

## Near-Infrared Therapeutic Laser and Pain Relief

Pain relief strategies using a continuous output Gallium-Aluminum Arsenide(GaAlAs) laser.



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In previous articles, I have concentrated my discussions on the clinical applications of therapeutic laser for the relief of pain using those protocols involving the GaAs superpulsed laser. In this article, I will discuss treatment protocols and strategies for use with a continuous wave output GaAlAs laser.

Therapeutic lasers have been shown to have pain relieving and anti-inflammatory effects from a variety of mechanisms. Some of these mechanisms are listed below:

- The GaAlAs laser has been shown to affect substance P and substance P-like immuno reactivity(SP-LI) levels.<sup>1</sup>
- Inhibition of nerve action potentials in dorsal roots.<sup>2</sup>
- Acceleration of recovery from acute joint and soft tissue injuries by 35-50% in 85% of the cases studied.<sup>3</sup>
- Pain reduction in neuropathic foot pain.<sup>4</sup>
- Pain relief and control of inflammation in degenerative osteoarthritis patients.<sup>5</sup>
- Naloxone-reversible analgesia has been observed in rats using a GaAlAs laser.<sup>6</sup>
- Significant analgesia in patients with TMJ pain and for the reduction of post impacted 3rd molar extraction pain.<sup>7,8</sup>
- Reduction of pain and increased circulation in Reynaud's phenomenon.<sup>9</sup>

### Near-Infrared Therapeutic Laser

The Gallium-Aluminum Arsenide (GaAlAs) is a semiconductor laser. This is a near infrared laser, which means that the light emission is invisible to the naked eye. This laser has historically operated in the 780-890nm range. This type of

Recommended Anti-inflammatory Dosage for Low Level Laser Therapy Laser classes 3 or 3 B, 780 - 860nm GaAlAs Lasers Continuous or pulse output less than 0.5 Watt			
Diagnoses	Energy dose delivered to the skin over the target tendon or synovia		
TENDINOPATHIES	Points or cm <sup>2</sup>	Joules 780 - 820nm	Notes
Carpal-tunnel	2-3	12	Minimum 6 Joules per point
Lateral epicondylitis	1-2	4	Maximum 100mW/cm <sup>2</sup>
Biceps humeri c.l.	1-2	8	
Supraspinatus	2-3	10	Minimum 5 Joules per point
Infraspinatus	2-3	10	Minimum 5 Joules per point
Trochanter major	2-4	10	
Patellartendon	2-3	6	
Tract. Iliotibialis	2-3	3	Maximum 100mW/cm <sup>2</sup>
Achilles tendon	2-3	8	Maximum 100mW/cm <sup>2</sup>
Plantar fasciitis	2-3	12	Minimum 6 Joules per point
ARTHRITIS	Points or cm <sup>2</sup>	Joules	
Finger PIP or MCP	1-2	6	
Wrist	2-4	10	
Humeroradial joint	1-2	4	
Elbow	2-4	10	
Glenohumeral joint	2-4	15	Minimum 6 Joules per point
Acromioclavicular	1-2	4	
Temporomandibular	1-2	6	
Cervical spine	2-4	15	Minimum 6 Joules per point
Lumbar spine	2-4	40	Minimum 8 Joules per point
Hip	2-4	40	Minimum 8 Joules per point
Knee medial	3-6	20	Minimum 5 Joules per point
Ankle	2-4	1	
<i>Daily treatment for 2 weeks or treatment every other day for 3-4 weeks is recommended</i>			

TABLE 1. GaAlAs Dosage Chart (Courtesy of the World Association of Laser Therapy; WALT).

