Rehabilitation Science
2022; 7(4): 43-50
http://www.sciencepublishinggroup.com/j/rs
doi: 10.11648/j.rs.20220704.11
ISSN: 2637-5931 (Print); ISSN: 2637-594X (Online)

Review Article

Chronic Musculoskeletal Pain and Disability: A Problem of Trapped Lactic Acid

Michael Raymond Binder

5 Revere Drive, Suite 200, Northbrook, USA

Email address:
mbinder@drmichaelbinder.com

To cite this article:
Michael Raymond Binder. Chronic Musculoskeletal Pain and Disability: A Problem of Trapped Lactic Acid. *Rehabilitation Science*. Vol. 7, No. 4, 2022, pp. 43-50. doi: 10.11648/j.rs.20220704.11

Received: December 8, 2022; **Accepted**: December 23, 2022; **Published**: January 17, 2023

Abstract: Chronic musculoskeletal pain is the leading cause of disability worldwide yet continues to be the most misunderstood of all illnesses. Historically and still today, the assumption has been that chronic back, neck, shoulder, knee, and other areas of chronic pain are the consequence of some type of injury or disease process in the affected joints and associated tissues. However, the evidence points to a different problem altogether. A thorough analysis of the anatomy and physiology of the neuromuscular system suggests that most of the pathological findings that are associated with chronic musculoskeletal pain are not the cause of the pain but the consequence of a much more subtle but highly treatable problem. Skeletal muscles produce lactic acid, and when this natural byproduct of muscle metabolism begins to accumulate in muscle tissue, it distorts the neural feedback that allows the brain to properly regulate the resting tension of the affected muscle. As tension in the muscle increases, more lactic acid is produced, thus creating a vicious circle of tension and toxicity that ultimately causes local nerves to become irritated by the tightening muscle. In addition to causing pain, the nerve irritation causes the muscle to become even more spastic, the consequence of which is a downward spiral of pain and disability from which there is no natural escape. Though some of the therapies that are currently available for chronic musculoskeletal pain may provide symptom relief acutely, they fail to get to the root of the problem; they fail to unlock the lactic acid that is accumulating in the muscle. Hence, they fail to provide any lasting symptom relief. This review will discuss the theoretical mechanisms behind the most common treatment approaches to chronic musculoskeletal pain and discuss them in light of a simple, non-invasive way to both treat and prevent this highly common and often disabling condition.

Keywords: Low Back Pain, Chronic Musculoskeletal Pain, Sciatica, Piriformis Syndrome, Herniated Discs, Hypertonic Muscle Spasm, Stretch Reflex, KANON Myotherapy

1. Introduction

According to the World Health Organization, approximately 15% of the world's population is currently disabled [1]; and in developed countries, the leading cause of disability is chronic musculoskeletal pain [2]. In Canada, pain is the most common reason for scheduling a doctor's appointment [3], and the America Board of Hospital Accreditation recently adopted pain as the "fifth vital sign." Yet despite the frequency of this condition and the myriad of treatment modalities that are currently available, few if any achieve lasting symptom relief. Hypothetically, the reason for this is that none of the currently available treatment options address the root of the problem. Instead, clinicians either attempt to correct the structural abnormalities that they presume to be causing the pain, or they attempt to achieve symptom relief through non-invasive but palliative approaches to pain.

Contrary to prevailing theories, a detailed analysis of the anatomy and physiology of the neuromuscular system has revealed that nearly all forms of chronic musculoskeletal pain are rooted in a surprisingly simple abnormality—the toxic build-up of lactic acid in muscle tissue [4]. By integrating his clinical observations with long-held tenets of neuromuscular physiology, Sir Thomas Griner, a therapeutic neurophysiologist and former research engineering technician at NASA, hypothesized that lactic acid was at the root of most

chronic musculoskeletal pain syndromes. In accordance with this hypothesis, Dr. Griner developed a technique for releasing hypertonic spasm, the pathophysiological consequence of lactic acid toxicity. This technique, which he calls "kinetically-activated nerve organ normalization" (KANON), purportedly relieves hypertonic spasm by facilitating lactic acid release from the affected muscles [4]. This review will discuss the various theoretical approaches that are currently being employed to treat chronic musculoskeletal pain with an emphasis on the unique ability of KANON myotherapy to completely correct this condition, fully restore mobility, and return dysfunctional muscle tissue to its youthful vitality.

