Effective intervention strategies for management of impaired posture and fatigue with post-polio syndrome: A case report

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Case Study

Examination

- Patient History
  - 49 y.o.f. acquired polio at 15 months with primary involvement in LEs R>L
  - Full time legal assistant
  - Independent in ADLs/IADLs
  - Chief Complaints: fatigue and low back pain
  - Past Medical History: scoliosis (upper lumbar convexity on R, increased rotation L2-3)

Examination

- Systems Review
  - Height 5’3”   Weight 130 lbs.
  - Musculoskeletal System Impairment
    - Gross Symmetry
    - Gross Strength
  - Neuromuscular System Impairment
    - Gait
    - Balance

Examination

- Tests and Measures
  - Gait
    - Gluteus medius gait pattern
      - Without R AFO/cane 12” arm out from side
      - With R AFO only 9” arm out from side
      - With R AFO/ L cane 6” arm out from side
  - Muscle Performance (Table 2)
  - Pain 5/10

Modified Fatigue Impact Scale (MFIS)

- 21-item measure
  - physical, cognitive, and psychosocial functioning
- Established validity and reliability
- Developed by a panel funded by the National Multiple Sclerosis Society

- Physical 33/36

Intervention

- Patient/Client Related Instruction
  - Education on PPS
  - Energy Conservation
- Assistive Device: Single Lofstrand L
  (non dominant hand)
- Adaptive Device: Shower Bench
  Handheld nozzle

Re-Examination

- 6 Months
  - No Change in Pain with meds 5/10
  - No Change in MMT
  - MFIS 21/36
- 18 Months
  - Pain relief with epidurals 2/10
  - No Change in MMT
  - MFIS 21/36

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Effective intervention strategies for management of impaired posture and fatigue with post-polio syndrome: A case report

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This case report describes effective intervention strategies that included gait training with the use of an acceptable, assistive device for the management of impaired posture and fatigue associated with post-polio syndrome. Review of videotaped gait-training sessions enhanced patient compliance with the assistive device, a single forearm crutch. The 49-year-old female acquired childhood polio with resulting leg length discrepancy, lower extremity weakness, and complaints of fatigue. She walked with a right ankle foot orthosis and increased right lateral trunk flexion during right stance. Interventions consisted of patient education regarding the diagnosis and management of post-polio syndrome, health promotion, and energy conservation strategies that included gait training with a single forearm crutch. An outcome measure not previously documented in the post-polio literature was used to measure the patient's perceived fatigue. Six-month and 18-month reexaminations found that the patient was compliant with the assistive device, reported a 30% reduction in fatigue, and walked with a more upright posture for longer distances in a shorter period of time. Patient education, health promotion, and energy conservation strategies that included walking with a properly fitting assistive device reduced perceived fatigue and improved posture and function in an individual with post-polio syndrome.

Introduction

The World Health Organization (WHO) has estimated there are 20 million survivors of poliomyelitis worldwide having some degree of disability (WHO, 2003). Poliomyelitis is a neuromuscular disease caused by the poliovirus. In 1–2% of the infections, the poliovirus invades the brainstem and the spinal cord motor neurons. Motor neuron death can result in denervation of muscle fibers, thus causing muscle weakness and paralysis. Recovery of some neurons, collateral sprouting from remaining motor axons, and muscle fiber hypertrophy aids in recovery of muscular force, and many survivors of poliomyelitis are able to return to active lives (Borg and Edstrom, 1995; March of Dimes [MD], 2001; Silver, 2001; Smith and Kelly, 2001; Post-Polio Health International [PHI], 2004).

Many years after acute poliomyelitis, survivors began reporting symptoms that included the occurrence of new muscle weakness, fatigue and pain in muscles and joints. Post-Polio Syndrome (PPS) is called a "diagnosis by exclusion" because it cannot be made without excluding the other likely conditions that may cause new muscle weakness, fatigue, and pain. When other conditions are excluded, and there is a confirmed history of polio followed by a period of stability

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for 15 years or more, the neurological disorder is termed PPS. The etiology of PPS is still unclear, but the general consensus is that the major symptom of new muscle weakness is caused by the degeneration of motor units. Several authors have suggested the motor unit degeneration has resulted from the long-term overuse of enlarged post-polio motor units in conjunction with the normal aging process (Maynard and Headley, 1999; MD, 2001; Silver, 2001; PHI, 2004).

