

Simple Protocols for Light Therapy

**Recommended Application Protocols & Suggested Treatment Parameters for
Common Complaints**

For

Clinicians & Practitioners

**By
Gerald Cartier**

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OVERVIEW OF LIGHT THERAPY

Light therapy has been shown in over 50 years of independent research worldwide to deliver powerful therapeutic benefits to living tissues and organisms. Both visible red, blue and "invisible" infrared light effect at least 24 positive changes at the cellular level. Red light, which is visible, at a wavelength of 640-650 nanometers (nm; 1 nanometer is equal to one billionth of a meter), penetrates tissue to a depth of about 8-10 mm. It is very beneficial in treating issues close to the surface such as wounds, cuts, scars, trigger and acupuncture points and is particularly effective in treating infections. Infrared light (880 nm) penetrates to a depth of about 30-50 mm, which makes it more effective for bones, joints, deep muscle, etc. Some scientists suggest infrared can penetrate up to 10 cm or about 4-5 inches.

Light therapy causes biologic effects because different wavelengths are absorbed by specific proteins. Stated another way, diverse tissue and cell types in the body all have their own unique light absorption characteristics because they are characterized by different proteins; that is, they will only absorb light at specific wavelengths and not at others. For example skin layers, because of their high blood (many different types of proteins) and water content, absorb red light very readily, while calcium and phosphorus of deeper tissue and bone absorb light of a different wavelength. Recently (2009) scientists reported that two proteins, hemoglobin found in red blood cells and myoglobin found in muscle both absorb red and infrared light and during this absorption, nitric oxide is released. Nitric oxide may be partly responsible for the vasodilation effects of red and infrared light. Evidence supporting local nitric oxide increases in normal subjects during LLLT was published by Mitchell in 2013.

Light Generating Systems

Light Emitting Diodes (LED's) are form of light therapy that is a relatively recent outgrowth from the laser industry. LEDs are similar to lasers inasmuch as they have the same healing effects but differ in the way that the light energy is delivered. LED disperses light (red, blue or infrared) over a greater surface area; this tends to result in shorter overall treatment times for a given area than laser.

LED's and LASERS are no more than convenient devices for producing electromagnetic radiation (in this case, light) at specific wavelengths. Several studies establish that it is the light itself at pulsed at specific wavelengths that are therapeutic in nature and, importantly, **not the machine that produced it.**

For example, Kendric C. Smith at the Department of Radiation Oncology, Stanford University School of Medicine, concludes in an important article entitled *The Photo biological Effect of Low Level Laser Radiation Therapy (Laser Therapy, Vol. 3, No.1, Jan - Mar 1991)* that "1) Lasers are just convenient machines that produce radiation (light). 2) It is the radiation (light) that produces the photo biological and/or photo physical effects and therapeutic gains, not the machines. 3) Radiation (light) must be absorbed to produce a chemical or physical change, which results in a biological response."

In summary the primary reason that Light therapy chose's the LED's over lasers is that LED's are safer, more cost effective, provide a gentle but effective delivery of light and a greater energy output per unit of surface area in a given time duration. Our products contain a mixture of red and infrared diodes. Specifically we use visible red diodes at 640 nm and infrared light diodes at from 830 nm to 930 nm, with 880 nm as their average. Together our system stimulates a broader range of tissue types.

Medical Evidence Shows that Red and Infrared Light Each Enhance Release of Nitric Oxide from Hemoglobin. Why is This Important?

1. Nitric Oxide Improves Circulation at The Site of Treatment

- Nitric oxide increases blood flow **to injured or damaged tissue**. It dilates vessels, which are already present at the site of light treatment, and increases the formation of new capillaries. These additional blood vessels replace damaged ones. New capillaries speed up the healing process by carrying more oxygen and nutrients needed for healing and they help to remove waste products.
- **Nitric oxide stimulates the production of collagen**. Collagen is the most common protein found in the body. Collagen is the essential protein used to repair damaged tissue and to replace old tissue. It is the substance that holds cells together and has a high degree of elasticity. By increasing this form of collagen, less scar tissue is formed at the damaged site.
- **Nitric oxide stimulates the production of adenosine triphosphate (ATP)**. ATP is the major source of energy produced by cells. Increases in ATP allow cells to accept nutrients faster and get rid of waste products faster. Increased delivery of oxygen and nutrients to cells enhances cell ATP production thereby providing the chemical energy that maximizes cell function.

Other Effects of Nitric Oxide

- **Increases lymphatic system activity**. Research has shown that the lymph vessel diameter and the flow of the lymph system can be doubled with the use of light therapy. This effect enhances removal of lymph and interstitial fluid which can cause swelling and pain. Nitric oxide also helps to increase the number of lymph vessels much like it grows new capillaries.
- **Increases RNA and DNA synthesis. Cells must replicate (multiply) before new tissue is formed. A doubling of DNA, which occurs in the presence of nitric oxide, precedes cell division**. This helps damaged cells to be replaced more promptly.
- **Reduces the excitability of nervous tissue. Nerves deprived of oxygen and nutrients (and therefore ATP) are overly excitable**. Nitric oxide, much like morphine (but without the side effects) can also suppress pain signals directly.
- **Stimulates fibroblastic activity**, which aids in the repair process. Fibroblasts are present in connective tissue and are capable of forming collagen fibers.
- **Increases phagocytosis** which is the process of by which white blood cells (WBC) scavenge dead or degenerated cells. This is an important part of the infection fighting process. Specific WBC also fights infection. These events must occur before the healing process can take place.
- **Induces a thermal like effect in the tissue. Increased flow of blood (at 98.6 F) to the skin at the site of treatment and production of ATP itself both raise the temperature of tissues** although there is little heat produced from the diodes themselves.

- **Stimulates tissue granulation and connective tissue projections**, which are part of the healing process of wounds, ulcers or inflamed tissue.
- **Stimulates acetylcholine release.** Acetylcholine has important parasympathetic nervous system effects. Among these are local vasodilatation and improved gastrointestinal peristalsis.

