelated to the MS. It is important to rule out such things as infection, sprain, dislocation and fracture in determining the actual cause of pain and deciding upon the appropriate treatment.

Skin Care

Because of sensory impairment and decreased mobility associated with MS, proper skin care becomes very important in the prevention of pressure sores which can cause serious complications including infection and hospitalization. About 15% of patients with MS develop pressure sores at some time during their illness. This number could be reduced considerably if the appropriate preventative measures are taken. Several important factors contribute to the development of pressure sores: decreased skin sensation, inadequate nutrition, certain medications, incontinence (stool and/or urine) or other moisture on the skin, inadequate blood flow to the area from prolonged pressure, and shearing forces (as when patients are dragged across bedding). Areas of bony
prominences such as, the ischial tuberosities, the sacrum, greater trochanter, the heels and the malleoli of the ankles are at risk, as well as areas of decreased sensation. \(^2, \^25\)

The first sign of tissue destruction is a reddened area that does not blanch when finger pressure is applied, pressure should be relieved immediately to allow the tissue to recover. \(^2, \^25\) If pressure is not relieved a sore will develop. Pressure sores can be classified into 4 stages. A grade I sore involves tissue loss of the epidermis only and resembles an abrasion, a grade II sore extends through the dermis to the subcutaneous fat and is a full-thickness skin defect. A grade III sore extends through the subcutaneous fat with extensive undermining and a grade IV sore extends down to the underlying muscle and bone and may result in osteomyelitis. Grades I and II can be completely reversed nonsurgically through the use of antiseptic washes and saline dressings. Grades III and IV usually require surgical treatment. \(^2\)

Prevention is the key to treatment of pressure sores. The patient and family should be taught the causes and results of pressure sores and the appropriate prevention measures. \(^23\) They should be taught to examine the skin regularly for signs of tissue damage, especially in the most commonly involved areas. \(^2\) Those who spend a great deal of time in their wheelchair or bed should be taught pressure relieving techniques. \(^2, \^25\) Patients in wheelchairs should push up from their wheelchairs and turn from side to side and forward every 15 minutes. \(^2\) Bed-ridden patients should turn themselves or be turned by their caregiver every 1 to 2 hours, being careful to avoid shear forces in the process. \(^25\) They should also be taught proper positioning techniques that will decrease the pressure on bony prominences. \(^25\) Care should be taken to keep the skin dry and clean by preventing incontinence, excessive perspiration and maintaining good perineal hygiene. \(^2\) Pressure-distributing seat cushions for wheelchairs and special mattresses for beds that contain air, water, hydrophilic gels or silicon beads (Clinitron) and egg crate foam cushions, will also aid in prevention. \(^2, \^23\) The patient and family should also be instructed to seek medical attention immediately if problems are noted. \(^23\)
Outcomes Assessment

The outcome of rehabilitation efforts in MS is determined through an assessment of function. The most widely used functional assessment instrument specific to MS is the Kurtzke Expanded Disability Status Scale, a combination of impairment (findings on neurologic examination) and basic disability (mobility and self-care status) assessments. Another well known comprehensive scale for MS is the Minimal Record of Disability (MRD), developed by the International Federation of Multiple Sclerosis Societies. The MRD was designed to adhere to the WHO's classification of dysfunction (impairment, disability, handicap).

Regular and careful assessment throughout the course and treatment of the disease may help provide an estimation of what course the disease will take and what treatment measures are or are not working. Feigenson and co-workers designed an assessment tool of their own called the "MS Functional Profile" in order to assess if disabled MS patients improved after intensive interdisciplinary inpatient rehabilitation. They found statistically significant reversals in many disabilities and handicaps. Rehabilitation efforts can succeed in improving the functional level and quality of life for MS patients.