Recommended strategies to manage PPS symptoms have emphasized patient education regarding PPS, the promotion of health and wellness, and the reduction of muscle and joint overuse. Nutrition, weight management, and judicious exercise are the principal strategies used in the promotion of health and wellness and the prevention of secondary conditions when individuals are aging with a disability. In general, a gradual training program that avoids excessive muscle fatigue allows individuals with PPS to achieve improvement in their cardiovascular conditioning (Willen, Sunnerhagen, and Grimby, 2001; Kriz et al, 1992; Jones et al, 1989). Strengthening exercises for individuals with PPS can be safely executed without exacerbating fatigue in muscles with a manual muscle test (MMT) grade that is greater than a 3 out of a possible 5 points on an ordinal scale. However, if an individual with PPS has muscles with a MMT less than a 3/5, avoidance of overuse and fatigue is the recommended approach for those muscles (Agre, 1995; Agre, Rodriguez, and Franke, 1997). Interventions suggested to assist in the reduction of muscle and joint overuse include energy conservation; pacing techniques; and the use of adaptive, assistive, orthotic, and/or protective devices.These intervention strategies also help preserve function, promote safety, and reduce fatigue (Maynard and Headley, 1999; MD, 2001; Silver, 2001; PHI, 2004).

Compliance with recommended interventions is often difficult to achieve with the polio survivor (Creange and Bruno, 1997; Silver, 2001). The response of this population to recommended intervention strategies has varied from relief to despair, depending on the coping mechanism used during and following the initial poliomyelitis recovery period. Many individuals with polio learned during their initial recovery period that hard work and ignoring symptoms of pain most often resulted in muscle strength gains and the ability to discard assistive devices, even if an obvious limp and inefficient gait pattern remained. As a result, these individuals may experience despair and great difficulty embracing strategies of energy conservation and fail to use assistive devices necessary for achieving goals related to management of PPS symptoms. Furthermore, some individuals with PPS may have feelings of failure associated with intervention compliance. Clinicians need to be aware of the psychological issues associated with recommended interventions and prudently review and modify their approach if an individual with PPS has difficulty with intervention compliance. (Creange and Bruno, 1997; Maynard and Headley, 1999; Silver, 2001; MD, 2001.)

Few studies have reported on the effectiveness of assistive device and/or energy conservation intervention strategies for individuals with PPS. The purpose of this case report, therefore, was to describe the effectiveness of an energy conservation approach that included the use of an assistive device for the management of fatigue in an individual with PPS. Compliance with the assistive device was enhanced with the use of videotaping the patient walking with and without the recommended device. The Modified Fatigue Impact Scale, an outcome measure not previously documented in the PPS literature, was used to measure the patient's perceived fatigue.

Fatigue in individuals with PPS is a complex phenomenon for which the causes are not well defined. Agre (1995) has proposed that PPS fatigue may be associated with emotional or psychosocial distress, central nervous system or cognitive changes, and/or peripheral neuromuscular factors associated with physical fatigue. There are a limited number of self-report fatigue scales that have been used in the post-polio population (Packer et al, 1991; Bruno, Galski, and Deleftuca, 1993; Clark et al, 1994; Stein, Dambrosia, and Dalakas, 1995; Bruno et al, 1996; Trojan et al, 1999). A frequently used instrument has been the Krupp's Fatigue Severity Scale, which focuses primarily on the physical symptoms of fatigue (Packer, 2001; Clark et al., 1994; Stein, Dambrosia, and Dalakas, 1995; Trojan et al, 1999). Another instrument is the Post-Polio Fatigue Questionnaire, which addresses the impact of fatigue on attention, cognition, and memory (Bruno, Galski, and Deleftuca, 1993; Bruno et al, 1996). However, neither scale includes all components proposed by Agre (1995) associated with post-polio fatigue nor have they been rigorously tested in the target population.

The Modified Fatigue Impact Scale (MFIS) is a multidimensional scale that measures an individual's perceived impact of fatigue on physical, cognitive, and psychosocial functioning. Developed by a panel funded by the National Multiple Sclerosis Society, the MFIS is a shorter version of the 40-item Fisk Fatigue Impact Scale (MSCCPG, 1998). The MFIS is a simple, self-report measure with established validity and reliability. An individual rates the impact of fatigue for 21 activities and functions, which can be aggregated into 3 subscales of physical, cognitive, and psychosocial functioning, as well as an overall score. Items are scaled from 0 to 4 (0 = never, 1 = rarely, 2 = sometimes, 3 = often, and 4 = almost always), and higher scores indicate a greater impact of fatigue on the functioning of the individual. The physical subscale score of the MFIS can range from 0 to 36 points; the cognitive subscale can range from 0 to 40 points; the psychosocial subscale can range from 0 to 8 points; and the total or overall MFIS score can range from 0 to 84 points. The author chose to use the MFIS (Multiple Sclerosis Council for Clinical Practice Guidelines [MSCCPG], 1998) as the outcome measure to assess response to an energy conservation strategy that included the use of a single forearm crutch because it addressed the multiple proposed components of fatigue in the individual with PPS.

