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Exercise Therapy for Chronic Low Back Pain

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EXERCISE THERAPY FOR CHRONIC LOW BACK PAIN

By

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ABSTRACT

Chronic low back pain (CLBP) is currently ranked as the 13th most frequent diagnosis in family practice (DynaMed Plus, 2017). Unfortunately, the severe nature of this pain leads providers to prescribe opiates for these patients. Opiates are effective for short term pain management but they have a significant side effect profile. Other forms of management for CLBP need to be identified and utilized. The purpose of this study was to determine the role exercise therapy plays in the treatment and management of patients with chronic low back pain.

A literature review was conducted in order to find high quality systematic reviews, meta-analyses and randomized controlled trials (RCT) looking at exercise therapy in the management of chronic low back pain. Multiple high quality systematic reviews were found in the Cochrane Database of Systematic Reviews. The reviews analyzed included the topics of Pilates, yoga, motor control exercises, and general exercise. The SPORTDiscus, CINAHL, and PubMed databases were searched for randomized controlled trials (RCT), systematic reviews and meta-analyses that focused on the topic of CLBP and exercise therapy. Studies chosen for this review met the inclusion criteria of: adult-only populations and outcomes measured included decrease in pain intensity. All of the studies were published between 2010 and 2017.

After reviewing the current literature on the effects of exercise therapy in the management of CLBP, it does appear that certain forms of exercise are efficacious for pain control amongst this population. The most effective forms of exercise therapy seem to be those that include a strengthening component. This is encouraging data regarding the future of CLBP management.

INTRODUCTION

Chronic low back pain (CLBP) is defined as low back pain without an identifiable source lasting for more than three months (DynaMed Plus, 2017). It is estimated that the lifetime prevalence of CLBP is around 80 percent (Devin & Rubin, 2007) and is the second most common cause of disability (CDC, 2005). Currently ranked as the 13th most frequent diagnosis in family practice (DynaMed Plus, 2017) it is estimated that costs associated with CLBP reach upwards of 19.8 billion dollars (Stewart, Ricci, Chee, Morganstein, Lipton, 2003). Needless to say, CLBP presents a heavy cost to this nation.

The first line treatments for CLBP are nonsteroidal anti-inflammatory drugs (NSAIDs) or acetaminophen (DynaMed Plus, 2017). However, due to the chronicity and severity of symptoms, these first line treatments often fail. Many family practitioners turn to opiates in order to manage pain and disability in these patients. Unfortunately, opiates have a high risk of abuse potential and serious adverse effects. Overprescribing and abuse of these medications has led to a national crisis, with the Trump administration declaring it as a national public health emergency (U.S. Department of Health and Human Services, 2017). Use of oxycodone has increased by approximately 500 percent from 1999 to 2011. During this same period of time, opiate related deaths has increased by nearly four times (Kolodny et al., 2015). Due to these staggering statistics the Center for Disease Control (CDC) has declared the current opiate crisis as the "worst drug overdose epidemic in history" (Kolodny et al., 2015). With the frequent use of opiates in the management of CLBP, it is crucial that safe and effective non-pharmacological treatment routes are utilized. One of these treatment options widely available and well researched is exercise. The aim of this literature review is to identify the role exercise therapy has in the management CLBP and what forms of exercise are most effective in the management of pain.

REVIEW OF LITERATURE

Methods

The Cochrane Systematic Review database was searched with key words including "chronic low back pain", "exercise therapy", and "opioid therapy." The SPORTDiscus, CINAHL, and PubMed databases were searched with the following subject headings and key words including "Chronic Low Back Pain" [Mesh], "Physical Therapy Modalitites" [Mesh], "low back pain," "chronic pain management," "lumbar pain," "exercise," "exercise therapy," "physical therapy," "opioid," and "pain clinics." The studies included in this review were limited to meta-analyses, randomized controlled trials, and systematic reviews. The inclusion criteria were as follows: the studies were written in the English language, the studies involved male and female adults diagnosed with chronic low back pain without an identifiable source, the studies measured pain as an outcome, and the research was published between 2010 and 2017.

Strength Exercises

Six studies were reviewed which analyzed the ability of strength exercises to decrease CLBP. Strength exercises use resistance, either body weight or added weight, to stimulate muscle contraction which overtime leads to greater muscle strength. Five of the studies looking at strength exercises used body weight and one study used free weights.

