

Effectiveness of Laser Therapy on Musculoskeletal Conditions: A Literature Review

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ABSTRACT

Objective: This article provides an overview of literature on the effectiveness of laser therapy for musculoskeletal conditions. Emphasis is given to investigate what laser therapy consists of and the different classifications of lasers. Also, how laser therapy is used to treat musculoskeletal conditions and how laser compares to other modalities in effectiveness. Finally, any limitations that may exist in the utilization of laser therapy when treating musculoskeletal injuries and conditions.

Data Source: A computer-aided search using PubMed generated articles relevant to the use of laser therapy in musculoskeletal injuries and conditions. Referenced sources were identified from the online database searches and from the review of scientific literature. The PubMed search generated over 9,600 articles on laser. The PubMed search generated over 2,900 articles on laser therapy and over 150 articles on low level laser therapy.

Data Synthesis: Musculoskeletal conditions are very complex in nature but there is strong evidence in the searches performed that support laser therapy as an effective tool to be utilized in the treatment and care of musculoskeletal conditions and diseases.

Conclusions: Laser therapy has strong evidence to support its usefulness in treating musculoskeletal conditions. It has demonstrated its effectiveness in its ability to decrease pain, and increase healing time in both soft tissue and bony structure conditions. It has shown to be a valuable clinical tool in decreasing inflammation. Lasers can also be used as an alternative to NSAIDs therapy and can also lower the effects of IL-1. Laser therapy can be effectively utilized in acute and/or in chronic musculoskeletal conditions, such as the chronic condition of rheumatoid arthritis. Laser therapy has been tested to show it increases angiogenesis and blood flow by promoting new blood vessel capillary budding and increased collateral circulation. Laser therapy is more effective than ultrasound or infrared therapy in treating musculoskeletal conditions but it can be enhanced by using it in conjunction with exercise therapy. Laser therapy does have contraindications, but when used with adequate precautions; its benefits outweigh the potential harmful side effects. Overall, strong evidence support the safety and efficacy of laser therapy in treating musculoskeletal conditions.

Key Indexing Terms: laser, laser therapy, low level laser therapy, musculoskeletal, bone, muscle

INTRODUCTION

Laser therapy, also known as photobiomodulation, is a medical technique in which exposure to laser light increases tissue growth and healing. Laser therapy has become increasingly popular in the treatment of musculoskeletal conditions and injuries and is used in a wide array of therapies. Thanks to increasing technology and the more affordable purchasing price, laser therapy can be utilized outside of the hospital setting and in the individual practitioner's office. With such advances and widespread use, this literature review will attempt to review the effectiveness of laser therapy for musculoskeletal conditions. Emphasis will be given to investigating what laser therapy consists of and the different classifications of lasers, how laser therapy is used to treat musculoskeletal conditions, and how laser compares to other modalities in safety and effectiveness. Limitation in the utilization of laser therapy when treating musculoskeletal injuries and conditions will also be addressed.

Musculoskeletal conditions and injuries are a major concern in the health industry today. They represent a problem that costs society billions of dollars annually. Low back pain alone has been estimated to be over \$50 billion annually, and some sources say the costs may even be as high as \$100 billion annually.^{1,2,3} With so much being spent on musculoskeletal conditions, and laser therapy being one of the latest technologies in the health care arena, there has been much debate on whether or not it is actually beneficial to the patient. This review will examine the contributions of laser therapy in treating musculoskeletal conditions and outline the classifications, applications, comparisons, and possible limitations of laser therapy.

DISCUSSION

What is Laser Therapy

The history of laser therapy has advanced much throughout the years, and as it has advanced it has been broken into different classes and been known by different names. This has included the Low-level Laser Therapy (LLLT), Low-intensity Laser Therapy (LILT), High Power Laser Therapy (HPLT), Cold Laser Therapy, Soft Laser Therapy, Low Reactive Laser Therapy, Low Power Laser Therapy, Light Emitting Diode Therapy, Low Energy Photon Therapy, Class III Laser Therapy, and Class IV Laser Therapy ⁴.