2. The Premise of KANON Myotherapy

It is widely known that lactic acid is a natural byproduct of muscle metabolism. However, what had remained unrecognized until the 1960s was that lactic acid can become trapped in muscle tissue, where it begins to distort the neural feedback that muscle spindles normally give to the brain [4] (Figure 1). This distortion is problematic because it prevents the cerebellum of the brain from recognizing that the resting tension in the muscle is too high. As a result, the muscle is maintained in a hypertonic state, which in turn causes the muscle to accumulate even more lactic acid because veins and lymphatics, which are responsible for removing lactic acid but have much thinner walls than arteries, begin to collapse. Over time, the affected muscle tissue becomes so tight that no amount of exercise or fluid intake is able to rid the muscle of the excess lactic acid. As a result, the resting tension of the muscle becomes permanently elevated, a state called "hypertonic spasm."

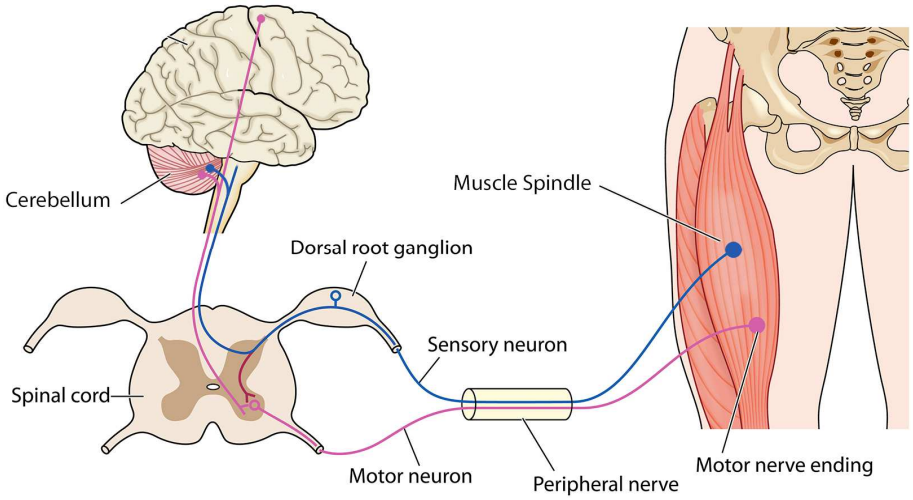

Figure 1. *Communication pathways between skeletal muscles and the brain.*

Because muscle tissue is insensate, hypertonic spasm is, in and of itself, painless. However, the portion of the muscle that is becoming hypertonic can eventually progress to the surface layers, which in turn exposes local nerves to irritation and impingement. According to Dr. Griner, this is the root cause of chronic musculoskeletal pain and its debilitating effects.

3. Traditional Approaches to Treating Chronic Musculoskeletal Pain

3.1. Physical Therapy

As an umbrella term, "physical therapy" refers to a wide range of non-invasive treatment modalities that involve an attempt to loosen, strengthen, or otherwise rehabilitate muscles that are injured, spastic, or weak. Such therapies, many of which date back to antiquity, are based on the simple premise that regular exercise, stretching, and massage strengthen muscles and reduce pain. However, these therapies have diverse effects, some of which may be counterproductive, particularly in persons with hypertonic spasm. That could explain why physical therapy sometimes helps, sometimes doesn't help, and sometimes makes symptoms worse [5]. Of course, physical therapists are taught to tailor their treatments to the individual; however, the analysis of an individual's condition has heretofore been limited by a traditional understanding of musculoskeletal pain syndromes. The general thinking continues to be that strengthening muscles can reduce pain and improve function [5]. It is also thought that improvement can be achieved by relaxing the mind and manipulating the muscles in various ways [6]. What has been misleading, however, is that most of the tenets of physical therapy, while being true, may not be addressing the core abnormality in chronic musculoskeletal pain syndromes.