Patient Education

Providing MS patients and their families with the appropriate information regarding their disease is vital to the success of their rehabilitation program. Education can give patients and families a sense of control and can aid them in making the best decisions for their situation. Patients need to understand how their actions and environment affect the course of their disease and the ways in which they can help to prevent exacerbations from occurring. They need to be made aware of the lifestyle adjustments they and their families will need to make. They will also need to be aided in making these adjustments. They also need to be informed of the assistance that is available to them, such as local support groups and assistance offered by the National
Multiple Sclerosis Foundation. Patient education is an important part of the home program. If patients understand why they are asked to perform certain exercises or therapy procedures they will be more likely to be compliant with this part of their therapy. Education will help to combat the fear experienced by the patient and help to foster open communication between patient and therapist.
CHAPTER FOUR

Symptoms not Managed by Physical Therapy

Multiple Sclerosis can affect any area of the CNS, resulting in a variety of symptoms. There are a variety of symptoms and psycho social issues related to MS that, although they do not fall under the realm of physical therapy treatment, affect the goals and success of the therapy program. Symptoms may affect treatment directly, such as vision or cognitive changes that may make it difficult for the patient to perform requested activities, or indirectly, such as problems with family adjustment or employment that may make the patient distracted or depressed decreasing the patient's motivation or interest in therapy.

Bowel/Bladder

Bowel and bladder symptoms are common in MS. Patients cite bladder dysfunction as the second most disabling symptom, after gait. Bowel problems are less common but very troublesome when they due occur. The most common bladder problems are increased frequency of urination, urgency, dribbling, hesitancy and incontinence. The most common bowel problem is constipation and only occasionally incontinence.

Bladder problems develop when demyelination occurs in the area of the Voiding Reflex Center (VRC) located in the spinal cord or in the connections between the VRC and the brain. The VRC sends signals to the brain when the bladder is full resulting in the awareness of the need to urinate. The brain then signals the bladder wall to contract and the urethral sphincter muscle to relax, at the appropriate time, resulting in urination. The problems experienced by the patient will vary depending upon the location of the
demyelination and it is important to determine the area of the lesion in order for appropriate treatment to be prescribed. 25

If the connections between the VRC and the brain are damaged, the VRC will assume direct control of voiding and stimulate the bladder to empty automatically. This results in a small spastic bladder, also called "failure to store" bladder. The bladder fills quickly and voiding becomes a reflex activity, resulting in increased frequency, urgency, dribbling and /or incontinence. The amount of voluntary control the individual has will depend upon the extent of the lesions. 2, 25

If the lesion occurs in the area of the VRC the result will be a flaccid or "big" bladder. The bladder fills but the VRC cannot transmit the message to the bladder walls to contract or to the sphincter to relax, therefore urination does not occur. The bladder will fill to capacity and then continue to fill until it overfills resulting in hesitancy, post voiding sense of fullness, weak urinary stream, infrequent voiding, or dribbling incontinence. 2, 25

Problems related to the coordination between the bladder wall contraction and the urethral sphincter relaxation can also occur, this is known as the dyssynergic or "conflicting" bladder. In this situation either the bladder wall contracts while the sphincter remains closed, resulting in urgency followed by hesitancy, or the bladder wall remains relaxed while the sphincter remains open, resulting in dribbling or incontinence. 25

Bladder problems are frequently managed by pharmacological intervention and there are a variety of anticholinergic medications which may be prescribed. In addition to medications there are a number of other options available to the patient to help control bladder dysfunction. With minor dysfunction only regulation of fluid intake and setting a schedule for voiding may be necessary to avoid overstretching of the bladder and to minimize urgency and frequency. 23 For those patients suffering from a flaccid bladder, alternative techniques to aid in voiding include: the crede's maneuver (pressure down on
the lower abdomen with both hands while bearing down), abdominal tapping, straining, rubbing the thighs, tugging on pubic hair or intermittent self-catheterization. If the situation cannot be managed by medication and or the techniques previously mentioned a continuous (Foley) catheter will become necessary. 

Urinary tract infections (UTI) are a common problem for MS patients, especially those with bladder dysfunction. UTI occurs most commonly in those patients who present with a flaccid bladder and those who use Foley catheters. Since UTI is not only detrimental to the patients overall health but can also increase other neurologic symptoms such as spasticity, the patient and those working with him/her should be aware of the signs and symptoms so treatment can be administered early on. All patients presenting for the first time with bladder symptoms, or those who experience a change in their usual symptoms, should be evaluated for UTI with microscopic urinalysis and urine culture. Symptoms include: frequent urination, burning or discomfort when urinating, fever, foul-smelling urine, and presence of blood or mucus in urine. Treatment involves prescription of appropriate antibiotics.