Gomes-Neto et al. (2015) selected 11 RCTs for a systematic review to determine if stabilization exercises were more efficacious in management of CLPB than general exercises or manual therapy. The stabilization exercises described in the studies aimed to strengthen trunk muscles in order to enhance control and coordination of the spine and pelvis. For this study, general exercises were considered to be activities such as cardiovascular fitness and/or strengthening and stretching muscle groups. Manual therapy consisted of manipulation

techniques administered by physical therapists. The length of the program, individual sessions, and frequency of sessions varied from study to study. The outcomes measured in these studies were pain, disability, or function. The review found that stabilization exercises resulted in a greater improvement in pain over the general exercise group with a weighted mean difference of -1.03 (95% CI: -1.29 to -0.27.) These results were not duplicated in the stabilization exercise versus manual therapy group, with both showing equal improvement in pain.

These results suggest that stabilization exercises are an effective approach to CLBP pain management. The analysis does suffer, however, from inconsistency between each RCT. These inconsistencies include duration of treatment, standardization (or protocol) of treatment, and tools used to assess pain intensity. The discrepancies between studies likely leads to poor data. This study was conducted in 2015 and then revised in 2016 which shows its relevance for today. The authors noted no conflict of interest (Gomes-Neto et al., 2015).

Kendall, Emery, Wiley, and Ferber (2014) conducted a randomized controlled study to determine if the addition of hip strengthening to a lumbopelvic motor control exercise (MCE) program would decrease pain in CLBP patients compared to just a lumbopelvic MCE program. Eighty patients were enrolled in this study. Each group received six rehab sessions, a home exercise program, and an education session. The outcomes, including pain intensity, disability, and hip strength, were measured at baseline and at the end of the six-week program. Both groups showed reduction in pain intensity from baseline. However, there was no statistically significant difference between the two groups in pain outcomes (95% CI; $p = 0.29$).

The authors hypothesized that the addition of hip strengthening exercises to lumbopelvic motor control exercises would decreases the amount of pain in CLBP patients compared to no

hip strengthening exercises; the results showed otherwise. The authors' decision to publish the results even though their hypothesis was not proven speaks volume to the integrity of the study. However, a concern of this study is that the authors did not specify the limitations of their study. Another limitation in this study was that the assessors and therapist were not blinded, possibly leading to biases. Lastly, pain is a subjective measurement which can lead to biases (Kendall, Emery, Wiley, & Ferber, 2014).

Michaelson, Holmberg, Aasa, and Aasa (2016) conducted a randomized controlled trial in order to compare high load lifting versus low load motor control exercises and the effects on pain intensity in the CLBP population. A total of 70 participants were divided equally into two groups. Each group participated in their respective exercise program for 8 weeks with a total of 12 sessions. The outcomes were measured at 2, 12 and 24 months. Two of the high load group participants reported adverse side effects, while zero participants in the low load group reported adverse effects. At each measurement there was a decline in pain intensity for both groups, (2 months $p = 0.001$, CI 95%; 12 months $p = 0.001$, CI 95%; 24 months $p = 0.006$, CI 95%) but no significant difference present between the two groups.

Several limitations of this study need be noted. This was a small study with only 70 total participants, and the interventions were only implemented for eight weeks, a relatively short period of time. There was no placebo group in this study so, the decrease in pain intensity measurements could simply be an effect of time. The authors disclosed that the physiotherapists managing the interventions were not blind to the specific intervention of their group. Unfortunately, only 71 percent of participants completed the 12-month follow up and only 83 percent of participants completed the 24-month follow up, possibly altering results (Michaelson, Holmberg, Aasa, & Aasa, 2016).

Saragiotto et al. (2016) conducted a systematic review in order to determine if MCE are effective in the management of CLBP. Motor control exercises focus on deep trunk muscle activation in order to strengthen and regain coordination of these muscles. This review analyzed 29 randomized controlled trials resulting in a total of 2,431 participants being studied. Motor control exercise programs varied from one session to five sessions weekly. Variability among length of intervention was present; the interventions were conducted anywhere between 20 days to 12 weeks. The questionnaires used to measure pain in the various studies included the visual analog scale (VAS) or the numerical rating scale (NRS). For the systematic review, the authors converted the pain outcomes to a 0 to 100-point scale. At all measurement intervals, motor control exercises were found to be effective at decreasing pain control when compared with little or no interventions (Short term: MD -10.01; 95% CI; $p = < 0.001$; Long term: MD -12.97; 95% CI; $p = < 0.001$). They were however, not found to be more effective than manual therapy or other exercises.