A reconceptualization of physical therapy from the perspective of lactic acid production and elimination could help therapists more accurately assess the nature and timing of the treatments they recommend for their patients. For example, some forms of stretching can help loosen muscles, whereas others can drive them deeper into spasm by activating the stretch reflex [7]. The stretch reflex is a spinal-mediated contraction of muscle in response to stretch that allows the nervous system to maintain muscle length and, thus, body position without conscious attention. As another example, resistance exercises can strengthen healthy muscles, whereas

they can drive hypertonic muscles deeper into spasm if they are made to contract too forcefully or too suddenly. This could explain why physical therapy can be helpful in some ways but unhelpful or even harmful in others. In addition, the tissue injury that occurs during exercise stimulates the release of endorphins, and the associated pain relief can mask the negative effect that resistance exercises have on hypertonic muscle [8]. This is what misleads physical therapists and athletic trainers into thinking that strengthening muscles is an effective intervention. The range-of-motion limitations that are caused by hypertonic muscle spasm can likewise be obscured by the fact that stretching can lengthen tendons, thereby improving range-of-motion without releasing the underlying muscle spasm [7]. These deceptive phenomena could help explain why so-called "old injuries" create a chronic vulnerability to re-injury. Though seemingly resolved, the underlying spasm is still there, quietly waiting to become symptomatic again if the affected muscles are overworked or re-traumatized in some way. The recognition of this underscores the importance evaluating the patient for hypertonic spasm before embarking on any program of stretching and strengthening.

As with active exercises, the manipulation of muscles through various forms of massage can create the impression that the underlying spasm is being released. That's because manual manipulation of muscles can trigger the stretch reflex, and the associated contraction can fatigue the involved fibers. Like exercise, manual manipulation can also stimulate the release of endorphins, and it can quiet the brain by relaxing the mind [9]; both of these can have the effect of easing pain. However, the effect is generally minor and unsustained; it is only sufficient to keep those who observe it believing that they are addressing the root of the problem.

In reality, muscles are not clumps of dough that can be effectively loosened by kneading and manipulation. Rather, they are sacks of liquid with an indwelling contractile system that is stimulated by electrical signals from the brain (along with some reflexive input from the spinal cord). The brain also receives electrical input from the muscles, thus allowing it to continuously regulate their resting tension [10]. Thus, the only reliable way to loosen spastic muscle is to therapeutically modify the two-way communication between the brain and the muscles.

3.2. Chiropractic Care

The central tenet of chiropracty is that spinal malalignments and bulging discs can cause irritation of spinal nerve roots as they exit the vertebral column [11]. This irritation is thought to account for chronic musculoskeletal pain syndromes, such as chronic neck, shoulder, back, hip, and knee pain. However, a thorough inspection of the foramina through which the spinal nerves exit the vertebral column has demonstrated that the spine would have to be bent or twisted to the point of tearing before any nerve impingement could occur [12]. So that begs the question: what really causes the nerve irritation that underlies the symptoms of chronic musculoskeletal pain?

As previously discussed, spastic muscles can irritate the nerves that pass through and between them. That explains why a simple movement, such as a normal twist or bend, can sometimes cause a sharp pain, muscle rigidity, and vigilant guarding. Hypothetically, what happens in such cases is that the contracting muscle pinches or otherwise irritates local nerves as the movement occurs. In addition to causing pain, the nerve irritation may cause the involved muscles to become reluctant in an effort to prevent the nerves from being further irritated. It is important to note, however, that such events are not the start of the problem but rather symptoms of a problem that has been developing over many years as trapped lactic acid has accumulated in the muscles and caused them to become more and more spastic. Hypothetically, this gradual increase in muscle spasticity is what pulls the spine out of alignment and causes vertebral discs to bulge or even herniate. Nonetheless, chiropractic care can reduce pain via the production of endorphins. However, the benefits are only temporary, and the forceful compressions and manipulations of the spine that are employed in some forms of chiropracty create the risk of injury [13]. Much greater good with much lesser risk can be achieved by unlocking the lactic acid that is trapped in hypertonic muscles.

3.3. Ice and Heat

Icing and heating painful tissues are perhaps the most commonly employed methods of reducing pain and facilitating healing. However, the effects of these treatments are misleading. Both icing and heating cause disturbances in tissue consistency, blood flow, and metabolism. This "thermal shock" triggers the production of endorphins, which, as alluded to earlier, act on receptors in the brain to block the conscious perception of pain. Cooling the tissue also reduces the sensitivity of pain receptors at the injury site, and although cooling can facilitate the healing of acute injuries, it prevents congested muscles from receiving the circulation that they need to rid themselves of lactic acid. In contrast, heating the tissue increases circulation, and although this tends to prevent the further accumulation of lactic acid, it does nothing to free up the lactic acid that is already trapped in spastic muscles.

