LASER POINTER THERAPY:

AN INEXPENSIVE, EASY TO USE, ADJUNCTIVE THERAPY

FOR PATIENTS WITH CHRONIC PAIN

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ABSTRACT:

Most patients with chronic pain have a variety of factors which cause or contribute to their ongoing condition. For example, a herniated disk may lead to, or be further complicated by spasms of spinal muscles, postural misalignment, or nerve root compromise. This complex interplay where problems occur locally but interact globally makes it unlikely that a single treatment will remit or resolve all of a patient's problems. Thus, it is essential to consider several therapeutic modalities when designing a treatment plan. In addition to mainstay options like medication, surgery, and physical rehabilitation, physicians should also consider adjunctive therapies which, though limited in application and effectiveness, can still make important contributions to a patient's overall maintenance, management and recovery. This paper discusses one such adjunct - Laser Pointer Therapy (LPT) - a technique for applying deep stimulation into joints and muscles by means of laser pointers which are currently available without a prescription through a variety of retail sources. This treatment is inexpensive and easy for patients to use at, or away from home, and it may be beneficial when focal therapy is desired.

KEY WORDS:

1. Laser Pointer Therapy (LPT)
2. Low Level Laser Therapy (LLLT)
3. OSHA Laser Classifications
4. Electromagnetic Spectrum
5. Chronic Pain Management

INTRODUCTION:

As with many forms of technology, lasers are at the cutting edge of medicine today. According to the U.S. Food and Drug Administration (FDA) website (1), lasers are approved for a wide variety of medical applications, including general surgery, hair and scar removal, wrinkle treatment, dental whitening and temporary relief of pain. This pain relief modality is classified as Low Level Laser Therapy (LLLT), with lasers used in this category referred to as biostimulation lasers, cold lasers, soft lasers or acupuncture laser devices. To better understand these, and the overall medical laser family, one must first understand what lasers are and what they do.

The word laser is an acronym for *l*ight *a*mplification by *s*timulated *e*mission of *r*adiation. Unlike most common light sources, such as the sun or household light bulbs which emit a variety of light at different wavelengths, lasers emit a single wavelength of light that is uniform and homogenous. For analogous comparison, consider sunlight to be like a large group of joggers, represented by various people of different shapes and sizes, dressed in individual manners, each proceeding at their own pace. Laser light, in comparison, would be a contingent of military personnel marching along, evenly spaced, in step and in line with one another, uniformly dressed alike.

THE ELECTROMAGNETIC SPECTRUM:

To further understand lasers, one must be familiar with the electromagnetic spectrum. This spectrum represents all forms of radiation: energy emitted as either waves (light) or particles

(photons). Visible light is part of the electromagnetic spectrum, and it is represented by wavelengths of 400 to 700 nanometers. Above visible light (over 700 nanometers wavelengths) are infrared light, microwaves and radio waves, while below visible light (under 400 nanometers wavelengths) are ultraviolet light, x-rays and gamma rays.

From a safety point of view, the significance of the electromagnetic spectrum can be summarized by the acronym *BBC* which, while in another context stands for the British Broadcasting Corporation, here refers to *b*urns, *b*lind and *c*ancer. Burns are the major health risk for exposure to the portion of the electromagnetic spectrum above visible light (greater than 700 nanometers), the capacity to transfer heat being the basis for microwave ovens. Blindness is the main risk within the visible light portion of the spectrum (400 to 700 nanometers), which is why our mothers warned us that we would go blind if we stared directly at the Sun. Lastly, cancer is the byproduct of excessive exposure to wavelengths below visible light (under 400 nanometers), as typified by skin cancer from the Sun's ultraviolet radiation, as well as the other familiar cancer hazards of x-rays and gamma rays.

OSHA LASER CLASSIFICATIONS:

The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) published its *Guidelines for Laser Safety and Hazard Assessment* on August 5th of 1991 (2). In it, OSHA divides all lasers into four categories, I through IV. These classifications are based upon the hazards of coming in contact with laser light during the device's normal operation. Class I lasers are those which emit no radiation when operating and are considered to present no known health hazards.

Contrary to what this implies, these are often high powered lasers used in industrial settings. However, as they are totally enclosed under normal operating conditions, it is unlikely that anyone will come in direct contact with the laser beam.

