DIAGNOSIS OF SPINA BIFIDA AND SYMPTOMS OF BILATERAL FOOT PAIN: A CASE REPORT

By

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Abstract

Background and Purpose: Spina bifida is a rare neural tube defect in which malformation of the posterior arch of vertebra leaves the spinal column open. Signs and symptoms of spina bifida include but are not limited to back and lower extremity pain, bowel and bladder dysfunction and lower extremity weakness and deformity. My goal of the case report is to provide a unique report of a patient who had significant clinical improvement and developed a new belief in the positive impact of physical therapy.

Case Description: The patient is a 34-year-old logistic analyst who presented to physical therapy with a chief complaint of bilateral foot pain causing limited standing and walking tolerance. The onset of pain was insidious approximately 3 years ago. The patient was diagnosed with spina bifida occulta and tethered cord syndrome and had corrective surgery about 1 year ago. Previous treatment for their condition included bilateral tarsal tunnel decompression surgery 1 year ago. Primary interventions include pain neuroscience education, gastrocnemius stretching, and strengthening.

Outcomes: The patient present had improvement in ankle dorsiflexion and a slight improvement in plantar flexion range of motion. The patient had improvement in plantar flexion strength with no increase in pain with inversion during manual muscle testing. The patient's pain scale improved during the time of the progress note and in their reporting of worst pain in the past 2 weeks. The patient also improved on their LEFS and the single leg balance test.

Discussion: An important finding from the case report is the positive effect of pain neuroscience education for a patient with chronic pain. A primary lesson to take away is to look at the biological, psychological, and social aspects of a person to provide the best care to the patient.

Key Words: Spina bifida; chronic pain; nerve pain

Introduction

Spina bifida is a rare neural tube defect in which malformation of the posterior arch of vertebra exposes the spinal column. Birth defects such as spinal bifida occulta (SBO) are largely asymptomatic and overlooked. The estimated prevalence of spina bifida is 12.4%, with spina bifida occulta being the most prevalent .[1] Spina bifida is more common in men than women. It is commonly accompanied by a birthmark, dimple on the low back, or a small patch of hair .[2] The term “occulta” is commonly diagnosed incidentally and implies the defect is hidden under skin with no other discernible signs or symptoms .[3] Spina bifida has a constellation of signs and symptoms that include but not limited to back and lower extremity pain, bowel and bladder dysfunction, and lower extremity weakness and deformity. One case described a patient with spina bifida occulta who presented with radicular symptoms of weakness and pain through both of their legs. A minimally invasive surgical approach with endoscopic visualization was performed and resulted in a decrease but not complete elimination of radicular symptoms .[4]

Medial and lateral arch pain and heel paresthesia is rare and may be due to peripheral or central lesions. Patients with heel and/or foot pain is mostly caused by an overuse injury. It is often thought that pain in the foot is due to repetitive stress and pressure on the calcaneus .[4] There is also little research on bilateral foot pain specifically on the arches of the feet in relation to spinal lesions and complications. This case report will hopefully allow for a better understanding of the effects of physical therapy on a patient with spinal bifida occulta who presents with bilateral foot pain.

Case Description

The patient is a 34-year-old logistic analyst who presented to physical therapy with a chief complaint of bilateral foot pain causing limited standing and walking tolerance. The onset of pain was insidious and began approximately 3 years ago. The patient was diagnosed with spina bifida occulta and tethered cord syndrome and had corrective surgery about 1 year ago. He also reported a subarachnoid cyst at L5-S3. Previous treatment of their condition was bilateral tarsal tunnel decompression surgery 1 year ago. The patient reports no relief of symptoms post tarsal tunnel decompression surgeries. The patient also presents with a history of depression due to their recent medical history in the past few years. At the time of their physical therapy initial evaluation, the patient reported a chief complaint of severe foot pain on the medial and lateral arches while standing and walking. They report not being able to walk for more than a few minutes and reported using a wheelchair to get around at work. Patient denied any red flag signs or symptoms.

Patient reported prior physical therapy and chiropractic treatment that resulted in little to no improvement. No improvement was seen with the use of dry needling, therapy cupping, or electrical stimulation.