The ANSI Laser Standard Classifications of the different lasers are divided into groups or classes determined by their wattage. Class I lasers are measured in microwatts and some common examples of where Class I lasers are utilized are in such common items as a laser printer that you use when printing pages from your home computer or in a compact disc player used to play music in your home and vehicle. A Class II laser is measured up to one (1) milliwatt and some common examples of where Class II lasers are utilized are in a laser pointer device used during a PowerPoint demonstration or when someone is giving a speech to a group of people. Other examples include the grocery store scanner you use when checking out your groceries and the laser device scans the barcode on your grocery items. Class II devices are also utilized in the therapy of musculoskeletal conditions in health care facilities. Class III lasers are divided into two groups depending upon their wattage, there are Class IIIa and Class IIIb lasers. Class IIIa are measured up to 5 milliwatts and some common examples of where Class IIIa lasers are utilized are in range finder machines on guns,

binoculars, and other such items. They are also used in the more powerful laser pointer devices utilized in PowerPoint presentations as discussed in Class II lasers. Class IIIa lasers are also used in the therapy of musculoskeletal conditions in health care facilities. Class IIIb are measured up to 500 milliwatts and some common examples of where you would come across Class IIIb lasers are in light shows at science centers or music concerts. Class IIIb lasers are also used in the treatment of musculoskeletal conditions in health care facilities. The final class of lasers is the Class IV laser group and this is a very wide and vast classification of laser. It encompasses everything that uses more than 500 milliwatts. Class IV lasers are used in everything from cutting industrial steel for fabrication of steel products to cutting out metal molds. Class IV lasers are also used in the military as weapons to be used from aircrafts and other . Class IV lasers are used in the healthcare arena in two main forms. The first is the Thermal Class IV lasers that are used in surgical applications and in this application the laser can actually burn through tissue, vessels, etc. In the second type, the Photo-Chemical Class IV lasers, the lasers are not used to surgically cut through tissue but are used to deliver laser therapy to the tissue of target ⁴. This is one of the main differences between Class III and Class IV lasers. Class III lasers are extremely safe due to the fact that you could use Class III lasers on a patient for a very long time, hours even, and because they do not generate any heat, they would not damage the tissue that you were treating. This is where the term “cold laser” came from, it was not heat generating. Class IV lasers on the other hand do create heat, therefore they are much more dangerous to use and need to be monitored more closely when being used to treat musculoskeletal complaints on patients. Class IV lasers on the other hand, if used for even a few

minutes, could cause serious damage to the skin and tissue being treated if not monitored correctly, they can even cause burns to occur on the skin.⁴ So why would someone want to use a Class IV laser instead of a Class III laser seeing as how they are so much more dangerous potentially? The answer lies in researching the wattage of the laser.

Lasers have two different measurements. They are measured by their power and by their energy. The power of a laser is measured by its wattage. The wattage of a laser has been described by some by comparing a laser to a light bulb. The wattage of the laser is likened to the brightness of a light bulb. As the wattage of the laser is increased, it is similar to increasing the brightness of a light bulb, or in other words, you are increasing the power to the light bulb so the bulb is increasing in brightness. Therefore, the higher the wattage of a laser, the higher power of the laser. Next, you have the energy of the laser; the energy of the laser is measured in units called Joules. If the power of a laser is comparable to the brightness of a light bulb, then the energy of the laser could be compared to the amount of heat the light bulb is giving off as it shines. If you have ever tried to unscrew a light bulb that has been on for several minutes you will recall how extremely hot that light bulb was. Yet, if you turn the light bulb off and let it cool off then you are able to unscrew the light bulb with no problem at all, the bulb is not hot to the touch at all. This is a way you can think of what is called a therapeutic dosage in laser therapy. The energy of the laser is what is being delivered to the tissues that are being treated by the laser therapy.⁴ Here is a breakdown of how increasing the power of a laser can increase the amount of energy that laser is able to deliver in a set five minute time frame. A 5 milliwatt laser is able to deliver 1.5 Joules of energy in five

