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The Calm App as an Adjunct to Physical Therapy for Chronic Neck and Shoulder Pain

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Abstract

Background: As Physical Therapists tasked with treating chronic pain to combat the opioid epidemic it becomes necessary to treat both the physical and psychological aspects of pain in the outpatient clinic. Integrating a guided meditation application can be an effective way for Physical Therapists to integrate mindfulness training into their treatment plan. **Purpose:** The purpose of this case is to describe the integration of a meditation application in combination with a graded exercise program as part of the Physical Therapy treatment plan for chronic neck and shoulder pain. **Case Description:** A 66-year-old female presented to physical therapy for treatment of her long-standing neck and shoulder pain. The patient has a history of multiple motor vehicle accidents (MVA) along with an extensive list of comorbidities including cancer, anxiety disorder, and psychogenic non-epileptic seizures (PNES). **Outcomes:** The QuickDASH and Neck Disability Index(NDI) where used to evaluate shoulder and neck physical function and both showed significant improvement after 6 weeks of treatment. Subjective reports of fatigue, and stress were assessed at each treatment session. **Discussion:** While not a substitute for skilled clinical psychological intervention, a meditation application may be a way to integrate mindfulness practice, with Physical Therapy interventions, as a home program for patients with chronic pain.

Introduction and Background

Chronic regional pain is present in 20% to 25% of the population and chronic widespread pain is present in approximately 10% of the population[1]. As our healthcare system battles the opioid epidemic chronic pain patients become more prominent in outpatient orthopedic physical therapy clinics. Treating these patients isn't easy. Patients who have one chronic pain condition are more likely to develop another.[1] Pain makes our daily experience less enjoyable. The fear and anxiety of wondering if there is a solution to chronic pain can be further exacerbated by the stress of everyday life.

Research investigating the biopsychosocial model and its role in treating pain are still in their infancy. Approaching patient care, and pain for that matter, from a holistic perspective is not new, but it can be difficult to integrate the holistic approach into a medical system that rewards specialty. As medical practitioners move away from pharmaceuticals for pain relief to prevent dependence and serious health consequences other means of treatment are being established.

Physical Therapists traditionally are tasked with treating musculoskeletal pain that is mechanical in nature. For that reason, fully integrating the biopsychosocial model may mean that Physical Therapists will have to work with other healthcare professionals to treat the whole patient. Physicians, psychiatrists, and other health professionals have used a number of methods for addressing the psychosocial aspects of treating pain. One technique is to use meditation or mindfulness training to improve coping skills and reduce pain.[2] Specifically, research has shown that mindfulness based pain relief engages brain mechanisms involved in mediating the cognitive modulation of pain, including areas like the anterior insula, and the anterior cingulate cortex, and orbitofrontal cortex.[3]

The first line treatment for chronic pain when treated by Physical Therapists is not entirely established. As the evidence for Physical Therapy interventions in the treatment of chronic pain is considered low quality and inconsistent.[4] While further research is necessary an observant practitioner can utilize technology as to augment their treatment of chronic pain. Accordingly, it is important to look at Physical Therapy as one aspect of a multi-modal approach to combatting chronic pain.

In some instances, a referral to another provider may not be necessary and a smartphone application may be of use to start a mindfulness practice. Certainly, these applications cannot replace a skilled practitioner, but along with traditional Physical Therapy techniques they may improve patient outcomes. Mindfulness training has been shown to contribute positively to pain management for those with chronic pain.[5] One application that is easily downloaded for home use is the Calm app. The app provides guided sessions ranging from 3 to 60 minutes, emphasizing being mindful of breath, sensation, assessing emotional state without judgement, and coaching users through techniques to relax.

As there is little research on the use of technology to implement a biopsychosocial model in the treatment of chronic pain, the purpose of this case study is to highlight the utilization of a smartphone application for meditation and mindfulness in conjunction with traditional physical therapy treatments in a patient with chronic neck and shoulder pain.

Case Description

History

The patient is a 66-year-old female with an extensive medical history including cancer, multiple motor vehicle accidents, fibromyalgia, chronic pain, depression, anxiety disorder, panic disorder, tension headaches, asthma, atrial fibrillation, hypothyroidism, and lymphedema. She was referred to Physical Therapy by her Physical Medicine Physician for chronic neck and bilateral shoulder pain, who had extensive history providing care to the patient. The patient was incredibly involved in her care and proactive in seeking treatment options.