There are a number of measures that can be taken to prevent UTI, these include complete and frequent emptying of the bladder, keeping pubic area clean and dry, those patients using catheters need to keep catheters, tubing and bag as clean as possible and change catheter at least once per month using proper sterile technique, take 1000 mg of vitamin C per day to increase the acidity of the urine and thus prevent bacterial growth.

Most patients with bowel complaints cite constipation as the primary problem. This constipation may be due to decrease absence of normal colonic motility after eating, lack of exercise, inadequate dietary fiber, inadequate fluid intake or effects of medication (especially those used to control bladder symptoms). Patients suffering from constipation should be encouraged to drink six to eight glasses of water per day (adjustment may be necessary so as not to interfere with bladder management), and eat
high-fiber foods or, if needed, take unprocessed wheat bran, Metamucil, or Colace. Scheduling bowel care every other day at approximately 45 minutes after the largest meal of the day, in order to take advantage of the gastrocolic reflex, is also helpful. If constipation persists laxatives or enemas may be required. 2, 23

Fecal incontinence occurs much less frequently and is usually treated with dietary changes and establishment of a bowel care schedule. In very severe cases a colostomy may need to be performed. 26

Bowel and bladder problems can be both troublesome and embarrassing for the patient. It is important for the physical therapist to understand both the physical and social implications of these problems, in order to help the patient function at their highest possible level. For example, the patient may avoid exercising or going out in public because of fear of becoming incontinent, or UTI may increase other neurological symptoms and affect physical therapy treatment. The physical therapist, along with the other health care professionals involved with the patient, needs to be able to educate the patient on ways to manage and prevent these problems.

Vision

Impairment of vision is common in patients with MS and total loss of vision, permanent or temporary, may occur. Optic neuritis, inflammation of the optic nerve, may result in acute overall loss of vision, which may return fully or partially after inflammation abates. It is common for patients to have difficulty seeing at night or in dim light, or to have "holes" in their vision where part of their visual field is obscured. Weakness in coordination and strength of the eye muscles results in double vision, a patch over one eye will avoid the problem of double images and should be alternated from one eye to the other every few days until the brain learns to compensate for the double vision. 23, 25, 26

Vision problems may affect things such as gait and activities of daily living and should be taken into consideration when establishing physical therapy treatment and
goals. Patients complaining of visual problems should receive ophthalmologic care and those blinded by their disease should be referred to Services for the Blind for additional assistance. 23

Speech

Dysarthria is common in MS and the severity of speech disturbance parallels the severity of neurologic impairment. 2 Nevertheless, only 10% of MS patients have disability severe enough to interfere with activities of daily living. 32 Disturbances in speech usually result from problems with coordination of movements of the tongue, lips, palate and vocal cords and also from weakness, spasticity or tremors of the facial muscles. 26 A particular type of speech disturbance, known as "scanning speech" has long been considered most typical of MS, however, impaired articulatory agility is much more common. 33 Scanning speech refers to a particular rhythm and cadence in which each word or syllable is given even emphasis. However, scanning speech seldom interferes with effective communication. When communication is affected the patient should be evaluated by a Speech Therapist who can prescribe specific exercises to improve speech and breathing. 2, 23

In the case of severe disability, when speech therapy is no longer effective, alternatives to speech are available. These include picture, word, phrase and alphabet boards and also voice synthesis computers. 2 It is important for the physical therapist to be aware of the existence and use of alternative methods of speech in order to communicate effectively with the patient.

Cognitive and Emotional Changes

Awareness of cognitive dysfunction in MS patients has increased in recent years, although abnormalities have been variably reported in 0-90% of cases. 34 Severe dementia is unusual in MS, but more subtle abnormalities are common. 27 Studies that assessed overall intelligence found mild to moderate changes over time in patients with MS. 35 The most frequent problems are associated with memory and abstract/conceptual
Impairments in learning and retrieval processes have also been noted. Cognitive changes can vary both in type and degree of severity, which seem to correspond to the location and severity of the lesion. In general it appears that in patients with MS, general intelligence seems to change gradually over time, especially in those with more severe progressions. This should be taken into consideration when developing patient education programs, as it may be important to simplify or repeat instructions for some patients.

