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Michael Gassett
Governors State University

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**Physical Therapy Management of 44-year-old Female with Lateral
Ankle Sprain and Multiple Sclerosis in the Outpatient Setting: A
Retrospective Case Report**

By

Michael P. Gasset
B.S., Butler University 2012

Capstone Project

For the Degree of Doctor of Physical Therapy

Governors State University
University Park, IL 60484

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ABSTRACT

Background and purpose: Recent literature has shown that neuromuscular re-education and lower extremity muscle strengthening are important therapeutic components of preventing re-injury in patients with lateral ankle sprains (LAS). There is very literature however on the effectiveness of this treatment on a person with a LAS as well as overall balance issues secondary to a medical diagnosis such as multiple sclerosis (MS). The purpose of this retrospective case study is to describe the outcomes of using neuromuscular re-education as well as lower extremity muscle strengthening in a 44-year-old female patient with a LAS and a medical diagnosis of MS.

Case description: The subject was a 44-year-old female that presented to outpatient physical therapy with a diagnosis of a left LAS. She also reported a history of MS, which had caused overall balance issues throughout her life prior to the injury. Impairments included decreased strength in her left lower extremity, increased pain, decreased balance, and decreased functional abilities. The patient was seen for 12 treatment sessions over 4 weeks.

Outcomes: The patient demonstrated improvements on the following outcome measures: Lower Extremity Functional Scale, Manual Muscle Testing, Numerical Pain Rating Scale, Modified Romberg Test, and Single Leg Stance Test. All Physical Therapy goals were met.

Discussion: Rapid improvements in pain, function, strength and balance were seen in this patient following physical therapy with neuromuscular re-education and lower extremity muscle strengthening. These results are consistent with the findings in the current literature on the use of neuromuscular re-education to treat LAS. The relationship between the interventions and the results cannot be considered causative due to the single subject in this case report. More research is needed in order to study the effects of neuromuscular re-education and lower extremity muscle strengthening in a larger population of patients with LAS.

INTRODUCTION

Lateral ankle sprain (LAS) is among the most common lower extremity injuries with an estimated 2 million acute ankle sprains occurring annually in the United States (an incidence of 2.15 per 1000 person - year)¹. While LAS is a common sporting injury, often as a result of landing or turning during these activities, LAS can be caused by relatively minor events of every day life such as tripping, falls, or slipping². While LAS are very common and physical therapy rehabilitation is often a component of treatment, many people who experience a LAS continue to have residual symptoms such as functional instability (FI), recurrence of injury, and pain long after the injury³. One study by Verhagen et al. showed that among non-athletes with ankle sprains, 6% were unable to continue their previous occupation and 15% required external support, such as bracing, to continue their original occupation⁴. FI stemming from neuromuscular and proprioceptive deficits has been hypothesized to be a major contributing factor in the chronic ankle symptoms some individuals experience following a LAS. Even with this current research, the use of lower extremity strengthening in combination with neuromuscular re-education to increase proprioception and balance has not been adequately studied in the physical therapy management of a patient with a LAS and confounding neuromuscular disorder such as MS. The objective of this retrospective case

study is to discuss the outcomes of physical therapy management in an outpatient setting with an increased focus on neuromuscular re-education and muscular strengthening on a non-athlete patient with a LAS as well as a medical diagnosis of relapse remitting MS.

Outcomes: By the end of treatment the patient demonstrated improvement on the following outcome measures: LEFS, Numerical Pain Rating Scale, increased manual muscle testing grades on the impaired lower extremity, and improved balance demonstrated by the modified Romberg and the single leg stance test.

