The Step-Wise Approach for Treating Intention Tremor 2 (SWAT-IT$_2$): The Community Application

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PRACTICE POINTS

- An effective series of nonpharmacological, nonsurgical interventions for treating intention tremor secondary to multiple sclerosis is feasible for implementation in the clinical environment.
- The client-centered intervention administration protocol allows patients to select the targeted interventions that best fit their physical needs, overall environment, and desired daily activities.
- Clients who receive this protocol may be more satisfied with their functional abilities and report less tremor interference in their daily life.

ABSTRACT

Background: The Step-Wise Approach for Treating Intention Tremor 2 (SWAT-IT$_2$) is a revised version of the original SWAT-IT that has been developed for broader application. This study aims to test the feasibility and clinical utility of the SWAT-IT$_2$ in the community and to determine if the SWAT-IT$_2$ impacts participants' satisfaction of function, perceived function and self-efficacy. **Methods:** Using the SWAT-IT$_2$ protocol, one-on-one sessions were conducted with seven participants with Multiple Sclerosis (MS)-related IT. The protocol was applied to the daily functional activities. Data was collected using a demographic questionnaire (DQ), medical status questionnaire (MSQ), the new generalized self-efficacy scale (NGSE), the Multidimensional Assessment of Tremor (MAT), Expanded Disability Status Scale (EDSS), Symbol Digits Modalities Test (SDMT), and Tremor Treatment Techniques Visual Analog Scales (T^3-VAS), and the Daily Tremor Evaluation Form (DTEval). Descriptive statistics were used to analyse the data.

Results: Seven participants received the SWAT-IT$_2$ protocol. Most participants found the SWAT-IT$_2$ techniques easy to use and incorporate into their daily lives. After a month of using the techniques, the majority of participants reported increased satisfaction with their performance and less tremor interference in their daily lives. No clinically significant changes in self-efficacy were found.

Conclusions: This study adds to the literature surrounding nonpharmacological, noninvasive interventions for MS-related IT by providing a feasible and effective intervention protocol addressing functional activities.

INTRODUCTION

Multiple sclerosis (MS) is a chronic autoimmune inflammatory disease that attacks the myelin insulating the nerves in the central nervous system (CNS).[1] This demyelination affects the transmission of signals throughout the body leading to many life altering symptoms for those affected including intention tremor (IT). Tremor is estimated to occur in 25-60% of individuals diagnosed with MS[2] and is highly correlated with a decrease in functional abilities.[3] Many noninvasive activity modifications are documented in the literature, but there is no standard protocol for suggesting which modifications may work best for clients. This paper provides evidence for a standardized administration protocol for increasing the functional ability of people with IT secondary to a diagnosis of MS in their daily activities.

BACKGROUND

Common Symptoms

MS symptoms can be divided into primary, secondary, and tertiary symptoms. Primary symptoms are the direct result of demyelination and axonal loss, and may include fatigue, weakness, decreased balance, spasticity, gait problems, depression, cognitive difficulties, bladder/bowel deficits, sexual deficits, visual and sensory loss, and neuropathic pain.[4] IT is a primary symptom that results in tremor during movements towards a visual target.[4] Secondary symptoms are physical complications that arise due to primary symptoms; for example, urinary tract infections as a result of urine retention. Tertiary symptoms can arise due to primary symptoms, secondary symptoms, or a combination of both. For example, persons diagnosed with MS have a suicide rate 7.5 times higher than the general Canadian population,[5] a trend also seen in other countries.[6]

Prevalence

The World Health Organization states that MS affects around 2.5 million people worldwide, and is one of the most common neurological disorders and cause of disability of young adults, especially in Europe and North America. The prevalence of MS varies globally with the diagnosis frequency increasing with distance from the equator in both hemispheres. Regardless of geographical location, the disease is more common in women than in men.[7]

Types of MS

Four different variations of MS are documented in the literature, each with their own unique symptomology.

Relapsing-remitting MS (RRMS)

This form of MS is characterized by clearly defined yet unpredictable episodes where current symptoms worsen and/or new symptoms develop. In between episodes, patients may go into remission or even recover some of their former function. Overall, this form of MS affects 85% of MS patients.[8]

Primary progressive MS (PPMS)

A slow accumulation of disability without relapses is the hallmark of this form of MS. Symptoms may stabilize for a period of time, or even show minor improvement, but no periods of remission are present. Approximately 10% of MS patients are affected by this category of the disease.[8]

Secondary progressive MS (SPMS)

RRMS develops into SPMS within 10 years of diagnosis in approximately 50% of patients. SPMS has the same characteristics as PPMS, but develops out of the initial diagnosis of RRMS.[8]

Progressive Relapsing MS (PRMS)

This is the rarest form of the disease, affecting about 5% of patients. With this diagnosis, patients face a steady worsening of the disease from the beginning, but also experience clear attacks with increased symptoms, with or without recovery.[8]