Examination

During the evaluation, the five outcome measures used were range of motion, manual muscle testing, the Numerical Pain Scale, the Lower Extremity Functional Scale (LEFS) and the Single Leg Balance Test. Tables 1-3 represent outcome measurements from the initial evaluation. Table 1 lists the patients range of motion measurements. Table 2 represents the patients manual muscle testing scores. Table 3 represents the patients Numerical Pain Scale results. The patients filled out the Lower Extremity Functional Scale questionnaire and scored 32.0. The patient also participated in the Single Leg Balance Test and was unable to balance on either leg in a single-leg stance.

The numerical pain scale is an appropriate scale to use for foot pain and inflammation.[5,6] A case study found the importance of testing range of motion due to potential mechanical dysfunction from heel pain.[7] Manual muscle testing used by physical therapists was shown to be a clinically useful tool but should be used without other outcome tools to provide quality baseline measures.[8] The article states the LEFS is a reliable and valid outcome measure for foot dysfunction, pain and various lower extremity injuries .[9,10,11] In an article that looked at the reliability and validity of the single leg stance test, the interrater reliability was high but limited concurrent validity was found. The finding suggests that single leg standing balance tasks can be reliable when evaluated by physical therapists.[12]

The patient presents with signs and symptoms consistent with chronic bilateral foot dysfunction including pain, tenderness to palpation, weakness, stiffness, neural tension, abnormal posture, abnormal gait mechanics, poor static and dynamic balance, fear avoidance behaviors, and increased tissue irritability. Chronic pain is a factor to take into consideration for this case report

due to the length of time in pain and fear avoidance behaviors observed from the initial evaluation. The patient presents with fair prognosis and a plan of care of 2 treatment visits per week for 6 weeks.

Intervention

The focus of the first 3 weeks was strengthening and stretching exercises which can be seen in Table 4. The 4th week through the 6th week of treatments are described in Table 5.

Pain neuroscience education was an intervention for the patient that aimed to reduce pain and disability by explaining the biological reasoning behind the pain experienced by the patient. When looking at the bio-psycho-social model for this patient, there is a huge psychological and social tie to the patient's condition. It is important to address all aspects of the model to give the patient the best quality care. Pain neuroscience education helps inform the patient of how our brain and social environment can affect our biology. The education worksheets presented to the patient are referenced in Appendices 1-2. A systematic review of pain neuroscience education for adults with chronic pain found providing education allows the patient to gain more control in their treatment session. This can create greater patient autonomy and an overall decrease of musculoskeletal pain.[13]

Research has been found that myofascial release and soft tissue massage were treatments that reduced the pain of a patient with foot pain and inflammation.[5] It has been found that there is benefit in de-sensitization of the tibial nerve for heel and overall foot pain. Ankle 4-way with TheraBand was used to strengthen the tibialis posterior muscle with inversion banded exercises. As a result, the patient reported less stress on the medial arch of their foot.[7] Plantar fascia stretching reduced pain for a patient with foot pain and inflammation.[5] Single leg balance exercise on unstable surfaces works on balance, lower extremity and core strengthening and postural stability. Also, the balance exercise improves sensory orientation for ambulation and other functional tasks.[7]

There were several progressions made to the patient's plan of care from the first three weeks to the second three weeks. A single leg hop exercise and a TRX squat with heel raises were added to the treatment plan. Ankle 4-way with a red TheraBand and a plantar fascia stretch were added to the patient's home exercise program. For the RDL exercise, a 25-pound kettlebell upper extremity hold was added. For the seated heal raise exercise, the resistance was increased from 20 pounds to 35-pounds.

Outcomes

A progress note was performed 6 weeks after the initial evaluation. The patient's re-evaluation outcome measures of range of motion, manual muscle testing, and the Numerical Pain Scale are described in Tables 6-8. The patient's Lower Extremity Functional Scale (LEFS) score was 60.0. The patient's single leg balance score was 60 seconds bilaterally.

