



# Pain MANAGEMENT

**SPECIAL INTEREST GROUP • ORTHOPAEDIC SECTION, APTA, INC.**

## **LOW-LEVEL LASER THERAPY: NEW POSSIBILITIES IN PAIN MANAGEMENT AND REHAB**

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Two companion landmark studies in 2000 and 2001 gave support for the 635Nm low-level laser to become the first low-level laser of any kind to be approved by the FDA as safe and effective for treatment of chronic, minor pain relief in conditions of osteoarthritis, muscle spasms, and cervical and thoracic spine strain. These and other studies suggest new possibilities in many areas of pain management and rehabilitation.

The purpose of these clinical studies was to determine the effectiveness of the use of the 635 Nm low-level laser in providing temporary relief of chronic minor neck or shoulder pain by emitting 5 mw of near-infrared light (630 Nm-640 Nm) to the affected area(s) for short durations.† Other devices that emit other wavelengths from 670 Nm, and 800 Nm to 900 Nm show conflicting results.

The 635 Nm laser is technologically different from other laser devices. The 635 Nm laser uses a much lower level of power and a different light wavelength than the other lasers. As a result the findings from these pain studies were used to support a request from the FDA to place this laser into a Class I or Class II Exempt category based on the results of effectiveness.

In 2000, 100 patients were recruited to participate in a randomized, double-blind study of the temporary effects of the 635 Nm low-level laser on ameliorating minor neck and shoulder pain and improving range of motion. Ninety percent of all test group subjects met or exceeded the individual success criteria by demonstrating a 30% improvement in degree of pain rating from pre- to postprocedure measurements while only 14% of all placebo group subjects met or exceeded the success criteria. Temporary improvements in pain levels for test patients were statistically significant at the  $P < 0.05$  level. For the majority of patients, the reduction in degree of pain immediately after treatment with the laser was maintained or reduced further 24 hours posttreatment. Postprocedure linear range of motion measurements suggested significant improvements in range of motion for the right side of the neck and both right and left sides of the shoulders.

In 2001, out of a group of 100 patients, 65.1% of the test subjects met individual success criteria in improvement of pain, while only 11.6% of the placebo subjects met this criterion. Statistically significant differences were found for range of motion for the right and left shoulder in test vs. placebo subjects.

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The results of both clinical studies strongly support the use of the 635Nm low-level laser as a new possibility for single-use pain relief for patients with chronic pain in the neck or shoulder areas originating from the conditions of osteoarthritis, muscle spasms, and cervical and thoracic spine strain and improving range of motion. Other therapeutic applications also have been demonstrated.

#### PAIN

Guyton<sup>1</sup> explained that there are 2 leading causes of pain: muscle spasm and tissue ischemia. Muscle spasm is a common cause of pain and is the basis of many pain syndromes, resulting from the direct effect of muscle spasm in stimulating mechanosensitive pain receptors and from the indirect effect of muscle spasm compressing blood vessels and causing ischemia. A spasm increases the rate of metabolism in muscle tissue, making relative ischemia even greater, and creating ideal conditions for release of biochemical pain-inducing substances.

The suggested causes of pain in ischemia include accumulation of large amounts of lactic acid in the tissues, formed because of anaerobic metabolism, or other chemical agents such as bradykinin, proteolytic enzymes, and other chemical mediators formed in the tissues because of cell damage and that these, rather than lactic acid, stimulate the pain in nerve endings.

#### LOW-LEVEL LASER IN PAIN MANAGEMENT AND REHABILITATION

When ischemia or muscle spasm is reduced, pain can be reduced. When transmission is inhibited by tactile sensory signals, the degree of pain experienced also is reduced. All of these modalities have been accomplished using low-level laser energy. By applying laser energy to affected areas, the frequency of sensory nerve firing is increased, which subsequently increases the frequency of stimuli to the spinal cord, brain stem, and brain, in turn inhibiting pain at the spinal cord and brain stem levels.

When peripheral nerves are lasered, they send sensory information into the spinal cord, up the brain stem to the brain. Guyton explained that there are 3 major analgesic centers or areas for pain control: one is located in the spinal cord and the other two are located in the brain stem.

In addition to increasing stimuli to the spinal cord, brain stem, and brain, low-level laser treatment (LLLT) reduces inflammation caused by ischemia, excess lactic acid, and other muscle irritants. Elimination of muscle spasm and ischemia reduce pain.