She reported seizure-like activity that was "pain induced". She consulted multiple physicians regarding this symptom and had been told by her neurologist that she had "PNES", which stands for psychogenic non-epileptic seizures. She stated that these seizures had been chronic, and "they will never go away". Psychogenic nonepileptic seizures (PNES) are clinical events resembling epileptic seizures but lacking abnormal cortical electrical discharges. They are involuntary

manifestations of a psychological distress. PNES are not associated with physiological central nervous system dysfunction but are instead psychogenically determined.[6] For this patient, her pain and history of trauma was most likely the cause of her seizure-like activity. She attributed the PNES to the persistent pain and the stress associated with it.

The patient had previously been seen by an Occupational Therapist for lymphedema of her left upper extremity in 2010 following mastectomy for breast cancer. The patient went through thirteen sessions of treatment focusing on returning her to her prior level of function after breast cancer treatment. She was instructed in energy conservation, due to high levels of fatigue, and Pilates principles were incorporated into her home exercise plan. The patient did not report going to any Pilates classes but enjoyed performing what she learned with Occupational Therapy. She reported preferring to exercise at home and having equipment like bands, light free weights, and a treadmill. At the end of her thirteen sessions the patient stated that she returned to her prior level of function with both upper extremities.

The patient expressed the fact that “I will always have pain”, but she was willing to try a course of Physical Therapy even though she had prior treatment at a different physical therapy group. The patient described pain throughout her entire body, frequent headaches, and increasingly pervasive neck and shoulder pain that was limiting her ability to perform activities at home. She was having difficulty reaching overhead. The patient was formerly employed as a school bus driver, but she has been on disability since her last MVA approximately 9 years prior. She lives with her spouse and has three adult children and multiple grandchildren.

The patient’s goals were to reduce her pain levels to feel more comfortable throughout the day. Having large amounts of pain added to her stress levels creating a cyclical stress-pain relationship. Further, she wanted to be able to reach overhead with minimal pain and get stronger through her neck and shoulders to perform functional tasks. Finally, the patient wanted to be provided with a home exercise program that she could perform on a regular basis utilizing the equipment she had at home.

Examination and Evaluation

At the first visit, the patient filled out a Neck Disability Index (NDI) and a Quick Disability of the Arm Shoulder and Hand (QuickDASH). The patient scored a 44% measure of disability on the NDI and 47.5% disability on the QuickDASH. The subjective interview with the patient revealed that she always had pain ranging 5 to 8 using a 0 to 10 scale. The patient further reported that, “for me to be less than a 5/10 for pain I have to be medicated”.

Observing the patient’s gait revealed an antalgic gait pattern due pain in the plantar aspect of her left foot. The patient stated that she was scheduled for a plantar fascia release in two weeks. Although, this referral was for neck and shoulder pain the patient did state that she has a history of low back pain and plantar fasciitis. The patient displayed a forward head, and rounded shoulders posture with a prominent Cervical-Thoracic junction, and a decreased lumbar lordosis.

The patient was asked to perform active range of motion of Cervical, Thoracic, and Lumbar spine, as well as for bilateral shoulders. Pertinent values are given in Tables 1 and 2 below. The patient reported pain and demonstrated fear with movements of her cervical spine and bilateral upper extremities. Gross range of motion was assessed and manual muscle tests were performed with the goal of avoiding symptoms. The patient demonstrated involuntary seizure like behavior with palpation to the cervical spine and with manual muscle testing to bilateral upper extremities. Most notably, the patient did not tolerate loading of the neck in any direction. She began to shake uncontrollably, and reported pain 9/10. The shaking and pain immediately diminished when load was relieved.

With active movement of bilateral upper extremities multiple compensations were noted and the patient expressed apprehension. The patient required extensive use of her upper trapezius to complete shoulder flexion and scaption. She did not demonstrate the ability of scapular stabilizers to perform active movements of bilateral upper extremities. Further, the patient, while not morbidly obese, did report a decrease in overall activity in the past 3-4 months and a slight weight gain because of that lack

of activity. She stated that she could benefit from prescriptions of "low impact" exercise to improve her overall health.

The evaluation continued into the 2nd visit, when the patient filled out a Fear-Avoidance Beliefs Questionnaire (FABQ) as well as a Tampa Scale for Kinesiophobia. The patient scored 5 out of 24 on the physical activity portion and 12 out of 42 on the work portion of the FABQ. Neither, of those is particularly alarming. Further, the patient 33 out of 68 on the TSK which while not insignificant didn't match with the levels of fear of movement observed during evaluation. The therapist bluntly asked, "are you afraid to move?". To which the patient replied, "I just know it's going to hurt."