CASE DESCRIPTION

Subject

This case study included a single subject, a 44-year-old female who presented to outpatient orthopedic physical therapy with a medical diagnosis of left ankle sprain. She was not currently employed but was active as a stay at home mother of two children, which she stated required her to be moving around, standing and performing other parental responsibilities. The patient reported her injury had occurred when she had rolled her ankle to extreme inversion when descending the stairs six weeks prior to beginning outpatient physical therapy. She reported having radiographs, which confirmed that ligamentous damage had occurred in her left ankle but she was never able

to bring them in for the therapist to view. Her chief complaint at the initial evaluation was of pain on the lateral and dorsal aspect of her left ankle, which she reported as 6/10. Her symptoms worsened with ankle inversion, prolonged standing, and palpation on lateral/dorsal aspect of the foot and ankle. She also reported having functional limitations walking on even and uneven surfaces, getting in/out of a car, ascending/descending stairs, and standing for over 5 minutes. At the initial evaluation the patient was wearing a store bought ankle brace limiting ankle inversion/eversion, which she reported wearing for increased stability and to avoid painful motions. The patient's pertinent medical history included relapse remitting multiple sclerosis, which she reported to cause overall balance issues such as difficulty single leg standing, difficulty on uneven surfaces and decreased endurance. The patient presented with an antalgic gait pattern which she reported was secondary to the current pain level in her ankle. Prior to the current injury she reported her overall health as good.

Systems review

The patient's cardiopulmonary system was cleared as their vitals were found to be normal. The patient's integument was intact and there was no discoloration present. Slight edema was noted on the lateral aspect of the dorsum of the left foot. All lower extremity dermatomes were found to be normal. Neuromuscular systems impaired secondary to MS including balance

and proprioception deficits. Musculoskeletal system impaired secondary to current ankle sprain. A positive anterior drawer test of the left ankle and decreased ankle eversion and inversion strength was noted at the initial evaluation

Tests and measures & clinical impressions

Neuromuscular testing. "Recent evidence has demonstrated that the majority of patients with functional instability of the ankle do not have mechanical hypermobility of the ankle joint. Functional instability of the ankle results from a loss of neuromuscular control."⁶ Given the patient's presentation at initial evaluation, medical diagnosis, history of balance issues as well as the comorbidity of MS and the current literature on importance of neuromuscular control following a LAS, assessing her neuromuscular system was deemed critical. Neuromuscular control was assessed in order to gain baseline measurements so that progression or regression could be tracked throughout treatment. The neuromuscular tests used in this study included sensation testing, the modified Romberg, and single leg stance. The single leg stance test was included at the advice of the clinical instructor. Sensation testing was used to assess deficits in the nervous system so that a plan of care could be determined. The modified Romberg and single leg stance test were used to provide a baseline measurement for standing balance, functional movement, and neuromuscular control so that progression or

regression could be documented throughout treatment. The modified Romberg was used because it is a commonly used test used in assessing balance issues associated with MS. Progression of neuromuscular testing can be seen below in table 1. The positive final phase of the modified Romberg test is potentially due to the patient's overall balance issues that accompanied her MS.

Table 1

Date	Balance	
	<u>SLS</u>	<u>Modified Romberg</u>
06/30/2014	(L) 30 seconds (R) 60 seconds	NT At this point
07/11/2014	(L) 38 seconds (R) 60 Seconds	(-) even surface, eyes open (+) even surface, eyes closed (+) uneven surface, eyes open (+) uneven surface, eyes closed
07/29/2014	(L) 49 seconds (R) 60 Seconds	(-) even surface, eyes open (-) even surface, eyes closed (-) uneven surface, eyes open (+) uneven surface, eyes closed

Muscle strength. LE muscle strength for myotomes L2-S2 was assessed using manual muscle testing (MMT) and was performed according to Daniels and Worthingham⁷. LAS result in structural damage to the ligamentous tissue but also the musculotendinous tissue around the ankle complex. While injury to the ligaments may result in laxity of the joints of the ankle complex, neuromuscular deficits are also likely to occur due to the injury to musculotendinous tissue⁸. For these reasons, assessing the patient's lower extremity strength was important to determine if there were any deficits that needed to be addressed in therapy. Manual muscle testing data throughout treatment for left ankle can be seen below in table 2. Strength of the right ankle was not included in the table as it was 5/5 throughout at initial evaluation and discharge.