Class II lasers are low energy lasers which emit visible light not exceeding 1 milliwatt of power. They are considered to be a minor health risk, due to the small amount of energy they produce and our normal aversion behavior to bright lights. A subclass of this group, called class IIa, includes lasers not normally intended for viewing, such as the scanners found in most supermarkets.

Class III lasers emit both intermediate (1-5 milliwatts) and moderate (5-500 milliwatts) amounts of energy. The intermediate group, also known as class IIIa lasers, are considered hazardous only when the beam is directly projected into the eye without being diluted by diffusion (scattering of the coherent beam into infinite directions, thereby decreasing its intensity in any one direction). The common laser pointer is the best known example of this type, and it will be the main topic of this paper. Class IIIb lasers, the moderate group, are distinguished by their greater power output which creates a proportionately greater risk for injury. Beyond the potential for optical damage, however, none of the class III lasers (a or b subtype) are considered capable of producing life threatening harm.

Class IV lasers are those above 500 milliwatts which can be extremely hazardous to one's health under normal operating conditions. They can carry enough energy to damage the eye when viewed directly or indirectly (i.e. - with out without diffusion), may be capable of burning skin and, under certain circumstances, may be capable of starting a fire. Interestingly, the only distinguishing feature between many Class I and Class IV lasers is that the former are totally enclosed when operating, while the latter are not.

FDA APPROVAL:

Today, the FDA has approved only class IIIb lasers for LLLT (see *Introduction* section, above). According to one manufacturer's data (3), these lasers emit a wavelength of 830 nanometers, placing them in the lower end of the infrared portion of the electromagnetic spectrum (700 to 50,000 nanometers). As they operate above the visible light range, they are invisible, with burns from prolonged exposure being the major health risk associated with their use (the first "B" of BBC, above). Being in the infrared range, the FDA classifies them as infrared lamps, but not as thermal heating devices as they produce less than 100 milliwatts of power (for comparison, common household light bulbs radiate 40 to 100 watts of energy). While they do not emit significant amounts of heat, their penetration into soft tissue can be as deep as five centimeters which is farther than the thickness of an average adult's wrist. Specifically, the FDA has approved these devices to be labeled for "adjunctive use in the temporary relief of hand and wrist pain associated with carpal tunnel syndrome" (4), while their off-label applications include arthritis and muscle pain treatment.

DISADVANTAGES OF CLASS IIIB LASERS:

The FDA has approved class IIIb lasers to be safe and effective when used as prescribed. Unfortunately, wherever they meet, technology and medicine tend to triangulate with high cost. Not surprisingly, these lasers are expensive, their purchase prices ranging from a few thousand to tens of thousands of dollars. In addition, most insurance companies do not yet cover this form of therapy.

As multiple applications are required over extended periods of time, the resultant out-of-pocket cost to the health care consumer can be hundreds to thousands of dollars. Thus, though effective, price can be a barrier to use of class IIIb laser technology.

In addition, States tend to regulate the use of class IIIb lasers. The regulations of the state in which I practice are contained in Chapter 64-E4 of Florida's Administrative Code (FAC) (5). According to the 2004 FAC, all class IIIb and class IV lasers must be registered with the state. This oversight includes the need for specially trained personnel to staff each laser facility, which includes having a designated laser safety officer. In addition, the devices must be inspected, calibrated and checked for radiation levels on a prescribed basis. Many states have similar regulations, and though they protect public safety, these requirements add further financial burden to the laser therapy provider, which ultimately will be passed on to the patient. Thus, in an effort to break through the triad of technology, medicine and cost, class IIIa lasers were examined as an alternative adjunctive therapy to treat pain.

ADVANTAGES OF CLASS IIIA LASERS:

Laser technology permeates many fields of medicine today. Unlike other classes of lasers, however, those of class IIIa have some distinct advantages for the relief of mild to moderate muscle and joint pain. First, given proper instructions, these devices are very safe for patients to use. They operate at low energy levels, radiating 5 milliwatts or less of power, making it improbable that they will cause burns (the first "B" of BBC, above). Next, given appropriate patient education, the hazard

of optic injury can be prevented by not shining the laser's beam directly into one's eyes (the second "B" of BBC). Finally, and perhaps of greatest concern to most patients, they emit no ultraviolet light, x-rays or gamma rays and, therefore, do not cause cancer (the "C" of BBC). Thus, as there is no known toxicity from the proper, prescribed use of class IIIa lasers, they may provide therapeutic benefit as an adjunct or alternative to medication in treating mild to moderate muscle or joint pain.