Table 1. Left Upper Extremity Initial Evaluation.

	AROM Degrees	Strength	Pain -Y/N
Flexion	120	4/5	Y
Scaption	130	3+/5	Y
ER	85	3+/5	Y
IR	65	3+/5	Y

Table 2. Right Upper Extremity Initial Evaluation.

	AROM	Strength	Pain-Y/N
Flexion	125	4/5	Y
Scaption	125	3+/5	Y
ER	80	3+/5	Y
IR	65	3+/5	Y

Diagnosis and Prognosis

Upon completion of the examination, the therapist concluded that the patient's chronic neck and shoulder pain was due in part to a long and complex medical history that included both traumatic and psychologic problems along with increased sensitization due to fear and avoidance of moving the patient's neck and shoulders. The patient's PNES made evaluating a specific mechanical irritant difficult.

Based upon the patient's subjective history, her physical exam, and from information obtained in the medical record the Physical Therapy diagnosis became acute exacerbation of chronic neck and shoulder pain brought on by decreased muscular endurance of scapular and cervical stabilizers. The patient had had no evidence of disc pathology or other structural abnormality on imaging. Further, the patient declined steroid injection to her UE by her physical medicine physician.

Despite not being able to conduct the most thorough of physical examinations, due to symptoms, there was observable room for improvement in the patient's ability to perform active upper extremity movements as well as increase strength. The patient's goals for therapy provided a framework to structure her plan of care.

Intervention

Overview of Physical Therapy Intervention

The goal of the therapy intervention was to promote increased strength to scapular stabilizers, decrease apprehension to movement of affected regions, provide postural cues to adjust position regularly, and ultimately decrease pain to promote normal use of both arms. Initially, the patient reported high pain levels and decreased tolerance to passive treatments. It was evident that the patient had developed a sensitization to pain that made her apprehensive to someone else physically touching her. Further, the patient believed these were tasks that would invoke pain.

The first intervention utilized was to begin each treatment session was cardiovascular exercises. A general warmup of stationary biking was the patient's self-selected mode. The duration of the warmup was initially 5 minutes with a goal to increase duration as tolerated. The goal for this warm up was to promote increase in body temperature, increase heart rate, and increase the patient's respiratory rate. The goal was "vigorous activity" and a Rate of Perceived Exertion (RPE) of between 13 and 15 to fall in the "somewhat hard" to "hard" region. At a "somewhat hard" RPE the idea is to build some tolerance to a difficult task. The patient was repeatedly surprised by her ability to go a little longer on the bike and push a little bit harder. Mentally, this provided a great achievement for her and seemed to keep her excited and motivated. Further, moderate to high intensity activity has been shown to improve fitness in patients with chronic pain.[7]

The second segment of treatment sessions incorporated Manual Therapy and diaphragmatic breathing used in concert to decrease the patient's sensitivity and decrease tension headaches. This was integrated as a brief rest period between the initial cardiovascular warm up and more specific therapeutic exercise. A sub-occipital release was performed for up to 5 minutes in combination with instructions for diaphragmatic breathing. Soft tissue mobilization, passive range of motion, and joint mobilizations to the gleno-humeral joint and scapulothoracic region were incorporated as indicated by her lack of active range of motion and palpable tone in neck and shoulder musculature.

Finally, therapeutic exercise interventions were initiated to increase strength and endurance of cervical, thoracic, and upper extremity musculature. The general prescription was to begin with isometrics, move to concentric unweighted exercises, and then begin to load the movement as adequate range of motion and decreased pain allowed. Evidence supports a multi-modal approach with an emphasis on resistance exercise for those patients with chronic pain and fibromyalgia. [8,9]

Timeline of Treatment Plan

Week 1: Sessions 2 and 3

Cardiovascular exercise for 5 to 6 minutes were performed at the beginning of treatment as an active warm up. We would ask the patient, "tell me when it first becomes about a 12" on the RPE scale at which point we stopped the patient. Sub-occipital release was performed for 4 to 5 minutes as tolerated without evoking seizure like activity, and PROM to assess joint range of motion and increase tolerance to movement. The last segment of each session was dedicated to the performance of therapeutic exercises including scapular squeezes (retraction), cervical chin tucks, and scapular distraction followed by scapular clocks integrating proprioceptive neuromuscular facilitation for anterior elevation and posterior depression. Initially, the number of reps was dictated by form. The patient performed low repetitions with good technique, and as her neuromuscular control improved and she could perform more quality repetitions the number of reps was increased. When the patient could do 10 repetitions of an exercise with good technique we would add another set or introduce load.

