

Potential of Frequency Specific Microcurrent Therapy as a Healing Modality

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Abstract

This Honors College thesis will explore the possibilities and opportunities for advancement in resonance therapy, and its potential applications in the treatment of nerve pain, wound management, orthopedic fractures, arthritic pain, fibromyalgia, TMD, spine pain, scar release, increasing range of motion, and many more conditions. Resonance therapy incorporates different forms of resonance, including frequency specific microcurrent (FSM), pulsed electromagnetic field, sound, and lasers. This thesis will focus specifically on FSM because it has existed over a longer period of time; thus, it is the most developed and most utilized resonance therapy technology providing the most research data. However, it remains a relatively unknown and infrequently practiced treatment modality by medical practitioners, and may have limited funding available to use the technology and certify practitioners in it. However, if practitioners were more knowledgeable of its benefits, FSM may become more universally accepted in the medical field as a viable treatment option.

Introduction

Chronic pain is estimated to affect 20.4% of U.S. adults as of 2016, proving to be one of the most common reasons that medical care is sought (“Prevalence of Chronic Pain,” 2019). Chronic pain restricts mobility and daily activities, increases dependence on opioids, increases the likelihood of developing anxiety or depression, and overall reduces quality of life (“Prevalence of Chronic Pain,” 2019). Electricity as a medical treatment, or electrotherapy, has been shown to be efficient in treating a variety of clinical ailments, including many pain related disorders (Mercola & Kirsch, 1995). Electrotherapy functions under the hypothesis that the human body relies on energies to communicate between vital systems in the body, as well as other characteristics such as stimulating the repair of tissues, and powering nerve conduction, digestion, circulation, and movement (McMakin & Oschman, 2013). Frequency specific microcurrent (FSM) is a relatively new form of electrotherapy designed to relieve pain and symptoms of a variety of clinical symptoms by focusing on the electrical signaling of cells and how they resonate within the body (Sharp, Huynh, & Filart, 2019). FSM is performed with a microcurrent device that is adjustable to the frequencies of various tissues and organs in the body, helping to modulate pain and symptoms associated with specific ailments (Sharp, Huynh, & Filart, 2019). FSM has the potential to be a valuable treatment modality for a wide span of medical conditions; provided that more research is conducted on it to be able to determine its numerous benefits and expand the knowledge of FSM in the medical community.

History of Electrotherapy

Electrotherapy has been shown to have the ability to regenerate damaged nerve and muscle structures (Cheng, et al., 1982). The therapeutic use of electricity started in the early 1900s when clinicians used electric devices to treat a variety of ailments in the United States and

England. Copies of *Electricalmedical Digest* were discovered in the National College of Neuropathic Medicine book room in Portland, outlining different frequencies and protocols for various conditions, as well as their clinical outcomes from 1921-1951. In 1934, The American Medical Association prohibited the use of electrotherapy, homeopathy, herbs, and other treatments as being “unscientific,” only allowing pharmaceutical medications and surgery to be practiced as standardized medicine. Subsequently, use of electrotherapy and the research conducted on biophysics decreased until the 1980s.

In 1995, a British osteopath found a machine in the practice he bought in Vancouver, BC (Canada) that came with a list of frequencies created in 1992 that were connected to specific tissues and medical conditions (Curtis, Fallows, Morris, & McMakin, 2011). The list included 100 frequencies hypothesized to “neutralize” conditions, and over 200 frequencies hypothesized to address specific tissues (Curtis, Fallows, Morris, & McMakin, 2011). The device the osteopath found was thought to have been plugged into the DC wall current in 1922, though this is not confirmed. Despite this uncertainty, the osteopath developed a device inspired by his findings that used microcurrent and frequencies to treat nerve pain, muscle pain, injury repair (Curtis, Fallows, Morris, & McMakin, 2011). The device employed the osteopath’s method of treatment which incorporated two channels with different frequencies; one channel to “remove a pathology” combined with the frequency of the second channel that “addresses a specific tissue” (Curtis, Fallows, Morris, & McMakin, 2011). Frequencies utilized on the first channel have exhibited effectiveness in treating hemorrhage, fibrosis, scar tissue, mineral deposits, histamine, and inflammation (Curtis, Fallows, Morris, & McMakin, 2011). The second channel is designated for frequencies specified to treat muscles, fascia, tendons, nerves, arteries, and other tissues (Curtis, Fallows, Morris, & McMakin, 2011). The hypothesized frequency pairings were