2. Nitric Oxide Decreases Pain and Numbness in Extremities

Benefits For Pain and Numbness in Extremities:

Light therapy offers hope for those patients suffering from neuropathy, including diabetic neuropathy, in their legs, feet, wrists and hands. Light therapy delivers safe and effective infrared and visible red light that has been clinically shown to improve circulation in the extremities. Each subsequent treatment builds on the improvements gained during the prior treatment session so patients experience steady improvements in sensation and decreased (ischemic) pain. However, Light therapy does not stand alone as a therapy, anymore than do hot packs or heating pads. It must be part of a comprehensive therapy plan. When coupled with standard physical or occupational therapy treatments, Light therapy can improve the quality of life for patients who suffer from the ill effects of neuropathy.

One additional effect of local increases in nitric oxide, even without a measurable increase in circulation, is its effect on ion channels in nerves. Specifically nitric oxide improves the physiologic activity of ATP-dependent potassium channels and in this manner mimics almost exactly one of the effects of the potent pain medicine, morphine. This may be an important consideration for the therapist who is faced with attempting to treat a neuropathy patient who has extreme pain.

Patients with diabetic neuropathy may eventually develop gait and balance problems needing to rely on an assistive device for ambulation. Proprioceptive changes affect their gait pattern and ability to properly weight shift balance. The patient's normal body locomotion often changes. These patients have decreases in ROM, not only at the ankles and feet, but also in the knees, hips, and trunk. When patients experience changes in proprioception, gait pattern, and balance, they also lose strength. This can result from walking with an altered gait pattern that is decreased from its normal range. It can result from changes in sensation since patients are unable to judge the amount of motion occurring in the distal extremities. It can also result from decreased activity due to pain and discomfort, or from fear of falling. Some diabetic patients may also experience debilitation secondary to the presence of diabetic ulcers and decreased skin integrity, which can interfere with weight bearing activities. While neuropathic symptoms are encountered less frequently in the wrists and hands, patients can still develop a wide variety of deficits in their use and function as a result of diabetic neuropathy. Most patients are usually victims of a combination of these factors. Luckily, physical therapy along with light therapy can help.

By doing a thorough evaluation of the patient's problems, the therapist can develop an appropriate treatment plan to address these deficits. For example, the assessment of the legs and feet must include gait, balance, coordination, and proprioception, as well as in the patient's strength, ROM, circulation, and sensation. After identifying the physical deficiencies, the therapist can establish goals based on the patient's unique physical condition. Establishing goals that address the patient's dysfunction through standard treatment supports the suitability of

skilled physical therapy services, and reinforces the idea of medical necessity.

This type of intervention allows the therapist to treat using Light therapy as an adjunct modality to improve the patient's circulation, decrease pain, parenthesis or numbness, and increase sensation in the distal extremities. Most patients have a much better outcome with this comprehensive type of care plan, experiencing a level of improvement in their quality of life that was essentially unattainable in the past.

At this time, Medicare reimbursement for use of Light therapy is minimal, despite its effectiveness. It is essential that use of this modality be incorporated into a standard treatment plan, if the patient is to benefit from its use, while allowing the therapist to make it cost effective. Regardless, Light therapy is a powerful tool in the treatment of diabetic neuropathy. The efficacy of this treatment is clinically documented by the specific, and easily identifiable, responses following the use of Light therapy.

Light therapy is non-invasive and easy to use. This unit produces only gentle heat, so it does not require constant monitoring or complex safety precautions after the patient-specific treatment parameters are established; it is completely safe for patient use.

Extensive studies and documentation of treatment results document the mechanisms for, and benefits of, treatment outcomes during use of red and infrared light.

ACCESSORY EQUIPMENT CARE:

- Disinfect the non-porous pads regularly with hospital grade disinfectant solution (1:10 bleach solution). Spray onto a cloth and lightly wipe clean with cloth. Do not soak or saturate. Do not autoclave.
- Keep pads clean by always covering treatment area or pads with a **clear plastic barrier such as plastic wrap or clear bags for the foot.** (<http://www.uline.com/ProductDetail.asp?model=S-10890&ref=106>). For more detail, see Infection Control.

The following are suggested protocols for many of the clinical problems encountered in rehabilitation medicine. Each has the goal of relieving pain or improving circulation or both and each combines standard physical or occupational therapy techniques along with light therapy.

Suggested Guide for Treating Neuropathy Patients

In order to ensure that patients with neuropathy have the opportunity to receive the remarkable benefits of Light therapy on the symptoms such as loss of sensation and/or pain, the best method for making it cost-effective must be considered. Fortunately, the skills developed by therapists, or others, for patient evaluation and treatment planning make this task much easier.

By assessing the patient thoroughly, the many symptoms associated with neuropathy are easily identifiable and addressed. This allows the therapist to establish a treatment plan that is best for the patient. This method provides the means for adding Light to the patient's plan of care, thus providing the opportunity to significantly improve the treatment outcome.

While the primary diagnosis may be diabetic neuropathy in many instances, the therapist must choose a treatment diagnosis that reflects the symptoms to be addressed. The list would be comprised of a variety of physical impairments that include, but are not limited to:

- Gait dysfunction
- Balance deficits
- Increased risk for falls
- Safety impairments

As with most conditions, the neuropathy patient usually has more than one of these problems that severely restrict function. Providing a global overview of these deficits and their effects on the patient's activity level, physical function, and quality of life is the next basic requirement of the assessment process. Don't forget to include explanations of changes that occur as a result of pain, parenthesis or numbness, edema, or wounds. Descriptions should reflect specific activities, which are now, limited as a result of worsening neuropathy symptoms.

Treating Patients presenting with Symptoms of Peripheral Neuropathy

Patients will have varying degrees of complaints of pain, sensation loss, and/or hypersensitivity. Additionally, if lower extremity symptoms exist, there are associated deficits such as balance loss, gait dysfunction, transfer dysfunction. In upper extremities, the symptoms may include weakness, fine motor skill dysfunction and ADL deficits.

Establishing a treatment plan involves identifying a problem that has objective and measurable deficits that can be documented.