Intention Tremor in MS

IT is a type of kinetic tremor where tremor amplitude increases during visually guided movements,[9] particularly as the subject nears the visual target. It can be present in the lower extremities, upper extremities, neck, and/or torso.[10] Since the neural lesions that develop in MS are present throughout the CNS, the specific neurophysiological etiology of IT is not yet clear.[11] However, some studies have implicated the involvement of the cerebellothalamocortical pathway.[12] IT varies in severity, and the functional implications of IT depend on the body part affected. Upper limb intention tremor (ULIT), the focus of this study, has been shown to affect many activities of daily living, including eating, drinking, grooming, dressing, and writing.[13]

Methods for Assessing Intention Tremor

IT in MS can be assessed using a variety of different techniques including the standardized tests and functional assessments. Standardized tests include Fahn's tremor rating scale[14] and the MAT.[15] Functional assessments include the finger-to-nose test, the nine-hole-peg-test, and writing and drawing tasks.[16]

Current Treatment Methods

General Pharmaceutical Treatment for MS

Disease-modifying therapies (DMT) are pharmaceutical agents that provide immediate treatment options for people diagnosed with MS, and effectively control the disease if taken on a regular basis.[17, 18] Current guidelines for treatment suggest to start with first-line drugs such as interferons, glatiramer acetate, fingolimod, and then advance into second line drugs like natalizumab, mitoxantrone and fingolimod.[17,18] Second-line drugs have been found to be more effective but are generally more toxic, so they are provided to patients with diagnosed with aggressive forms of MS.[19]

Yadav and colleagues[20] carried out a literature review to establish evidence-based recommendation for complementary and alternative medicine used to treat MS. These authors suggest offering oral cannabis extract (OCE) to patients with MS as it has been reported to be effective in reducing spasticity symptoms and pain, excluding central neuropathic pain, and advise patients that this treatment is beneficial for up to one year.[20] However, OCE is not effective in improving spasticity measures short-term or tremor. Further, these authors found isolated tetrahydrocannabinol, a psychoactive chemical found in the cannabis plant, yielded similar results.[20]

Treatment for Intention Tremor

Pharmacological Interventions

Pharmacological interventions in MS with ULIT have been well-documented.[21] A recent review explored 11 pharmaceutical agents including: isoniazid, botulinum toxin A, cannabis, levetiracetam, primidone, 4-amino-pyridine, ethanol, glutethimide, natalizumab, onadansetron,

and topiramate. The authors specifically highlighted isoniazid as successful in reducing IT in 60-80% of patients and ondasterone as having no effect on tremor severity.[21]

Surgical Procedures

Deep Brain Stimulation (DBS), using an implanted electrical device inside the brain to modify neurological activity, has been shown to reduce symptoms to a limited extent due to the progression of the disease.[22] Additionally, a significant reduction of the therapeutic effect is seen after five years.[22] Thalomotomy, a procedure where the local cerebral tissue is destroyed by a high-frequency thermocoagulation at a target site within the thalamus, has been found to be an effective short-term treatment for MS. However, IT was found to decrease in only one third of patients and reoccurs after three years.[22] DBS generally yields a better functional status with regards to activities of daily living (ADLs) than the thalamotomy procedure, and more side effects were observed in individuals who underwent the thalomotomy including dysarthria, gait disturbances and cognitive deficits.[22]

Zakaria and colleagues[23] evaluated the outcomes DBS of the ventral intermediate (VIM) nucleus for treatment of MS related tremor. This study did not specify the specific type of tremor participants had thus, one must use caution when generalizing these findings to individuals living with MS related IT. Sixteen patients between ages 24 to 59 underwent surgery. Five of the sixteen patients observed at least a 50% tremor reduction. Eleven of the sixteen reported at least a 30% tremor reduction. Patients who found the 50% tremor reduction were found to be slightly older and had been diagnosed with MS for a longer period of time, yet had MS IT for a shorter period of time. Overall, these authors highlighted that VIM DBS can reduce tremor in some patients with MS. Of most importance, when VIM DBS does reduce tremor it is associated with small improvements in quality of life such as ADLs, especially feeding.[23]

Behavioural Interventions

Research has examined different behavioural interventions for managing IT,[24, 25, 26, 27] including positioning, energy conservation, weighted wrist cuffs, and assistive technology. Morrison, Sosnoff, Pula and Motl[24] investigated the impact whole body positon had on IT, and found that IT increases significantly from sitting to standing. These authors suggest that fatigue or brainstem dysfunction contributes to IT dysfunction in individuals diagnosed with MS and that standing for people diagnosed with MS makes them work even harder as their tremor is greater than when in a seated position.[24]

Another study explored whether placing wrist weights on the forearm of an individual with ULIT would make feeding themselves more functional.[25] Results from this study show that placing weighted wrist cuffs on the forearm of an individual with IT lead to functional improvements in self-feeding. Further, these authors mentioned that the amount the individual benefitted from the weight wrist cuff was determined by the amount of weight used.