The patient demonstrated improvements in dorsiflexion, and a slight improvement in plantar flexion range of motion. The patient also improved in plantar flexion strength and had no increase in pain with inversion during manual muscle testing. The patient's pain scale improved at the time of the progress note and decreased for their worst pain within the past 2 weeks. In regard to the LEFS, the patient improved from a score of 32.0 to a score 60.0. The minimal clinically important difference (MCID) for The LEFS is a 9-point improvement, therefore the patient improved in their function at a meaningful amount. The patient improved on their single leg stance balance from 0 seconds bilaterally to 60 seconds bilaterally. These findings are represented in Table 9. The patient reported that physical therapy has helped their impairments and improved their quality of life.

Discussion

This case report demonstrates an examination and treatment for a patient with bilateral foot pain potentially due to a neurogenic origin. There potentially is a larger psychological component to the patient's condition. Chronic pain was addressed due to the amount of time the patient has been in pain and their report of depression. Chronic pain has been researched by looking at brain structure differences through MRI imaging. For patients with chronic pain, many brain regions that are involved in pain processing, sensory and cognitive tasks have been altered. Pain catastrophizing is related to brain areas involved in pain processing, attention to pain, emotion, motor activity and to diminished top-down pain inhibition. Maladaptive emotional and cognitive factors are associated with several brain regions involved in chronic pain.[14] Treatment management consisted of neuroscience education, pain reduction, restoring strength and lower extremity mobility. The patient's past medical history of lumbar and sacral nerve damage of the spinal cord could cause myotomal and dermatomal pattern dysfunction to the foot and ankle.

Due to the patient's lack of ability to rise onto their toes, heel raise exercises were implemented to strengthen the gastrocnemius and soleus muscles. Eccentric gastrocnemius strengthening exercises such as heel raises off a step were implemented into the treatment plan. The patient then progressed to jumping exercises for both eccentric and concentric loads at a higher demand. A case report describing a patient with foot pain used the exercises explained above and resulted in decreased pain.[15] In a case study for a patient with foot instability, one of the interventions was squatting with heel raises to focus on strengthening and balance. The study reported positive results of increased strength and balance. Also, these exercises improve weight-bearing functional tasks like walking and running.[16]

The patient presented at their initial evaluation with limited belief of the benefit of physical therapy for their condition. After pain neuroscience education, the patient responded well and gained self-efficacy to their therapy program. The patient was compliant to all interventions and reported progress of symptoms 6 weeks into the treatments. This case report is unique because it highlights the effectiveness of pain neuroscience education, specifically the worksheets in Appendices 1-2.

In a recent case study, a patient presented with restricted ankle dorsiflexion due to adaptive shortening of gastrocnemius muscle. This limitation has been identified as one of the musculoskeletal deficits that can lead to development of sub calcaneal heel pain. Literature supports the restoration of foot and ankle flexibility to the involved tissues as an important component of the overall treatment program for heel and medial arch pain. Secondly, increasing the mobility of the gastrocnemius and soleus muscles may decrease compression of the tibial nerve at the fibromuscular arch of the soleus.[7] To improve the treatment sessions, an extra verbal cue to provident pronation would have been beneficial to allow for better quality stretching. Pronating in a gastrocnemius stretch could be compensation of tight tissues of the foot. To prevent this, the foot should be placed in a more supinated position to lock the mid tarsal joints and allow for more stretching of ankle plantar flexors. Overall, the patient in this paper improved dorsiflexion range of motion on both feet during the progress note.

An important finding from the case report is the positive effect of pain neuroscience education for a patient with chronic pain. A primary lesson to take away is to look at the biological, psychological, and social aspects of a person to provide the best care to the patient. Future

research could investigate the outcomes of different pain neuroscience education workbooks or resources. Literature on pain neuroscience education is limited and could benefit from further research.