tested through trial and error and were found to be either effective or didn't produce any improvement, but did no harm to the tissue (Curtis, Fallows, Morris, & McMakin, 2011). It was observed that deviating from the hypothesized frequency combinations did not produce any effect on the tissue (Curtis, Fallows, Morris, & McMakin, 2011). After many years of clinical use, it can be implied that the frequency pairings are accurately represented, although much more extensive research must be done before this can be proved.

Microcurrent

Microcurrent has been shown to be effective in rapid pain control and acceleration of healing (Mercola & Kirsch, 1995). The microcurrent amperage that is delivered through devices is measured in millionths of an ampere, or 10^{-6} amperes (amps). Because of its small amperage, the microcurrent is below the sensation threshold, as opposed to other technologies where it can be felt (Mercola & Kirsch, 1995). Microcurrent pulses last approximately 0.5 seconds, which is 2500 times longer than previous technologies (Mercola & Kirsch, 1995). Microcurrent instruments are small machines supplied with graphite/vinyl gloves. The gloves are designed to deliver current to the cells and provide sensitive tactile perception. However, because of improvements in the technology, gloves are not typically used anymore in modern practice. The machine has two leads that deliver current to the affected tissue through the gloves, with an alternating positive and negative ramped square wave form. Frequency-specific microcurrent uses an identical ramped square wave and voltage, but uses two channels delivered through four body contacts. FSM is applied to the affected tissue in combination with wet towels and/or gel electrodes.

Mechanism of Microcurrent

Microcurrent therapy mimics the electrical intensity of tissues in the body, and is hypothesized to increase the number of sarcomeres and adenosine-5'-triphosphate (ATP)

production (Ahn, et al., 2017). The role of ATP in electrical stimulation is essential to the function of electrotherapy. ATP is necessary for the activation of phosphorylation of target proteins, as well as an integral part of maintaining Ca^{2+} homeostasis (Seegers, Engelbrecht, & Papendorp, 2001). It has also been suggested that alterations in ATP in result of an electric field being applied to tissue may affect P2-purinergic receptors, causing a change in pain sensation (Seegers, et al., 2002). P2-purinergic receptors are responsible for triggering depolarization due to the extracellular ATP and increasing intracellular levels of calcium. In a study conducted on rats, electrostimulation was applied to rat skin, resulting in significantly increased ATP concentrations (Cheng, et al., 1982). The amino acid transport through the cell membrane of the rat skin was estimated, and ATP concentrations were measured in the control samples and the experimental samples. It was determined that with currents ranging from 50 μA to 1000 μA , ATP levels increased by 3-5 times (Cheng, et al., 1982). Currents beyond 1000 μA caused a plateau in ATP concentrations (Cheng, et al., 1982). It was determined that when currents are applied to the tissues of rat skin, an increase of ATP concentrations in the tissue was observed with current levels ranging from 10 μA –1000 μA (Cheng, et al., 1982). Additionally, the amino acids incorporated into the proteins of the skin was stimulated between 100 μA and 750 μA (Cheng, et al., 1982). This increase in concentration of ATP is an important function of microcurrent because it stimulates cellular physiology and growth within tissues (Mercola & Kirsch, 1995).