Studies have also described the views of individuals diagnosed with MS about the use and perceived effectiveness of energy conservation strategies.[26] Findings show that strategies that implemented rest and delegation were used most often, followed by modifying priorities and standards. It was found that the majority of participants in this study found the energy conservation strategies they learned to be effective.

Research has also reviewed assistive technology for individuals with MS to maintain or improve functional capabilities.[27] Examples include using scoop plates and weighted utensils for eating, or alternate keyboards and built up pencils for writing.

SWAT-IT$_2$ Techniques

The SWAT-IT$_2$ is a treatment protocol originally consisted of 12 techniques, the same six as the previous SWAT-IT and six new techniques, divided into five intervention categories: (1) cognitive-psychoeducation, (2) optimal positioning, (3) behavioural strategies, (4) assistive devices, and (5) coupling any of the 12 techniques. Evidence behind each of the 12 is discussed below.

Cognitive psychoeducation research has found that providing education to individuals with MS can be effective.[28, 29] Optimal positioning allows for the stabilization of the affected limb. Evidence for proximal stabilization, comes from research that has shown that positioning has an impact on one's ability to independently perform meaningful daily tasks.[30] Proximal stabilization can be explained as immobilizing the proximal end of the limb experiencing tremor against a stable object in the environment. This technique has been demonstrated effective in reducing IT while performing the functional occupations.[31] Research by Forwell et al.[31] found that by stabilizing the wrist/forearm/hand in the tremor-producing limb the number of joints involved decreases, thus increasing stability in the movement. The third category consists of behavioural interventions. Hand-over-hand is implemented in the SWAT-IT$_2$ as Forwell et al.[31] found this method to be effective in reducing the effects of tremor when performing functional activities. Another technique shown to dampen the effects of tremor during functional activities of writing and eating is stabilization of the wrist/forearm/hand. Further evidence to support the next intervention reducing travel distance comes from Hawes, Billups and Forwell[32] who found that reducing travel distance between the starting point of the moving extremity and the target may reduce tremor. Research has demonstrated effectiveness in reducing IT using the start-stop-start technique.[33] Another technique that has been trialed in the SWAT-IT$_2$ is switching

handedness; if IT only affects the dominant hand it can be helpful for individuals to learn to carry out occupations using their non-dominant hand. The fourth category of the SWAT-IT$_2$ interventions are grouped into assistive devices. Research behind the use of interventions that involve the weighted wrist cuffs and weighted wrist splints has found that adding weights to the distal upper limb was effective in participants with static brain lesions in reducing IT during skilled purposeful movements.[25] Further research has reported that wrist weights were more beneficial for people with IT related to MS compared to other types of tremor experienced by people with MS.[34] A weighted wrist splint merges the effect of the weight provided by the weighted wrist cuffs with a reduction of range of motion achieved with the wrist splint providing a greater reduction in tremor than either technique if used independently.[34, 35] Additionally, studies have found that adding weight to objects such as pens and utensils has been shown to be useful for dampening tremor during functional activities.[36] It is important to match the size of the tools with the patient's hand size and gripping ability as both of these factors play a role in the amount of tremor experienced by the patient.[37] Studies have also found splinting to be effective in reducing tremor by decreasing the range of motion at a specific joint, leading to improvements in functional performance.[31] A cooling forearm wrap has shown to reduce tremor by blocking peripheral nervous system inputs.[36, 38] It is predicted that a reduction in both general afferent signals and signals sent by muscle spindles decreases input to regions of the cerebellum that are known to be involved in the production of IT, consequently reducing an individual's IT.[38] Further, Feys et al.[33] found that cooling of the distal joints of the forearm reduced forearm tremor amplitude and frequency, and increased an individual's function for at least 30 minutes. The last category trialed in the SWAT-IT$_2$ is coupling, where participants combine techniques they found successful with one another to further improve tremor reduction.

History of the SWAT-IT$_2$

The SWAT-IT was originally developed and tested by Hawes, Billups and Forwell[32] as a comprehensive treatment protocol for individuals living with MS related IT. It consisted of six interventions designed to reduce IT: education about tremor, proximal stabilization, hand-over-hand technique, weighted tool, wrist weights and splinting[32]. Based on the findings of this study, changes were made leading to a revised version of the SWAT-IT now known as SWAT-IT$_2$. The SWAT-IT$_2$ builds on the original SWAT-IT, and was developed to treat and reduce the functional impact of IT on activities. It is the first intervention for MS related IT that uses a comprehensive battery of therapeutic techniques and formulates a set of recommendations that are tailored to the client during one treatment session.

Occupational Therapy and the SWAT-IT$_2$

The SWAT-IT$_2$ has been developed for administration by OTs. As it was developed with the theoretical framework of the Person-Environment-Occupation model.[39] Interventions emphasize improving the client's engagement in daily occupations, as they intervene at the person level using behavioural strategies and adaptive equipment. They also target a person's environment by examining a person's positioning to increase independence.