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Tables and Figures

Table 1. IE: Range of Motion

Ankle ROM *(*degrees)	**LEFT**	**RIGHT**
DF @ 90° knee flexion	1.0°	0.0°
Eversion	WNL	WNL
Inversion	WNL	WNL
Plantarflexion	56.0°	51.0°

Lumbar ROM (degrees)	
Forward bending	Reaches to mid shin, radiating symptoms down posterior legs
Backward bending	10.0°
Left rotation	15.0°
Right rotation	15.0°
Left side bending	WNL
Right side bending	WNL

Table 2. IE: Manual Muscle Test

BODY PART	LEFT	RIGHT
Ankle dorsiflexion	5/5	5/5
Ankle Plantarflexion	2+/5	2+/5
Ankle eversion	4+/5	5/5
Ankle inversion	5/5 w/pain	5/5 w/pain
Hip flexion	4/5	4/5
Hip extension	4+/5	4+/5
Hip abduction	4+/5	4+/5
Hip adduction	4+/5	4+/5
Hip internal rotation	4+/5	4+/5
Hip external rotation	4/5	4/5
1st toe extension	Weak/painless	Strong/painless
1st toe flexion	Strong/painful	Weak/painful

Table 3. IE: Pain Scale

Body part:	Foot
Side of body:	Bilateral
Type of pain:	Chronic
Pain at best in past 2 weeks:	0
Pain at time of visit:	5
Pain at worse in past 2 weeks:	9
Pain descriptions:	Burning, constant
Pain aggravating factors:	Walking, standing, applying, pressure, exercising
Pain alleviating factors:	Resting

Table 4: Treatment Flow Sheet Week 1-3

EXERCISE	SETS	REPS	RESISTANCE	DURATION	Notes
Manual Therapy				20 mins	Trigger point release on medial arch of feet. Soft tissue mobilization along plantar surface of both feet. Targeting desensitization.
DF Stretch	2			20 secs	While standing in staggered stance, patient leans body forward until feels stretch in back leg. Therapist is monitoring for compensation and over-pronating of foot.
Heel Raises	3	10			The heel is placed off a step while the front foot is placed on a step to allow for eccentric targeting of heel raises.
Ankle 4-way with band (inversion, eversion, dorsiflexion & plantarflexion)	2	10	Yellow Theraband		
RDL	2	10			
Seated Heel Raises	1	20	20 lbs		With the kettle bell placed on each leg above the knee.
Plantar Fascia Stretch	1			90 secs	Patient is sitting in chair, legs crossed and extending their toes with their hand.
BOSU Squat	2	10			Both feet on round side of BOSU and hands out in front.
BOSU Lunge	2x per foot	10			Land front foot on round side of BOSU and lunge forward.
BOSU Single Leg Balance	2x per foot			60 secs	Foot positioned on center of round side of BOSU.

Table 5. Treatment Flow Sheet Week 4-6

EXERCISE	SETS	REPS	RESISTANCE	DURATION	Notes
Manual Therapy				20 mins	Trigger point release on medial arch of feet. Soft tissue mobilization along plantar surface of both feet. Targeting desensitization.
DF Stretch	2			20 secs	While standing in staggered stance, patient leans body forward until feels stretch in back leg. Therapist is monitoring for compensation and over-pronating of foot.
Heel Raises	3	10			The heel is placed off a step while the front foot is placed on a step to allow for eccentric targeting of heel raises.
Single Leg Hop	4	8 hops			Two cones are set up 3 feet away from each other. The patient hops laterally back and forth to each cone.
TRX Squat with Heel Raises	3	10			Hold onto TRX straps when squatting, then rise onto toes.
Seated Heel Raises	1	20	35 lb		With the kettle bell placed on each leg above the knee.
RDL	2	10	25 lb kettlebell		Patient holds kettlebell with both hands
BOSU Squat	2	10			Both feet on round side of BOSU and hands out in front.
BOSU Lunge	2	10			Land front foot on round side of BOSU and lunge forward.
BOSU Single Leg Balance	2			60 secs	Foot positioned on center of round side of BOSU.