Application of an External Field

When an electrical field is applied to a molecule, the charge distributions are affected, which causes molecules to modify its accessible conformational states with different electric properties (Seegers, Engelbrecht, & Papendorp, 2001). It is hypothesized that resonance is the mechanism responsible for the effects due to the current resonating with charged particles within

the specific tissue (Mcmakin & Oschman, 2013). Electric fields can affect specific membrane protein-linked functions as a result of changing charge distribution, including Na^+/K^+ ATPase and Ca^{2+} ATPase activity, ion channels, transport systems and receptors (Seegers, Engelbrecht, & Papendorp, 2001). Electric fields, if strong enough, can open Na^+ -, Na^+/K^+ , and Ca^{2+} - channels (Seegers, Engelbrecht, & Papendorp, 2001). Na^+ inflow results in an action potential, further depolarizing the cell. Ca^{2+} increases in influx, which effects functions of the cell body, including cell shape changes, signal transduction mediation, muscle contraction, cytoskeletal reorganization, cell orientation and migration, immune-cell functions, cell proliferation, and metabolic processes (Seegers, Engelbrecht, & Papendorp, 2001). Muscle neglect has been linked with intracellular Ca^{2+} elevation, which results in elevating calpain levels (Thompson & Kaplan, 2019) Calpain is a protease involved in apoptosis, or programmed cell death (Thompson & Kaplan, 2019). Irregular Ca^{2+} levels are thought to disrupt muscle and tissue structure within the body, activate atrophy and necrosis of tissue, and disturb other processes in the body (Thompson & Kaplan, 2019). Microcurrent is often used to regulate Ca^{2+} homeostasis levels in the tissue (Thompson & Kaplan, 2019).

It is known that biological systems are affected by electrical treatment (Cheng, et al., 1982). By applying electrical stimulation to biological systems, it has been observed to stimulate growth and tissue repair (Cheng, et al., 1982). The application of an electric field increases the activation of growth factors, which are necessary to produce the cells for wound healing and tissue generation (Seegers, Engelbrecht, & Papendorp, 2001). It has been reported that when an electric field is applied to bone cells, several growth factors are increased. There is an increased secretion of the growth factor IGF-11 (insulin growth factor-11) which is associated with bone fracture healing (Seegers, Engelbrecht, & Papendorp, 2001). It has also been found that prostaglandin E2 (PGE2)

is implicated in bone cells exposed to an electric field (Seegers, Engelbrecht, & Papendorp, 2001). Applying an electric field connects the resonant frequencies between the oscillating electric field and the tissue. If the electric field is of appropriate strength and frequency, it can change the conformational state of membrane proteins, which affect the signal transduction processes within the membrane (Seegers, Engelbrecht, & Papendorp, 2001).

Therapeutic Effects of Frequency-Specific Microcurrent

When a cell or tissue has been injured, its basic resonant frequency is changed (Sharp, Huynh, & Filart, 2019). Frequency specific microcurrent returns the cell or tissue to its original frequency, it allows the cells to heal more efficiently (Sharp, Huynh, & Filart, 2019). FSM has been used to treat and heal an extensive list of medical conditions, including bone fractures, fibromyalgia, torticollis, chronic lower back pain, macular degeneration, nervous system conditions, delayed onset muscle soreness, cancer-related pain, shingles, scar tissue, and many more conditions. Various experiments and clinical examinations have been conducted to study the effects of frequency specific microcurrent on these conditions. The frequencies on one channel are targeted for specific conditions and are combined with frequencies on the second channel targeted for the specific tissue (Mcmakin & Oschman, 2013). FSM therapy often causes a palpable change in tissue texture immediately after application of the correct frequencies for a disorder (Mcmakin & Oschman, 2013). Many combinations have been tested and proved to be an effective treatment modality.

Musculoskeletal

A study was conducted on the effects of microcurrent on patients with chronic low back myofascial pain. Myofascial pain refers to pain caused by muscular irritation that radiates from sensitive points, or myofascial trigger points, throughout muscle tissue, which can cause

restrictions of biomechanical joint function and impair neurologic function. These trigger points have been a known source of back pain, producing pain in the muscles of the skull, jaw, and cervical spine. Often, there will be a sensation of paresthesia at the referral site and the muscles or tissues will become hypersensitive. In this study, 22 patients with chronic low back pain for an average duration of 8.8 years were analyzed for an average treatment period of 5.6 weeks (Mcmakin, 2004). A range of frequencies meant to address chronic fibrotic myofascial tissue were used on patients, who observed a reduction and pain and changes in the tissue itself (Mcmakin, 2004). The average pre-treatment pain score was rated 6.5/10 on the Visual Analog Scale (VAS), whereas the average post-treatment VAS score was rated 1.7/10 (n=22), stating they all experienced a significant and continuing reduction in pain (Mcmakin, 2004). This study concluded that FSM provided the most consistent, immediate, and drastic change in tissue and pain levels for the 22 participants (Mcmakin, 2004).