Another key component in reducing pain is the engagement of ATP at the myosin head in order to reset the muscle. When doing myotome testing, this may explain why the patient with a fair or good muscle function returns to normal within 1 to 2 minutes of laser stimulation at the nerve root and the muscle itself. In the rehabilitation process, this is a tremendous benefit which shortens the time to health quickly and efficaciously.<sup>2</sup>



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#### HISTORY, USES, AND BENEFITS

In a careful review of LLLT studies since the 1960s when low-level lasers were first used, Woodruff et al<sup>3</sup> found the data revealed significant positive effects on wound healing in animal experiments as well as human clinical studies, significant positive effects on acceleration of the inflammation process, augmentation of collagen synthesis, increased tensile strength, reduced healing time, and diminution of wound size. That LLLT can be effective in pain reduction has also been demonstrated by Bjordal<sup>4</sup> for reducing pain in chronic joint disorders, Gur and colleagues<sup>5</sup> in reducing chronic back pain, and Kulekcioglu et al<sup>6</sup> in reducing pain in temporomandibular disorders. Anders et al,<sup>7</sup> Snyder and associates,<sup>8</sup> and Medrado<sup>9</sup> also have demonstrated that LLLT promoted nerve regeneration, enhanced healing, and reduced inflammation. Even in severe diabetic impairment of circulation, Schindl et al<sup>10</sup> found “an increase in skin microcirculation due to athermic laser irradiation in patients with diabetic microangiopathy.”

Simunovic<sup>11</sup> demonstrated pain relief and functional recovery of patients treated with LLLT in sport and traffic injuries. In clinical trials, Simunovic<sup>12</sup> also used LLLT on trigger points, myofascial zones of pain focal points, and found it effective for ameliorating headaches, facial pain, skeletal muscular ailments, myogenic neck pain, shoulder arm pain, epicondylitis humary, tenosynovitis, low back and radicular pain, and Achilles tendonitis.

Milojevic and Kuruc<sup>13</sup> found that laser stimulation of acupuncture points in patients with bronchial asthma improved both lung function and gas exchange parameters and these benefits lasted several weeks to months. Naeser et al<sup>14</sup> found that low-level laser therapy on acupuncture points of patients with carpal tunnel syndrome significantly reduced pain, and patients could afterwards perform their previous work (computer typist, handyman) and were stable for 1 to 3 years. Gur and colleagues<sup>15</sup> found that laser therapy administered daily for 2 weeks was effective in decreasing pain, muscle spasm, morning stiffness, and total tender-point number in fibromyalgia. Sobetskii<sup>16</sup> found that laser irradiation at acupuncture points was effective in treating in

stage I of hypertension. Carati et al<sup>17</sup> found LLLT effective in postmastectomy lymphedema for reducing the extracellular fluid volume in the affected arm and tissue hardness in approximately 33% of patients at 3 months posttreatment. Brosseau and associates<sup>18</sup> found LLLT effective for short-term pain relief and morning stiffness in rheumatoid arthritis, but conflicting results were found for osteoarthritis. Lutai et al<sup>19</sup> found LLLT effective for rehabilitation of elderly patients with pneumonia. al-Awami<sup>20</sup> found LLLT to significantly lower the frequency and severity of Raynaud's attacks in patients with primary and secondary Raynaud's phenomenon.

#### CLINICAL PERSPECTIVE

I have enjoyed the use of lasers for almost 30 years. I am amazed that such a modality has had such a hard time catching on. There are over 2000 clinical papers on the use of low-level lasers and over 100 are double blinded. Woodruff et al<sup>5</sup> did an excellent meta analysis of many of the articles proving its efficiency in many applications compared with laser studies that show conflicting results. One of the problems is that now we are seeing photo-stimulators come onto the scene, which are much slower in their response time than LLLT at 635 Nm. In my experience, many of the other low-level lasers that use different wavelengths seem to take a longer time to get results and are not as effective. I can't emphasize enough the importance of the 635 Nm wavelength and established frequency protocols† that have evolved over decades to get effective results!

#### CLINICAL APPLICATIONS

As a senior consultant to a large aeronautical company, I have seen almost every injury possible in my practice. I have found that 635 Nm LLLT to be most effective for the majority of injuries that we have seen. With LLLT, we have also reduced the treatment time to almost half and have been able to send most patients back to modified duty shortly after their injury, which further contributes to the reduction of Workman's Compensation costs. I use LLLT in combination with neuromuscular re-education of the myotomes, myofascial release, and therapeutic exercise. The LLLT works very much the same way, but is far superior to the icing and stroking modalities of the Rood techniques used years ago.

I have found LLLT to be one of the most important tools in the amelioration of chronic as well as acute pain and edema. When using proper protocols, most of the results are nothing short of miraculous. I would say that this should be the main tool used by therapists in their practice for most indications. Its use in the area of burns is remarkable. In a recent study by Dr Jeff Nelson presented to the ABA, he saw over 60% reduction of pain immediately and a 50% reduction in the time of healing on 60 patients. Its use in wound healing shows equally impressive results. With such effectiveness possible, it is unbelievable that we are so slow to change and embrace a technology that has been available for almost 30 years. Ockham's razor states, "What can be done with fewer is done in vain with more." It is time that we

turn our attention to change and learn that we can all "See the Light." It is ruby red and at 635 Nm.

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