Another advantage of class IIIa lasers is cost. For those who respond well to this modality, these devises are inexpensive and readily available at most office supply stores, sold as laser pointers. A unit sufficient for therapeutic use can be purchased for under twenty dollars, with the only recurrent cost being the replacement of two AAA batteries (some units come with watch batteries that are slightly more expensive to replace). This recurrent cost is negligible, as most of our patients find their units' batteries last several weeks to several months, depending upon use.

In addition to cost, these devices are extremely convenient to use. Being small and battery-operated, they are portable and easy to carry. Patients can use them in their homes, offices, or any other place they require temporary relief. The ones we distribute (6) come with a carrying case that, in addition to the laser, holds two extra AAA batteries as back-ups, should those in the unit wear out (picture 1). The only difficulty in using these devices are their tiny on-off buttons which must be constantly depressed during operation (a safety feature to prevent the lasers from remaining on while unattended). Because of their small size, these little buttons can become uncomfortable to hold down after a while. Taping a penny or some other small flat object over them can make the units much more comfortable to operate (picture 2).

LASER POINTER THERAPY (LPT):

Class IIIa lasers are commonly sold today as laser pointers, which are about the size of a common pen and emit a visible red light. They are diode lasers (solid-state), so, unlike lasers which operate on gas tubes, they are durable and not readily damaged by every day handling. Due to the low tolerance standards associated with mass producing such inexpensive lasers, the actual wavelength of any given diode can vary from between 630 to 680 nanometers, however, this does not appear to diminish their therapeutic effectiveness. They operate on two AAA or watch style batteries, and can be used at or away from home.

Though class IIIa lasers are not FDA approved for treating pain, their use can be considered an off-label adaptation of class IIIb technology. Being of lower power than their bigger brothers, class IIIa lasers have a limited penetration into soft tissue of approximately one to two centimeters (this can be easily demonstrated to patients by holding the lighted laser to the palm side of a finger tip, which will illuminate the nail on the other side). They should be primarily applied in cases of mild to moderate muscle or joint pain, just as an aspirin might be effective in certain circumstances where steroid use would be excessive. Realistic expectations and a thorough understanding of these lasers' capabilities can make LPT a valuable component of any pain management physician's armament.

The actual mechanism by which class IIIa or IIIb lasers work is not fully understood. However, it is known that many cells within our bodies react in beneficial manners to light, the production of vitamin D and melanin by our skin being just two examples. Also, given the widespread and longstanding use of heat lamps for muscular-skeletal pain, it is likely all class III

lasers work through a mechanism similar to that of other light modalities which reduce pain.

Prior to use, for safety purposes, patients are first instructed never to point their laser directly at anyone's eyes (human, pet, or otherwise) or at a reflective surface such as glass, shinny metal or mirrors which could bounce the beam directly into someone's eyes. The light is safe to view off of a flat, non-reflective surface, such as carpet or a painted wall, as the beam is dispersed in many different directions simultaneously, decreasing the intensity of light any one individual can see.

The instructions for use of class IIIa lasers are similar to those given for class IIIb, though modified to take into account the lower wattage output in LPT. Patients can treat any outer area of their bodies that are covered by clean, intact, healthy skin. They should avoid ulcers, sores, cuts, and any dermatologic lesions, such as moles or varicose veins, since the therapeutic value of class IIIa lasers for these conditions has not yet been determined. For hygienic purposes, between applications the tip of the device can be wiped with an alcohol swab.

To perform LPT, the light emitting end of the laser is gently applied directly to the skin over the selected muscle or joint. With the laser on, it is slowly moved in either a circular or back-and-forth motion for three to five minutes per application. Any site may be treated this way up to three times per day. Though they are low power units, many patients reported feeling a warming sensation deep inside the treatment area which coincided with relief of their pain symptoms. While they are not considered to carry enough energy to generate heat, one patient described a mild, first degree burn after holding the laser motionless over a single spot for ten minutes, against medical advice. This minor burn resolved in three days without treatment, scarring or functional impairment, and after re-education the patient continued to use LPT several times per week with beneficial results.