minutes. A 500 milliwatt laser is able to deliver 150 Joules of energy in that same five minute time frame. And a 5 Watt laser is able to deliver an amazing 1500 Joules of energy in only five minutes!⁴ This really helps to emphasize the advantages of a higher power laser. This allows the patient to receive a larger dose to a larger volume of tissue and even to be able to reach deeper tissues if that is where their problem lies.⁴ If a patient has a large surface area injury, it could potentially take a much longer time to treat with a lower wattage therapeutic laser. It is also important to remember that each layer of tissue will absorb some of the energy of the laser therapy. It is just like shining a flashlight through a piece of paper and seeing how much of the light can go through the paper and still shine on the wall behind the paper. You could try this with a piece of paper, and piece of clothing like a shirt sleeve or a hand towel, etc. Note, the thicker the item is, the less light from your flashlight there is that reaches the wall behind the item. This is the same way a laser works with superficial or deep lying tissues. The deeper the target tissue, the more power and energy it will take to reach the target tissue. If you have an injury site with lots of muscles and tissues surrounding it, like in a knee injury or a sacroiliac joint injury, this comes into play. In the knee injury example, for pain and inflammation in large joints like the knee, it would take quite a lot of Joules to get through the superficial tissues that absorb some of the laser as it passes through them, and then be able to reach the joint in question and allow the actual target tissues to receive the energy that they need.⁴

Time is also another important aspect that needs to be discussed. How much time does it take to deliver the therapeutic dosage of laser therapy? Let's investigate this by looking at another comparison. The average size of a humans palm on their

hand is approximately 100 cm². Let's assume that someone had a back ache that they wanted to have treated with laser therapy and we will say that this area to be treated is approximately 200 cm² or about the size of a two palms of a human hand. We will say that the amount of energy that we want to deliver to this site is 2000 Joules of energy. To deliver 2000 Joules of energy using a 5 milliwatt laser, which is a Class IIIa laser, it would take 6,666 and 2/3 minutes, or 111 hours to deliver this amount of energy. If we used a Class IIIb laser, using a 500 milliwatt laser, it would take 66 and 2/3 minutes to deliver this amount of energy. That is still over an hour of laser therapy to this patient's back to be able to finally deliver the requisite 2000 Joules of energy. Now let's look at using a Class IV laser, with 8 Watt of power, it would only take 4 and 1/6 minutes to deliver that same 2000 Joules of energy that took over 111 hours using the first example ⁴. This is another reason why using a higher power laser can be so beneficial. The faster a doctor can deliver the therapeutic dosage of laser therapy, faster response times of healing have been reported. Furthermore, the patient is happier and more satisfied because they do not have to spend as much time at the doctor's office being treated.

Decrease Pain

Laser therapy is able to help to decrease pain associated with musculoskeletal conditions. According to a study published in Pain Med, low level laser therapy is able to decrease pain and give more effective short-term relief than a placebo therapy that they used in conjunction to the study.⁵ The study set out to investigate the clinical effects of low level laser therapy on patient who were suffering from acute neck pain with radiculopathy. They used a double-blind, randomized, placebo-controlled study at the

Clinic for Rehabilitation at the Medical School, University of Belgrade, Serbia. The study took place between January 2005 and September 2007 and their study included 60 test subjects that received 15 laser therapy treatments over a three week period. One group received the therapy from an active laser and the placebo group received their therapy from an inactivated laser as a placebo. The following settings were used: wavelength 905nm, frequency 5,000 Hz, power density of 12mW/cm(2), dose of 2 J/cm(2), treatment time of 120 seconds, at whole doses 12 J/cm(2). Their results showed a statistically significant difference between groups for arm pain intensity and for neck extension range of motion.⁵ They utilized the visual analog scale (VAS), range of motion, neck pain disability index, and quality of life measure as their outcome assessment tools.