Progress notes must reflect improvements in function and frequency and duration of treatment. Progress notes must demonstrate patient response and benefit of treatment in a measurable fashion (can they walk further, is pain decreased, has sensation improved, is balance better, etc.).

Discussing pain, it must be measured by one of the many scales available; VAS, Wong-Baker, PQAS and NPRS, just to name a few. Remember, although these can demonstrate improvement, they are subjective. Therefore the therapist has to measure and treat functional deficits, recognizing that the function will improve as pain decreases.

For example, a patient may present with complaint of pain in both lower legs, rated on the numeric scale of 8/10. Additionally, the patient requires moderate assistance to help stand from a chair and ambulates 10 feet with moderate assistance, perhaps in a walker, with short stride length and an abbreviated stance phase. There is a balance loss frequency of 3 times per every 10 feet. Given these problems, the therapist must then establish the problem as weakness, balance loss, and gait dysfunction accompanied by pain. A patient with neuropathy will have several of these deficits.

- Gait dysfunction
- Balance deficits
- Increased risk for falls
- Safety impairments

Goals would include:

1. Able to ambulate independently with or without assistive device for at least 60 feet
2. Able to stand from chair independently
3. Pain reported on numeric scale of 2/10

Treatment plan would be:

- Therapeutic exercise
- Stand-sit training
- Gait training
- Infra-red treatment

Frequency: 3 days per week for 6-8 weeks.

In this scenario, a progress note would look like this:

Patient treated per plan, treatment session started at 9:00 AM, concluded at 10:00 AM. Performed modified hip bridging, 5 reps/2sets, knee extension supine with knees over bolster vs. 5-10 reps/2sets.

Performed training from sitting to standing, emphasizing slide forward in chair, feet flat on floor, and push-off from arms of chair. Required minimal assistance to achieve standing 3 reps/2sets, able to sit from standing with supervision.

Performed gait training in walker required minimal-moderate assistance with short but equivalent stride length, and equal stance phase R&L.

Ambulates 15 feet by 3 reps.

Infrared treatment to bilateral lower legs at setting A on the Light therapy, for 25 minutes.
Patient reports pain now at 5/10 (vs. previous 8/10).

This example enables the plan to address problems, the treatments directed at those problems and measurement of progress as a result of the treatments.

In many of the following examples you will be introduced to other Light therapy configurations. For example, in the figure below you see a pad design used extensively by various practitioners. These are compatible with all controllers.

Pain And Numbness In Extremities

Rationale: Infrared technology is used to increase circulation and this should decrease the symptoms of pain or numbness and inflammation that characterize peripheral neuropathy.

Podiatric Device bilaterally. Be certain that the diodes have light contact with skin surface. Pressure with application may increase potential of burns.

Bilateral placement of small pad on medial and lateral aspect of lower leg. This area of placement should begin at the location in the leg where pain, inflammation or numbness begins to be a problem. This site could be close to the knee or just above the ankle and should not be difficult to determine in your patient.



Protocol

Length of time:

- 20 minutes once or twice or even three times daily.
- Number of treatments: Initially three applications in a 5 to 7 day period. Physical Therapist should re-evaluate every two weeks. Physician consultation should occur before the first treatment, and their physician should see patient on visit 10 to 12. Patient should improve within 6-12 treatments providing the therapy has been executed in timely manner.
- Minimum of 3 times per week. Consider more often if patient pain increases, or severity of pain and numbness is severe.
- If patient is not responding, consider differential diagnosis of spinal stenosis and/or consider L-Arginine (a source of nitric oxide) or other dietary deficiency.
- Patient should be evaluated to consider prescription for home unit so they can continue treatments at home especially if the neuropathy is due to a chronic condition such as diabetes.

Setting: 1, 4, 5; 7 minutes each or setting A.

****Note: These settings (numbers) correspond to different frequencies. For a more complete description of the biologic effects of these frequencies, please read page 38.

SPINAL STENOSIS

Rationale: Infrared therapy can be utilized to address pain and inflammation due to spinal stenosis. Increasing circulation will delivery more blood to flow to the nerve. That blood flow is often reduced in spinal stenosis and reduced blood flow can cause various degrees of inflammation and pain.

Placement: The figure shows a Universal Plus U2 pad covering most of the spine including LI-L4 region.



Protocol

Length of time:

- 20 minutes

Number of treatments:

- 3 to 5 times per week for minimum of 12 sessions. Patient should be re-evaluated by Physical Therapist every two weeks.
- Physician evaluation after completion of 12 treatments.

Setting: 1, 4, 5 (7 min each) or setting A

OSTEOPENIA



Rationale: Infrared therapy can be utilized to address lower back pain (LBP) associated with spinal crush fractures and inflammation that occurs every time there is tissue injury. There are also numerous case studies, which have clearly demonstrated a localized reversal of osteopenia and increased healing of non-union fractures in areas treated with personal individualized laser therapy technology. Nitric Oxide increases osteoclastic activity while inhibiting osteoclastic activity. These dual effects lead to enhanced bone mineralization. Don't simply guess that the patient has bone issues. X-rays are the gold standard before starting treatments.

Placement: The patient is being treated with a Universal U2 pad.

Protocol

Length of time: 20-30 minutes; if possible, treat twice a day.

- Number of treatments: Daily for a minimal period 4 to 6 weeks, depending on severity of osteopenia. Reevaluations by a Physician with follow up DEXA scan or imaging in 6 weeks.

Setting: 4, 5 & 7 (7-10 min each) or setting B

PERIARTICULAR DISORDERS

BURSITIS:

Rationale: To address the inflammation of the thin walled bursal sac surrounding tendons and muscles over bony prominences. Subacromial and greater trochanteric bursae are most commonly involved.

Placement: Figure depicts use of the Universal Plus pad.



Protocol

Length of time:

- 30 minutes

Number of treatments:

- Begin with treatment daily for first week, followed by three times per week for 2-3 weeks or prn.