Case description

The elements of patient management in this case report are introduced in a format consistent with *The Guide to Physical Therapist Practice* (American Physical Therapy Association, 2002). These elements include examination, evaluation, diagnosis, prognosis, and intervention. According to *The Guide*, the term examination encompasses patient history, systems' review, and pertinent tests and measures. The systems' review is a limited examination of the musculoskeletal, neuromuscular, cardiovascular/pulmonary, and integumentary systems. The communication ability and learning style of the patient are also assessed in the systems' review. *The Guide* identifies 24 categories of test and measures used by physical therapists, but only those relevant to this case report are listed below. The tests and measures are listed alphabetically and are neither in the order in which they were conducted nor in order of importance. The evaluation process synthesizes the data obtained from the examination to help the physical therapist identify impairments and establish a diagnosis and prognosis. Interventions are the interactions and procedures chosen to produce changes in the patient or client's condition consistent with the diagnosis and prognosis.

Examination

History

The patient was a 49-year-old female who acquired polio at 15 months of age. The primary involvement was in her lower extremities (LEs) with the right LE having greater impairment than the left LE. The patient reported she had achieved maximum recovery from polio in her teens and had used a short leg brace on her right LE ever since. Her medical history was unremarkable. She did not smoke, she ate a well-balanced diet, but she did not exercise on a regular basis. She was married and lived in a one-story house. She was independent in all activities of daily living and worked full-time as a legal assistant. Although the patient used a standard cane when walking long distances, she did not use it at work because she felt it was inconvenient and difficult to use with her variety of responsibilities. Her job required the filing and transport of files between the offices of her employers. She reported that it was awkward to hold onto the cane while transporting files and she often dropped it or left it behind in her office. Her primary complaints were increased general fatigue and muscle weakness in bilateral LEs, especially the left quadriceps, after her workday. She reported that she was "generally exhausted" at the end of a workday and felt less fatigued after a weekend of rest.

Systems review

The patient was 5′3″ (160 cm) in height and weighed 134 pounds (60.91 kg). A systems' review indicated impairments in gross symmetry and strength of the musculoskeletal system and impairments in balance and gait of the neuromuscular system. These impairments indicated the need for more specific tests and measurements in the musculoskeletal and neuromuscular systems.

Tests and measures

Aerobic Capacity and Endurance: Table 1 documents the MFIS scores recorded for the patient. Total MFIS score was 65 out of a possible 84 points (65/84).

Assistive Devices: A standard cane was used in the left hand for long-distance walking.

Circulation: The right toes were slightly bluish in color, and the right foot was cooler to touch than the left foot.

Gait and Balance: The patient was unable to maintain right single limb standing. She was observed walking at a self-selected speed without the cane in the left hand and during the right stance phase of gait, exhibited right genu valgus and increased right lateral trunk flexion with marked right arm excursion away from the side of her trunk.

When the patient was observed walking with a standard cane held in the left hand, a 50% reduction in right arm excursion during right stance was observed. No change was noted in the patient's self-selected speed of walking.

Orthotic Device: A custom, plastic right ankle foot orthosis (AFO) was worn when walking.

Muscle Performance: Manual muscle testing was accomplished by using a five-point ordinal scale (Reese, 1999). MMT for the upper extremities was 5 of 5 for all major muscle groups. Table 2 illustrates the trunk and LE MMT grades. Repetitive muscle testing was conducted for the left quadriceps muscle as fasciculations were palpated in the initial break test. However, there was no degradation in strength with the repeated MMT. Cramping of the left hamstring musculature was noted during the manual muscle testing.

Posture: The right LE was 1″ (2.54 cm) shorter than the left, and the right foot was smaller than the left foot. A functional scoliosis was present with the right shoulder lower than the left, and the convexity of curve was on the left.

Reflex Integrity: Intact with the exception of absent left Achilles tendon reflex.