RATIONALE

Despite the abundance of research conducted on medical interventions that help to alleviate symptoms of MS,[17, 18, 19, 20, 21] limited research has investigated nonsurgical, nonpharmacological interventions to address functional activities for individuals living with MS. Noninvasive and nonpharmacological interventions do not require physicians to implement, and can assist people with MS to live a better quality of life and have better functional outcomes. The SWAT-IT$_2$ is a nonsurgical, nonpharmacological intervention protocol that provides strategies to

address functional activities for individuals living with MS,[15] but the clinical feasibility and utility of this protocol is not yet known.

PURPOSE STATEMENT AND RESEACH OBJECTIVES

The purpose of this study is to test the clinical utility of the SWAT-IT_2 in the community, and to determine if the SWAT-IT_2 impacts participants' satisfaction of function, perceived function, and self-efficacy. There were four main objectives guiding this study.

(1) To determine the feasibility of the SWAT-IT_2 for use with individuals with MS with ULIT as measured by the feasibility questionnaire.
(2) To determine if the SWAT-IT_2 protocol impacts participant satisfaction related to function in individuals with MS with ULIT as measured by the Daily Tremor Evaluation Form.
(3) To determine if the SWAT-IT_2 protocol impacts participant perceived function in individuals with MS with ULIT as measured by part D of the Multidimensional Assessment of Tremor and the Daily Tremor Evaluation Form.
(4) To determine if the SWAT-IT_2 protocol impacts participant self-efficacy in individuals with MS with ULIT as measured by the new generalized self-efficacy scale.

METHODS

Research Design

Few studies have explored the noninvasive, nonpharmacological interventions for individuals with MS and none specifically describe intervention strategies that individuals diagnosed with MS find helpful to improve their quality of life. A quantitative pre-post cross-sectional design offered the opportunity for individuals diagnosed with MS to trial the SWAT-IT_2 intervention strategies. They were able self-report their overall self-efficacy and satisfaction

with their ability to perform their desired occupation pre- and postintervention, based on a protocol initially created by Hawes, Billups, and Forwell.[32]

SWAT-IT$_2$ Intervention Protocol

The SWAT-IT$_2$ is a treatment protocol originally consisted of 12 techniques divided into cognitive-psychoeducation, optimal positioning, behavioural strategies, and assistive devices, and coupling any of the 12 techniques. Based on participant feedback, a 13th technique, applying compression to the affected limb using a light compression garment, was added half way through recruitment as research has found the use of lycra garments as splints to be effective in smoothing movements for other neurological conditions.[40] Table one outlines the techniques.

Table 1 – SWAT-IT$_2$ Techniques

Intervention Category	Technique	Description
Cognitive Psychoeducational	Education	Education on IT provided to individuals.
Optimal Positioning	Proximal stabilization	90˚-90˚-90˚ seating position and support of trunk and arms.
Behavioural	Hand over hand	For individuals with unilateral IT; Use of the unaffected hand to stabilize the hand that is engaged in the activity.
	Reduce travel distance	Reducing the distance required for upper limbs to reach target.
	Start-Stop-Start	Start movement, stop before reaching the target, and then resume movement once tremor has reduced.
	Stabilization of the wrist/ forearm/ hand	Using a hard/flat surface to stabilize forearm, wrist and/ or hand.
	Switching handedness	Performing activity with unaffected non-dominant hand.
Assistive Devices	Weighted wrist cuff	Wrap a weighted wrist cuff around upper limb.
	Built up and weighted tool	Add weight and girth to tool
	Splinting	Splinting of the upper limb.
	Weighted wrist splint	Put on a weighted wrist splint.
	Cooling forearm wrap	Apply cooling wrap to forearm for 15 minutes.
	Compression	Apply compression garment to forearm, wrist, and hand
Coupling	Combination of techniques	Complete each activity using most successful techniques in combination (as determined by the participant).

Participant Recruitment

Following approval from the University of British Columbia's Clinical Research Ethics Board and the Vancouver Coastal Health Research Institute, participants were recruited from the UBC MS Clinic, private physiotherapy clinics in the Vancouver area, and G. F. Strong Rehabilitation Centre, and community dwelling individuals receiving community OT services.

Participants in this study included a convenience sample of individuals diagnosed with MS and currently experiencing ULIT, fluent in English, and older than 19 years of age.

Recruitment posters were posted at the UBC MS clinic located in the Djavad Mowafaghian Centre for Brain Health at the UBC hospital, G.F. Strong Rehabilitation Centre, and private physiotherapy clinics in the Vancouver area. Additionally, recruitment flyers were provided to Vancouver Coastal Health Community OTs via email.

Clinicians, staff and occupational therapy students at the UBC MS clinic were made aware of the study. Private physiotherapy clinics within the Vancouver area and the OT Educator with Vancouver Coastal Health were also contacted by email and spoken to in person to inform them about the study. Clinicians, staff, OT students, and community occupational therapists were asked to make their eligible clients aware of this study, and provide them with a copy of the recruitment poster.

