

“COLD” LASER: THE NEWEST TOOL FOR COMBATING PAIN

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Most physicians are familiar with the use of “hot” lasers, which have been used in surgery for decades. Although “cold” lasers have been well researched for almost as long, they are just now gaining more attention. Because they can treat a variety of conditions involving pain, inflammation, injury, and wounds, and do so quickly, effectively and with virtually no side effects, such lasers are a valuable tool that every pain doctor should consider having in his armamentarium.

Cold lasers are scientifically referred to as low-level energy lasers, or LLEL. They produce wavelengths from about 625 nm to 904 nm, versus the hot lasers that range from 1064 nm (YAG) to 10,600 nm (Carbon Dioxide), meaning that they do not cause heating of the tissues. Instead, LLEL produces photo-bio-activation of the tissues, which translates to healing rather than destruction.

There have now been over 200 clinical studies and over 2000 published articles on LLEL over several decades, which have established many of its mechanisms as well as its benefits. This article will review the LLEL and how it can be utilized in clinical practice.

MECHANISMS OF ACTION

LLELs are described as lasers that penetrate the deepest into tissue without causing tissue damage. In fact, studies have shown that the cold laser does not affect normal tissue. At the same time, tissues that are ischemic and poorly perfused as a result of inflammation, edema and injury have a significantly higher response to laser photon stimulation than normal healthy structures.

The primary target systems for the LLEL include lymphatics, circulatory and nervous tissue. A major effect of cold laser is to provide energy for repair of damaged tissue in these systems. It does so by its effects on cytochromes, which are proteins that act as energy producers for biological functions. Laser photon stimulation accelerates the functions of several cytochrome enzymes, in turn providing significant increases in ATP and Nitric Oxide, which enhance cellular metabolism, circulatory improvement and nerve function.¹

As a result of these basic mechanisms, additional processes and events have been elucidated in research on LLELs, directly decreasing inflammation and pain as well as enhancing tissue healing and regeneration. These are listed in Charts 1-3².

**CHART 1
LLEL PROCESSES FOR
REDUCTION OF INFLAMMATION**

Stabilization of cellular membranes	Vasodilation stimulated
ATP production and synthesis enhanced	Acceleration of leukocytic activity
Reduction in Interleukin 1 (IL-1)	Enhanced lymphocyte response
Temperature modulation of inflammatory areas	Increased angiogenesis
Decreased C-reactive protein and neopterin levels	Enhanced superoxide dismutase (SOD)

**CHART 2
LLEL PROCESSES FOR PAIN REDUCTION**

Increase in beta-endorphins	Increased nitric acid production
Blocked depolarization of C-fiber afferent nerves	Increased nerve cell potential
Axonal sprouting and nerve cell regeneration	Decreased bradykinin levels
Increased acetylcholine release	Ion channel normalization

**CHART 3
LLEL PROCESSES FOR TISSUE HEALING**

Enhanced leukocyte infiltration	Increased macrophage activity
Increased neovascularization	Increased fibroblast proliferation
Keratinocyte epithelialization	Increased growth factor
Enhanced cell proliferation and differentiation	Increased mitochondrial membrane potential
Enhanced healed wound tensile strength	

CONDITIONS BENEFITED BY LLEL

Based on the above mechanisms of action, there are many medical conditions that can respond beneficially from LLEL treatment. TABLE 1 lists the major conditions that have been researched or have sufficient experiential results. The following are brief summaries of some of the more common indications.