Self-Care and Home Management: The patient reported independence in all activities of daily living. She did not use adaptive equipment in the bathroom, such as a shower bench, handheld nozzle, or nonskid surfaces in the shower.

Table 1. Initial modified fatigue impact scale scores

MFIS Category	Patient*	Possible Score
Total:		
Combined score	65	84
Subscale:		
Physical	33	36
Cognitive	24	40
Psychosocial	8	8

*A higher score reflects a higher level of perceived fatigue.

Table 2. Initial manual muscle test grades of the lower extremities

	Muscles	Right	Left
Trunk	Abdominals		
	upper/lower	4/4−	4/4
	Extensors	5	5
Hip	Iliopsoas	3−	5
	Gluteus		
	Maximus	2+	4+
	Gluteus Medius	2+	3−
	Adductors	2+	5
Knee	Quadriceps	3+	4
			fasciculations
	Hamstrings	2+	3+
			cramping
Foot/ Ankle	Tibialis		
	Anterior	3	5
	Gastroc-Soleus	0	5
	Peroneals	0	5
	Toe Extensors	4	5
	Toe Flexors	0	5

Evaluation, diagnosis, and prognosis

The findings of spotty weakness and functional limitations in her muscle performance in the left lower trunk and bilateral LEs, with the right being worse than the left, confirmed the prior diagnosis of poliomyelitis. Evidence of a confirmed history of poliomyelitis followed by a period of stability, coupled with the new symptoms of increased fatigue and weakness, was consistent with a diagnosis of post-polio syndrome.

A Total MFIS score of 65 of 84 provided a baseline measurement that quantified the patient's complaints of fatigue. In addition, the physical, cognitive, and psychosocial subscale scores indicated the relative areas of greatest impact of the patient's perceived fatigue. The psychosocial subscale score of 8 of 8 indicated that the patient's perceived fatigue "almost always" limited her ability and motivation to participate in social activities outside of the home as described by the two items in this subscale. The physical subscale score of 33 of 36 indicated that the patient perceived that her fatigue "almost always" limited her ability and motivation to do anything that required sustained physical effort for the majority of the nine items described in this subscale. The cognitive subscale score of 24 of 40 for 10 items indicated that patient's perceived fatigue "sometimes" and "occasionally often" limited her ability to think clearly and concentrate.

Increased right lateral trunk flexion during right stance while walking and standing was due to the weakness in the right gluteus medius (3-/5) as well as the right LE being 1″ (2.54 cm) shorter than the left LE. The left quadriceps muscle fasciculations were consistent with muscle overuse in the less involved LE when walking. The 1″(2.54 cm) difference in leg length and the cold right foot were consistent with the long-term effects (47+ years) of diminished muscle mass and muscle contractions on bone growth and on resulting skin temperature in the right lower leg. The 1″ shortness of the right lower extremity and the absence of a lift in the AFO assisted with right foot clearance during the swing phase of gait despite a 3-/5 MMT for the right hip flexors.

The muscle and skeletal imbalance in the lower trunk and LEs contributed to the presence of impaired posture and mobility with limitations in specific activities as identified by the *International Classification of Functioning, Disability and Health* (WHO, 2001). The limitations in specific activities included maintaining body positions or postures; carrying, moving, and handling objects; and walking and moving. Although the patient did not report a history of loss of balance or falling, it was thought that the loss of ability to balance on the right lower extremity placed her at risk for loss of balance and falling.

The patient's prognosis was favorable. With the use of an assistive device acceptable to the patient, she would likely gain improved standing and walking postures. It was anticipated that improved posture would enhance her mobility and reduce her limitations in specific activities and complaints of fatigue. Specifically, it was the impression of the physical therapist that the use of an assistive device would diminish the physical fatigue associated with abnormal gait kinematics as evidenced by a reduction in both the total MFIS and physical subscale scores.

Intervention

The patient was initially seen for two 1-hour sessions of patient education regarding the diagnosis and management of PPS, health promotion, and energy conservation. She was instructed to conserve energy in the muscles most affected by the poliovirus, as evidenced by MMT grades of 3 of 5 or below. A program of judicious, moderate physical activity, which used only those muscles with a MMT greater than 3 of 5, was recommended to promote health and wellness (Gawne, 1995; Agre, 1995; Agre, Rodriquez, and Franke, 1997). The patient was instructed to avoid unnecessary activities such as walking, bicycling or stair climbing for exercise, which would require her to overuse the muscles in the right lower extremity and the left hip abductors. Instead, seated circuit weight training and/or resistive exercises for strengthening muscles in the uninvolved upper extremities, trunk and left lower extremity, with the exception of the hip abductor, were recommended. In addition, these exercises could be incorporated into a gradual program of cardiovascular training. The use of an upper body ergometer and/or participation in aquatic exercises for the upper extremities, trunk, and left lower extremity, with the exception of the hip abductor, were additional activities that could be included in a program of strengthening and cardiovascular training.