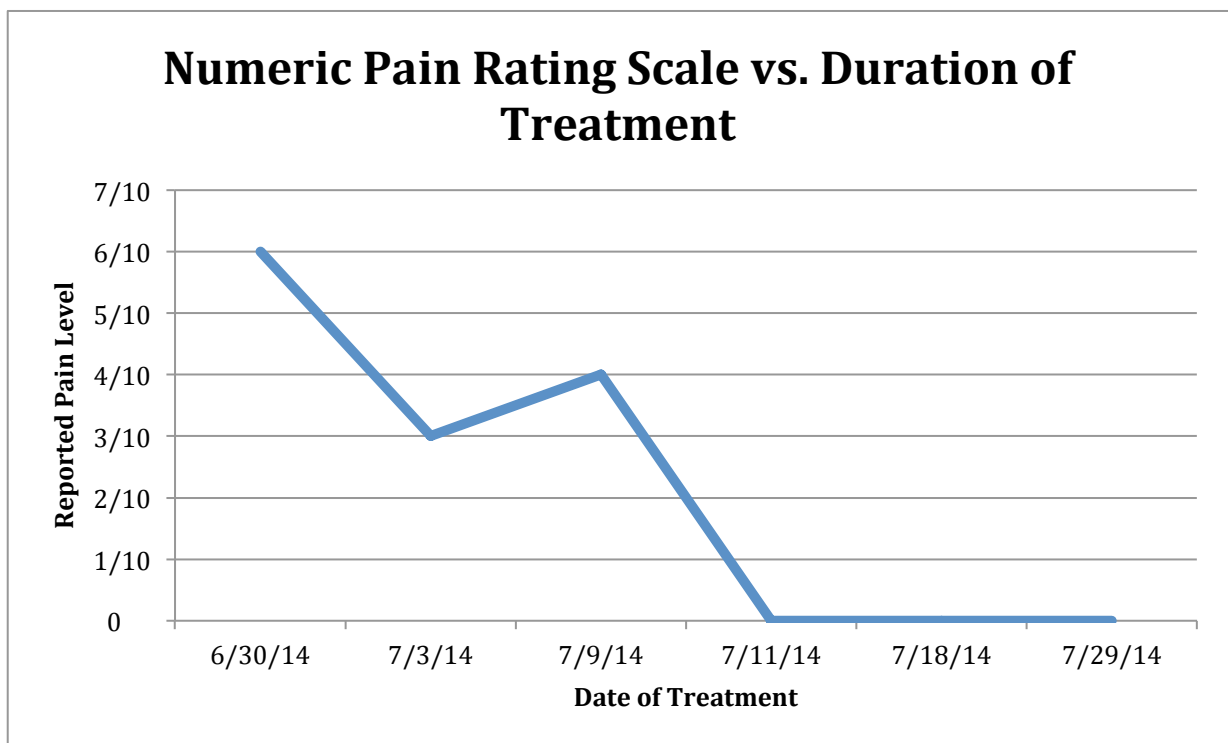
Table 2

Date	Strength (in left ankle)			
	<u>DF</u>	<u>PF</u>	<u>Inversion</u>	<u>Eversion</u>
06/30/2014	5/5	5/5	4/5 with pain	3+/5
07/11/2014	5/5	5/5	5/5	3+/5
07/29/2014	5/5	5/5	5/5	5/5

Pain. One of the patient's main complaints was of increased pain. The Numerical Pain Rating Scale (NPRS) was used to measure the patient's pain levels at initial evaluation so that progression or regression could be documented and the plan of care could be adjusted accordingly. The patient was instructed to rate her current level of pain on a 0-10 scale with 0 indicating no pain whatsoever and 10 indicating the worst pain she had ever experienced.

The patient's pain levels throughout her time in therapy can be seen in graph 1 below. Pain levels were taken at the beginning of sessions.

Graph 1



The patient reported her son accidentally stepping on her ankle on 7/8/14, which may explain the slight increase in pain reported on 7/9/14.

Functional measures. The Lower Extremity Functional Scale (LEFS) is a valid and reliable tool applicable to a wide variety of lower extremity orthopedic conditions including LAS⁹. The LEFS was used in this case study to document progression or regression of the patient's functional abilities so that the plan of care could be adjusted as needed. An Example of the LEFS can be seen below.

Lower Extremity Functional Index

We are interested in knowing whether you are having any difficulty at all with the activities listed below because of your lower limb problem for which you are currently seeking attention. Please provide an answer for each activity.