Data Collection

The study activities consisted of five study periods: *initial contact, intervention session, home practice, week 1 follow-up and week 4 follow-up*. The data collection that occurred at each study period is outlined below and the measures used for each period are outlined in table two.

Initial contact: Participants called or emailed researchers expressing an interest in participating in the study. Researchers screened participants to determine their eligibility using the Eligibility checklist. Participants who met the inclusion criteria were sent the consent form, demographic questionnaire (DQ), a medical status questionnaire (MSQ), the new generalized self-efficacy scale (NGSE) and parts A, B and D of the Multidimensional Assessment of Tremor (MAT) to be complete prior to the in-person intervention session.

Intervention Session: The intervention session took approximately 1.5 hours and took place at a time and location of the participant's choice (e.g., at participant's home or UBC hospital). The questionnaires completed during the initial stage were reviewed. During the intervention session part C of the MAT, the Expanded Disability Status Scale (EDSS), and the Symbol Digit Modalities Test (SDMT) were administered. To administer the SWAT-IT_2 protocol participants were first invited to rank their perceived satisfaction at completing their chosen task, and the perceived difficulty of that task on the Tremor Treatment Techniques Visual Analog Scales (T^3-VAS). Then, the SWAT-IT_2 techniques were trialed in order and participants were invited to re-rate their perception of their performance on the T^3-VAS. Participants selected the techniques they would like to continue using, and received an instruction sheet containing photos of the techniques. At the end of the visit, participants were provided with the feasibility questionnaire, Daily Tremor Evaluation form (DTEval), NGSE and part D of the MAT to be completed and sent back to the researchers.

Home Practice: Participants trialed SWAT-IT_2 techniques they felt were most helpful for them for the entire month following the intervention session. During the seven days following the intervention session participants completed the DTEval.

Week 1 follow-up: During the week following the intervention session researchers contacted participants by phone on day two, five and seven to discuss the interventions, complete DTEval and troubleshoot any problems.

Week 4 follow-up: Participants were contacted by phone on week 4 to ensure the feasibility questionnaire (FQ), NGSE and part D of the MAT were completed, and to remind participants to return these questionnaires to researchers in the pre-addressed envelope they received at the intervention session.

Table 2: Measures Used During Each Study Period

Measure	Initial Contact	Intervention Session	Home Practice	Week 1 Follow-up	Week 4 Follow-up
Demographics Questionnaire (DQ)	✔				
Medical Status Questionnaire (MSQ)	✔				
New Generalized Self-Efficacy Scale (NGSE)	✔				✔
Multidimensional Assessment of Tremor (MAT)	A, B, D	C			D
Expanded Disability Status Scale (EDSS)		✔			
Symbol Digit Modalities Test (SDMT)		✔			
Tremor Treatment Techniques Visual Analog Scale (T^3- VAS)		✔			
Feasibility Questionnaire (FQ)					✔
Daily Tremor Evaluation Form (DTEval)			✔	✔	✔

Measures

Pre-intervention and Intervention Session

The DQ, the MSQ, the EDSS, and parts A, B and C of the MAT, and the SDMT were used to develop a profile of the participants. The T^3-VAS which is administered during the intervention session is composed of ratings on satisfaction and tremor and is used to record the impact of the various SWAT-IT_2 intervention strategies.

There are 4 different sections of the MAT and each section assess different areas: Part A includes a description of tremor and various factors affecting tremor; Part B describes

psychosocial effects tremor has on the participant; Part C objectively examines tremor via the Tremor Severity Scale; Part D is a self-report Functional Severity Scale which has the participant self-report their ability to perform multiple activities from zero (can perform with no difficulty) to four (can perform activity with extreme difficulty or cannot perform activity at all).

Post intervention

Part D of the MAT, the DTEval, the NGSE, and the FQ were used as a measure to evaluate the outcomes of the study. The DTEval evaluates the participants perceived satisfaction with function and tremor severity. The NGSE uses a 5-point Likert scale from strongly disagree to strongly agree, 1 to 5 respectively, to evaluate participant's perceived self-efficacy regarding their ability to complete tasks.

The FQ includes seven questions for participants to answer using a visual analogue scale (VAS). Questions are focused on participant's satisfaction with the protocol, continued use of treatment techniques, technique usefulness, administration time, ability to trial techniques, instruction accessibility, and confidence using treatment techniques.

Data Analysis

To ensure participant confidentiality all participants were assigned a study number. Study documents were stored in a locked cabinet in a locked office at the University of British Columbia. This study used descriptive statistics to analyse the data from the DQ, EDSS, and the MAT parts C and D. Tremor Impact Score was calculated as outlined in the MAT.[15] The Tremor Severity Score, Functional Severity Scale, Tremor Impact Score, SDMT and FQ were also analyzed using descriptive statistics.