Setting: 4, 5 & 6 (10 min each)

TMJ

Rationale: The pain associated with craniofacial issues, tendonitis, and cervical myalgia, in both acute and chronic conditions, responds well to Light therapy technology.

Placement: TMJ pad is placed over the affected area and each carotid artery with gentle pressure so circulation is not restricted. The approach is to treat where the patient has a complaint.



Protocol

Length of time:

- 20 minutes

Number of treatments:

- Three times per week.
- Post surgical - Daily treatment for 2-3 weeks. If there is a dressing, then treat over skin close to the dressing site until the dressing is removed. Thereafter treatments can be done directly over the incision site.

Setting: 3, 5 & 7 (7-10 min each) or setting B

Chronic Inflammatory conditions that include Osteoarthritis (OA) Rheumatoid Arthritis. And Long-term Postoperative management

Rationale: Osseous involvement, intra or extra-capsular, long-term management of inflammation, range of motion and pain are all-responsive to Light therapy treatments.

Placement: Pad placement encircles the joint.



Protocol

Patient is using a Sports pad, a variation of the U2 Universal.

Length of time and Overall Number of Applications:

- 20 minutes.
- Overall numbers of applications vary with each individual. Often, this type of patient requires an ongoing treatment regimen to maintain a level of comfort and quality of life with decreased oral medication(s). This type of patient should be considered for an Light therapy home system for chronic maintenance therapy. This approach should only be considered if the patient has responded to treatments in a clinic.

Number of treatments:

- Minimum of three treatments per week. Home system 20 minutes twice daily. Also L.P.N. at patient's discretion.

Setting: 3, 5 & 7 (7-10 min each) or setting B

TENDONITIS

Rationale: To address pain and inflammation associated with Tendonitis.

Parameter: Absence of architectural or organic dysfunction.

Placement: Examples. Various pads are used depending on the anatomical area being treated.



Protocol:

- Initially, three applications in a 5 to 8 day period followed by re-evaluation.
- Reapply every second to third day until no additional improvement for three consecutive visits.
- After 10 to 14 days re-evaluate.
- *Note: If no improvement in signs and symptoms occur within the first three treatments, generally there is no reason to continue treatment under these guidelines.*
- *For acute conditions, additional diagnostics should be considered.*
- Length of Time (Individual Application):
- *Some patients' respond in 10 to 15 minutes, other individuals need as much as 45 minutes to obtain same effect of treatment. Since there are no known side effects to this treatment, always allow the patient the greatest opportunity for positive response. This is most important for the first three applications.*
- One 45-minute application, or two 30-minute applications per day. Let patient responses guide you as to frequency and length of time of treatments. Number of treatments: Minimum of 6 treatments

Setting: 4, 5 & 6 (10 minutes each)

PLANTAR FASCIITIS

Rationale: To reduce pain and inflammation with plantar fasciitis.

Placement: The Podiatric pad is most useful for this inflammatory complaint.

Improved circulation will help reduce inflammation and with this reduction, pain should also decrease or disappear.

Mechanical manipulation • rolling over hard rubber ball (size of tennis ball) in conjunction, pre or post IR therapy may be helpful.



Plantar and dorsal aspect of foot, being sure to cover the entire plantar surface to calcaneus.

It is also recommended that a pad be applied over the gastroc soleus group.

Protocol

Length of time:

- 30 minutes.

Number of treatments:

- Minimum of three treatments per week until resolved.

Setting: 4, 5 & 6 (10 minutes each)

EPICONDYLITIS

Rationale: Pain management and resolution of inflammation.

Placement: Use Sports pad over medial or lateral aspect of joint line.



Protocol

Length of time:

- 20 minutes treatment time.

Number of treatments:

- At least three applications per week until resolution. Treatments can be as often as 3X/day, separated by about 5 hours.

Setting: 4, 5 & 7 (7 minutes each) or setting B

SMALL PADS, SUCH AS THE UNIVERSAL 2, MAY BE USED FOR THE FOLLOWING LOCAL CONDITIONS.

SHIN SPLINTS

Rationale: To address pain and inflammation.

Placement: Anterior aspect of Tibia; origin at patellar tendon extending distally to tarsal crural joint.

Protocol

Length of time:

- 20-30 minute treatment time

Number of treatments:

- Minimum three treatments per week.

Setting: 2, 5 & 7 (7-10 minutes each)

NEURITIS

Rationale: Pain management.

Placement: On skin surface superficial to and along involved nerve path.

Protocol

Length of time:

- 20 minutes

Number of treatments:

- Daily during acute phase.
- Reduce to minimum of three times per week in sub-acute phase.

Setting: 1, 4, & 5 (or setting A)

SYNOVITIS

Rationale: Reduce intra capsular edema and inflammation.

Placement: Surrounding involved joint.

Protocol

Length of time:

- 30 minutes

Number of treatments:

- Minimum three times per week until resolved.

Setting: 2, 5 & 6 (10 minutes each)

NEURALGIA

EXAMPLE: BELL'S PALSY

Rationale: Reduce inflammatory involvement and restore muscle control. This problem often responds well to use of a home unit during the days the patient is not being treated by you.

Placement: Originating at facial nerve, extending distally to nerve end (at lip and eye). In simpler terms, use over the cheek bone.



Protocol

Length of time:

- 30-minute treatment time.

Number of treatments:

- Minimum of three times per week.

Setting: 3, 4, 5 (10 minutes each) or setting B

POST HERPETIC HERPES ZOSTER

Rationale: Pain management. Reduce inflammation.

Placement: Originating at spinal nerve root and extending distally over dermatome to cover entire area.

Protocol

Length of time:

- 30 minutes.

Number of treatments:

- Minimum of three treatments per week.
- Often necessary to treat for 30 minute twice daily for pain management.

Setting: 3, 4, 5 (10 minutes each) or setting B

OTHER CONDITIONS

TENIA CORPUS (RING WORM):

Rationale: Reduce inflammation.

Placement: Over area of involvement.

Protocol

Length of time: 30 minute treatment time.

Number of treatments: Minimum of three times per week.