3.4. Biofeedback and Progressive Muscle Relaxation Techniques

Consciously learning to relax muscles is another commonly-employed way to reduce chronic musculoskeletal pain. This can be done by monitoring the effects of specific mental activities on muscle activity (biofeedback) or by mental exercises alone, such as yoga, mindfulness meditation, and progressive relaxation techniques. Such practices work by calming the brain, which temporarily reduces top-down muscle stimulation and reduces neurological sensitivity to nociceptive feedback. However, any relief of muscle tension or pain that these practices achieve is only temporary because they do not unlock the lactic acid that is hypothetically at the root of the symptoms.

3.5. Spinal Traction

Spinal traction techniques are based on the premise that

bulging and herniated discs irritate peripheral nerve roots as they exit the spine. However, as previously discussed, these and other abnormalities of the spine, such as malalignments, radiculopathies, and compression fractures, are rarely the cause of chronic musculoskeletal pain. Rather, they tend to be incidental findings when imaging studies are performed to evaluate the patient's symptoms. Hence, decompressing the spine, which is believed by some to facilitate the healing of bulging and herniated discs, is not likely to achieve any symptom relief, at least not directly. Moreover, it does nothing to correct the underlying problem of hypertonic spasm. In fact, it could worsen it by triggering the stretch reflex, which, as previously discussed, can cause spastic muscles to become even tighter. Any benefits that patients experience from spinal traction are more likely due to non-specific factors associated with the treatment than to the treatment itself.

3.6. Nerve Stimulator Techniques

The use of electricity to achieve pain relief dates back more than two centuries, when the ancient Egyptians applied electrogenic fish to painful body parts [14]. During the 18th century, electrostatic generators became popular, but these were later replaced by pharmacological agents. Nonetheless, electrical stimulation is still being used in several forms, including transcutaneous electrical nerve stimulation (TENS), repetitive transcranial magnetic stimulation (rTMS), and accelerated recovery performance (ARP).

The central tenet of TENS is that stimulation of large diameter afferent nerves can inhibit central transmission of noxious stimuli [15]. TENS can also enhance the activity of descending nociceptive inhibitory inputs. The central premise of rTMS is that neuropathic pain is rooted in a hyperexcitability of the neurological system [16, 17]. It is thought that the associated pain signals can be reduced by modulating cortical excitability [18]. The fundamental basis of ARP is that delivery of a direct current to working muscles can increase the speed at which they can be strengthened during rehabilitation [19]. Thus, it is a means of amplifying the effects of physical therapy. However, none of these treatment modalities do anything to relieve hypertonic muscle spasm; hence, their benefits are only temporary.

3.7. Acupuncture

The ancient technique of acupuncture continues to be widely used for the rapid relief of musculoskeletal pain. Now available in many forms, including the passage of an electric current through indwelling needles, the technique appears to mediate its effects by stimulating the production of endorphins. These compounds, which were so-named because they block pain receptors even more effectively than naturally-occurring plant alkaloids, are up to 200 times more powerful than morphine; hence the term "endo-morphine." However, as with the other treatment modalities that have been discussed, acupuncture does nothing to relieve the spasm that is hypothesized to underlie chronic musculoskeletal pain. On the other hand, it could throw the affected muscles deeper into spasm as they contract in response to the invasive insertion of needles, particularly if an electric current is applied.

3.8. Pharmacotherapy

The use of pharmaceutical drugs to treat chronic musculoskeletal pain is aimed at three main targets: muscle spasm, inflammation, and pain signaling. Although muscle relaxants can reduce pain by loosening spastic muscles, the effect is short-lived and often complicated by sedative and potential withdrawal effects, the latter of which can cause a rebound increase in muscle spasm. Anti-inflammatory drugs are likewise ineffective because the underlying abnormality appears to be physiological rather than inflammatory. The third target, pain signaling, has traditionally involved the use of local anesthetics and opioid analgesics. However, their effects are again only temporary and fail to unlock the lactic acid that holds hypertonic muscles in spasm. In recent years, the increasing recognition that some persons may experience chronic pain due to a hypersensitivity of the neurological system has led to efforts to reduce this hypersensitivity with anticonvulsant drugs [17]. Although such drugs can reduce neuronal firing and, thus, top-down stimulation of spastic muscles, the degree of effect is generally inadequate to provide any significant reversal of hypertonic spasm. Hence, the reduction of central signaling provides symptomatic relief only.