FSM has also been used to treat congenital muscular torticollis (CMT), which is a common musculoskeletal disorder that affects infants. CMT restricts cervical lateral flexion and rotation, and can present with a sternocleidomastoid muscle mass, cranial deformation, and cervical spine musculature imbalances (Thompson & Kaplan, 2019). CMT is classified by severity scale with 7 grades, and the 8th classification is specifically for children older than 12 months who present with torticollis symptoms that have not been treated yet. A 19-month-old male toddler was seeking treatment for grade 8 CMT; presenting with 12 degrees of left head tilt, 25 degrees restriction of passive left cervical rotation, mild postural cervical hyperextension, and left upper trapezius restriction; and received a poor prognosis using conservative methods (Thompson & Kaplan, 2019). The treatment protocol included conservative measures such as strengthening, postural reeducation exercises, and massage, and FSM was added to the program

after two weeks of the intervention (Thompson & Kaplan, 2019). Channel A was programmed to four frequencies, each lasting five minutes, to treat three calcium conditions and fibroma, while Channel B was targeted towards muscle tissue. These frequencies are thought to provide a stimulus for tissue repair and regeneration of the sternocleidomastoid muscle mass (Thompson & Kaplan, 2019). FSM may have helped this patient by improving stretching and massage tolerance, further increasing range of motion. More so, it is proposed that the FSM treatment affected the patient on a cellular level by restoring the Ca^{2+} homeostasis in the tissue because he had the same reaction to stretching and massage prior to FSM treatment (Thompson & Kaplan, 2019). By restoring the calcium levels, calpain activation is balanced and muscle fibers begin to heal. The use of FSM in this case study was very beneficial because the toddler presented with grade 8 CMT at the time of the referral, and was given a poor prognosis. FSM combined with the conservative care improved range of motion, strength in lateral flexors, and reduction of head tilt (Thompson & Kaplan, 2019). Though there is little data on the effects of FSM on CMT thus far, it is clear that FSM has the potential to be a beneficial treatment modality.

FSM has also been shown to help resolve chronic pain and neural adhesions in post-operative patients. Ulnar transposition surgery often causes perineural scarring with a poor prognosis for treatment, restricting range of motion and subsequent chronic pain (Adams & McMakin, 2017). Physical therapy has been used as a treatment modality, but often it is a slow, painful and difficult process that doesn't always produce optimal results. FSM was used to treat a 28-year-old male who reported persistent pain and increased cutaneous sensitivity in the area following an ulnar transposition surgery he underwent 10 years ago (Adams & McMakin, 2017). Initially, his VAS score was 5/10 before receiving physical therapy where he was treated with electrical stimulation therapy and ice (Adams & McMakin, 2017). After discharge, he reported

his VAS score had decreased to 4/10, however in the following year his pain increased to 7/10, which lead him to seek alternative treatment. (Adams & McMakin, 2017). He began FSM therapy, using frequencies of 40 Hz on channel one to reduce inflammation and pain, and 396 Hz on channel two to target the nerve as a tissue (Adams & McMakin, 2017). Additionally, 13 Hz was used on channel one in combination with channel two to soften and dissolve scar tissue (Adams & McMakin, 2017). Succeeding three treatment sessions, the patient reported pain free full range of motion and resolution of hyperesthesia in the surgical area with a pain score of 0/10 (Adams & McMakin, 2017). FSM successfully resolved the patient's symptoms of neuropathic pain and neural adhesions, which shows potential to be an effective treatment for failed ulnar nerve transposition surgery or further orthopedic procedures. Furthermore, it could conceivably serve as a conservative modality instead of or preceding surgery.