Setting: 3, 5 & 7 (10 minutes each)

CELLULITIS:

Rationale: Pain management. Control inflammation. **Be sure patient is being treated with antibiotics.**

Placement: Over area of involvement.

Protocol

Length of time: 30 minutes.

Number of treatments:

- First two to three weeks: daily treatments of 30 minutes, or two 30-minute treatments daily for pain management.
- Starting week 3 to 4; treatment time of 20 minutes three times per week should be adequate to resolve condition.

Setting: 1, 2 & 3 (10 minutes)

OSTEOMYELITIS (MUST BE ON IV ANTIBIOTICS!!!):

Rationale: Pain management and reduction of inflammation. Increase circulation for better delivery of antibiotic.

Placement: Directly over area of involvement. Second pad placed over proximal lymph nodes.

Protocol

Length of time: 30 minutes.

Number of treatments: Patient should be treated daily for two to three weeks, or until OM shows indications of being resolved.

Setting: 4, 5 & 6 (10 minutes each)

RANGE OF MOTION DEFICITS

FROZEN SHOULDER:

Rationale: Pain management. Reduce inflammation.

Placement: Circumvent shoulder. Pad placement over upper trapezius and into mid and lower cervical region.



Protocol

Length of time:

- 30-minute treatment before physical or occupational therapy.
- 30-minute treatment post therapy.

Number of treatments:

- Minimum of three treatments per week.
- Patients often respond better with 30-minute treatments on non-therapy days. Your patient will tell you what seems to work best for them.

Setting: 7, 5 & 3 (10 minutes each)

CONTRACTURES:

Rationale: Pain management and flexibility.

Placement: Surrounding or over the contracture.

Protocol

Length of time:

- 30-minute treatment time.

Number of treatments:

- Daily until sufficient pain management has been established where patient can withstand physical therapy.
- Minimum of three applications per week.
- **Setting: 1, 2 & 3 (10 minutes each)**

ORTHOPEDIC

NON-UNION/JONES FRACTURES:

Rationale: Pain management and reduction of inflammation; stimulate bone formation.

Placement: Directly over fracture site. If casted, place pads as close as possible to fracture site.

Protocol

Length of time:

- 30-minute treatment time.

Number of treatments:

- Minimum three applications per week.
- Daily treatment with home unit may accelerate recovery.

Setting: 1, 5 & 6 (10 minutes each)

DEGENERATIVE DISC DISEASE

Rationale: To address pain and inflammation of nerve root. Be sure x-rays have confirmed this diagnosis.

Placement:

- For radiating leg pain; follow dermatome pattern originating at spinal level distally. (i.e. pad placed over spinal nerve root and piriformis, back of thigh, first metatarsal.... etc.)
- Low Back Pain only: Two pads placed across the lower back at origin of pain, or one pad over origin of pain and a pad directly above and below that region.



Protocol

Length of time:

- Begin with 30-minute treatment times once daily. May increase to twice daily.

Note: Pads may be worn during physical therapy exercise or while receiving mobilization procedures, myofascial release, etc.

Number of treatments:

- Daily during acute phase, decreasing to three treatments per week during sub-acute and chronic phase of condition.
- Outcome: Average time to initial pain relief is usually 1-2 treatments with anywhere from 2 hours to days of relief. Some patients may eventually experience close to 100% relief from pain at the end of 4-6 weeks of treatment twice weekly.

Setting: 4, 5 & 6 (10 minutes each)

LOW BACK PAIN (LBP)

Rationale: For pain and inflammation with chronic LBP

Placement: Over area affected.

Protocol

Length of time:

- 30 minutes.

Number of treatments:

- Minimum of three treatments per week. Patient may require more frequent application, depending upon underlying cause of pain, and pain level.

Setting: 5, 6 & 7 (10 minutes each)

INTERVERTEBRAL DISC HERNIATION

Rationale: Pain management. Reduce inflammation at nerve root.

Placement: Over spine, at level of involvement.

Protocol

Length of time:

- 30-minute treatment time.

Number of treatments:

- In acute phase, it is often necessary to treat 30 minutes, twice daily. Home unit might be appropriate for pain management.
- In sub-acute stage, a minimum of three times per week. The goal is to increase circulation at the inflamed site that, by reducing swelling, should decrease the pain.

Setting: 7, 6 & 4 (10 minutes each)

POST-SURGICAL

TOTAL KNEE ARTHROPLASTY:

Rationale: To address post surgical pain.

Placement:

- If MD allows the dressing to be removed then place the pads with sterile covers over the incision site.
- Place second pad over femoral artery/vein approximately 2 inches medial and slightly inferior to the ASIS on the ipsilateral side.
- A third pad may be placed in the popliteal fossa.

Protocol

Length of time/ Number of Treatments:

- On open wound site; 12-20 minutes on setting 2. This will be dependent on patient response. Some individuals sense discomfort at higher settings. This treatment should be done for the first 1-2 weeks, or until the incision site heals.
- Closed incision sites: 20-40 minutes of treatment time dependent on patient response with pain and swelling. If response is not as desired, then increase to 30 minutes. Note that since pad placement can be on either side of the incision site, exercise may be done while the pads are in place.

Expected Outcome: The reduction in pain and edema should allow the required range of motion (ROM) to be obtained sooner in the therapy plan. Desired ROM might be obtained within 2 to 6 weeks of treatment which is often much shorter than achieved with physical therapy alone (i.e., without Light therapy).

Setting: 7, 5 & 4 (10 minutes each)

TOTAL HIP ARTHROPLASTY

Rationale: Address post-surgical pain.

Placement:

- If dressing is allowed to be removed by MD, the pads should be placed in sterile sleeve and placed directly over incision site.
- Pad should also be placed over femoral artery on the ipsilateral side.
- If the dressings cannot be removed, then pad placement should be made as close to incision site as possible.

Protocol

Length of Time/ Number of Treatments:

- Open wound site should be treated for 20 minutes. Use this treatment time until the incision site is healed, usually in 1 to 2 weeks.
- Closed incision site: 20-40 minutes per treatment dependent on patient's time needed to obtain optimal results for edema resolution and pain control.
- Exercise may be performed while pads are in place.