3.9. Surgery

Like many of the other treatments for chronic musculoskeletal pain, surgical intervention is based on the belief that symptoms are caused by structural abnormalities and associated inflammation in the musculoskeletal system. However, as previously discussed, chronic musculoskeletal pain appears to be more of a physiological problem than a structural one. That strongly challenges the necessity of surgery and other invasive procedures for chronic musculoskeletal pain. Nonetheless, the physical trauma of surgery, like acupuncture, can reduce pain by stimulating the production of endorphins. From a strictly analgesic standpoint, surgery is like having an entire series of acupuncture treatments simultaneously. Thus, the procedure itself can markedly reduce musculoskeletal pain regardless of what is actually done in the surgery. In a placebo-controlled pilot study [20], five osteoarthritis patients who were deemed to need arthroscopic knee surgery were randomly assigned to two groups. Three subjects received arthroscopic lavage only, and two received standard arthroscopic debridement. The patients remained blinded to the type of procedure they received, as did the physicians who performed the postoperative assessments. Like the patients who underwent the standard procedure, the patients who underwent the sham procedure reported decreased frequency, intensity, and duration of their knee pain. Both groups thought that the procedure was successful and said they would recommend it to family and friends. In another study, this one aimed at determining whether epidural steroid injections were of any

benefit in relieving lower back pain, Johns Hopkins anesthesiologist Stephen Cohen and his colleagues reviewed dozens of published studies on the subject [21]. As expected, they found that epidural steroid injections were far more likely to produce relief of symptoms than steroid injections into muscle tissue near the spinal canal. What was surprising to the researchers, however, was that epidural injections of any kind, whether they consisted of steroids, anesthetics, or saline, were also far more likely to be effective than intramuscular injections of steroids. What they concluded was that the relief of symptoms might be coming from something other than the steroid. These studies suggest that factors other than those believed to be important are at work when invasive procedures are performed to treat musculoskeletal pain. Moreover, although surgical procedures can provide some relief of symptoms, the long-term prognosis can be adversely affected due to the negative effects of post-surgical immobilization on hypertonic muscles.

3.10. KANON Myotherapy

In distinction to any of the aforementioned techniques, KANON myotherapy effectively releases the trapped lactic acid that keeps hypertonic muscles locked in spasm. As the lactic acid is released, the muscle spindles begin to supply the brain with corrective feedback about the muscle's resting tension. This causes the brain to reflexively reduce the stimulatory signals that it is sending to the muscle. As the muscle begins to relax, venous and lymphatic drainage begin to improve, and the mobilized lactic acid starts to be whisked away, thereby beginning to undue the vicious circle of muscle tightening and lactic acid build-up that had been keeping the muscle in spasm. As the muscle begins to relax, local nerve irritation begins to decrease. This not only reduces the associated pain, but it also increases range of motion. As range of motion increases, the muscle is able to generate more force, thereby helping to restore normal physical activity. Also, as blood flow increases, the muscle begins to resume its normal diameter, thus demonstrating that much of what is thought to be muscle atrophy is actually muscle *hypotrophy*—the loss of muscle diameter due to the fluid reduction in chronically contracted muscle.

What distinguishes KANON myotherapy from all other treatment modalities is that it has the potential to completely reverse hypertonic spasm. In the process, it completely eliminates the associated pain, and it completely restores physical function. Also, it does so without the need for maintenance therapy provided that 1) enough of the muscle is loosened to keep lactic acid from re-accumulating and 2) the patient does not return to the habits that drove the muscle into hypertonic spasm in the first place. Those habits include anything that causes the muscles to accumulate lactic acid, such as standing for too long, sitting for too long, or bearing weight for too long. One must also recognize that a complete resolution of symptoms does not necessarily mean that the health of the affected muscles have been completely restored. Hypertonic spasm develops from the core of the muscle outward, and it is only when the outer-most layers of the muscle become locked in spasm that symptoms begin. Conversely, symptoms begin to resolve as the most superficial layers of the muscle begin to loosen enough to stop irritating local nerves. At the tipping point, however, the muscle would have virtually no reserve capacity, and so the superficial layers could easily become locked in spasm again. For this reason, treatment should continue long after symptoms have resolved. As each successive layer of muscle fibers is loosened, the treatment is allowed to penetrate to the next successive layer of spasm; and as more and more of the muscle is loosened, the risk of relapse becomes smaller and smaller.