This review has a robust amount of research studies looking at a specific question. All of the studies included in this review were randomized controlled studies which are high quality study designs. Multiple databases were searched and inclusion and exclusion criteria were stringent. Overall, this was a very thoroughly conducted systematic review (Saragiotto et al., 2016).

Yamato et al. (2015) conducted a systematic review in order to determine if Pilates is effective in the management of CLBP. A total of 10 randomized controlled studies were included in this review amounting to a total of 510 participants. The length of intervention was largely varied, ranging from 10 to 90 days. Outcomes were measured anywhere between four weeks to six months. The studies showed that Pilates is slightly more effective in reduction of pain in

CLPB patients compared to no or minimal intervention (Short term: MD -14.05, 95% CI; Intermediate term: MD -10.54, 95% CI).

The topic of Pilates in the management of CLBP is not an area with a robust amount of research completed. Ten studies with a total of 510 participants is a rather small population. The design of the systematic review is solid. Cochrane Systematic reviews are well known for their high-quality reviews (Yamato et al., 2015).

Masharawi and Nadaf (2013) conducted a randomized controlled study in order to determine whether non-weight bearing group exercises were effective in treating chronic low back pain. The study group participated in 45-minute sessions of group exercises lead by a physiotherapist. These group sessions were held two times a week for four weeks. The exercises were designed to strengthen the deep trunk and abdominal muscles. Forty females were involved in this study. Multiple outcomes were measured including pain intensity. The outcomes, including pain intensity, disability, lumbar flexion and extension, were measured after four weeks of the intervention, then again eight weeks later. The intervention showed a statistically significant decline ($p = < 0.001$) in pain intensity in the intervention group compared to the control group in both the four-week and eight-week measurements.

This study showed promising results, but it had several glaring limitations. First, only 40 participants were enrolled in this study. All of the participants were female, thus misrepresenting the true CLBP population. This study was conducted for only eight weeks, which is a relatively short period of time for an exercise intervention to take effect. Lastly, pain intensity is a subjective measurement, making it a less reliable outcome measurement than others **(**Masharawi & Nadaf, 2013).

Stretching Exercises

Four studies are focused on stretching exercises as an intervention for CLBP. For the purpose of this review stretching exercises are considered as exercises that elongate muscle fibers in order to increase range of motion and flexibility. As with all forms of exercise, there are multiple approaches to stretching with the similar aim of increasing flexibility and range of motion. This review includes two studies on yoga, one on the McKenzie method, and one study on global postural reeducation.

Garcia et al. (2017) conducted a randomized controlled trial of 148 participants to determine if the McKenzie method was in fact efficacious in reducing pain amongst CLBP patients. The McKenzie method is a comprehensive approach to CLBP management that uses physical assessment, education, and exercise to treat patients. The exercises involved in the McKenzie approach include stretching exercises and postures individualized for each patient to correct their postural, dysfunctional, or anatomical problem relating to their low back pain. Participants were randomly assigned to either a McKenzie method intervention group or a placebo group. The McKenzie group received two sessions weekly for five weeks. Outcomes were measured at baseline, immediately following intervention and then again at three, six and twelve months from baseline. The results of this study showed that there was a small and most likely not a clinically relevant decrease in pain intensity at all intervals measured.

Considering the large population of patients with CLBP, a sample of 148 is a small number. A larger study sample, such as that in the ongoing Cochrane Review of the McKenzie Method in CLPB (Machado, van Tulder, Lin, Clare, Hayden, 2012) may be more reflective of the general population. Another limitation of this study is the short intervention duration. After only five weeks there was a slight decline in pain intensity. This short duration of the

intervention may not have allowed for the exercise program to be effective. Given the fact that this population is diagnosed with a chronic condition, five weeks is mere snapshot of the course of their needed treatment (Garcia et al., 2017).