Nervous System

The nervous system is an essential component of every body process. Without neuroendocrine feedback, body processes would not function. FSM has been documented for 20 years to have an effect on the nervous system and treat conditions including inflammation, PTSD, brain injury, and autonomic function. In a study conducted on 45 patients with inflammation in association with fibromyalgia from spine trauma, it was documented that after 60 minutes of FSM treatment, there were reductions of all the inflammatory cytokines by factors of 10 and 20 times (McMakin, 2019). The only frequency combination found to be effective was 40 hertz in channel one to target inflammation and 10 hertz in channel two to target the spinal cord (McMakin, 2019). The patients reported a reduction in pain from 7.4/10 to 1.4/10 on the VAS scale after one treatment, and 58% of patients reported recovery from fibromyalgia within four months (McMakin, 2010a).

The PTSD FSM treatment protocol consists of frequencies that target the midbrain stress centers, inflammation in the forebrain, and the sympathetic nervous system (Mcmakin, 2019). In a study done on 3-5 year chronic, combat-induced PTSD patients, it was reported that after four treatments covering four weeks, there was a rapid decrease in PTSD symptoms (Mcmakin, 2019). To treat traumatic brain injury, stroke, concussion, and individuals with autism, it has been documented to be most effective when a combination of FSM and speech therapy is used, as well as nutritional support and brain exercises (Mcmakin, 2019). FSM has also shown to induce rapid changes in autonomic function and heart rate variability by applying a frequency to “increase secretions” of the sympathetic nervous system and reduce parasympathetic tone (Mcmakin, 2019). FSM has great potential as a treatment modality for nervous system conditions; that being said, more data must be collected to discover how to make treatments more efficient and less expensive for patients struggling with these issues.

FSM also has potential to be a treatment modality for myofascial and neuropathic pain. It has been shown to have an effect on cytokines, prostaglandins, and sodium channels (Mcmakin, 2010a). It is hypothesized that applying microcurrent affects the voltage gated ion channels (VGIC) in cell and neural membranes (Mcmakin, 2010a). VGICs transport ions across the cell membrane in result of ATP activation, which is gained from a current being applied to the tissues. A case report was conducted on 20 patients suffering from neuropathic pain. One lead was placed on the spine where the nerve exits, and the second lead was placed at the distal end of the nerve (Mcmakin, 2010a). The frequencies that were applied were 40 Hz to reduce pain and 396 Hz to target the nerve (Mcmakin, 2010a). Additionally, patients were treated with a protocol of 13 Hz and 396 Hz to target adhesions between nerves and the surrounding fascia of the nerve, cord, and dura that cause limitations in range of motion (Mcmakin, 2010a). Prior to FSM

treatment, the average initial pain score was 6.78/10 with a range from 4 to 10 (McMakin, 2010a). After concluding four treatments, the posttreatment pain score was 0.29/10, and 65% (n=13) of patients fully recovered from neuropathic pain (McMakin, 2010a). This treatment protocol proved to be successful in treating and resolving chronic neuropathic pain in these 20 patients. More clinical data needs to be collected to evaluate efficiency and possible side effects, but it has promise as a valuable treatment modality for chronic neuropathic pain that otherwise is a difficult condition to successfully treat.

Cancer

FSM has been proposed as a treatment modality for patients who have completed chemotherapy and radiation therapy that are struggling to maintain posttreatment quality of life. An issue that has been observed as a result of the aggressive therapy protocol is tissue becoming hard and limiting range of motion as well as increasing pain with movement (Lennox, Shafer, Hatcher, Beil, & Funder, 2002). In a study of 26 head and neck cancer patients experiencing tissue discomfort or range of motion limitations due to fibrosis of the tissue, microcurrent was used as a treatment modality. Patient's range of motion and pain levels in cervical rotation, extension/flexion, and lateral flexion were measured before and after treatment. Conclusions of the study found that patients experienced an improvement in range of motion, and were able to alleviate symptoms of radiation-induced fibrosis (Lennox, Shafer, Hatcher, Beil, & Funder, 2002). Although this study didn't use FSM specifically, it is still noteworthy that the use of microcurrent was effective in providing relief to cancer patients. More research should be conducted in addition to this study to determine specific frequencies that could be used to target aspects such as fibrosis, immobility, pain, numbness, etc. that may be more beneficial when used as an FSM treatment.