Week 2 and 3: Sessions 4,5 and 6

We continued progressing cardiovascular exercise by increasing the duration to 8 minutes by session 6 with a focus on maintaining heart rate above 100 BPM for the final 3 minutes. We continued with sub-occipital release and performed joint mobilizations for posterior glide of the gleno-humeral joint bilaterally. PROM was utilized to demonstrate that the patient could achieve normal range of motion without pain. The patient quickly progressed to active assist range of motion (AAROM) eventually active range of motion into flexion, abduction, internal and external rotation in supine. During treatments 4,5, and 6 the Therapist instructed the patient in rowing exercises, unweighted scaption, thoracic rotational exercises in side-lying (open book, and big swing), and a loaded latissimus pull-down. We continued to educate the patient on proper performance of exercise with an emphasis on recruiting the correct musculature.

Week 4 and 5: Sessions 7,8 and 9

The duration of cardiovascular exercise was increased to 12 minutes with target heart rate of 105-110 BPM and RPE of 13. The patient continued demonstrated improved tolerance to physical touch with sub-occipital release and deep breathing which remained in the treatment plan until session 9. The patient began demonstrating improved bilateral upper extremity range of motion and strength with therapeutic exercises and scapular stabilization exercises were the patient's homework. We progressed the patient to core stabilization (bird-dogs), modified push-ups, and loaded lat pull-downs.

Week 6: Discharge from Therapy

The final session was spent reviewing therapeutic exercises to build a routine at home. We provided guidelines for continuing cardiovascular endurance training, and provided recommendations for sets, repetitions, and frequency. We prescribed performing 3 sets of 6-8 repetitions of theraband rows, unweighted scaption, and modified push-ups on an elevated surface. Further, the patient and therapist discussed tactics for building good habits, stress reduction, and avoiding the cyclical pattern

that lead her to physical therapy in the first place. A discharge NDI and QuickDASH were obtained and range of motion and strength testing were performed.

Mindfulness Using Calm Application

In clinical and research contexts, mindfulness as a specific type of meditation practice has been described as a "non-elaborative, non-judgmental awareness" of present-moment experience.[10] With that definition in mind the goal of the mindfulness intervention was to focus on the present moment, and relax for ten to fifteen minutes. The patient had never tried mindfulness, but we provided her with an overview of mindfulness as part of an active multi-modal approach to chronic pain treatment.

The goal of using the Calm Application was to integrate a small dose of mindfulness into the patient's routine. The application itself is easy to use. It has multiple features and can track usage. It identifies "streaks" that help reinforce the habit over time. The application has a variety of programs that focus on anxiety, stress, breathing techniques, and non-reactivity. It costs $5 dollars per month for the Calm Application, but there are other applications that are free. Overall, the application was low cost and the patient voiced interest when the idea was proposed.

It is important to distinguish this application for mindfulness from referral to a skilled clinical psychologist. This patient had sought intervention for psychological concerns at an earlier time. The patient and practitioner explicitly discussed that using an application for mindfulness was not a replacement for a consult to psychology or psychiatry. Instead, we chose to integrate the application into an active approach to physical therapy. The goal was to think about her pain as not just something physical that was affecting her, but to think about her overall health as a product of both her mental and physical state. For that reason, we counseled her that relieving stress and taking time to be mindful of her feelings and stress levels could be a good adjunct to traditional therapy.[11,12]

Meditation Practice Throughout the Plan of Care

Adherence to meditation using the Calm Application was assessed at each session. It was intended to be a "no pressure" intervention and not meant to add any extra stress to the patient's routine. The patient repeatedly noted that she performed 10-15 minutes of mindfulness training 5 out of 7 days of the week. At the patient's discharge evaluation, the patient reported that she finds the application useful for stress relief and tries to integrate it into her home exercise program as part of her cool down. She stated that it helped her begin to realize that her pain is at least in part controllable by her thoughts, and stress levels. The therapist encouraged her to keep up the practice and remain cognizant of her pain and stress levels as she continues with her home exercise program.