Groessl et al. (2017) studied a group of 150 veterans in a RCT to determine if yoga played a role in reducing pain in patients with CLBP. Both the intervention and control group were instructed to maintain their current low back pain treatments, whether pharmacological or not, during the length of the study. The intervention group participated in two 60-minute yoga sessions weekly. The control group did not participate in any yoga intervention. Outcomes were measured at baseline, six weeks, three months, and six months. It was found that a small decline in pain intensity did in fact occur with the intervention group, but this decline may not be clinically significant ($p = 0.001$ at 6 weeks, $p = 0.005$ at 12 weeks, $p = 0.013$ at 6 months).

Yoga is unlike other exercise programs in that it involves a multidimensional approach; it includes breathing, meditation, flexibility, coordination, and a bit of strength and cardiovascular exercise. This study did not investigate the individual components of practicing yoga, which could have strengthened the study's usefulness in my review. More data would need to be collected to identify which individual aspects of yoga effect management of CLBP and which do not.

Although not an indication of poor research quality, the lack of isolation of components does limit the usefulness of the study in my review. In terms of limitations acknowledged by the authors, they note that there was only one yoga instructor for all of the participants. Yoga is an exercise that greatly relies on the instructor in order for participants to have safe and effective practice. Thus, it is unknown if patients utilizing an alternative yoga instructor would benefit from the same results as those in this study (Groessl et al., 2017).

Global postural reeducation (GPR) is a therapy program that is designed to slowly stretch and strengthen muscles that have shortened over time due to misuse or injury. GPR is intended to be used for any type of musculoskeletal pain. Lawand et al. (2015) conducted a RCT in order to determine if GPR is efficacious in pain control for CLBP. Sixty-one participants were involved in this study, split equally into the GPR and control groups. The patients assigned to the GPR group participated in a 60-minute session of GPR once a week for 12 weeks. Pain was measured using the visual analog score (VAS) at baseline, immediately after the 12 weeks of GPR and at 6 months from baseline. The GPR group showed statistically significant improvement ($p = <0.05$) in pain after intervention compared to the control group.

The researchers did an excellent job keeping the intervention and control groups similar in regards to BMI, smoking status, education, gender, age, and duration of low back pain symptoms. The intervention was implemented for a total of 12 weeks, which in comparison to many of the other studies looking at exercise therapy for CLBP, is a longer period of time for intervention. Unfortunately, there were only 61 participants in this study which is a rather small population group. This study gives promising results about the possibility of decreasing pain through GPR in the CLBP population. Further studies are warranted to replicate these responses (Lawand et al., 2015).

Wieland et al. (2017) conducted a systematic review in order to determine if yoga was efficacious in the treatment of chronic low back pain. Twelve randomized controlled trials were chosen for this review. The studies included in this analysis compared yoga therapy to either no exercise, other exercise treatment, or non-exercise treatment. The authors concluded that there is low to moderate evidence that yoga may be efficacious for pain control (SMD = -0.40, 95% CI)

when compared with no exercise. They do note however, that yoga compared to other exercise programs reported more adverse effects.

The authors note that there are many possible limitations to the studies they analyzed. One trial had a financial conflict of interest, having been funded by a yoga institute. Patients were not able to be blinded to the yoga intervention. This review does have strong positive aspects. Twelve studies on the topic of yoga specifically geared towards chronic low back pain treatment resulted in about 1000 participants being studied. All of the studies included in this review were randomized controlled studies which are high quality study designs (Wieland et al., 2017).

Aerobic Exercises

Two studies included in this review analyzed aerobic exercises' effect on CLBP control. Aerobic exercise comes in many forms. However, for this review aerobic exercise is considered any exercise that is aimed at increasing heart rate for an extended period of time. The aim of this type of exercise is to increase cardiovascular capacity.

Meng and Yue (2014) conducted a meta-analysis in order to determine whether aerobic exercise is efficacious in the treatment of CLBP. In this study the definition of aerobic exercise was rather vague. It included various activities such as running, walking, cycling, and calisthenics done for an unspecified period of time at a low to moderate intensity with the intent of maintaining an elevated heart rate.

Multiple databases were searched resulting in a total of eight clinical studies chosen for the analysis. Pain was one of the outcomes measured using the McGill Pain Questionnaire or the VAS for pain. The analysis found that aerobic exercise did significantly reduce the VAS score ($p < 0.001$) and strength exercises reduced the McGill Pain score significantly ($p = 0.011$).