Setting: 7, 5 & 4

ROTATOR CUFF REPAIR

Rationale: To address post surgical pain and inflammation and to improve circulation to tendons and skin.

Placement:

- Place pads inferior to the acromion and follow the base of the acromion from posterior to anterior. Athletic tape may be used to help secure pads.
- Place second pad over suprascapular artery medial to the acromion and superior to the spine of the scapula.
- If there is increased swelling in ipsilateral hand, one pad may be placed on ventral carpals. A second pad placed over brachial artery in upper arm. Each of these interventions is designed to increase circulation and reduce edema that together reduce pain and speed up the healing process.

Protocol

Length of Time/ Number of Treatments:

- Begin with 30-minute treatments bid for the first 2 weeks.
- The following 2-week period, treatment can be reduced to a single daily treatment time of 30 minutes.
- The 5th and 6th weeks post surgery; Treatment time is again reduced to 30 minutes, three times per week.
- Following 1-2 weeks of Light therapy treatment and pendulum exercises with gentle passive range of motion (PROM), the pain should decrease by 50-60%.
- Following 4-6 weeks of Light therapy treatment and active ROM (AROM) with beginning PRE, there should be 80-90% reduction in pain and patient should be ready for neuromuscular retaining with PRE.

Setting: 7, 5 & 4 (10 minutes each)

KNEE SURGERY - BURSITIS & INJURY

Rationale: Address post surgical pain, edema, and inflammation.

Placement:

- Pad on either of the Patella following the medial and lateral joint lines.
- One pad over femoral artery at the iliotibial band level and one pad over the femoral artery at the joint with knee in 15-20 degrees of flexion.
- **Alternate Pad Placement**: Pad placed on either side of the patella following the medial and lateral joint line. One pad placed over the anterior knee with the knee in 60-90 degrees of flexion (which will allow the patella to translate anteriorly). One pad over the femoral artery at the iliotibial band level.

Protocol:

Length of Time/ Number of Treatments

- For the first 1-6 days post surgery, treatment times should range from 20-30 minutes depending on patient tolerance in position.
- At 2-3 weeks post surgery: treat for 30-45 minutes or as needed for edema and pain management.

Outcomes: By 6 days post surgery, incisions should heal and patient should have at least 60 to 110 degrees ROM.

Setting: 7, 5 & 4 (10 minutes each)

FOOT SURGERY

Rationale: To address post surgical pain and inflammation.

Placement:

- Place pad directly over the site of involvement using sterile sleeve if incision site is open.
- Place pad over the ipsilateral femoral artery near inguinal ligament.
- Place pad over anterior tibial artery or the posterior tibial artery.

Protocol:

Length of Time/ Number of Treatments:

- 30-minute treatment time, depending upon patient tolerance and pain level.
- Physical Therapy exercise can be executed in other areas while the pads are in place.

Outcomes: 3-6 treatments should bring on increased sensation from nerves that may have been severed during surgery or are not receiving a normal amount of blood flow because of post surgical swelling and edema. Nitric oxide does help to grow nerves. Edema and pain level should begin to decrease dramatically. Be prepared for complaints of an early increase in pain that is a sign that nerves are growing or now are beginning to receive an increase in blood flow. These complaints should lessen and eventually disappear after 3-6 treatments.

Settings: 7, 5 & 4 (10 minutes each)

TRAUMA

BRUISE:

Rationale: Reduce pain and circulation issues of bruise. A bruise is a visible sign that blood vessels have been torn or become leaky during the trauma. The discoloration is due to the red blood cells that have accumulated at the bruise site. As they lose their oxygen the area becomes “bluish”.

Placement: Directly over bruising site.

Protocol

Length of time:

- 30 minutes

Number of treatments:

- Daily treatment until bruising has resolved (often complete in 3-4 days).

Setting: 1, 2 & 3 (10 minutes each)

SPRAIN /STRAIN:

Rationale: Decrease pain, inflammation and swelling. Often best results seen in acute phase.

Placement: See examples. Pad placement should contact skin surface directly over the site of injury.



Protocol

Length of time:

- 30 to 45 minutes.

Number of treatments:

- Best to treat acute phase of injury daily.
- Do not use ice in acute phase while treating with Light therapy™. Why? Because ice decreases circulation and the goal is to restore blood flow, oxygen, glucose, nutrients and growth factors as quickly as possible. Nitric oxide increases blood flow to the site as well as in the veins and lymphatic ducts that help to remove edema. Ice cannot do this.

Setting: 1, 2 & 3 (10 minutes each)

WOUNDS

VENOUS STASIS; PRESSURE ULCERS (ARTERIAL); DIABETIC ULCERS:

Rationale: To address pain and inflammation of wound. No wound heals without good blood flow. Nitric oxide helps new tissue to form.

Placement: Directly over wound bed. Sterile sleeve may be used over therapy pad. MUST be a clear plastic barrier. If dressings prohibit direct access to wound bed, place pads as close as possible to wound margins. If patient cannot tolerate pad placement over wound bed, pads should be placed at wound margins, surrounding wound bed.

If there is a tunneling present from wound, care needs to be taken assure pad placement is utilized over tunnel area initially, then move over the wound bed. It is important to prevent closure of wound over the tunnel before the tunnel has been resolved.

Protocol

Length of time:

- 30 minutes.

Number of treatments:

- Daily, until wound resolves.

Setting: 1, 2 & 3 (10 minutes each)

CIRCULATION CONDITIONS

VENOUS INSUFFICIENCY:

Rationale: Reduce pain, swelling, edema and inflammation.

Placement: Above area of insufficiency (i.e. at surgery or trauma site); work proximal to distal at weekly intervals.

Protocol

Length of time:

- 30 minutes.

Number of treatments:

- Daily, until resolution of condition.

Setting: 3, 4 & 5 (10 minutes each or setting B)

FIBROMYALGIA

PAIN MANAGEMENT:

Rationale: Pain management. Apparently nitric oxide, through vasodilation, increases oxygen delivery to these sites and more oxygen reduces pain.