Table 6. Progress Note at 6 Weeks of Treatment: Range of Motion

Ankle ROM (degrees)	**LEFT**	**RIGHT**
DF @ 90° knee flexion	5.0°	6.0°
Eversion	WNL	WNL
Inversion	WNL	WNL
Plantarflexion	60.0°	53.0°

Lumbar ROM (degrees)	
Forward bending	Reaches to mid shin, radiating symptoms down posterior legs
Backward bending	20.0°
Left rotation	15.0°
Right rotation	15.0°
Left side bending	WNL
Right side bending	WNL

Table 7. Progress Note at 6 Weeks of Treatment: Manual Muscle Test

BODY PART	LEFT	RIGHT
Ankle dorsiflexion	5/5	5/5
Ankle Plantarflexion	4/5	4/5
Ankle eversion	4+/5	5/5
Ankle inversion	5/5	5/5
Hip flexion	4+/5	4+/5
Hip extension	4+/5	4+/5
Hip abduction	5/5	5/5
Hip adduction	4+/5	4+/5
Hip internal rotation	4+/5	4+/5
Hip external rotation	4+/5	4+/5
1st toe extension	Weak/painless	Strong/painful
1st toe flexion	Strong/painless	Weak/painful

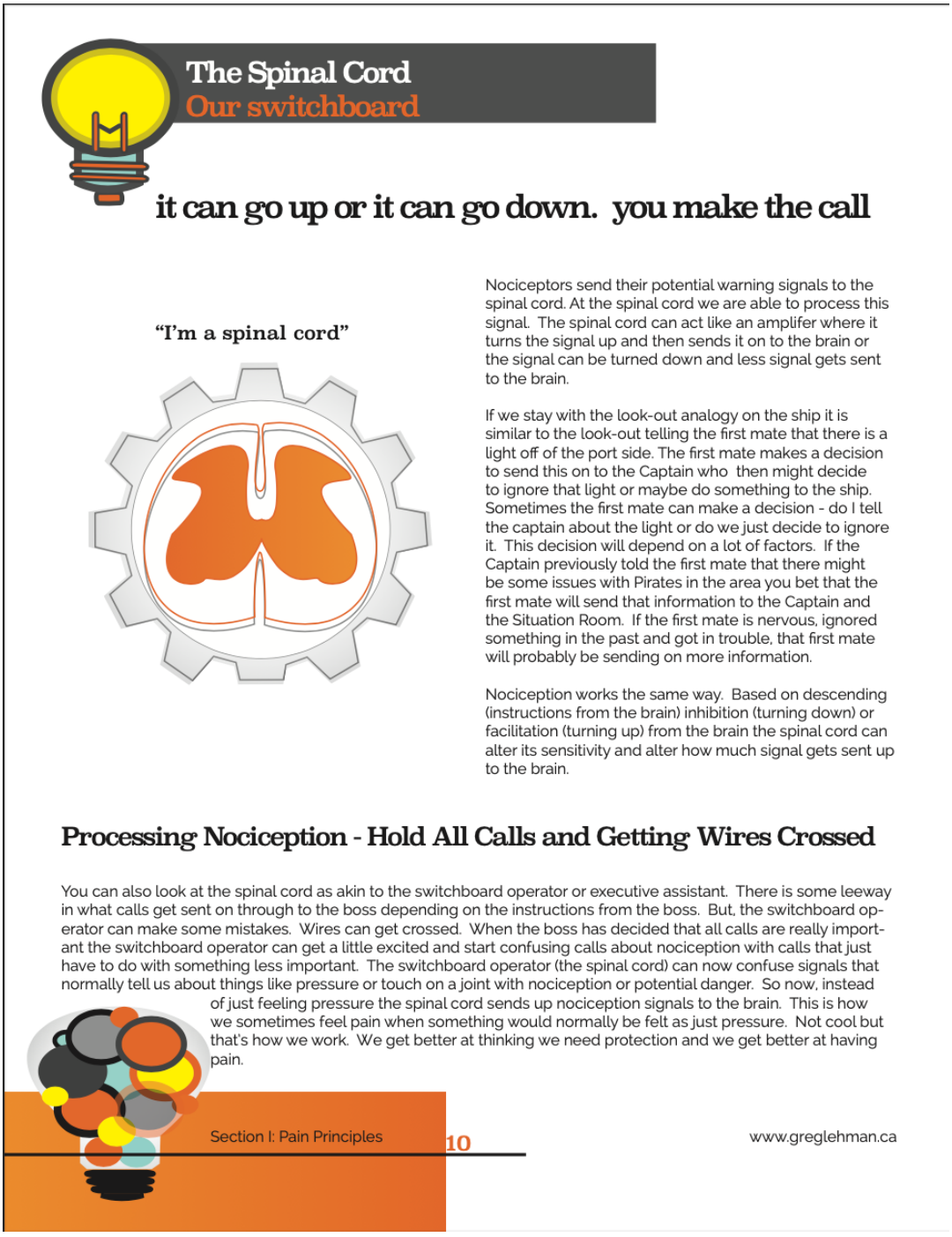
Table 8. Progress Note at 6 Weeks of Treatment: Pain Scale