Another study was performed on rats and results showed that they were able to reduce sciatica pain in rats using low level laser therapy.⁶ The reason why this is a great addition to the current volume of literature in laser therapy use is because animal experiments are not susceptible to the placebo effect often experienced in health care today, which is when a doctor or scientist tells a patient they are going to feel better because of therapy "XYZ", there is often time some improvement in symptoms, even if only temporarily, simply because the patient wants to believe so much that they will get better, that they do in fact get better. These effects can be short term, or long term, but they are not due to the therapy itself, but in the physician telling the patient the expectations that they should receive, thus skewing the results. Animals on the other hand are not prone to this effect. It does not matter if the physician delivering the therapy believes in it or not, which has been shown to alter results in the past. It does

not matter if the physician delivering the therapy tells the animal in the test that the therapy will or will not help them, the therapy itself is the only variable being measured because it is the only thing that can truly have an effect on the outcome. This is why using animal testing can be so beneficial. It can eliminate possible bias. In the experiment using the rats with sciatica pain, they used a 830 nm low level laser therapy. Eighteen rats were in the study and they were divided into three different groups. They all had their sciatic nerve exposed and compressed using catgut thread to induce sciatic pain. Six rats received a simulated treatment. Six rats received low-level laser therapy (LLLT) with only 4 J/cm² and the last group of six rats received LLLT with 8 J/cm². They started the five days of LLLT on the third postoperative day and assessed the pain by measuring the paw elevation time during the rats gait cycle. It was shown through this experiment and they concluded that LLLT did in fact produce a pain reduction in the rats that they put through their model for sciatica.⁶

Another experiment went as far as to declare that laser therapy is actually able to regenerate a sciatic nerve after it has suffered damage from a crush injury.⁷ They also used rats in their experiment and studied the effects on peripheral nerve damage that can occur in crush injuries. They wanted to compare the effects of different wavelengths of laser therapy, thus comparing a 660 nm and a 830 nm laser therapy. This experiment demonstrated how laser therapy is able to benefit those suffering from musculoskeletal conditions because it explored how a damaged peripheral nerve can greatly alter the motor and sensory functions in the patient.⁷

It has also been found at the Department of Physical Therapy at the Graduate Institute of Rehabilitation Science, China Medical University in Taiwan, that low level

laser therapy can promote function recovery and may also promote nerve regeneration in rats who suffered from chronic constriction injuries.⁸ After the rats received seven consecutive days of treatment using a 660 nm, 9 J/cm(2) laser their functional indices improved compared to their sham treatment cohorts. The low level laser therapy was shown to significantly improve the paw withdrawal threshold and the sciatic, tibial and peroneal functional indices.⁸

Increase Healing

Laser therapy has been shown to increase skin flap survival in rats using a 670 nm laser.⁹ The experiment used forty rats in its study and they were divided into four different groups and the fourth group was the control group and it received no laser therapy. The other three groups received differing amounts of laser therapy, specifically, 0.06J, 0.15J and 0.57J. They received the laser therapy immediately after their surgery, and then on the first and second day postoperatively. The area of skin was then evaluated on the seventh postoperative day. The results showed that the group that received the highest dose of laser therapy had a significant improvement in tissue survival compared to the control group that received no treatment.⁹ Laser therapy can help improve tissue survival and healing by time both reducing the wound size and by increasing collagen synthesis. This accelerated skin wound healing process is probably due to inducing collagen synthesis.¹⁰ Sutured wound healing times can even be enhanced by the use of laser therapy.¹¹

Skin flaps are not the only soft tissue that can benefit from laser therapy however. A study was performed on another musculoskeletal condition involving rat

Achilles tendon injuries. The use of laser therapy was able to significantly improve the repair, strength, and maximum stress of Achilles tendons in rats.¹²