Placement: Over area of involvement. Start with most troublesome site first.

Protocol

Length of time:

- 30-minute treatment time.
- Number of treatments:
- Daily until appropriate pain management is obtained, then minimum of three times per week. The fibromyalgia patient can be candidate for home system for long term management of their condition.

Setting: 4, 6 & 7 (10 minutes each)

NERVE ENTRAPMENTS

CARPAL TUNNEL SYNDROME:

Rationale: Pain management, decrease inflammation, reduce edema (that compresses the blood vessels delivering oxygen to the nerve).

Placement: Anterior and posterior aspect of carpals. Pad placed over pronator and supinator muscles.



Protocol

Length of time:

- 30-minute treatment time.

Number of treatments:

- Minimum of three applications per week.
- During acute episode, daily application may be needed for pain management.

Setting: 7, 3 & 2 (10 minutes each)

APPENDIX QUICK REFERENCE:

Earlier we mentioned that the seven settings have their foundation in applied biomedical science. This Table expands on that information and provides the rationale for using various settings.

Setting	Frequency	Anatomical Function
1	73 Hz	For use when cellular activity is hypoactive, such as chronic recurring problems, nonunion fractures and chronic splints and for stimulation of osteoid. It is also helpful in activating humoral and endocrine functions. (Field work has shown setting 1 helpful in stimulating (tonifying) acupuncture and trigger points and increasing circulation in areas being treated. This includes wounds when they are past the acute stage.)
2	146 Hz	For areas of yellow scar tissue that are generally formed internally on tendons, ligaments and sub-acute (lingering but chronic) conditions. (Field use has shown setting 2 to be helpful in reducing inflammation associated with injuries and infections.) This is often called the "universal frequency" because most problems involve inflammation.
3	293 Hz	For tissue of ectodermal origin, such as body openings (throat, sexual organs, anus), skin and nerve. (Field applications include wounds, eye injuries and after surgery. Setting 3 tends to tone tissue while minimizing the chance of hemorrhaging fresh wounds or recent surgical sites.) It is also good for the treatment of acupuncture and trigger points, corneal ulcers, and ulcerated mucous membranes. This is called the "universal frequency" in acupuncture.
4	587 Hz	For circulatory and lymphatic stimulation and treatment of tissue endodermal origin. (In field applications, setting 4 has been used in conjunction with settings 5 and 2 for tendon, ligament, joint and other injuries where reaching deeper levels of tissue is needed.)
5	1174 Hz	For tissue of mesodermal origin, such as bone, ligament, viscera and tendon. (Field experience has shown setting 5 to be especially good for tendon and ligament injuries when used with settings 4 and 2.) It also helps in relaxing large muscle groups.
6	2349 Hz	For chronic conditions not responsive to setting 3 or 5. (Field experience shows setting 6 to be a good supplement to setting 3 when healing processes appear to have reached a plateau.)
7	4698 Hz	For pain control, primarily when C nerve fibers are transmitting to dorsal root ganglia and when involvement of neurotransmitters is of physiological importance. (Field experience shows setting 7 will help suppress pain and sedate acupuncture and trigger points and aid in diminishing excess calcification associated with chips, spurs and arthritic conditions).

General Rule: When stimulation is required, use lower frequencies. When sedation is required, use higher frequencies.

LIGHT THERAPY

THE LIGHT THERAPY SYSTEM GENERATION OF LED THERAPY.

LED light therapy has been recognized in the veterinary medicine world for injuries since 1983 when CEFCO Inc. first marketed the technology.

Although few physiotherapy departments or clinics would be without a low level light modality, some skepticism, regarding this type of therapy, remains even though LED devices are being used by physicians, nurses, veterinarians, equine therapists, chiropractors, dentists, remedial massage therapists, physiotherapists, and others. More and more publications within the medical and scientific community attest to the clinical usefulness of these devices and their many biological effects.

Acute and sub-acute pain and inflammation arise in humans and animals due to the stress of training and performance or from injuries or even certain diseases. Sometimes, as would be in the case of trauma, these conditions require immediate help from your medical doctor. However, traditional mainstream medical interventions may benefit from alternative therapies to provide long-term resolution of the problem. Many people have found that LED therapy can provide a complete and lasting resolution of many physical problems if the original medical diagnosis implicated pain, circulatory problems and/or inflammation.

Most existing scientific studies deal with Low Level Laser Therapy (LLLT). Essentially these studies show light therapy may reduce pain after dental extractions, improve immune function, decrease wound healing time, increase the time of fracture healing, relieve the discomfort of eczema, increase mitochondrial ATP production, improve the cosmetic appearance of stretch marks, help heal pressure ulcers, increase production of DNA and collagen, and increase the activity of fibroblasts. Similar studies are beginning to appear in which LEDs were used and the same or very similar health benefits are documented. Both LLLT and LED treatments appear to trigger the same responses. This may be because the amount of energy (Joules) delivered by the devices is similar.

The Light therapy system uses non-coherent (dispersed rather than focused or collimated) light. LEDs produce a larger light dispersion beam than lasers and allow a greater margin of error in their effectiveness at reaching the targeted area. Lasers can be very dangerous when not used properly or by properly trained people. LED therapy is completely safe to use. In fact, the FDA has relaxed most restrictions on human LED infrared therapy.

Because lasers were used in early research, we see names such as low-level laser, infrared laser, helium neon (HeNe) laser, cold laser, low-level light laser, and low power laser when we read about light (sometimes called photon) therapy. The term laser therapy is inappropriate for the photon therapy used today; LEDs are **NOT** lasers!. It is the energy produced and the interaction of photons of light with molecules such as proteins within the cell that creates the biological effect, **not the type of device.**

Light therapy has also been given the names phototherapy or photodynamic therapy (PDT) or Intense Pulsed Light therapy (IPL). A study done by the Mayo Clinic in 1989 suggests that the results of light therapy are a direct effect of light itself, generated at specific wavelengths, and

are not necessarily a function of the characteristics of coherency and polarization associated with lasers.