Today, do you or would you have any difficulty at all with:

(Circle one number on each line)

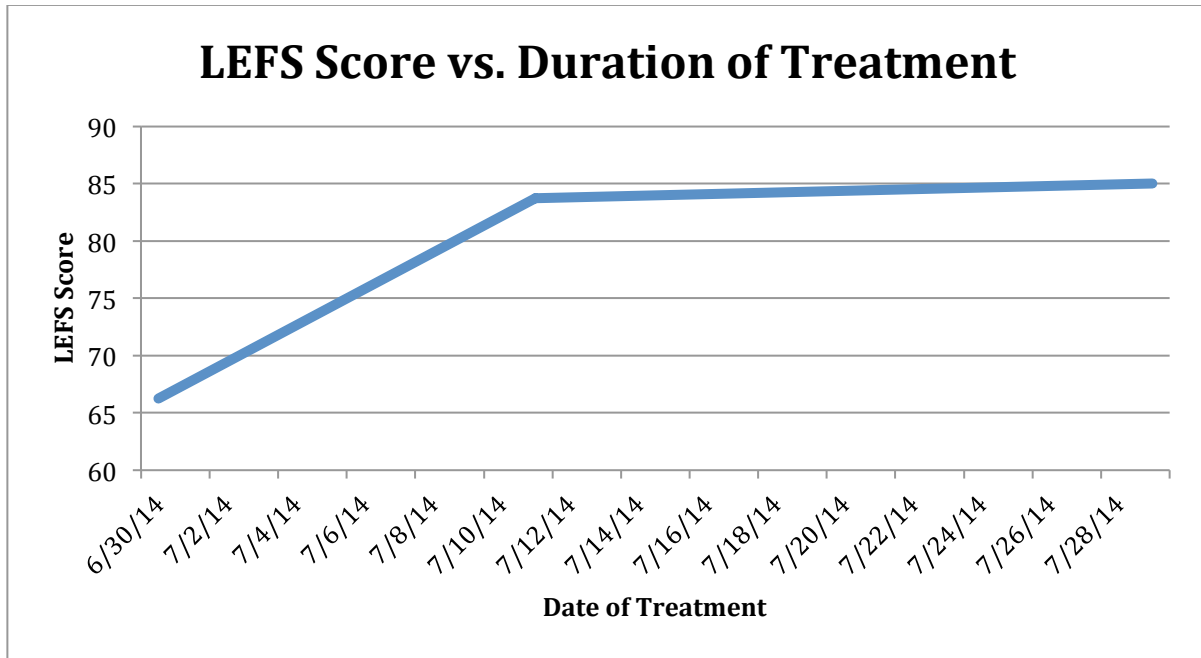
Activities	Extreme Difficulty or unable to perform activity	Quite a bit of difficulty	Moderate difficulty	A little bit of difficulty	No difficulty
a. Any of your usual work, housework or school activities.	0	1	2	3	4
b. Your usual hobbies, recreational or sporting activities	0	1	2	3	4
c. Getting into or out of the bath.	0	1	2	3	4
d. Walking between rooms.	0	1	2	3	4
e. Putting on your shoes or socks.	0	1	2	3	4
f. Squatting.	0	1	2	3	4
g. Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
h. Performing light activities around your home.	0	1	2	3	4
i. Performing heavy activities around your home.	0	1	2	3	4
j. Getting into or out of a car.	0	1	2	3	4
k. Walking 2 blocks.	0	1	2	3	4
l. Walking a mile.	0	1	2	3	4
m. Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
n. Standing for 1 hour.	0	1	2	3	4
o. Sitting for 1 hour.	0	1	2	3	4
p. Running on even ground.	0	1	2	3	4
q. Running on uneven ground.	0	1	2	3	4
r. Making sharp turns while running fast.	0	1	2	3	4
s. Hopping.	0	1	2	3	4
t. Rolling over in bed.	0	1	2	3	4
COLUMN TOTALS					

Score variation \pm 6 LEFTS points
MDC & MCID = 9 LEFS points

Score ____/80

Progression of LEFS scores throughout treatment can be seen below in Graph 2.

Graph 2



The psychometrics for the previously mentioned tests are listed below in Table 3.