As a comparison, we will review a study performed on human subjects who suffer from temporomandibular disorders and are not able to open their mouth in both the acute and chronic stage of the disorder. The study included both male and female subjects, no age limits were in place and it included patients who had limited jaw movements or difficulty chewing. The study concluded that by utilizing a low level laser therapy that both patients with acute and chronic conditions showed improvement in function of their temporomandibular joint, as noted by their increased ability to open their mouth, but also a decrease in their pain.¹³ It was noted that the individuals who suffered with acute TMD had an even greater response to the laser therapy and will most likely have the best outcome, and that laser therapy can be considered as a real alternative to physical modalities in the management of temporomandibular disorders.¹³ These results could be due to increased healing of the temporomandibular joint itself, but it could also be due to the ability of laser therapy to reduce muscle fatigue in the involved musculature in humans.¹⁴ In TMD, as in other musculoskeletal conditions, muscle fatigue can be a contributor to the issue. Laser therapy can actually reduce or delay muscle fatigue in human skeletal muscle and thus enhance muscle performance.¹⁴

Laser therapy has also been shown to be successful in treating carpal tunnel syndrome in patients who suffer from rheumatoid arthritis. They used the Tinel and Phalen signs in all subjects and used the VAS and symptom severity scale and hand grip strength as their outcome assessment tools and their results showed significant

improvement in their pain scale as well as their functional status score.¹⁵ Another study performed at the University of Ottawa, School of Rehabilitation Sciences, found that laser therapy also helps to alleviate the symptoms associated with rheumatoid arthritis such as morning stiffness and that laser therapy could be considered for short-term care for pain management and morning stiffness because it has so few side-effects.¹⁶

Soft tissue structures such as skin, muscle, ligaments and tendons are not the only structures that can have their healing capacity increased by laser therapy. It has been shown that bony structures can also have their healing capabilities enhanced through laser therapy. Bone repair in the rat tibia has been shown to improve by utilizing ultrasound and low level laser therapy.¹⁷ Studies have shown that laser therapy is able to stimulate osteoblastic proliferation and osteogenesis at the fracture site of the tibia in rat subjects. Therefore, increasing the bone healing process. The study showed that compared to the control group the rats with tibial fractures that received laser therapy and ultrasound had considerably more woven bone tissue as compared to those that received no therapy.¹⁷ One would need to take care also to note that laser therapy is contraindicated to use over active bone growth plates because studies have shown that laser therapy can negatively affect distal bone growth in an active growth plate.¹⁸

Laser therapy has shown itself to be more effective than other modalities in treating musculoskeletal condition. In fact, when compared to ultrasound, laser therapy has been confirmed more successful in lowering pain and improving function in both shoulder myofascial pain syndrome and low back pain.^{19,20}

It is noted however, that laser therapy can enhance the usefulness of other modalities by being used in conjunction with these therapies to increase their outcomes

when treating musculoskeletal conditions. For example, it has been shown that laser therapy in combination with exercise is substantially better than exercise alone in relieving pain and improving shoulder range of motion in the musculoskeletal condition called subacromial syndrome.²¹

Decrease Inflammation

Inflammation can be both good and bad, depending on the particular situation, all sorts of stimuli, from both inside and outside the body can stimulate or provoke the complex reaction in the vascularized connective tissue called inflammation.²² The reactions within the blood vessels lead to an accumulation of fluid and leukocytes in the tissue outside the vessels. Inflammation is closely related to the repair process of the body. This is a good thing. Inflammation is one of the first steps in the repair process. Inflammation can serve to destroy and wall off agents that can harm the patient and it begins the process of healing damaged tissue. Inflammation really is fundamentally a protective response inside the body. If we did not have inflammation, whenever we had an infection this infection would continue completely unchecked. Our wounds would never heal and if one of our internal organs became injured it would remain a constant festering sore and never heal.²² So why would we want to decrease or lower the inflammatory process by utilizing laser therapy? This too is an important aspect of inflammation. One must also remember that too much of a good thing can become a harmful thing when in excess. The inflammatory process is the underlying cause of, for example, a life-threatening hypersensitivity reaction to an insect bite. Or perhaps, to a specific drug or toxin that the patient's body does not respond well to. Also, inflammation reactions are at the core of some common chronic diseases like

rheumatoid arthritis, atherosclerosis, and lung fibrosis.²² This is why our television commercials are jam packed with advertisements for anti-inflammatory drugs. The next time you are at the grocery store take a look at the pharmacy shelves; there are countless numbers of anti-inflammatory drugs to choose from. So the question comes again, if inflammation is a good thing, why would we want to use laser therapy or anti-inflammatory medications to decrease this process? Because inflammation is good in moderation and when it is correctly in check, but unchecked, it can lead to the problems mentioned above or other serious sequelae of inflammation. Accelerated wound healing and the reduction of wound size is accomplished through laser therapy by reducing the inflammatory phase when it is no longer being beneficial to the injury site.¹⁰