Skin

FSM has been shown to be an efficient non-pharmacologic treatment modality for shingles. Shingles is an infection of the dermatomal or cranial nerve due to herpes zoster virus. The infection in the nerve lasts for the lifetime of the host, and can cause pain, red lesions and blisters to break out over the area of the associated nerve. Shingles may flare up in response to stress or immune system compromise. The patient in the case study of the effects of FSM on shingles was an 85-year-old male, who presented with a rash on the forehead of his scalp which was diagnosed by a dermatologist as actinic keratosis (Mcmakin, 2010b). He began experiencing pain in the area of the rash, reporting VAS levels to be a 7/10 (Mcmakin, 2010b). He began FSM therapy for the treatment protocol of actinic keratosis: 40 Hz on channel one and 355 Hz on channel two (Mcmakin, 2010b). The patient reported an increase in pain with treatment, and it became obvious that the patient had shingles in the ophthalmic branch of cranial nerve five (Mcmakin, 2010b). He was then treated with a frequency protocol designated for shingles, which was 230 Hz on one channel and 430 Hz on the second channel, noted as being useful for the treatment of viruses (Mcmakin, 2010b). The patient was pain-free within 20 minutes, and after two treatment sessions of three hours total, the patient reported he was pain free and the lesions on his scalp were scabbed and healing (Mcmakin, 2010b). There have been no cases in patients with shingles that have received this treatment protocol that were not reported to be effective (Mcmakin, 2010b).

It has been documented in animal cases that the use of autocatalytic silver-plated nylon dressings (Silveron ®) was effective in wound management (Huckfeldt et al., 2003). A study was conducted on the effect of microcurrent on human burn patients that used Silveron. Range of motion, skin sensitivity, and scar discoloration were measured in six patients with Silveron. FSM

was applied for three treatment sessions with a duration of 60 minutes, and all six patients noted measurable changes in the areas treated (Huckfeldt et al., 2003). There were varying degrees of response, but no patients reported adverse effects to the microcurrent (Huckfeldt et al., 2003). With more research on the effects of Silveron combined with FSM, it may provide a feasible treatment modality for wound healing and scar tissue management.

Pain Disorders

FSM has been successfully used to treat various pain disorders, including complex regional pain syndrome, myofascial pain, visceral disorders, and somatic disorders. One case study described the effects of FSM therapy as an intervention for complex regional pain syndrome (CRPS). CRPS is chronic pain that commonly affects one limb, typically after an injury (“Complex Regional Pain Syndrome,” 2019). CRPS can also causes changes in skin texture, stiffness in the associated joints, difficulty with coordination of muscle movement, and dystonia in the affected limb (“Complex Regional Pain Syndrome,” 2019). The 17-year-old female presented with CRPS Type 2, reporting experiencing constant, sharp pain throughout the right lower limb, with decreased light touch from mid-right thigh to mid-leg with increased pain to deep palpation, and no sensation in the right medial foot (Burnham, Katholi, & Burke, 2019). The patient had seven treatment sessions of FSM therapy, with a protocol that targeted nerve pain, inflammation of the peripheral and central nervous system, and scarred nerve fibers (Burnham, Katholi, & Burke, 2019). The patient reported that after six treatments, she had no complaints of pain or irregular sensations (Burnham, Katholi, & Burke, 2019).