Table 3

	LEFS¹⁰	MMT¹¹	SLS	Modified Romberg	Anterior Drawer¹²	NPRS¹³
Test-retest reliability	Excellent 0.96	Excellent 0.98	Not Established	Not Established	Not Established	0.67-0.96
Sensitivity	0.81	0.35	Not Established	Not Established	0.83	Not established
Specificity	0.70	3.5	Not Established	Not Established	0.40	Not established
+ Likelihood Ratio	Not established	3.5	Not Established	Not Established	1.2	Not established
Interrater reliability	r-0.84	Not established	Not Established	Not Established	Not Established	excellent
Construct validity	Excellent r-0.80	Not Established	Not Established	Not Established	Not Established	r-0.95

Diagnosis & prognosis

Based on the information obtained in the initial examination of the patient, a physical therapy diagnosis of decreased strength, present visible edema, increased pain, muscle guarding, and decreased balance was made for this patient. The patient was highly motivated to decrease her pain levels and return to her prior level of function. Given this, along with her presentation of symptoms and the current literature on recovery following a LAS, the patient was given a good prognosis to return to her prior level of function. Limiting factors included her comorbidity of MS and the overall balance issues secondary to the MS discussed earlier in this case report.

Plan of care & goals for treatment

The patient received physical therapy for 4 weeks and was seen for a total of 12 visits. The patient was seeing PT in the outpatient setting for edema control, therapeutic exercise, balance/proprioception exercises, lower extremity strengthening, postural stabilization exercise, functional activities, IFC, hot/cold pack, and joint Mobilization. She reported her main goal was to decrease pain so that she could return to her normal activities and responsibilities as a mother. The main goals from a physical therapy perspective were to decrease pain, reduce edema, increase strength in the ankle and surrounding muscles, facilitate return to all activities of daily living (ADL) and increase overall balance and motor control.

Intervention procedures

Important considerations in the rehabilitation of ankle injuries include controlling the acute inflammatory process, regaining full ankle range of motion, increasing muscle strength and power, and improving proprioceptive abilities.¹³ Given the current literature on rehabilitation of LAS it was deemed important to have an increased focus on neuromuscular control exercises to increase the patient's overall stability, decrease the amount of chronic symptoms, and reduce the risk of re-injury in the future.

In a LAS, damage occurs to the ligaments in the ankle which results in the initiation of the inflammatory response. This acute inflammation can include increased pain, swelling, increased heat, and redness. Initially in

treatment it is important to address these symptoms so as not to cause further damage to the ligaments.¹³ Interventions in this phase included soft tissue mobilization (STM), cryotherapy (cold pack), and interferential current for edema control and pain management. Regaining strength bilaterally in the lower extremities is an accepted clinical practice when treating LAS and is thought to be critical in preventing future ligamentous injuries at the ankle.¹³ These strength deficits were addressed through therapeutic exercises and therapeutic activities. As stated previously, many patients experience FI following a LAS. Deficits in neuromuscular and proprioceptive control are hypothesized to be a main factor in this FI.⁵ These issues were addressed through balance and proprioception exercises/activities. The patient adhered to the plan of care by being present for most of her therapy sessions and reported compliance with the HEP. She missed one day, which she reported was due to an increase in pain when she woke up. She reported later that she regretted cancelling and that she wished she had gone to therapy on the missed day. Table 4 below shows the intervention record per session. Table 5 below describes the specific exercises in the daily exercise plan.

Table 4

Day #	I1	I2	I3	I4	I5	I6	I7
1	X	X	X	X	X		
2	X	X	X	X	X		
3	X	X	X	X	X		
4		X	X	X	X	X	
5	X	X	X	X	X	X	X
6	X	X	X	X	X		X
7		X	X				
8		X		X	X		X
9		X		X	X	X	X
10		X		X	X	X	X
11		X		X	X	X	X
12	X	X		X	X	X	X

1= Patient Education
2= Pain Management
3= Soft Tissue Mobilization
4= Balance/proprioception

5= Therapeutic Exercise
6= Therapeutic Activity
7= Manual Therapy

Table 5

The following describes the interventions used throughout this patient's plan of care Exercises were performed according to Kisner and Colby¹⁴:

- Ankle Theraband exercises: performed in all planes of motion. Resistance level progressed from yellow to red to green to blue based on patient abilities and therapist's clinical judgment.
- Ankle Circumduction
- Education: Included informing patient on the pathology of LAS, risk factors (activities and movements to avoid), importance of exercises, normal treatment and outcomes for LAS.
- Soft Tissue Mobilization (STM): For edema control in the ankle.
- Weight Shifting on Airex Pad: patient would balance on Airex foam pad and shift weight from side to side increasing weight bearing on single lower extremity.
- Calf Raises: on even ground and on Airex pad
- Bosu Ball Exercises: Side-to-side weight shifting, using lower extremity and body weight to perform circles on inverted Bosu both clockwise and counterclockwise.
- BAPS Board: level 3. Clockwise and counterclockwise. UE support was allowed for balance.

- Cryotherapy: Cold pack around ankle for 10 min concurrent with IFC.
- IFC: on lateral portion of ankle.
- Narrow base stance with perturbation: Patient stands with feet close together and the therapist applies forces in different directions to enforce patient righting their balance and rhythmic stabilization.
- Step up Marchers: On 4-inch board as well as on trampoline.
- SPROING Activities: The SPROING is a relatively new piece of equipment that allows the firmness of the standing surface to be adjusted. This allows certain weight bearing activities/exercises to be performed on a soft surface to decrease impact forces and encourage greater proprioceptive and neuromuscular control. For this case study marchers, lunges, and side lunges were performed on the SPROING.
- Manual Therapy: Distal fibular mobilizations in anterior/posterior direction of grade 3.
- Lateral up and over: on 6-inch board.
- Clams: Initially performed against gravity and was progressed to yellow theraband resistance. Progression was based upon the patient's abilities and the Therapist clinical judgment. Clams

were added to this patient's interventions to increase overall lower extremity strengthening and endurance.

- Short Arc/Long Arc quads: Performed in order to maintain lower extremity musculature and increase lower extremity strength and endurance.
- Wobble Board: Holding balanced position was performed on a rounded wobble board.
- Star Lunges: performed in all directions. Distance for lunge was based on patient abilities and therapist discretion.

Outcomes

The patient was seen for a total of 12 visits over 4 weeks. She cancelled 1 visit in that time, which she reported was due to an increase in pain when waking up. She reported later she regretted missing that day of treatment. At the conclusion of therapy, the patient demonstrated an increase in lower extremity strength in all muscle groups tested at initial evaluations. The patient also showed improved function as reported by the LEFS scale. The patient reported a decrease in pain from the initial evaluation using the NRPS. Finally balance improvement was shown through the modified Romberg test as well as single leg stance bilaterally. After 2 sessions the patient

reported no longer wearing the ankle brace because she “no longer felt she needed it”. All of the goals put in place by the therapist and the patient were met by the time of discharge and the patient reported “feeling very satisfied with the results from physical therapy”.

Discussion

The purpose of this retrospective case study was to discuss the effectiveness of physical therapy on a patient with a LAS and a medical diagnosis of MS. The treatments utilized in this report focused on improving neuromuscular re-education, balance, and muscle strengthening. This case study was necessary because it demonstrates an example of physical therapy including neuromuscular re-education and muscle strengthening being an effective method of rehabilitation in a patient with a LAS as well as MS. Following 12 visits the patient demonstrated improvement on the NPRS, the LEFS, Manual Muscle Testing, Modified Romberg, and the single leg stance test.

A few limitations can be seen in this case report. First, given this was a single subject being treated, this research cannot be generalized to a larger population. While a large portion of treatment focused on neuromuscular re-education and

muscle strengthening, other treatments such as IFC and soft tissue mobilization also were given. Because of this, there can be other explanations as to the reasoning behind the successful outcomes of treatment and it cannot be said that the neuromuscular re-education and muscle strengthening as a whole were responsible. The outcomes at the end of treatment may have been the result of natural healing or the other interventions given throughout therapy.

Further research should be done to focus solely on neuromuscular re-education and muscle strengthening as a treatment of LAS. LAS has a fairly high recurrence rate and further research should be done to focus on long term outcomes of treatment.

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