RESULTS

Participants

12 Participants were recruited to the study. Two did not meet eligibility criteria, one could not be reached, and two were found not to have IT on assessment day and therefore did not receive the protocol. In total, seven participants (five women, two men, mean age = 58 years) were enrolled. Participant demographic data are summarized in table three.

Table 3: Demographics

Characteristic	Participant						
	1	2	3	4	5	7	8
Age (years)	74	73	30	54	62	38	73
Sex	F	F	F	M	F	M	F
Marital Status	Married	Divorced	Never married	Married	Married	Never Married	Married
Level of Education	Graduate/ Professional designation	Some post-secondary	Graduate/ Professional designation	Vocational school graduate	High school graduate	Vocational school graduate	University graduate
Employed	No	No	Yes	No	No	No	Yes
MS Type	Unknown	Primary progressive	Relapsing-remitting	Relapsing-remitting	Secondary progressive	Secondary progressive	Secondary progressive
Duration of MS (years)	5	27	7	14	20	6	25
Hand Affected	Left	Both	Both	Left	Left	Both	Both
EDSS[a]	6	5.5	2	5.5	6	8	8
Part C – TSS[b]	25	35	17	10	44	34	12
Part D – FSS[c]	26	60	3	43	11	80	77
TIS[d]	Low	Moderate	Low	Low	Low	Moderate	Moderate
SDMT[e]	-	-	-	-	-	-	Very Low

[a] Expanded Disability Status Scale – 0 to 10 (10 = most severe)
[b] Tremor Severity Score – 0 (no tremor) to 100 (most severe tremor)
[c] Functional Severity Scale – 0 (no impact) to 100 (greatest impact on function)
[d] Tremor Impact Score –

- Low - 0-29, small tremor amplitude, no disengagement from tasks
- Moderate - 30-70, moderate tremor amplitude, disengagement from some tasks
- High - 71-100, high tremor amplitude, disengagement from many tasks

[e] Symbol Digits Modalities Test – Normal (within 1 SD of mean for age group), Low (between -1 and -2SD of mean for age group), very low (over -2SD of mean for age group)

The interventions selected by participants are summarized in table four. No two participants selected the same combination of intervention techniques. Each participant received education and was properly positioned to ensure proximal stabilization of the affected limb before trying the other techniques. Two participants reported using techniques included in the SWAT-IT$_2$ protocol prior to enrolling in the study. All participants chose to couple techniques.

Table 4: Techniques selected by participants during intervention

Technique	Participant						
	1	2	3	4	5	7	8
Education	✔	✔	✔	✔	✔	✔	✔
Proximal Stabilization	✔	✔	✔	✔	✔	✔	✔
Hand-over-hand			✔	✔			
Stabilization of the wrist/hand/forearm	*	✔			✔		
Reduce Travel Distance	✔					✔	✔
Start-Stop-Start		✔					
Switching Handedness		*	✔	✔	*		
Weighted Wrist Cuff		✔	✔[a]			✔	✔
Built-up							✔
Built-up and Weighted	✔			✔			
Splinting					✔		
Weighted Wrist Splint	✔						
Cooling Forearm Wrap	✔	✔		✔			
Compression						✔	
Coupling	✔	✔	✔	✔	✔	✔	✔

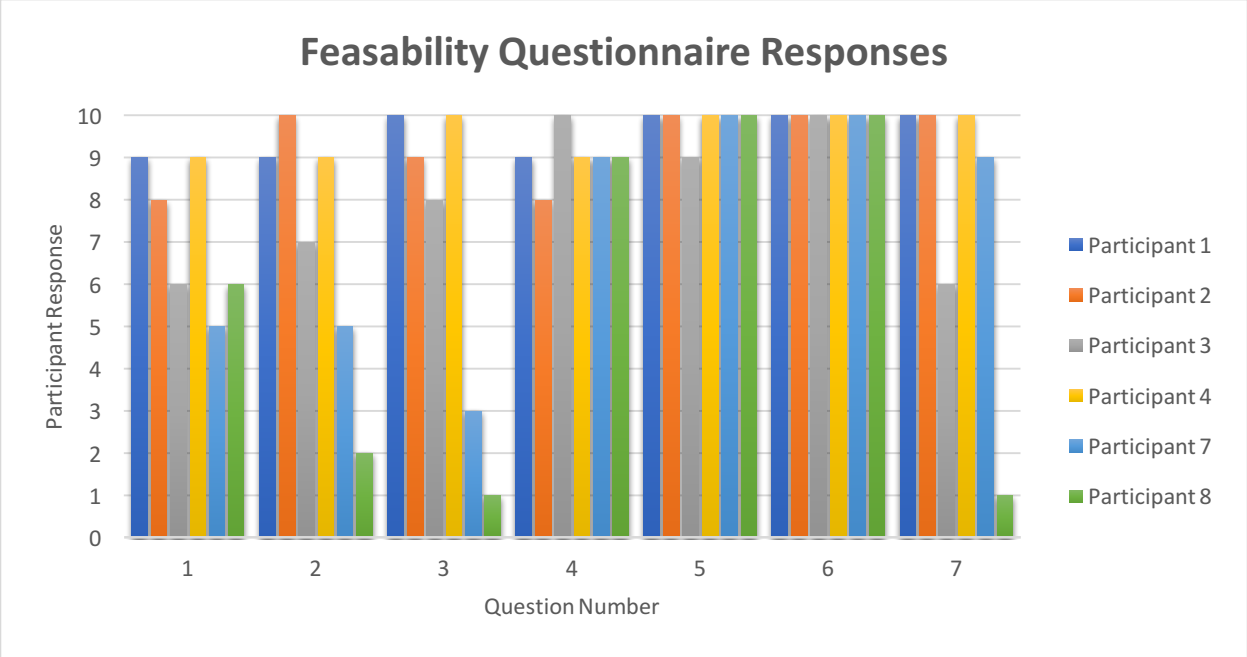
*Already performing techniques prior to intervention