4. Delivery of KANON Myotherapy

KANON myotherapy can be applied via two complementary modalities. It can be applied mechanically, and it can be applied manually. The mechanical treatment involves a hand-held machine called the "Biopulser®," which works by gently tapping the spastic muscle tissue. As this occurs, it stimulates corrective feedback to the cerebellum, which in turn causes the cerebellum to reduce its output to the muscle. The Biopulser® is different from all other percussive devices in that it is specifically calibrated to stimulate corrective feedback without activating the stretch reflex, which would otherwise cause the muscle to tighten in response to the drumming of the instrument. Treatments take about an hour, and a series of treatments is usually needed because the corrective vibration produced by the Biopulser® cannot reach the deeper layers of spasm until the more superficial layers are loosened. Equally important is the need for the patient to avoid overtaxing freshly treated muscle until the mobilized lactic acid has had a chance to be adequately flushed out. This process ordinarily takes about 3-7 days and is facilitated by walking frequently and staying well-hydrated. Walking is the preferred post-treatment exercise because it stimulates brisk venous return to the heart, which in turn bolsters circulation to all the muscles of the body, including those that are hypertonic. If walking is difficult due to the severity of symptoms, pneumatic compression massage may be helpful in circulating lactic acid out of the muscles between treatments.

When performed properly, the massage technique has the same effect as the Biopulser®; however, because it requires manual manipulation of the muscles, it may not be as effective as the Biopulser® if attempted on muscles that are very tightly locked in spasm. Finally, it is important to note that both the mechanical treatment and the manual treatment require practice and may not be optimally effective unless they are performed properly.

5. Discussion

The goal of this review was to discuss the various treatment modalities that are currently available to relieve chronic musculoskeletal pain and to summarize their strengths and weaknesses in light of an emerging new hypothesis on the pathophysiology of chronic musculoskeletal pain. Although

many of the available treatment modalities do benefit some patients, it is widely recognized that the benefits tend to be limited and unsustainable without continued treatment. That suggests that the current treatment options are failing to address the root cause of chronic musculoskeletal pain. According to Dr. Thomas Griner, who has had unprecedented success treating chronic musculoskeletal pain, the root cause of the symptoms is a gradual build-up of lactic acid that eventually causes the affected muscles to become so tight that they begin to irritate local nerves. This hypothesis, which is based on fundamental principles of the neuromuscular system, is much more consistent with clinical observations than the traditional belief that chronic musculoskeletal pain is caused by the structural abnormalities that may be seen on x-rays and MRI scans. As previously mentioned, many chronic pain patients say that their pain began after a relatively minor event, such as a minor accident, an awkward movement, or some other event that seems disproportionate to the degree of pathology that is often seen on imaging studies. Also, a fundamental challenge in linking the patient's symptoms to the observed structural abnormalities is that there are usually no baseline studies available for comparison. That makes it difficult to determine the temporal relationship between the symptoms and the test results. Amidst this uncertainty, it is tempting to assume that the symptoms are caused by the observed structural abnormalities. Another complicating factor is that conservative interventions are often unsatisfactory, which in turn drives patients to seek more aggressive forms of treatment out of desperation. Consequently, it is possible that many drugs are prescribed, and many surgical procedures are performed unnecessarily.

As the first comprehensive hypothesis on the pathophysiology of chronic musculoskeletal pain, KANON myotherapy has the potential to change all that. If it is indeed true that most chronic musculoskeletal pain syndromes are rooted in an abnormal build-up of lactic acid and that the consequent hypertonic spasm could be reversed safely and inexpensively, it could revolutionize the treatment of chronic musculoskeletal pain. It could also open the door to a whole new world of prevention. For example, educating those in the labor industry about how to protect their employees from developing hypertonic spasm could go a long way toward reducing the risk of on-the-job injuries, and educating youth about the development of hypertonic spasm could go a long way toward preventing the problem altogether. Early intervention is important because hypertonic spasm begins early in life and continues to progress at variable rates depending on the individual's lifestyle, activities, and routines.