TABLE 1
CONDITIONS BENEFITED BY LLEL

Arthritis of any joint	Plantar fasciitis
Spine arthritis	Trigger points
Frozen shoulder	Ganglion Cysts
Degenerative disc disease	Sciatica
Bulging or herniated discs	Bone spurs (inflammatory component)
TMJ	Osgood-Schlatters Disease
Dupuytren's contractures	Headaches (Migraine, tension, sinus)
Wound healing	Allergic rhinitis
Mucositis/Stomatitis	Lymphedema
Tendonitis	Bursitis
Acute injuries	Trigger fingers
Myofascial pain/Fibromyalgia ¹⁴	Burns
Compressive neuropathies (carpal, cubital, radial, tarsal tunnel)	

Joint Arthritis

Because the cold laser decreases inflammation and regenerates damaged tissue, joint arthritis responds exceptionally well³. This includes patients who describe "bone on bone" arthritis, as well as those who continue to have symptoms post-joint replacement. In the author's experience, a significant majority of patients with knee and hip arthritis can delay joint replacement by years and in many cases, altogether. Although knees are the primary joint treated, arthritis of hips, shoulders, ankles and fingers respond equally well. This includes both osteoarthritis and rheumatoid arthritis.

Degenerative Disc Disease

Again, decreasing inflammation (both acute and chronic) and regenerating damaged tissue are the mechanisms responsible for healing both ruptured discs⁴ and repairing chronic degenerative discs causing neck or back pain⁵. As with joint arthritis, treatment with the cold laser can often prevent the need for spinal surgeries, epidural injections and other conventional treatments in a large percentage of patients.

Nerve Conditions

The ML830 laser (see below) was the first laser to be approved by the FDA, after being shown to significantly resolve carpal tunnel syndrome⁶. Other compressive neuropathies respond equally as well. In addition, various other nerve conditions and injuries may benefit, including facial and 7th nerve (including Bell's palsy, trigeminal neuralgia), acute herpes zoster and post-herpetic neuralgia, brachial plexus injuries, peripheral nerve injuries⁷ and neuropathy caused by diabetes or chemotherapy.

Wound Healing

LLELs are exceptional for accelerating healing of wounds⁸. It has been used successfully for post surgical wounds and dehiscence, decubitus ulcers, diabetic ulcers, hematomas, and even some cases of dry gangrene. Wounds and fistulas that have not closed over several months to over a year have responded well to LLEL treatment and will close. With LLEL, wounds heal from the bottom up, stimulating granulation tissue and often reducing scarring.

Acute Injuries

Because LLELs increase blood flow, stimulate lymphatic drainage and reduce inflammation, acute injuries heal much more quickly. This includes skin, soft tissue (tendons, ligaments, cartilage, discs) and even bone. Thus, partial rotator cuff tears, epicondylitis⁹, Achilles injuries and partial cartilage tears can all respond beneficially.

Mucositis and Lymphedema

More recent studies have shown the cold laser to be very effective for mucositis^{10,11} and stomatitis, common side effects of types of radiation for head and neck cancers and certain chemotherapies for other cancers. In addition, because LLEL stimulates lymphatic flow, it can decrease lymphedema¹², even if present for a long duration.

RESPONSE, LENGTH AND DURATION OF TREATMENT

A significant aspect of LLELs is that they work quickly. Many patients will report benefits even after the first treatment, which also provides positive psychological reinforcement. In general, results should be observed within eight treatments, especially in acute conditions, although more treatments may be necessary for complete resolution.

For chronic conditions, results should again be observed within eight treatments, but such conditions may require ongoing treatment every few weeks after reaching a plateau level, to resolve or prevent exacerbations. However, long-lasting resolution of symptoms commonly is achieved in many chronic conditions within 8-12 treatments, even if the condition has been present for years.

In some cases, patients may observe excellent benefits in the first few treatments, then have no change for a few treatments, followed by continued additional benefit. If there is no added benefit after 4-5 treatments, the patient has reached plateau. However, restarting LLEL treatment a month or two later may provide additional benefit and is worth a try if the patient has only obtained partial relief.

The length of treatment depends on the area involved and condition being treated. Protocols are available that describe the required energy (measured in joules), with most

conditions receiving 3-9 joules per area involved. Usually, one area takes only 1-2 minutes to achieve the necessary energy, so length of treatment is determined by the number of areas treated.

As with any therapy, LLEL is not effective in every patient or for every condition. In general, over 80% of patients will respond fully, with about 10% obtaining partial response. Some conditions, such as tendonitis, may either respond immediately or not respond at all. The most difficult conditions to treat are post-surgical (such as lumbar fusions) due to structural interference. Even so, the LLEL may still be effective and should be tried in these patients: Most often, it will simply take longer to obtain benefits and a longer duration to achieve maximum results.