Depression and euphoria have long been associated with MS, in earlier literature it has been controversial as to which is more prevalent, although more recent literature indicates that depression is more common, occurring in up to 75% of MS patients. It is also unclear as to whether the depression experienced by some patients is a reaction to or a symptom of the disease process. Although usually relatively mild, major depression can occur. When it does occur, depression is more problematic and disabling than euphoria. Patients who suffer from depression lose interest in social activities, become self-destructive, and withdraw from family and friends. The patient may also lose interest in his/her rehabilitation program, the therapist should communicate any signs of depression to the rest of the rehabilitation team so that appropriate measures can be taken. Typically depression is treated with antidepressants and/or psychotherapy. Some medications, such as, steroids may have depression as a side effect, therefore all medications should be carefully monitored. The so-called euphoria is often actually the inability to inhibit emotional expression and results in inappropriate laughing and crying, other instances of euphoria can be associated with evidence of significant cognitive decline. Both conditions of depression and euphoria may flare up with exacerbations just like other symptoms.

Sexuality, Pregnancy, Birth Control

Sexuality is an important part of life, and it plays a major role in determining the self-assessment of a person. Chronic illness can have a tremendous impact on sexuality
and problems may arise from physiological or psychological origins. It has been reported that 91% of men and 77% of women with MS describe changes in their sexual lives. The effect these changes have on the individual depends a great deal upon how well they understand their disease, how they perceive sex, and how well they communicate with their partner.

Common problems for men include: inability or difficulty achieving or maintaining an erection; partial erection that is lost during intercourse; ejaculation that occurs much more quickly or more slowly than previously the case; lack of orgasm; numbness or lack of sensation in the genitals; and physical weakness or lack of mobility. Problems for women include: lack of vaginal lubrication or clitoral engorgement; difficulty in achieving orgasm; genital insensitivity with resulting lack of response to either clitoral or vaginal stimulation; hypersensitivity that makes genital stimulation unpleasant or painful; adductor spasms that interfere with intercourse; pain during intercourse; and physical weakness or lack of mobility. These symptoms may arise as a direct result of nerve damage or they can also arise as a result of psychological or relational reaction to MS.

The key to managing sexual problems is often honest and open communication between partners about what is pleasurable and what is not, and a willingness to experiment with different positions or alternatives to intercourse. Couples may need to identify what is important to them and what problems have arisen and then identify ways to modify sexual activity to make it more satisfying. This requires a good deal of frankness and some couples may need some intermediary help such as a sex therapist or discussing their situation with other couples who have gone through similar changes.

Medications used to treat other MS symptoms may sometimes have side effects which interfere with sexual activity. For example, antidepressants and anti-spasm drugs
may decrease sex drive or interfere with erection in men and with vaginal lubrication in women. 39

Multiple Sclerosis does not affect fertility, therefore couples not wishing to have children need to use some method of birth control. Any of the methods of contraception currently available can be used, however some may be impractical for those with severe disability. For example, an IUD may be contraindicated if adductor spasms create problems with hygiene, or in the case of reduced abdominal sensation, since warning signs of side-effects (i.e. pelvic pain or cramps) might be less noticeable. Barrier methods that require manual dexterity for insertion may be impractical for some individuals. Condoms may be difficult to use if maintaining an erection is a problem. In mild cases of disability it appears that any effective method would be appropriate; in cases of more severe disability the couple may need to rely on the unaffected partner for contraception. 26, 39

Pregnancy does not seem to increase symptoms, and in fact there is usually a decrease in exacerbations during pregnancy for many women. There is somewhat of an increased risk of exacerbation in the 6-9 months following delivery, but beyond that there appears to be no increased risk of complication for the mother or child above that of the normal population. Issues couples should take into account when considering to have a child might include the possibility of development of further disability as the disease progresses and what options for help with child care will be available should severe disability result. 26

Family Reaction

Multiple sclerosis not only redefines the life of the individual diagnosed with the disease but it also redefines the lives of those nearest to that person. For this reason it is important to not only educate the patient about their disease but the family also. The individual diagnosed with the disease will rely heavily on the support of family and close friends, especially in times of exacerbation or severe disability. Religion and family were
found, in one study, to be the most frequently used coping strategies. It is important that the family understand the nature and progression of the disease and what they can do to help prevent exacerbations. Family members may be confused by the variability of symptoms or by signs and symptoms which are not obvious to them such as fatigue, and vision problems, this confusion may create animosity between family members if it is not addressed. Responsibilities previously belonging to the affected member of the family, may now need to be redistributed to other members, who may need to learn to "pick up the slack". 23, 26, 40