[a] Participant used a weight on their thumb as opposed to their wrist

Objective 1: Feasibility

Six participants provided feedback on their experiences with the SWAT-IT$_2$ protocol. Figure one shows their responses to the feasibility questionnaire. All participants thought the SWAT-IT$_2$ was administered over a manageable amount of time with easy to understand instructions, and most were confident using their techniques at home. Approximately half the participants expect to continue using their techniques.

Figure 1. Responses to Feasibility Questionnaire[a]



Question 1: How satisfied were you with the techniques in the SWAT-IT$_2$ protocol?
Question 2: I intend to continue using the technique(s) learned during the SWAT-IT$_2$.
Question 3: The SWAT-IT$_2$ contained techniques that were useful in treating my intention tremor.
Question 4: The SWAT-IT$_2$ was administered over a manageable amount of time.
Question 5: I was able to trial all the techniques of the SWAT-IT$_2$.
Question 6: The instructions for each SWAT-IT$_2$ were easy to understand.
Question 7: I feel confident that I can continue to use my chosen SWAT-IT$_2$ techniques at home.
[a]Feasibility Questionnaire – Question 1: 1 (Not Satisfied) – 10 (Very Satisfied), Questions 2-7: 1 (Strongly Disagree) – 10 (Strongly Agree).

In addition to these results, participants were invited to elaborate on their experience. Participants one, two, and four reported that the cooling wrap was the most effective technique in reducing tremor, and therefore increasing function. Participant two stated that the initial intervention session was time consuming and therefore was not completely satisfied with the overall intervention. Participant three reported that the weighted splint did not suit her needs, and participant five reported that the prefabricated splint was heavy and cumbersome. Participants three, five, and eight reported that using the techniques took longer than completing activities without any techniques. Participant seven felt his tremor was too severe to be assisted by the techniques, however this participant was diagnosed with ataxia as well as IT after the study was conducted which may have affected the participant's experience. Participant eight felt that the techniques helped initially, but the strength level required to do the chosen activity for a prolonged period with the wrist weight was prohibitive.

Objective 2: Participant Satisfaction related to Function

Table five shows satisfaction scores for the first week. Baseline scores represent self-reported satisfaction regarding completing the participant's chosen activity prior to intervention. All participants initially reported an improvement in their satisfaction to perform their chosen activity immediately after receiving the intervention. In the week following the intervention, participants one, two, three, five, and seven indicated a range in their satisfaction. Participants three and seven indicated an average increase in satisfaction over baseline after one week.

Table 5: DTEval[a] scores on satisfaction over a week

Participant	Satisfaction			
	Baseline	Intervention	7 day average	Range
1	5	8	5	4 – 7
2	8	9	4	3 – 6
3	3	5	5	3 – 7
5	9	9	3	2 – 3
7	1	4	2	1 – 3
8	2	4	2	2

[a]DTEval – 1 (no satisfaction) to 10 (very satisfied)

Table six outlines satisfaction scores one month after intervention. After using their chosen techniques for one month, participants one, two, three, and seven indicated increased satisfaction over their baseline performance. These participants also had higher levels of satisfaction in their performance after one month than the average of their first week trying their chosen techniques. Participants five and eight reported lower satisfaction when using their chosen techniques for their desired activity than their baseline. It is believed that participant five indicated a lower level of satisfaction because of a ceiling effect the participant rated her baseline functional satisfaction quite high which did not allow room to indicate improvement. Participant eight reported low confidence in ever being able to meet her goal. It is hypothesized that being asked to practice the techniques caused her to focus on her deficit which may have contributed to the decreased satisfaction score.

Table 6: Goals scores[a] on satisfaction over a month

Participant	Goal	Satisfaction		
		Baseline	Post one-month	Change
1	Cutting with Knife & Fork	5	9	4
2	Handwriting	8	10	2
3	Eating Finger Foods	3	6	3
5	Cutting with Knife & Fork	9	8	-1
7	Self-feeding from bowl	1	3	2
8	Handwriting	2	1	-1

[a] Scores – 1 (no satisfaction) to 10 (very satisfied)

Objective 3: Participant Perceived Function

Table seven shows changes in participant perceived function as it relates to their IT. All participants who completed the study protocol, with the exception of participant eight, indicated a lower functional severity score post intervention. This translates to increased perceived function in daily activities. The same reasoning regarding participant eight's decreased satisfaction may also apply here.