Outcomes

The patient subjectively reported improved bilateral shoulder range of motion, she also displayed decreased apprehension with neck movements in all directions. Her range of motion and strength testing for bilateral upper extremities are noted in Table 3 and 4. The patient continued to have pain with left shoulder flexion, but it was greatly decreased from her initial evaluation.

The patient improved flexion and scaption that exceeds the minimal clinical difference(MCD) of 11 to 16 degrees for range of motion at the glenohumeral joint by a single evaluator.[13] The patient scored 13.64% disability on the QuickDASH, and 34% disability on the NDI at discharge. That is 34% and 10% improvement on the two outcome measures respectively. The change of 34% surpassed the

Table 3. Left Upper Extremity Final Evaluation.

	AROM Degrees	Strength	Pain - Y/N
Flexion	160	4+/5	Y
Scaption	160	4+/5	N
ER	90	4/5	N
IR	70	4/5	N

Table 4. Right Upper Extremity Final Evaluation.

	AROM Degrees	Strength	Pain- Y/N
Flexion	170	4+/5	N
Scaption	170	4+/5	N
ER	90	4/5	N
IR	70	4/5	N

minimal clinical important difference (MCID) for the QuickDASH which is 8%. The 10% change on the NDI met the MCID for the NDI. and the 10%. Subjectively, the patient stated feeling “75% improved since we started”. The use of “we” did invoke a sentiment that the patient and therapist had formed a therapeutic alliance which can positively affect outcomes.[14]

The patient’s Psychogenic Non-Epileptic Seizure activity reduced over the duration of treatment. During the discharge evaluation, the Therapist was able to palpate throughout the cervical spine without eliciting the seizure-like activity that was present during the initial evaluation. The patient still noted tenderness at the Atlanto-Occipital junction, but overall mobility of the cervical spine appeared to normalize. Tolerance to manual therapy interventions had increased over the course of the 5 weeks of treatment. The patient still exhibited occasional tremors with palpation and techniques like a sub-occipital release, but the PNES symptoms were greatly reduced from an observational standpoint.

Discussion

In a case such as this where a multi-dimensional approach was used it is difficult to establish which component was the most effective. Luckily, approaching the chronic pain patient with the perspective that you need to treat the whole patient is warranted.[15] Integrating manual therapy to decrease sensitivity to touch, cardiovascular training to promote systemic analgesia, and graded exercise exposure to increase strength and stability of affected musculature worked well in this case. The patient was able to return to a higher functional status with reduced pain. Integrating a mindfulness practice allowed the patient to practice stress reduction which the patient subjectively felt as a benefit.

Further, during interventions and throughout the treatment plan the therapist kept a realistic perspective, but also provided positive reinforcement to the patient. It is difficult to remain positive when faced with chronic irritation and pain. Combining mindfulness practice, progressive and challenging exercise, and coaching to remain positive benefitted the patient. When it comes to managing chronic musculoskeletal pain, myofascial pain, or fibromyalgia promoting a positive outlook can be a useful intervention in and of itself. Often practitioners focus on the deficits a patient displays which can feed further into their symptoms. Instead, it may be useful to create a positive environment that addresses all the aspects of treating a human being with emphasis on what can be improved upon and highlight those improvements as the plan of care unfolds.

Part of the goal for integrating mindfulness practice into a physical therapy treatment plan is to provide a framework for the performance of the home exercise plan. Bringing attention to sensation, stress, and the management of pain can help build a connection between mind and body. Often, in the clinic, patients note that their pain is decreased after their treatment session and the performance of therapeutic exercise. Still, attaining consistent adherence to a home exercise plan can be difficult for some patients. Integrating a practice like the Calm Application may start to build the connection between body, mind, and pain levels that can lead to better outcomes.

Finally, the application promotes a positive mindset. Mindfulness brings about a sense of non-reactivity that seems to be opposite of our normal everyday activity. It is easy to get into the routine of life and constantly react to what is happening to us. This can lead to greater stress levels and heightened pain levels for those with chronic pain. The therapist expressed these sentiments to the patient at the initial prescription, and the patient attested to these sentiments over the course of her treatment. Further, mindfulness practice may be a way to tap into cortical structures involved in pain.[16] This case provides an example of the successful integration of a mindfulness app as part of a home exercise program with traditional physical therapy, following the biopsychosocial model. While further research is needed to better delineate the contribution of each treatment component, the ability of this multimodal, non-pharmacologic intervention to improve one patient’s pain and function suggests it may be a relatively cost-effective approach to consider in the treatment of chronic pain.

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