This study was relatively small for a meta-analysis, only including eight studies for a total of 310 participants. The broad definition for aerobic exercise used in this analysis led to a wide variety of aerobic exercises. This heterogeneity decreases the ability to generalize findings. No conflict of interest was reported (Meng & Yue, 2014).

Marini et al. (2017) conducted a randomized controlled trial to determine whether postmenopausal females with low back pain would benefit from a 24-month physical activity intervention. Two hundred and ten women participated, equally divided into either the physical activity intervention group or no intervention. Included in the physical activity intervention was a minimum of one hour per day of moderate activity with one weekly session of strenuous activity.

The participants of the study reported on pain intensity at baseline and 24 months after the intervention was completed. The physical activity intervention group showed a decline in pain scores when measured against the group with no intervention. However, this difference was not statistically significant. Both groups showed a decline in low back pain after 24 months.

The authors note the small sample of women as being a limitation in their results. They also discuss the limitation of self-reporting pain as opposed to an objective measurement. Another limitation is that only women were involved in this study. All of the participants were female, thus misrepresenting the true CLBP population. This study does have some strengths that are worth noting. It was conducted in 2016 and published in 2017, showing its modern relevance. The study had a fairly high adherence rate due to supervised training sessions and exercise professionals available for the participants during the training sessions (Marini et al., 2017).

Mixed Exercise

Two studies were not able to be placed in one exercise category, so they are defined as mixed exercise. The first study is a systematic review that can be found in the Cochrane

Database of Systematic Reviews. It is included in the mixed exercise theme because it included any and all types of exercise as the intervention. The second study reviewed what are known as back schools. Due to the non-standardized nature of the exercise interventions within back schools, they were included under this theme.

Hayden, van Tulder, Malmivaara, and Koes (2011) conducted a systematic review in order to determine if exercise therapy is effective in treating adults with non-specific low back pain. The authors describe exercise therapy as any movements or series of movements intended to train or develop the body and promote overall good physical health. This review included 61 randomized controlled trials involving acute, subacute, and chronic low back pain patients. Of the studies analyzed, 43 were conducted within the CLBP patient population. The outcomes measured included patient-reported pain and function, absence from work, and global improvement outcomes. The studies measured either exercise therapy against a placebo, no treatment, an alternate conservative therapy, or other exercise regimen. This review found that exercise therapy does appear to have a positive effect on function as well as showing a modest decline in CLBP or patients' reported pain. However, the effectiveness of exercise therapy as an intervention appears to only be slightly more effective than other conservative therapies or placebo.

Cochrane systematic reviews are renowned for their high quality systematic reviews. They conduct a thorough analysis of existing research and evaluate it systematically. However, this review was published in 2011. In the field of medicine six-year old research is often considered dated. There have been multiple studies conducted since 2011 on the topic of exercise therapy and CLBP. In addition, the authors do note that many of the studies included in their

analysis have limitations such as heterogenous outcome measurements, poor reporting, and possible publication biases (Hayden, van Tulder, Malmivaara, & Koes, 2011).

Parreira et al. (2017) conducted a systematic review in order to determine the efficacy of back schools in the treatment of the CLBP population. Due to the rising prevalence of CLBP patients in the United States, back schools have become more popular in the management of this chronic condition. Back schools were first implemented in 1969 in Sweden. The foundational elements for these schools include exercise and education. Back schools have consistently focused on treatment of CLBP through nonpharmacological approaches whenever possible, although exercise programs and educational content has changed and is not standardized. Thirty trials with a total of 4,105 participants were included in this review. The outcomes measured included disability, pain intensity, and work status. Back school efficacy was measured against either pharmacological therapy, no treatment, physical therapy, or exercise. The results of this review showed that back schools compared with no treatment have slight effect on CLBP during the short term follow up (MD -6.10, 95% CI) but no statistically significant effect in the intermediate follow up (MD -4.34, 95% CI) or long term follow up groups (MD -12.16, 95% CI -29.14 to 4.83).

The non-standardized nature of back schools leads to a variety of exercise programs, medical providers administering treatment and education provided to patients. Some schools take an intensive approach while others approach CLBP with more modest treatment regimens. This heterogeneity decreases the ability to generalize findings. Another limitation within this review is the design flaws present in multiple studies. A common flaw was the lack of blinded participants, providers, or assessors. Another flaw noted by the authors was the inadequate

randomization of the participants. Both of these design flaws lead to low-quality data (Parreira et al., 2017).