Inflammation is divided into an acute and chronic phase. Acute inflammation only lasts a short time, lasting only minutes to hours to maybe a few days. While chronic inflammation lasts weeks to months. The vascular and cellular responses of both the acute and chronic phase of inflammation are activated and mediated by chemical factors that are derived from plasma or other cells. These mediators can act singly, or in combination with each other.²² These mediators can amplify the inflammatory response and influence how the inflammation progresses and evolves. If the inflammation is unchecked and it inadvertently goes to the chronic inflammatory phase, there are some serious sequelae that can accompany this. It can lead to some disabling diseases like rheumatoid arthritis, atherosclerosis, tuberculosis, and chronic lung diseases.²² The mechanism of how laser therapy is able to help in the care of diseases like rheumatoid arthritis may be due reducing levels of pro-inflammatory cytokines or chemokines produced by synoviocytes.²³ Autoimmunity diseases and conditions arise when the

patient's own immune system attacks their own tissues. In these cases autoantigens begin evoking a self-perpetuating immune reaction that results in the diseases above in addition to others like lupus erythematosus.²² This is why decreasing and lowering inflammation when needed can be so beneficial to the patient suffering from musculoskeletal diseases but also to those who suffer systemic diseases as well. Laser therapy has been shown to be able to decrease inflammation in musculoskeletal conditions and is a valuable clinical tool and has even been shown to be a good alternative to traditional NSAIDs therapy for inflammatory musculoskeletal conditions. Laser therapy has consistently been shown to be a valid alternative to NSAIDs.^{8,24} In studies involving rat Achilles tendonitis, results show that low level laser therapy doses of 3 J can significantly reduce inflammation, produce less COX-2 expression, and produce less edema formation than their nonirradiated counterparts and the authors went on to say that laser therapy may in fact have "potential to become a new and safer nondrug alternative to coxibs".²⁴

Reduction of Interleukin 1 Activity

Laser therapy is able to reduce the actions of Interleukin 1 (IL-1). IL-1 is a cytokine that acts as a mediator that serves many purposes, one of which is to bring about the destructive proliferative synovitis in musculoskeletal conditions and diseases like rheumatoid arthritis. IL-1 is produced locally by macrophages and early on they serve as the activators.²² IL-1 in coordination with tumor necrosis factor (TNF) serves to up regulate expression of adhesion molecules in endothelial cells which increases the buildup of white cells in the synovium and thus increases the synovitis. This complication in addition to the fact that we know that IL-1 enhances cartilage destruction

and pannus formation in RA patients and it also increases the production of degrading enzymes which makes it harder for proteoglycans to do their job of repairing damaged tissues.²² This is how laser therapy helps. Laser therapy can decrease or reduce the amount of IL-1, therefore stopping its destructive actions and helping the patient who suffers from musculoskeletal ailments like rheumatoid arthritis.⁸

Not only does laser therapy reduce the actions of IL-1, but it has also demonstrated its ability to significantly reduce the overexpression of hypoxia-inducible factor 1, tumor necrosis factor, and the activation of vascular endothelial growth factor.⁸

Increase Angiogenesis

Angiogenesis is a process in which preexisting vessels are able to send out capillary buds or sprouts to create new vessels. Laser therapy is able to increase the number of newly formed vessels.¹¹ Angiogenesis is an important process that is critical in inflammatory processes and in the formation of collateral circulation. It is also important in tumor cell growth and has been studied at length because of this, but this is not the focus of this literature review, suffice it to say that there are therapies that aim at both increasing and decreasing angiogenesis for different therapeutic effects. In musculoskeletal diseases the aim is usually to increase angiogenesis which will aid in the healing process. There are specific steps in the development of a new capillary vessel and they are as follows: first there must be a proteolytic degradation of the basement membrane of the parent vessel. This allows for the formation of a new capillary sprout and then later on the cell migration. The migration of the endothelial cells goes toward the angiogenic stimulation. Then the proliferation of the endothelial cells will occur. This occurs just proximal to the leading front of the migrating cells.