FSM has been used to treat various somatic and visceral conditions, such as fibromyalgia, chronic fatigue, and myofascial and neuropathic pain (McMakin & Oschman, 2013). A report studied the effects of FSM in muscle tension and muscle tone, including tissue softening, muscle

stiffness, and temperature of the tissue (Mcmakin & Oschman, 2013). Patients presenting with prominent muscle tone or stiffness is typically a result of previous trauma or disease (Mcmakin & Oschman, 2013). Fascia within the body is thought to have influence on passive muscle stiffness, elasticity, compliance, extensibility, resting tension, and muscle tone (Mcmakin & Oschman, 2013). When fascia thickens due to trauma or disease, it can leave residual effects such as inflammatory pockets in the tissue or non-resilient bands that are palpable within the tissue, creating stress and tension within the musculoskeletal system (Mcmakin & Oschman, 2013). FSM has the ability to soften tough, scarred, firm, or stiff muscle tissue, and within minutes of application the tissue becomes soft and “smooshy” (Mcmakin & Oschman, 2013). The tissue softening outcomes of FSM makes it a promising treatment for various visceral and somatic disorders, given that more research is conducted to determine the most effective frequency pairs for specific pathologies.

War Veterans

In a study conducted on the effects of FSM combined with acupuncture on three wounded warriors, or veterans, it was found that FSM is a safe, noninvasive treatment modality when used in conjunction with acupuncture (Sharp, Huynh, & Filart, 2019). The three wounded warriors struggled with pain and symptoms such as memory problems, mental sluggishness, and post-traumatic stress disorder (PTSD) (Sharp, Huynh, & Filart, 2019). The FSM concussion and FSM Brain Fog programs were used to treat the three participants. After a few sessions of FSM coupled with acupuncture, a reduction in pain was measured, as well as eliminating brain fog, memory, and headache in each participant (Sharp, Huynh, & Filart, 2019). There were no reports of adverse effects in the patients observed (Sharp, Huynh, & Filart, 2019).

Frequency Specific Microcurrent Compared to Other Modalities

FSM has been shown to be a successful treatment modality for an assortment of clinical diagnoses. However, since it is a relatively new technology that has not been introduced to most physicians, other treatment modalities are still being used to treat medical conditions.

Transcutaneous electric nerve stimulation (TENS) is a widely used treatment modality that has been in use since the 16th century. TENS functions on the theory that applying electric nerve stimulation triggers the mechanism of pain transmission and blocks it (Saranya, et al., 2019). The theory proposes that electrical stimulation results in the endogenous release of endorphins as well as stimulating the pain gate mechanism (Saranya, et al., 2019). TENS machines typically have a current range from 0-80 mA (10^{-3} amps), compared to the FSM frequency that is measured in μ A (10^{-6} amps) (“Transcutaneous Electrical Nerve Stimulation,” n.d.). The duration of each pulse varies from 40-250 microseconds compared to microcurrent which delivers pulses lasting 0.5 seconds; around 2500 times smaller than microcurrent (“Transcutaneous Electrical Nerve Stimulation,” n.d.).

A comparison of TENS versus microcurrent nerve stimulation (MENS) was studied in the treatment of masticatory muscle pain. Temporomandibular disorders (TMDs) affect the temporomandibular joint (TMJ) and the muscles located in the jaw. A group of 60 patients with TMD were separated into two groups; each group consisting of two subgroups of 15 patients each based on their VAS score. Group A received TENS while Group B received MENS. After one month of treatment, the patients' VAS scores and mouth opening were remeasured. The TENS treatment group noted an immediate and steady increase in mouth opening, while the MENS treatment group noted a significant increase mouth opening after day three of treatment (Saranya, et al., 2019). The VAS scores of both groups were similar after the one-month follow

up period (Saranya, et al., 2019). Compared to the TENS group, the MENS treatment group noted a significant increase in functional mouth opening in patients with moderate-to-severe pain by day five and at the one-month follow up (Saranya, et al., 2019). TENS group noted an improvement in pain by day two and pain improved by 43% by day three, and a 91.02% improvement in pain at the one-month recall (Saranya, et al., 2019). Contrastingly, the MENS group noted an improvement in pain by day one and a 60% improvement in pain by day three (Saranya, et al., 2019). Compared to the TENS group, the decrease in pain of the MENS group was more significant than the TENS group after day four (Saranya, et al., 2019). The study concluded that TENS and MENS were both effective in treating TMD; however, the MENS group had a better and immediate response to the treatment compared to the gradual pain relief in the TENS group (Saranya, et al., 2019). Additionally, because MENS delivers a smaller current that is below the threshold of feeling, there was an absence of side effects such as “tingling” and paresthesia that the TENS group experienced (Saranya, et al., 2019). Conclusively, both treatment modalities can be considered as effective treatment modalities for TMD, but MENS provides an immediate relief of pain compared to TENS, which is something to take into consideration when deciding between modalities.