LPT CLINICAL SURVEY:

In January of 2005, to better understand the clinical value of LPT, fifty-six patients were educated on its use and potential benefits as an adjunct therapy. These patients ranged in age from early thirties to late sixties, with females slightly outnumbering males. Three of these patients, all female, were wheelchair bound, the rest being self-ambulatory with little or no assistance. The vast majority of them were either full or part-time employed, even though they had suffered severe chronic pain on average from four to seven years. All used opioid medications as their main form of pain management, ranging in analgesic equivalence from 60 to 900 mg of oral morphine daily. After their introduction to LPT, patients were allowed to voluntarily try or decline use of a class IIIa laser. Two weeks later they were all surveyed, with the following results.

Of these patients, over half (33 of 56) declined use of the lasers. The two most common reasons sited for not trying were doubt of any real benefit and inability to easily reach the painful site, as in mid-thoracic back pain. Interestingly, one-third of the patients who declined to try this modality (11 of 33) said that they would recommend it to others with mild to moderate muscle or joint pain.

The 23 patients who tried the class IIIa lasers reported using them for adjunctive treatment of mild to moderate muscle or joint pain in the feet, legs, knees, lower back, hands, arms, elbows, shoulders, and neck. Of these, less than half (10 of 23) said that they would not continue to use the lasers, due to an insufficient perceived benefit. However, the majority of these unsatisfied patients (6 of 10) said they would recommend the lasers to others with mild to moderate muscle or joint pain.

Of the 23 patients who tried LPT, 13 perceived significant benefit from using the class IIIa

lasers. Significant benefit was qualified as a feeling of noteworthy pain reduction after using this adjunctive treatment, but it was not quantified in any manner. Though none of these patients reduced their baseline medication use once they started LPT, they all felt it had, at times, prevented their need to use additional break through medication (this was a perceived benefit by the patients which was not quantified in the survey). Over half of these patients (8 of 13) continue to use their devices daily, while two use LPT four to six times per week, and the remaining three use their lasers on an unspecified, as-needed basis. The vast majority of these patients (11 of 13) said they would recommend this therapy to others. The remaining two, though pleased with their results, did not feel knowledgeable enough to make such recommendations.

CONCLUSIONS:

Though not a panacea, LPT can be a valuable and important tool for those with chronic pain. Class IIIa lasers, sold commonly as laser pointers, represent an inexpensive and easy to use adjunctive therapy for select patients suffering mild to moderate muscle or joint pain. While our survey exposed a high patient skepticism that such devices could have therapeutic benefit, of those who were willing to try LPT, 56% (13 of 23) found it to be an effective adjunct in their strategy for managing chronic pain. LPT is also safe to use, as one patient's gross misuse of the device resulted in only a minor injury which quickly resolved without treatment or resultant impairment. In addition, from a physician's perspective, it is a pleasure to be able to provide patients with effective and affordable medical technology which may one day augment or even eliminate the need for certain medications.

DEDICATION:

This paper is dedicated to Dr. Glen Bobker, D.C.: physician, healer and friend.

REFERENCES:

1. U.S. Food and Drug Administration website laser facts updated as of 05/27/02, are available on the internet at *http://www.fda.gov/cdrh/consumer/laserfacts.html.*

2. *Guidelines for Laser Safety and Hazard Assessment,* U.S. Department of Labor Occupational Safety and Health Administration; Directive number STD 01-05-001; August 5, 1991. Available on the internet at *http://www.osha.gov*.

3. *The Healing Power of Light: introduction to low level laser therapy and the ML830 lasers*, copyright 2004, The Microlight Corporation of America, Missouri City, Texas.

4. U.S. Food and Drug Administration 510(k) summary of product number K010175 (the ML830 infrared laser), available on the internet at *http://www.fda.gov/cdrh/pdf/k010175.pdf.*

5. *Control of Nonionizing Radiation Hazards*, Chapter 64E-4 of the Florida Administrative code. available on the internet at *http://fac.dos.state.fl.us/*.

6. The laser shown was purchased through Edmund Scientifics Consumer Science Division, 60 Pearce Avenue, Tonawanda, New York, 14150-6711 (catalog number 30818-87). They can be reached at 800-728-6999, or on the internet at *http://www.scientificsonline.com*.

Picture 1: Laser with carrying case, instructions and two extra AAA batteries. (pencil in foreground for size reference)

Picture 2: The on-off button is located above the white arrow on the laser pointer in the foreground. The laser behind it has a penny taped over the button for ease of use. These lasers are of equal size, the apparent difference due to the angle of photography. Notice the batteries represent 2/3 of the devices length.