Although it is important for the family to be understanding and to learn to accommodate for the illness, it is also important that the family member with MS not be given unnecessary special attention at the expense of other family members. It is also important that the family does not exaggerate disabilities. They should avoid the urge to shelter the individual and should encourage as much independent activity as possible. 26

Family members may have a difficult time dealing with not only the reality of seeing a loved one become disabled but also from the added responsibilities, both physical and financial. It may be helpful for the family to receive counseling or join a support group to communicate with others who are in similar situations and perhaps gain additional ideas about ways to cope with their situation. 40

It is important for the physical therapist and other members of the rehab team to keep the family situation in mind when establishing goals and treatment plans. The family may offer insight in ways to motivate the patient or may be helpful in solving problems that might occur.

Employment

Most MS patients are able to keep their jobs unless dramatic disability exists. Frequently, the primary handicap to employment is not the disease itself but the attitudes of employers and society. Some patients who experience moderate disability may need some job modifications and they should be aware that employers have the responsibility
of providing "reasonable accommodations" for the disabled. Education of employers and co-workers may be helpful in clearing up any misconceptions about the disease, such as gait problems and slurred speech being mistaken for intoxication. It is also important to emphasize the abilities of the worker and not the disabilities. The National Multiple Sclerosis Society has been active in working with employers, brochures are available to answer common questions asked by employers. 23, 26

Recreation

Recreation is important in providing physical and mental stimulation, helps build a sense of self-worth, promotes socialization, and a feeling of acceptance. Leisure and recreation can be adapted to the needs of the MS patient. The amount of exercise and the time of day are important to consider when planning recreational activities. Tolerance should be developed slowly and the patient should be aware of increases in body temperature and humidity. With careful planning and creative ideas a broad range of recreational opportunities are available for the MS patient and can enhance the quality of life for that individual. Leisure assessment and recreational counseling are best provided by a recreational therapist with input from other members of the rehab team. 23

In treating patients with MS the physical therapist must keep in mind that the disease not only results in musculoskeletal symptoms but affects all aspects of the patients life and how the patient is dealing with those areas will also affect his/her physical therapy treatments.
CHAPTER FIVE

Conclusion

There are many issues that need to be addressed when developing a rehabilitation program for the MS patient. These issues will differ from patient to patient, as will the approach needed to successfully address them. The most effective rehabilitation program will be one that looks at all aspects of the patient's life, physical symptoms, emotional issues, family situation, and vocational and recreational problems and opportunities.

The physical therapist working with MS patients needs to become familiar with the signs and symptoms and course of the disease as well as the current treatment options. These options include both drug and physical therapies. Although the physical therapist will not be prescribing medication it is important to be aware of both the intended effects and side effects to the most commonly used medications because these effects can have an impact on how the patient performs in the physical therapy setting. There are a variety of physical therapy procedures available for treating the symptoms of MS and the therapist and patient will need to determine what is most appropriate for that individual. The therapist will need to evaluate the patient, determine the patient's abilities, functional level and areas of deficiencies. Together with the patient, the therapist will then create a problem list, along with a list of priorities and goals. An appropriate treatment program is then established, monitored and adjusted according to the disease progression.

Education of patients and families is vital to the success of the program and should be an ongoing process throughout patient treatment. The patient and family should be informed on the expected course and symptoms of the disease, as well as the treatment options available. They also need to be made aware of any available assistance programs. The patients attitudes and actions, as well as those of the family, can have a
tremendous impact on the success of physical therapy treatment. Communication between the patient and healthcare providers, as well as communication among the various healthcare providers involved with the patient, is also a very important element in the rehabilitation program.

Multiple Sclerosis is a complicated and potentially devastating disease. However, a comprehensive therapy program can help to reduce or avoid many of the complications associated with this disease. The issues and problems that occur with MS go beyond the physical symptoms. There are many psychosocial, and emotional problems that may develop for the patient and their family. In order for a successful treatment outcome these problems will need to be addressed along the the physical symptoms of the disease. The health care provider needs to be knowledgeable in the many aspects of MS, both physical and emotional, in order to provide effective treatment and patient education.
REFERENCES