Maturation of the endothelial cells is the next step to occur and this includes the inhibition of growth and then remodeling into specific formation called capillary tubes. Recruitment of periendothelial cells, which include pericytes for small capillaries and vascular smooth muscle cells for larger vessels, are used to support the endothelial tubes and provide a maintenance and accessory cell function for the vessels. All of these steps are controlled and regulated by interaction among growth factors and vascular cells in addition to the extracellular matrix itself.²² Laser therapy is actually able to aid in this process by increasing blood flow by increasing collateral circulation and microcirculation if a blood vessel becomes occluded for whatever reason.²⁵ In a study on rabbits, laser therapy was used to treat the areas of injury in their vascular deprived state. The results showed that by using laser therapy they were able to enhance microcirculation and accelerate collateral circulation in these areas of injury.²⁵

Contraindications of Laser Therapy

Contraindications include both absolute contraindications and relative contraindications. Absolute contraindications include not using laser therapy in the eye. Direct laser beams in the eye are highly harmful and dangerous and cause serious damage. You would also never use laser therapy directly over the thyroid gland on the anterior aspect of the neck of a patient. This is dangerous because it can elicit a harmful and dangerous situation known as a thyroid storm. A thyroid storm is a life threatening condition and is a medical emergency and necessitates a 911 call immediately. Symptoms would include agitation, change in consciousness, shaking, tremors, confusion, diarrhea, pounding heart and restlessness.²⁶ Using laser therapy over a

malignant tumor is also an absolute contraindication as is using laser therapy on a pregnant female.⁴

Relative contraindications for laser therapy would be using it on un-united fontanelles and growth plates. Using laser therapy with a pacemaker should be used with caution and avoided when possible as is when a patient is using photosensitizing medications at the same time they are receiving laser therapy. Last of all, laser therapy should not be used directly over tattoos because they have the potential to absorb more of the laser energy than the tissues adjacent to the tattoos and therefore are prone to potential risk of skin burns, etc, but the tissue and skin that are not directly covered by a tattoo are perfectly safe to use laser therapy on.⁴

CONCLUSIONS

Musculoskeletal conditions are very complex in nature but there is strong evidence in the searches performed that support laser therapy as an effective tool to be utilized in the treatment and care of musculoskeletal conditions and diseases.

There is a substantial amount of research that exists on the topic of laser therapy on musculoskeletal conditions. The PubMed search generated over 9,600 articles on laser. The PubMed search generated over 2,900 articles on laser therapy and over 150 articles on low level laser therapy.

Laser therapy has strong evidence to support its usefulness in treating musculoskeletal conditions. It has demonstrated its effectiveness in its ability to decrease pain, and increase healing time in both soft tissue and bony structure conditions. It has shown to be a valuable clinical tool in the decreasing of inflammation

and can also be used as an alternative to NSAIDs therapy and can also lower the effects of IL-1. Laser therapy can be effectively utilized in acute musculoskeletal conditions or in chronic conditions as well, such as the chronic condition of rheumatoid arthritis. Laser therapy has been tested to show it does indeed increase angiogenesis and blood flow by promoting new blood vessel capillary budding and increased collateral circulation. Laser therapy is more effective than ultrasound or infrared therapy in the treating of musculoskeletal conditions but it can be enhanced by using it in conjunction with exercise therapy. Laser therapy does have contraindications, but when used properly, with the adequate precautions, its benefits far outweigh any potential harmful side effect. Overall, there is strong evidence to support the efficacy of laser therapy in treating musculoskeletal conditions.

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