DISCUSSION

This review has demonstrated that there are several forms of exercise that can lead to decreased levels of pain in the CLBP population. The studies that examined the role strength exercises play in reducing CLPB are quite promising. Gomes-Neto et al. (2015) demonstrated that stabilization exercises compared with general exercises showed a significant improvement in reported pain. However, this study did show that manual therapy was as effective as stabilization therapy at reducing pain. The RCT conducted by Kendall, Emery, Wiley, and Ferber (2014) showed that both MCE and MCE with the addition of a hip strengthening program decreased pain levels in the CLBP population. However, they did not find superior results when combining MCE and a hip strengthening program. When Michaelson, Holmberg, Aasa, and Aasa (2016) conducted a RCT to observe the differences between high load lifting and low load MCE, they found that both were effective at reducing pain in the CLBP population. Saragiotto et al. (2016) discussed that MCE is effective at reducing CLBP but it is most likely not superior to other forms of exercise. Yamato et al. (2015) demonstrated through a systematic review on the topic of Pilates and CLBP that there is low to moderate quality evidence that Pilates is effective at reducing CLBP. Again, they could not demonstrate that it was more effective than forms of exercise. And last, Masharawi and Nadaf (2013) found that non-weight bearing exercises improves pain outcomes in women with CLBP.

It appears that stretching exercises are not quite as promising as strength exercises for the reduction of pain amongst CLBP patients. Although Garcia et al. (2017) found a small improvement in the reported pain of patients after participating in the McKenzie method for five

weeks this was most likely not clinically relevant. This minor reduction of pain was not found at any of the follow up intervals. Groessl et al. (2017) found that veterans participating in a yoga did have a decrease in pain at all intervals measured, but again, this was likely not clinically relevant. This study did note however, that although this decrease in pain was small, it occurred with reduction in opioid use. The systematic review conducted by Wieland et al. (2017) found that yoga most likely does not have a clinically significant impact on CLBP. There was evidence for improvement of pain at seven months post intervention but this was very-low-certainty evidence. Although most of the stretching programs do not show promise, GPR is the exception. This program showed both statistical and clinical significance in its ability to reduce pain in the CLBP population.

Meng and Yue (2014) were able to demonstrate through their meta-analysis that aerobic exercise is, in fact, efficacious in decreasing CLBP. Unfortunately, Marini et al. (2017) were not able to show that a general physical activity intervention had any impact on CLBP. Further research is warranted on the topic of aerobic exercise and CLBP.

The systematic review conducted by Hayden et al. (2011) that looked at all forms of exercise for the management for CLBP revealed mediocre results. It showed that overall, exercise therapy in the CLBP population slightly decreases pain. The setting in which exercise interventions were most effective was the healthcare setting. Parreira et al. (2017) showed that back schools in comparison with all other interventions showed none or only minor differences in favor of back school. Overall, the research currently points to strength exercises as the most promising exercise regimen in the management of pain amongst the CLBP population.

APPLICABILITY TO CLINICAL PRACTICE

Due to the rising prevalence of CLBP and the overprescribing of opiates, the need for alternative therapies to manage this disease is tremendous. The current research shows that strengthening exercises are a useful adjunct therapy to a comprehensive treatment plan for those suffering with CLBP. In some cases, exercise therapy may even be used successfully as the sole therapy.

As a busy health care professional, it is easy to reach for the quick fix. Many providers choose a treatment that will offer immediate pain relief and patient satisfaction. Unfortunately, the choice of therapy is often opiates. As discussed previously, these have little or no place in the management of CLBP. They may offer short term relief from pain but come with serious adverse effects. They can create addiction, cause worsening of pain in the long run and a myriad of other problems.

Providers need to take note of this information and start prescribing exercise therapy as one of the first line treatments in a comprehensive approach to those patients who present with CLBP. Providers including physician assistants, doctors, nurse practitioners and physical therapists need to be trained specifically in in this area. We need to work as a team to provide the most up to date, evidenced-based medicine to our patients. The topic of alternative therapies in pain management is an area that will continue to be researched at great depth due to the need to move away from harmful opiates. I look forward to staying current with this research and implementing it into my practice.

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