Body part:	Foot
Side of body:	Bilateral
Type of pain:	Chronic
Pain at best in the past 2 weeks:	0
Pain at time of visit:	0
Pain at worse in the past 2 weeks:	3
Pain descriptions:	Burning, constant
Pain aggravating factors:	Walking, standing, applying, pressure, exercising
Pain alleviating factors:	Resting

Table 9: Improved Outcomes in 6 Weeks

	Initial Evaluation	Post 6-Week Progress Note
Range of Motion		
Left DF:	**1.0°**	**5.0°**
Right DF:	**0.0°**	**6.0°**
Left PF:	**56.0°**	**60.0°**
Right PF:	**51.0°**	**53.0°**
Manual Muscle Testing		
Left PF:	**2+/5**	**4/5**
Right PF:	**2+/5**	**4/5**
Numerical Pain Scale		
Pain at time of visit:	**5**	**0**
Pain at worse in the past 2 weeks:	**9**	**3**
LEFS:	**32.0**	**60.0**
Single Leg Balance Test		
Left limb balance:	**0.0 secs**	**60.0 secs**
Right limb balance:	**0.0 secs**	**60.0 secs**

Appendixes



The Spinal Cord
Our switchboard

it can go up or it can go down. you make the call

"I'm a spinal cord"

Nociceptors send their potential warning signals to the spinal cord. At the spinal cord we are able to process this signal. The spinal cord can act like an amplifer where it turns the signal up and then sends it on to the brain or the signal can be turned down and less signal gets sent to the brain.

If we stay with the look-out analogy on the ship it is similar to the look-out telling the first mate that there is a light off of the port side. The first mate makes a decision to send this on to the Captain who then might decide to ignore that light or maybe do something to the ship. Sometimes the first mate can make a decision - do I tell the captain about the light or do we just decide to ignore it. This decision will depend on a lot of factors. If the Captain previously told the first mate that there might be some issues with Pirates in the area you bet that the first mate will send that information to the Captain and the Situation Room. If the first mate is nervous, ignored something in the past and got in trouble, that first mate will probably be sending on more information.

Nociception works the same way. Based on descending (instructions from the brain) inhibition (turning down) or facilitation (turning up) from the brain the spinal cord can alter its sensitivity and alter how much signal gets sent up to the brain.

Processing Nociception - Hold All Calls and Getting Wires Crossed

You can also look at the spinal cord as akin to the switchboard operator or executive assistant. There is some leeway in what calls get sent on through to the boss depending on the instructions from the boss. But, the switchboard operator can make some mistakes. Wires can get crossed. When the boss has decided that all calls are really important the switchboard operator can get a little excited and start confusing calls about nociception with calls that just have to do with something less important. The switchboard operator (the spinal cord) can now confuse signals that normally tell us about things like pressure or touch on a joint with nociception or potential danger. So now, instead of just feeling pressure the spinal cord sends up nociception signals to the brain. This is how we sometimes feel pain when something would normally be felt as just pressure. Not cool but that's how we work. We get better at thinking we need protection and we get better at having pain.

Section I: Pain Principles 10 www.greglehman.ca

Appendix 1: Recovery Strategies Pain Guidebook by Dr. Greg Lehman

The Brain
The situation room

"how dangerous is this really"?