Finally, the LLEL can be used effectively with other modalities, including physical therapy and medications. In my clinic, we combined the LLEL with acupuncture, resulting in even faster and more efficacious healing.

TYPES OF COLD LASERS

There are several different types and manufacturers of cold lasers, the differences being in wavelength and power output. The main factor that can affect the actual depth the laser beam penetrates is the wavelength. The output power is of secondary importance because the physical properties of the tissues limit the penetration of particular wavelengths, no matter how much power is behind them.

The most common wavelengths used and researched are 632.5 nm (Helium-Neon), visible red beam, and 830 nm and 902nm (Gallium-Aluminum-Arsenide), infra-red (invisible) beam. Although all these wavelengths (and others within this range) have been shown to have beneficial effects on tissue, the 830 nm wavelength has been proven to have the greatest consequence to healing¹⁴. This beam is well absorbed in sub cellular organelles, increasing their capacity to well beyond their normal state.

As for power outlay, some single diode lasers (akin to laser pointers and LEDs) have only about 5 mW, which limits their efficacy. Other LLELs have power ranges from 25 mW to 100 mW. The most efficacious outcomes appear to be from 60- 90 mW of power.

Depth of penetration is relatively important to the efficacy of LLEL therapy and the 830 wavelength has the deepest penetration of all LLELs, which correlates with its increased efficacy. Although the depth is only 5cm (see Figure 1), there appears to be a distal effect since tissues may still respond even if the area of concern is deeper than 5cm (such as large patients with lumbar disc disease). Such an effect has not been well researched or defined but has been noted in various studies and in the author's research.