The guiding principle in preventing the development of hypertonic spasm is to avoid the accumulation of lactic acid. As previously discussed, lactic acid begins to accumulate in muscle tissue whenever its rate of production exceeds its rate of removal. Hence, any activity that reduces circulation or produces lactic acid can potentially promote the development of hypertonic spasm. The most obvious of these is bedrest. Though lactic acid continues to be produced during sleep, circulation is poor due to the markedly reduced movement and fluid intake. Hence, after a full night of sleep, the entire muscular system, like a stagnant pond, is teaming with lactic acid. That's why the body tends to be stiff in the morning. The accumulated lactic acid temporary distorts the neurofeedback that would otherwise allow the muscles to stay loose. Upon rising from bed and walking around a bit, the excess lactic acid begins to be flushed out. However, a sedentary lifestyle can result in the gradual accumulation of residual lactic acid. If this continues habitually, the involved layers of muscle could eventually lose circulation to the point that the residual lactic acid becomes permanently trapped in those layers of tissue. That underscores the importance of starting the day with a little exercise, preferably outdoor walking, and a glass of water to help flush out the accumulated lactic acid. Although one might suppose that walking would only benefit the muscles of the lower extremity, the pumping action of the calf muscles vigorously stimulates venous return to the heart. As described by the Frank-Starling law [22], this significantly increases the volume of blood that is pumped to all the muscles of the body. Slow walking is better than fast walking because it allows the calf muscles ample time to completely refill with blood before the next step forces the blood back up to the heart.

Another lifestyle routine that can promote the accumulation of lactic acid is prolonged sitting. When seated, venous return to the heart is sluggish, yet the postural muscles continually produce lactic acid as they labor to maintain body position. Thus, when physical therapists advise their patients to avoid sitting for extended periods of time, they do them a great service. Posture is likewise important because good posture involves properly balancing the head on the spine. When the head is properly balanced, the neck muscles are spared the work of carrying the head and, hence, produce less lactic acid than when the head is improperly balanced on the spine.

On the other end of the high-risk spectrum are those who exercise excessively. Excessive running is less problematic than excessive lifting because venous return to the heart is more vigorous during running than lifting. However, both types of exercise, when done in excess, can accelerate the accumulation of lactic acid and hasten the development of hypertonic spasm. For this reason, joggers should walk intermittently rather than jogging continuously, and weight-lifters should limit their number of repetitions to the time it takes for their muscles to use up their local reserve of oxygen, which is about six seconds. Once the oxygen reserve is depleted, aerobic metabolism shifts to anaerobic metabolism, and lactic acid production begins to rise appreciably [4, 23, 24]. Weight lifters should also stay well-hydrated and go for a walk following their work-out. A relaxing swim can likewise be helpful in removing excess lactic acid from the muscles.

Though the aforementioned habits can help limit lactic acid production, persons who exercise excessively generally tend to develop hypertonic spasm at an accelerated rate simply because most exercises produce so much lactic acid. This is especially true for professional athletes, who, in addition to weight training, are typically required to perform ballistic

movements repeatedly. Ballistic movements produce more lactic acid than slower movements because they are powered by fast-twitch muscle fibers, which, being anaerobic, produce more lactic acid than slow-twitch fibers [4]. The accelerated development of muscle hypertonicity in professional athletes is ultimately what shortens their careers. The only exceptions to this are professional golfers, who have a senior division presumably because they do so much walking. Only rarely do other athletes enjoy such extended careers, and the few exceptions are likely those who, knowingly or unknowingly, have developed good lactic-acid-clearing habits.

6. Directions for Future Research

Urgently needed are clinical studies aimed at comparing the long and short-term benefits and cost effectiveness of KANON myotherapy to traditional physical therapy, medication, surgery, and other therapies that are currently be used to treat chronic musculoskeletal pain. Also needed are clinical studies aimed at assessing the effectiveness of different lactic-acid-clearing routines in preventing or at least delaying the development of chronic musculoskeletal pain syndromes in different age and occupational groups.

7. Conclusion

Chronic musculoskeletal pain is the leading cause of disability yet is also the most misunderstood of all illnesses. Consequently, there are almost as many different forms of treatment as there are therapists who practice them. Clearly, there is a lack of consensus about how to best manage chronic musculoskeletal pain, and the likely cause of the disagreement is the continued failure to recognize the underlying pathophysiology of the condition. KANON myotherapy and the theory behind it have the potential to change all that. They have the potential to completely revolutionize the way that chronic musculoskeletal pain is treated, and, beyond that, they have the potential to prevent symptoms from ever developing in the first place. It is up to us to examine the theory, put it to the test, and begin to translate it from bench to practice.