The brain ultimately makes a decision about what to do with nociception. But like most decisions it doesn't arrive at this decision based on one factor. This is why pain is so much more than nociception. Nociception is just a potential warning signal. It is the same as the lookout yelling that there is light off the starboard side. The brain is like the Captain of the ship and Captains often have a whole situation room to advise them. The Captain will make a decision about that light based on her past experience, where the ship is, what has happened previously and from insight from other officers. The brain works the same way. Expectations, past experiences, beliefs, attitude and emotions can all influence how much or whether you have pain. This is why for the same information (e.g. same nociception) you can have vastly different pain responses.

The brain doesn't just produce pain just like the Captain won't just sound an alarm. The Captain will do other things as well. There are a bunch of decisions to make and all are meant to help protect. Pain can occur but so can muscle tightness, releasing of different chemicals or a stress reaction. If the brain/captain is concerned with the information from the lookout the captain can ask the lookout to be hypervigilant and tell the spinal cord/first mate to keep sending more information up and order the engine room to increase speed and for Tiller operator to turn the ship. But fortunately, the captain can also suggest that while that information is a little bit important it is not too important. Its not worthy of freaking out and creating a lot of pain. Here the captain can send descending inhibition of nociception. Essentially, telling the first mate "don't worry about those lights. We understand what they are and there is no need to protect the ship with any evasive action".

What can happen with persistent pain is that the Captain and the whole crew stays on high alert.

They might have passed through the Pirate infested waters where caution and vigilance (and pain) were necessary but now there are no more Pirates. But, we still have the fear of Pirates so the ship stays on alert. Its sensitive and pain is created to keep protecting the ship even though that protection is no longer needed or can be detrimental.

The perceived need for Protection ("Danger in Me")

In the great self help book "The Protectometer" David Butler and Lorimer Moseley refer to things called DIMs and SIMs. A DIM means "Danger in Me" and a SIM means "Safety in Me". If you feel that something in your life is a DIM and these DIMs out weigh your SIMs then you are likely to have pain. The idea is that anything in your life that contributes to you feeling like you need protection (e.g. the DIMs) will contribute to you having pain. Performing a self audit of the things that contribute to your sensitivity (your DIMs) can be important part of recovery. See Section IV: Recovery Strategies for more on that.

Appendix 2: Recovery Strategies Pain Guidebook by Dr. Greg Lehman

Name:_____ DATE:_____ DOB:_____

THE LOWER EXTREMITY FUNCTIONAL SCALE

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:

	Activities	Extreme Difficulty or Unable to Perform Activity	Quite a Bit of Difficulty	Moderate Difficulty	A Little Bit of Difficulty	No Difficulty
1	Any of your usual work, housework, or school activities.	0	1	2	3	4
2	Your usual hobbies, re creational or sporting activities.	0	1	2	3	4
3	Getting into or out of the bath.	0	1	2	3	4
4	Walking between rooms.	0	1	2	3	4
5	Putting on your shoes or socks.	0	1	2	3	4
6	Squatting.	0	1	2	3	4
7	Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
8	Performing light activities around your home.	0	1	2	3	4
9	Performing heavy activities around your home.	0	1	2	3	4
10	Getting into or out of a car.	0	1	2	3	4
11	Walking 2 blocks.	0	1	2	3	4
12	Walking a mile.	0	1	2	3	4
13	Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
14	Standing for 1 hour.	0	1	2	3	4
15	Sitting for 1 hour.	0	1	2	3	4
16	Running on even ground.	0	1	2	3	4
17	Running on uneven ground.	0	1	2	3	4
18	Making sharp turns while running fast.	0	1	2	3	4
19	Hopping.	0	1	2	3	4
20	Rolling over in bed.	0	1	2	3	4
	Column Totals:					

Minimum Level of Detectable Change (90% Confidence): 9 points **SCORE: _____/ 80**

Please submit the sum of responses.

Reprinted from Binkley, J., Stratford, P., Lott, S., Riddle, D., & The North American Orthopaedic Rehabilitation Research Network, The Lower Extremity Functional Scale: Scale development, measurement properties, and clinical application, Physical Therapy, 1999, 79, 4371-383, with permission of the American Physical Therapy Association.

Appendix 3: The Lower Extremity Functional Scale Outcome Measure Tool