Traditional methods of treatment, such as physical therapy, pharmacologic treatment, hot packs, cold packs, and other forms of medicine are the immediate treatment provided to patients struggling with various medical conditions. While these modalities have been shown to be effective in some cases, the benefits of electromedicine should not be disregarded. Benefits of electromedicine include low incidence of adverse effects, easy to use technology, ability to be used by physicians or patients themselves, eliminates or reduces the need for medication, and the immediate and long-term effects that have been observed (Kirsch, 2006). From a physician’s

perspective, it is beneficial to introduce into practice because it expands their realm of knowledge and practice capability to treat a wider array of medical conditions (Kirsch, 2006). It provides an additional modality that can be used in combination with other treatment or after traditional methods fail, ultimately providing more options for treatment compared to other physicians. From a cost analysis perspective, though it is an expensive product to purchase initially, they are durable and cost effective, and can be used for years on various patient populations, compared to moist heat or cold packs which need to be replaced after extensive use (Kirsch, 2006).

Another form of “microcurrent therapy” that has been used for centuries is needle acupuncture. Originating from Eastern medicine, acupuncture is the insertion of very thin needles into the skin at specific points known as acupuncture points. Traditional Chinese medicine uses acupuncture to balance the flow of energy, or qi (“Acupuncture,” 2018). Western medicine views it as a method of stimulating nerves, muscles, and connective tissue (“Acupuncture,” 2018). Acupuncture has been shown to be effective at treating a variety of diseases and conditions, including chronic pain (“Acupuncture,” 2018). Acupuncture is considered to be the original form of microcurrent, because it is hypothesized that when needles are twirled underneath the skin, it generates electrical charges (Davis, 1992). Furthermore, when needles are left underneath the skin for periods of time, it is thought that this has a draining effect of the excess energy from tense or inflamed tissues (Davis, 1992). Microcurrent is a modern form of this treatment and has been observed to have similar effects when used as a modality; both providing alternative treatment methods for pain relief (Davis, 1992).

Conclusion

The research conducted on frequency specific microcurrent and its benefits has shown to be overwhelmingly successful at treating a wide variety of clinical diagnoses. FSM has been shown to be beneficial in treating medical conditions such as bone fractures, fibromyalgia, TMD, residual scar tissue, wound management, neuropathic pain, and myofascial pain. FSM often provides immediate and complete relief from pain and other associated symptoms. In several cases, it has been shown to completely resolve symptoms of conditions that have otherwise received poor prognoses, providing a modality option for patients that have exhausted traditional methods of treatment. Although FSM is not widely recognized by physicians, it would expand the capacity of treatments that a physician can offer to patients. FSM is a cost-effective treatment option that could be advantageous and ultimately be made into a significant asset of practice. The technology is easy to use as a physician, and is easy enough for patients to use at home on themselves. FSM has great potential to be a promising new public health tool, given that people are educated on its mechanisms and benefits. The ability of FSM to increase ATP in the body and other nutrients and hormones in the body is a relatively unexplored area of biomedical science, and the mechanisms of how FSM functions is still not completely understood. If more research was conducted on the mechanisms and potential treatments of FSM, it could become a more desirable and applicable treatment modality in medicine overall. If physicians were aware of its extensive range of uses and treatments, it could potentially become a universally acknowledged modality that could provide relief to patients. Given the positive characteristics explored in this paper, the potential for frequency specific microcurrent to be viable treatment for an assortment of medical conditions should not be disregarded or overlooked by the medical community.

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