Table 7: Tremor severity related to completing functional activities pre and post intervention

Participant	Pre FSS	Post FSS	Change
1	26	26	0
2	60	33	-27
3	3	2	-1
4	43	40	-3
5	11	-	-
7	80	75	-5
8	77	84	7

MAT Part D: Functional Severity Scale – 0 (no impact) to 100 (greatest impact on function)

Objective 4: Participant Self-Efficacy

Participant-reported self-efficacy values pre and post intervention are shown in table eight. Participants one, three, and eight reported a slight increase in self-efficacy after undergoing the SWAT-IT$_2$ protocol. Participants two, four, and seven reported no change in self-efficacy.

Table 8: Self-efficacy scores based on the NGSE[a]

Participant	Pre NGSE	Post NGSE	Change
1	29	32	3
2	31	31	0
3	36	37	1
4	25	25	0
7	16	16	0
8	30	34	4

[a] NGSE Scale – 0 (low self-efficacy) to 40 (high self-efficacy)

DISCUSSION

Participants five and eight reported lower satisfaction when using their chosen techniques for their desired activity than their baseline. It is believed that participant five indicated a lower level of satisfaction because of a ceiling effect the participant rated her baseline functional satisfaction quite high which did not allow room to indicate improvement. Participant eight reported low confidence in ever being able to meet his goal. It is hypothesized that being asked to practice the techniques caused him to focus on his deficit which may have contributed to the decreased satisfaction score. The same reasoning regarding participant eight's decreased satisfaction may also apply.

Although some participants indicated higher self-efficacy after working with their chosen techniques over one month, these were not clinically significant findings. Research has shown that it is difficult to achieve a significant change in participant's self-efficacy when measured

over a short period of time,[41] and for significant improvements in self-efficacy to readily occur it needs to be measured over a longer period of time, such as a 12-month period.[41] A randomized control trial also found that having peer support for individuals with MS led to positive gains in psychosocial functioning,[41] therefore a support group for past participants may be valuable as self-efficacy is a significant predictor of mood control, an indicator of well-being, and is a better predictor of involvement in social activities than disability level.[42]

Recruitment provided one of the largest challenges for this study, and resulted in a significant sample size limitation. Despite a comprehensive multisite campaign, fewer than expected participants were enrolled. A possible explanation is that IT is not as common as initially believed in the local population. There is little consensus on the rate of IT within the MS population. Weinshenker et al.[43] found cerebellar deficits in one third of 259 MS patients followed for three years but did not evaluate tremor. Alusi et al.[44] found tremor present in 58% of 100 London-dwelling MS patients, but the majority was not IT. They concluded that "intention tremor is a relatively uncommon manifestation of multiple sclerosis, occurring in only 6% of the population"[44]. Pittock et al. determined that tremor was present in 26% of their sample population, but they did not determine the prevalence of intention tremor specifically. While the protocol of this study was initially developed for IT[32] future SWAT-IT$_2$ investigations should examine the protocols effectiveness and feasibility in all MS patients with tremor due to the high prevalence of other types of tremor in MS compared to intention tremor.

A significant limitation of this study is that only one occupation is addressed in the intervention session. Participant feedback indicated that trialing the interventions on more than one occupation was too time consuming and did not align with participant energy levels. Researchers noted that participants were not readily incorporating the techniques into other daily

occupations. Only one participant, participant seven, described using the techniques for other occupations involving upper limb fine motor skills. It is recommended that the protocol is revised to include participant brainstorming regarding generalizing the strategies to multiple occupations as this could further reduce functional tremor severity. It is believed that engaging the participants in this process would increase buy-in.

CONCLUSION

Individuals diagnosed with IT secondary to MS have substantially more difficulty performing meaningful daily occupations. A quantitative pre-post cross-sectional design trialing the SWAT-IT_2 tool was used to explore interventions strategies that individuals diagnosed with MS and IT find helpful in reducing the impact of IT when performing their desired occupations. These preliminary results indicate that the SWAT-IT_2 protocol is feasible for implementation in a clinical setting and serves as a client-centered tool for addressing function due to IT secondary to MS. The majority of participants were more satisfied with their performance in their chosen activity after receiving the SWAT-IT_2 interventions, and felt their tremor was less severe in the context of completing their daily activities as measured by the MAT. However, due to a small sample size further investigation is warranted to validate the findings of this study.

Findings in this study contribute to the literature by demonstrating the SWAT-IT_2 tool as a valuable noninvasive, nonpharmacological option for the treatment of IT. Further, it has clinical implications as it provides a specific intervention health practitioners can administer to treat individuals diagnosed with MS and IT.

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