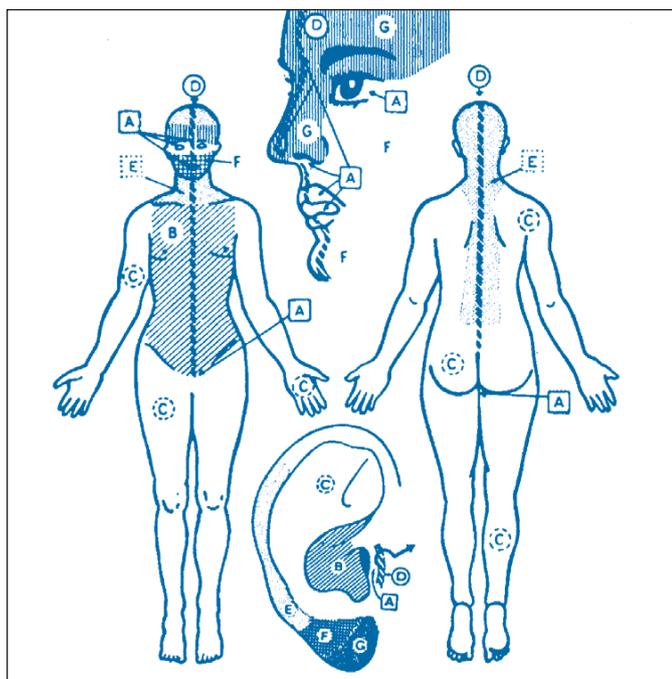


FIGURE 1. Body zones associated with each Nogier frequency.<sup>16</sup>

Frequency	Disease, part of the body	
A'/292	Acute illness, cellular level, inflammation, tumours; <b>Body orifices</b>	<b>Shu point</b>
B'/584	Chronic illness, metabolism, cell nutrition; <b>Abdomen</b>	<b>Sedation</b>
C'/1168	Circulation, energy transfer, locomotor disorders; <b>Bones, muscles, joints, extremities</b>	<b>Tonification</b>
D'/2336	Psychic disorders, fatigue, laterality disorders; <b>Commissures</b>	<b>Alarm point</b>
E'/4672	Nerve disturbances/pain, neuralgia, neuritides; <b>Spinal cord, nerves</b>	<b>Starting point</b>
F'/9344	Depressions, psychic symptoms and causes, bone; reconstruction; <b>Face, subcortex, emotions</b>	<b>End point</b>
G'/18688	Intellectual and psychosomatic disturbances; <b>Frontal cerebral zone</b>	<b>Source point</b>

Regenerating= A+B+F, Analgesic= C+D+G, Muscle relax.= E+F  
Low range A 2,28, B 4,56, C 9,12, D 18,25, E 36,48, F 73, G 146 Hz

TABLE 2. Laser Pulses/Second based on Nogier Frequencies (Courtesy of Medical Laser Systems).

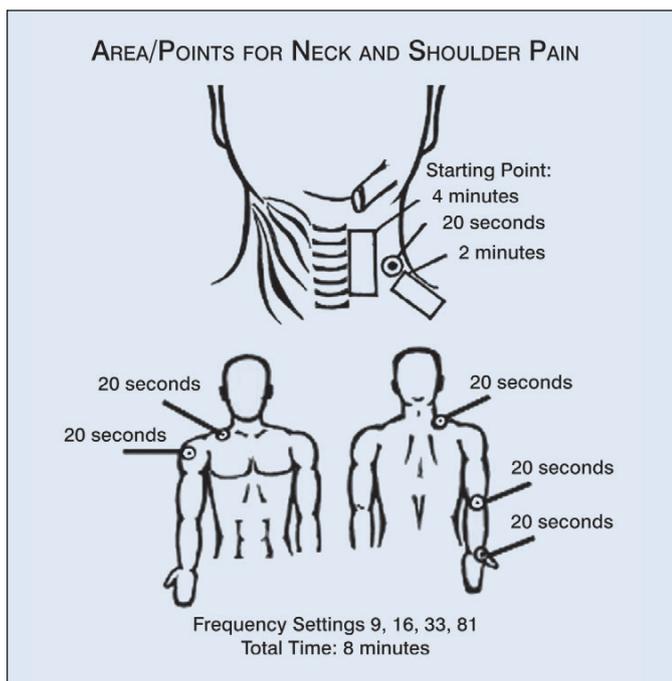


FIGURE 2. Suggested Treatment Points For The Neck And Shoulder after Dr. Pekka Pontinen.

laser also has a continuous output of power and is often pulsed with a duty cycle switch. This laser penetrates to 2–3 cm depth. These lasers are often utilized for medium to deep tissue structures such as muscles, tendons, and joints.<sup>10</sup>

The GaAlAs laser is perhaps the most widely used infrared therapeutic laser today. This is, in large part, due to its availability in a wide range of wavelengths. We will recall that, in large measure, the wavelength determines the depth of tissue pene-

tration. The wide variety of wavelengths available with this diode today—from the high 700 nm to the high 900 nm range—makes this laser diode applicable to many different body tissues. No other therapeutic laser has such a wide range of wavelengths.<sup>11</sup>

Tissue dosage of light energy is described in joules/cm<sup>2</sup> where a joule of energy is the same as a watt-second. The therapeutic dose can be calculated as follows:

$$\text{Dose (Joules/cm}^2\text{)} = \text{Power (watts)} \times \text{Time (secs)}/\text{Area (cm}^2\text{)}$$