In a study entitled "Low-Energy Laser Therapy: Controversies and New Research Findings", Jeffrey R. Basford, M.D. of the Mayo Clinic's Department of Physical Medicine and Rehabilitation, suggests that the coherent aspect of laser may not be the source of its therapeutic effect. He states, "...firstly, the stimulating effects (from therapeutic light) are reported following irradiation with non-laser sources and secondly, tissue scattering, as well as fiber optic delivery systems used in many experiments rapidly degrade coherency ... "

LEDs have seen a major increase in popularity and use since 1995. The first LED units available for purchase in the medical industry came from CEFCO. These devices used 8mW peak power per diode while today the Light therapy™ system uses LEDs with 200mW peak power per infrared diode and 3,000mcd (milli -candle power) for each red diode. This improved power greatly shortens the treatment time, which is economically important to healthcare professionals and clinically helpful for patients. The Light therapy™ system provides power at an affordable cost. There is one additional advantage to Light therapy™ technology: the pads containing the diodes are placed directly on the site of injury or pain, or on multiple sites, allowing the doctor, therapist or nurse to conduct other meaningful therapeutic interventions as appropriate. This cannot be done with laser therapies that are hand held devices.

Light therapy's multi-diode heads & pads make treatment easy and efficient. The photonic energy is in contact with the area being treated. Because the therapeutic efficiency decreases (inversely proportional) with increasing distance between the diode and treatment area, the Light therapy system keeps the diodes as near as possible to the area being treated thereby maximizing the beneficial effects.

The most common uses for the Light therapy system is for pain such as myofascial pain, fibromyalgia, and joint pain, and for bruising, fractures, muscle problems, edemas, and wounds. The Light therapy system is used to treat wounds that have failed to heal or are getting worse. Wound infections resolve quickly and wounds then close (heal) without a multiplication of proud flesh. Some wavelengths of light therapy also have an anti-bacterial, antiviral, and anti-fungal effect. Because light therapy induces the production of type 1 collagen, an increase tensile strength and elasticity in ligaments, tendons and scar tissue has been observed, allowing the repaired tissue to withstand movement without breaking down over time.

There is strong evidence that photonic (light) therapy cause a:

- Release of nitric oxide from hemoglobin, which initiates the healing process.
- Increase blood flow (circulation) by dilating existing blood vessels and by increasing the formation of new capillaries, which are additional blood vessels that replace damaged ones. New capillaries speed up the healing process by carrying more oxygen as well as more nutrients needed for healing. Increased blood flow through adjacent veins and lymphatic's carry more waste products away from the damaged, swollen and painful sites.
- Stimulate the production of collagen. Collagen is the most common protein found in the body. Collagen is the essential protein used to repair damaged tissue and

to replace damaged tissue. It is the substance that holds cells together and has a high degree of elasticity. By increasing collagen production less scar tissue is formed at the damaged site.

- Stimulate the production of adenosine triphosphate (ATP). ATP is the major source of energy in all cells. Increases in ATP allow cells to metabolize nutrients faster and get rid of waste products faster. ATP production is reduced when oxygen and glucose are not present and therefore the effect of Light therapy to increase blood flow (thereby restoring oxygen and glucose availability) is the reason ATP production is restored toward normal levels.
- Increase lymphatic system activity. Edema, or inappropriate swelling, has two basic components. The first is a liquid part that can be evacuated by the blood system, and the second is comprised of the proteins that have to be evacuated by the lymphatic system. Research has shown that the lymph vessel diameter and the flow of fluid through the lymph system can be doubled with the use of light therapy and this appears to be due, in part, to the effects of nitric oxide. Veins and arteries as mentioned above will dilate in the presence of nitric oxide. This means that both parts of edema (liquid and protein) can be evacuated at a much faster rate to relieve swelling.
- Reduce the excitability of nervous tissue. Nerve cells use ATP to regulate the concentration of ions within their cytoplasm. In the presence of swelling or injury, the delivery of oxygen (and nutrients including glucose) to the site is reduced and nerves cannot produce ATP. Ion concentrations change dramatically and this leads to pain and hyper-excitability. Use of Light therapy that improves oxygen delivery to nerves will help produce the ATP needed to normalize nerve function.
- Stimulate fibroblastic activity that aids in the repair process. Fibroblasts are present in connective tissue and are capable, when oxygen is at or near normal levels, of forming collagen fibers.
- Increase phagocytosis, the process of scavenging and ingesting dead or degenerated cells by phagocyte cells; improved blood flow brings these more of these phagocytic cells to the site of injury. This is an important part of the infection fighting process because white blood cells are anti-infective. No one doubts the need to eliminate an infection before healing can proceed and improved blood flow also delivers antibiotics to an infected site.
- Induce a thermal like effect in the tissue. Light therapy raises the temperature of the tissues in part because of increased ATP generation and also because vasodilation brings more, warm blood from the interior of the body toward the skin, bone, muscles and tendons.
- Stimulate tissue granulation and connective tissue projections, which are part of the healing process of wounds, ulcers or inflamed tissues.
- Stimulate acetylcholine release from certain nerves. Acetylcholine helps regulate heart rate, causes vasodilatation, and improves gastrointestinal peristalsis. These are called parasympathetic effects which means they are not under your

conscious control.

At this time, research has shown no side effects from LED light therapy although caution is urged for those people taking photosensitive drugs such as, but not limited to, tetracycline. Some research indicates that photosensitivity may be caused by ultraviolet wavelengths of light that is not produced by Light therapy. Occasionally, one may experience an increase in pain or discomfort for a short period of time after treating chronic conditions. This is normal as the nerves and tissues begin to improve from their clearly abnormal state. Many alternative practitioners refer to this as a "healing crisis" that may occur as part of the normal process of recovery in some people. Any temporary increase in pain or discomfort is simply the body acknowledging an old problem and may be seen as positive feedback that the light therapy is beginning to work. These healing crises generally disappear after 2-6 treatments.

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Light therapy devices fall under FDA classification (IRT) 890.5500