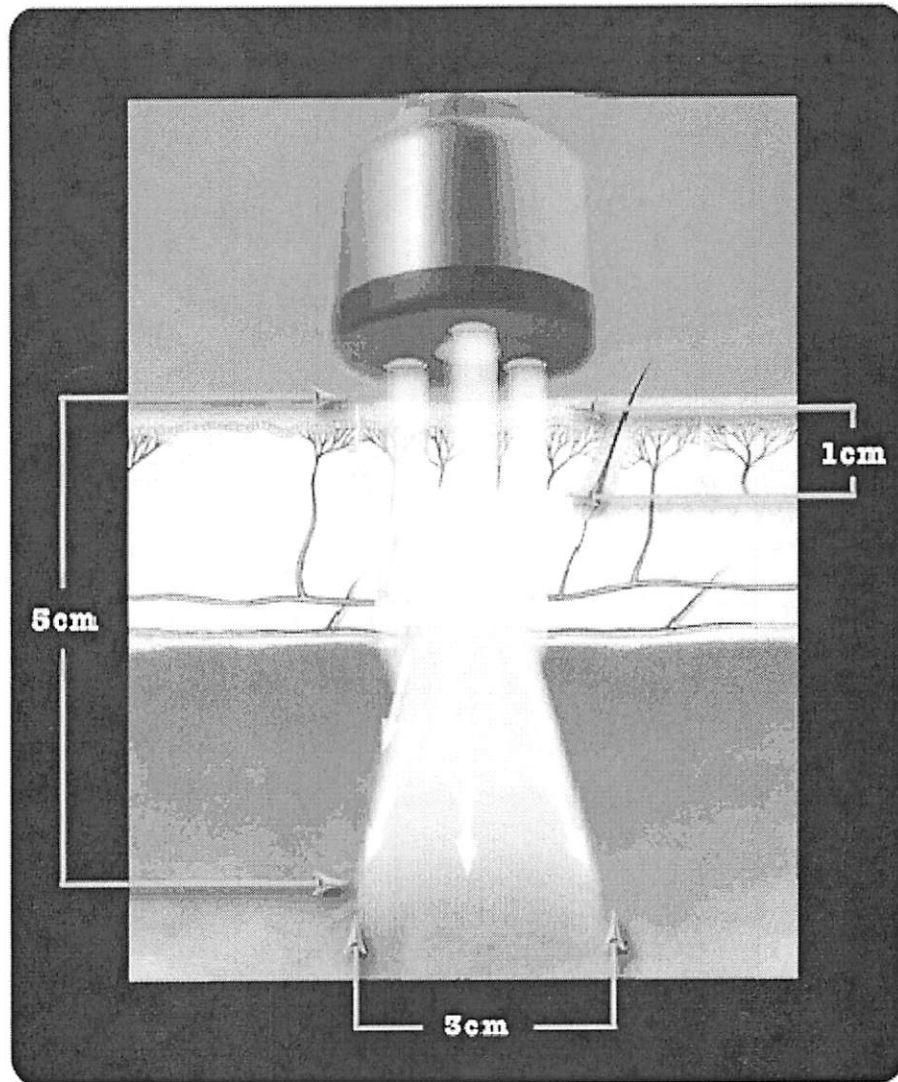


FIGURE 1
DEPTH AND WIDTH PENETRATION OF 830 nm LLEL

SAFETY AND SIDE EFFECTS

The only absolute contraindication of laser use is pointing it directly into the eye. Typical diode laser beam paths are highly divergent, so reflection of the laser beams while applying it to patients does not cause eye damage. There have been no reports of eye damage with use of LLEL. Nevertheless, eye goggles can be used if the provider or patient is concerned.

A relative contraindication is use on or around cancer cells. It is simply not known whether the cell stimulation effects of LLELs increase tumor growth. However, it is known that LLELs affect primarily injured tissues, which does not include cancer. Several studies on mucositis used the laser in the presence of active tumor and did not show any adverse effects on

tumor growth. It has also been used to control metastatic bone pain in palliative patients, again without cancer-stimulating effects.

The LLEL should not be used in patients taking immune suppression drugs, hemorrhages and should not be directly applied to the thyroid.

Side effects are minimal and rare. The majority of patients will not feel any reaction from cold laser treatment, although occasionally, patients may feel a “tingling” or warm feeling in the area of treatment or even distally when nerves are being treated, but this reaction is usually described as a pleasant feeling. In over 25 years of use, there have been no serious side effects reported to the FDA.

The FDA has classified the LLEL as a Class IIIB device under a NHN category (meaning non-heating). Hot lasers are Class IV devices. Laser pointers (with wavelengths of 635 nm) are classified as Class IIIa devices.

Because the LLEL has been declared a safe device by the FDA, it can be applied by any personnel, including medical assistants, although it is best to use it under the direction of a licensed practitioner.

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COSTS AND REIMBURSEMENT

LLELs range in cost from a few hundred dollars to \$12,000, depending on wavelength and power. Obviously, the less expensive lasers do not have as beneficial effects as the more expensive ones, but a mid-expense LLEL can be as effective as the more expensive products. You can obtain an excellent therapeutic LLEL for \$4000-\$5000.

Charges for LLEL treatment vary from practitioner to practitioner, depending on the duration of treatment or the number of areas treated. The average fee of most practitioners is \$45 for up to 15 minutes of treatment.

At this time, some insurance companies will reimburse fully or partially for LLEL treatment and some won't. Medicare will reimburse for some conditions but not others. As more studies on LLELs are accomplished, it is hopeful that all 3rd party payers will reimburse for LLEL treatment since it is very cost-effective and can prevent the need for expensive surgeries.

ABOUT THE AUTHOR

Dr. Altshuler is a board certified internist and hospitalist at Cancer Treatment Centers of America, where he currently utilizes the LLEL with cancer patients. He has conducted 25 years of research under FDA auspices on three different LLELs, and has treated over 10,000 patients

for numerous conditions with LLELs during that time. He also is the author of several books, including the award winning *Balanced Healing: Combining Modern Medicine with Safe and Effective Alternative Methods* and his latest e-book, *Boom or Bust: Conquering Diseases of Aging*. He can be contacted through his website at www.BalancedHealing.com.

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