In other words, dosage equals the laser's output power (in watts) times the treatment duration (in seconds) and divided by the area treated (in cm<sup>2</sup>). If the laser is pulsed, one would substitute the mean power output.<sup>12</sup>

A GaAlAs laser with a 10mW output will require 100 seconds to achieve a 1 joule output. A 100mW GaAlAs laser will require 10 seconds to achieve 1 joule. A 500mW output GaAlAs laser will require 2 seconds to achieve 1 joule output. These exposure times are for each cm<sup>2</sup> of area to be treated.<sup>13</sup>

Accurately determining and following tissue dose recommendations is important when using GaAlAs lasers or any other continuous wave output lasers. This is especially true when using a higher output laser, such as a 500mW GaAlAs laser, in order to minimize the possibility of overdosing the treatment area.

This type of laser is a continuous wave laser which, as the name implies, produces a continuous stream of photons of light energy. It is common practice to use an electromechanical or duty cycle switch to turn the photon beam on and off in order to produce a "pulsed" effect. Most switches are 50% duty cycle.<sup>14</sup> This means they are on half the time and off half the time. So, if the peak output of a laser is 50mW, the mean output would be 25mW. I am aware of at least one laser company that uses a 97% duty cycle. This means that it is outputting at full power 97% of the time and off only 3% of the time. This allows for negligible losses in mean power output.<sup>15</sup>

Treatment applications with the GaAlAs laser are straightfor-

Frequencies		
F1	73pps	Pain/Neuralgia: Acute injury, non-union of fractures, tonification of acupoints, fresh wounds
F2	146pps	Sub acute injury
F3	292pps	Chronic conditions, acupoints, scar tissue, outermost layer of skin (ectoderm)
F4	584 pps	General Stimulation: Circulatory system, innermost layer of skin (endoderm)
F5	1168pps	Edema/Swelling: Acupoint on the limbs, scar tissue, mesoderm
F6		General Stimulation/Inflammation: Chronic condition, pain control, sedation of acupoints
SC		Scans all of the above frequencies

**TABLE 3.** Another example of Nogier's frequency ranges adapted to lasers. (Courtesy of Medical Laser Systems)

ward. Treatment times with higher output lasers are relatively short. This might be as short as only a few seconds per cm<sup>2</sup>.

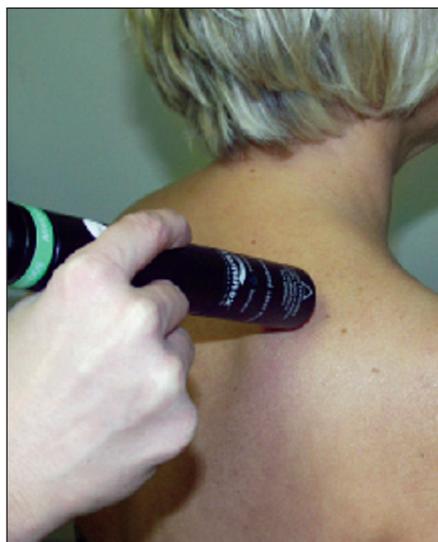
Several different frequency ranges have been used with the GaAlAs laser. One of the most commonly used are the Nogier frequencies. Paul Nogier, MD, was a French neurologist who developed the field of Auriculotherapy and Auricular Medicine in 1951. In the 1970's he experimentally observed that different frequencies, based on multiples of 1.14Hz, had healing effects on different tissues and systems within the body.<sup>16</sup> Many laser practitioners have successfully used harmonics of these frequencies converted to light pulses per second (pps). See Tables 2 and 3 below for frequencies and Figure 1 for the body zones associated with particular Nogier frequencies.

A typical treatment protocol, let us say for right shoulder and neck pain with limited range of motion, would include using frequencies C for pain relief and E for muscle relaxation (using Tables 2 and 3). Each area would be treated for a minimum of 6 joules per point using a grid pattern to cover the involved area (see Figure). Figure 3 illustrates application of a GaAlAs single diode laser probe to a patient's right neck and shoulder.

## Summary

GaAlAs lasers provide for a broad range of clinical applications. Treatment times are relatively short, especially when using devices in the 500 mW range. Depth of penetration for this therapeutic near-infrared laser is well-suited for medium to deep tissues depending on the wavelength used. It can be a valuable addition to managing and relieving acute and chronic painful conditions.

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**FIGURE 3.** GaAlAs single diode laser probe applied to right neck and shoulder (Courtesy of Medical Laser Systems).

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