Conflicts of Interest

The author declares that he has no competing interests.

References

[1] World report on disability. https://cdn.who.int/media/docs/default-source/documents/disability/world-report-on-disability-factsheet.pdf?sfvrsn=2a22ed1e_2.

[2] CDC Grand Rounds: Public Health Practices to Include Persons with Disabilities. MMDR. Morbidity and Mortality Weekly Report 2013; 62 (34): 697-701.

[3] Lynch ME, Watson PN. The pharmacotherapy of chronic pain: A review. Pain Res Manag 2006; 11 (1): 11-38.

[4] Griner T. What's really wrong with you? A revolutionary look at how muscles affect your health. Avery Publishing, 1995.

[5] Lima LV, Abner TSS, Sluka KA. Does exercise increase or decrease pain? Central mechanisms underlying these two phenomena. J Physiol 2017; 595 (13): 4141-4150.

[6] Weerapong P, Hume PA, Kolt GS. The mechanisms of massage and effects on performance, muscle recovery and injury prevention. Sports Med 2005; 35 (3): 235-256.

[7] Witvrouw E, Mahieu N, Roosen P, McNair P. The role of stretching in tendon injuries. Br J Sports Med 2007; 41 (4): 224-226.

[8] Kroll HR. Exercise therapy for chronic pain. Phys Med Rehabil Clin N Am. 2015; 26 (2): 263-81.

[9] Binder MR. Mind-Brain Dynamics in the Pathophysiology of Psychiatric Disorders. AJPN 2022; 10 (2): 48-62.

[10] Muscle tone physiology and abnormalities. Toxins (Basel) 2021; 13 (4): 282.

[11] Senzon SA. The Chiropractic Vertebral Subluxation Part 2: The Earliest Subluxation Theories From 1902 to 1907. J Chiropr Humanit 2018; 25: 22-35.

[12] Crelin ES. A scientific test of chiropractic's subluxation theory: The first experimental study of the basis of the theory demonstrates that it is erroneous. American Scientist, 1973.

[13] Whedon JM, Mackenzie TA, Phillips RB, Lurie JD. Risk of traumatic injury associated with chiropractic spinal manipulation in Medicare Part B beneficiaries aged 66 to 99 years. Spine (Phila Pa 1976) 2015; 40 (4): 264-270.

[14] Finger S, Piccolino M. The shocking history of electric fishes: From ancient epochs to the birth of modern neurophysiology. Oxford University Press, 2011.

[15] Johnson M. Transcutaneous electrical nerve stimulation: Mechanisms, clinical application and evidence. Rev Pain 2007; 1 (1): 7-11.

[16] Navarro X, Vivo M, Valero-Cabre A. Neural plasticity after peripheral nerve injury and regeneration. Prog Neurobiol. (2007) 82: 163–201.

[17] Fleming KC, Volcheck MM. Central Sensitization Syndrome and the initial evaluation of a patient with fibromyalgia: a review. Rambam Maimonides Med J 2015; 6 (2): e0020.

[18] Yang S, Chang MC. Effect of Repetitive Transcranial Magnetic Stimulation on Pain Management: A Systematic Narrative Review. Front Neurol 2020; 11: 114.

[19] Wright AR, Richardson AB, Kickuchi CK. Effectiveness of Accelerated Recovery Performance for post-ACL reconstruction rehabilitation. Hawaii J Health Soc Welf 2019; 78 (11 Suppl 2): 41-46.

[20] Moseley JB Jr, Wray NP, Kuykendall D, Willis K, Landon G. Arthroscopic treatment of osteoarthritis of the knee: a prospective, randomized, placebo-controlled trial. Results of a pilot study. Am J Sports Med 1996; 24 (1): 28-34.

[21] Bicker MC, Gupta A, Brown CH, Cohen SP. Epidural injections for spinal pain: A systematic review and meta-analysis evaluating the "control" injections in randomized controlled trials. Anesthesiology 2013; 119: 907-931.

[22] Delicce AV, Makaryus AN. Physiology, Frank Starling law. StatPearls [Internet]; February 10, 2022.

[23] Lund J, Aas V, Tingstad RH, Van Hees A, Nikolic N. Utilization of lactic acid in human myotubes and interplay with glucose and fatty acid metabolism. Scientific Reports 2018; 8 (9814).

[24] Binder MR. The golden book of muscle health and restoration. Lightningsource Publishers, 2012.