Pacing activities, so that physically strenuous activities were followed by a rest period of 15 minutes up to 1 hour throughout the day, was recommended (Young, 1998). An integral component of energy conservation intervention was the initiation of gait training with a variety of assistive devices. The patient was videotaped walking with and without a straight cane, a single forearm crutch, and a pair of *forearm* crutches. The patient observed that using an assistive device improved her posture and gait efficiency by reducing the amount of right lateral trunk flexion during right stance when walking. She was able to observe on videotape that she was able to attain an upright posture with greater ease when walking with a pair of forearm crutches than when walking with a standard cane or one forearm crutch held in the left hand. Despite the observed benefits obtained when walking with the pair of forearm crutches and the recommendation by the physical therapist that she use both forearm crutches on a full-time basis, the patient stated she was unable to accept using them. She was unable to embrace the image of walking with *two* assistive devices after walking without *any* assistive device since her teens. However, she felt she would be able to accept using *one* assistive device on a full-time basis. She selected a single forearm crutch over a standard cane because the single forearm crutch remained attached to her forearm when she needed to use her left hand to file papers and perform other functional tasks. In addition, the forearm crutch was then immediately available for use when walking. Figure 1 *illustrates* the patient's posture when walking without an assistive device, and Figure 2 shows improved posture when walking with a forearm crutch held in the left hand.

The patient was encouraged to use a shower bench with a handheld shower nozzle as a safe method to avoid right LE muscle overuse. Safety measures including a grab bar and nonskid surfaces in the shower were also recommended to the patient to prevent and reduce the risk for loss of balance and falling.

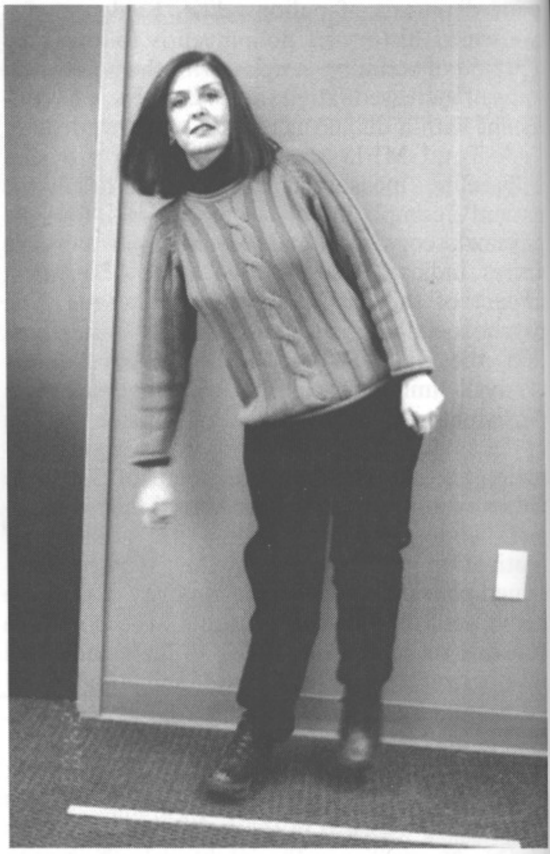

Figure 1. Patient's posture when walking without an assistance device.

Outcomes

The patient was reexamined at 6 months and 18 months following the initial evaluation. The patient reported she had been compliant with the use of a single forearm crutch at work, but she had not been compliant with the safety and energy conservation suggestions for the shower. The patient reported she was able to walk longer distances in a shorter period of time with less fatigue. MMT grades were unchanged over the 6-month interval. Left quadriceps fasciculations were not present during the 6-month MMT.

Table 3 shows the Total MFIS score and the three subscale scores at the 6-month reexamination. A decrease in the MFIS score is consistent with a decrease in perceived fatigue. The 6-month reexamination showed a 30% reduction in the total MFIS score and a decrease in each of the subscale scores consistent with the patient's self-report of reduced fatigue.

A second reexamination was completed 1 year later at 18 months after the initial evaluation. The patient remained compliant with use of a

Figure 2. Patient's improved posture when walking with a forearm crutch held in the left hand.

single forearm crutch at work, but she remained noncompliant with the use of adaptive devices in the shower. MMT grades remained unchanged.

Table 3. Summary of modified fatigue impact scale scores

MFIS Category	Initial Scores	6-Month Scores	18-Month Scores
Total:			
Combined score	65	40*	43**
Subscale:			
Physical	33	21	19
Cognitive	24	16	22
Psychosocial	8	3	2

*30% reduction from initial score consistent with a lower level of perceived fatigue.

**27% reduction from initial score.

Fasciculations were present in the left quadriceps muscle during the 18-month MMT. The patient reported increased fatigue in the left thigh with long-distance walking.

Table 3 presents the individual subscale and total MFIS scores at 18 months after initial evaluation. Although there was a slight increase in the total MFIS score at the 18-month reexamination compared to the 6-month reexamination, it still was less than the initial evaluation total MFIS score. The 18-month total MFIS score reflected an increase in the cognitive subscale, but the physical and psychosocial subscales were slightly decreased from the 6-months after the initial examination.

The use of two forearm crutches was recommended to the patient when walking long distances based on the subjective complaint of increased left thigh ache and objective observations of fasciculations in the left quadriceps muscle. Despite the increased symptom of muscle overuse and slight increase in total MFIS score, the patient reported she was still unable to accept using two forearm crutches.

Discussion

This case report describes the effectiveness of an energy conservation strategy that included use of an assistive device acceptable to the patient, a single forearm crutch, when walking for the management of fatigue in an individual with PPS. The case report also describes the clinical relevance of the MFIS when measuring the impact of assistive device intervention on PPS fatigue.

The patient's symptoms of fatigue were reduced with the acquisition of a properly fitting forearm crutch held on the opposite side of the most involved LE. The use of the forearm crutch compensated better for the leg length discrepancy and right gluteus medius weakness than the standard cane used previously by the patient. The improved posture resulted in a more erect posture with decreased lateral flexion during right stance. Improved efficiency of gait kinematics allowed the patient to walk longer distances with less fatigue.

Compliance with recommended interventions is often difficult to achieve with an individual diagnosed with PPS (Creange and Bruno, 1997;

Silver, 2001). The use of a videotape analysis of the gait pattern with and without the recommended assistive device(s) was included with patient education. This proved to be an effective strategy as the patient observed that an assistive device improved her posture and gait efficiency by reducing the amount of right lateral trunk flexion during right stance when walking. Although the patient did not wish to use the recommended pair of forearm crutches, she was compliant with the revised recommendation to use a single forearm crutch full time at work after viewing the videotape.

The MFIS was used to measure the change in perceived fatigue associated with the use of the forearm crutch. The total MFIS score and the individual subscales were viewed together to measure outcome effectiveness due to the complex interaction of multiple proposed causes of fatigue in the individual with PPS. A 30% decrease in the total MFIS score of the patient presented in this case study was achieved within 6 months after the initial examination. Although the reduction was not completely maintained over the following year because of an increase in the cognitive subscale, the total MFIS score remained at a reduced level (26.2%) when measured at 18 months after the initial examination. The physical and psychosocial subscale scores decreased at both 6 months and 18-months after the initial examination.

A limitation of this case report is the narrow use of the MFIS scale in the post-polio population despite the apparent clinical relevance of this scale for measuring effectiveness of assistive device intervention on fatigue. Although considerable effort and expertise were applied to the development of the MFIS for the individual with multiple sclerosis, the MFIS has not been tested in the post-polio population. A study (Strohschein et al, 2003) published after the conclusion of the patient's physical therapy episode of care explored the applicability of a different scale, the Piper Fatigue Scale (PFS) in the PPS population. The PFS is a multidimensional scale for measuring fatigue in four different domains: behavioral/severity, affective meaning, sensory, and cognitive/mood and measures. The study measured fatigue in 64 individuals with post-polio syndrome and 25 healthy controls, and the researchers determined that the PFS is a valid and reliable tool for measuring post-polio fatigue. Continued vigorous use of the PFS, the MFIS, and other self-report fatigue scales is necessary to establish the clinical relevance of these instruments and to support the growing body of evidence concerning the effectiveness of assistive device interventions for fatigue in this patient population.

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