Low Level Laser Radiation as a Stimulant in Acupuncture.

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Abstract – The non-invasive nature and overall cost effectiveness of laser bio-stimulation makes lasers a very attractive alternative in acupuncture. In previous work we were able to show a distinction in absorption between acu-points and non-points using pulsed infrared radiation. The experiment presented in this paper will expand on the previous experiments [4,5].
This paper presents a new design, which gives the ability to measure and compare laser radiation absorption at points of acupuncture and non-points. Data will allow an evaluation of the overall effectiveness of lasers in acupuncture and also help verify the unique nature of acu-points and complex meridian system.

I. Introduction

SINCE the early findings on the effects of low level laser irradiation in the mid 1960s, lasers have rapidly been adapted to many medical procedures ranging from dentistry, surgery, oncology and tissue bio-stimulation. In the last two decades laser stimulation has even been applied to the most traditional forms of medicine, acupuncture [6].

Traditional acupuncture involves the insertion of one or more fine needles into locations around the body known as acupuncture points to "cure" disease. It has been well documented that acupuncture can also be performed with other forms of energy. This energy can be in the form of heat, pressure, and electrical current, either AC or DC [9].

Generally it is believed that lasers are more effective on superficial acupuncture points. In practice they are used on points which are situated up to 10mm beneath the surface of the skin This is due to the laser lights penetration limits, which depends on its intensity, collimation, wavelength and power [1].

II. Laser tissue interactions

When laser radiation is focused upon tissue, three things occur. Some of the light is reflected, some absorbed and some scattered (figure 1). Reflection is defined as the returning of electromagnetic radiation by surfaces upon which it is incident, absorption is the result of the transformation of photon energy into some other form of energy, while scattering may be define as a change in the propagation direction of the light. These modes are dependant upon the surface of the tissue, the type of tissue through which the light is passing, as well as the wavelength of the incident light [8].

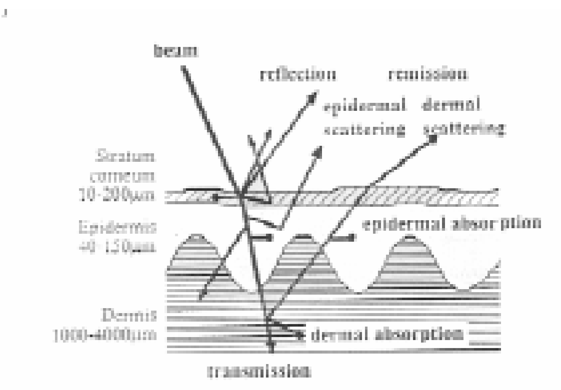

Figure 1. Laser-tissue interactions[8]

III. Measurement Techniques

The techniques for measuring laser-tissue interactions are all limited to a sample of the tissue being taken and observed. The three main techniques are outlined below [7].

Method One

Method 1 is a simple set up for measuring total attenuation (figure 2). A beam-splitter is used to split the laser source into two. One on the beams is focused upon the sample and the other upon a detector as a reference signal. A second detector is placed behind the sample. This detector measures the transmitted intensity. By subtracting the intensity of the measured and reference signal, the attenuation coefficient can be found.

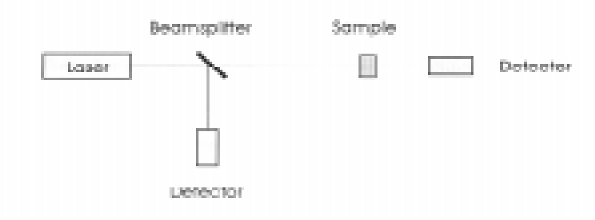

Figure 2 Experimental methods for measuring total attenuation [7].

Method Two – Integrating Sphere Method

This method relies on a component called the integrated sphere (figure 3). The sphere has a highly reflective coating. An integrated detector measures light that has not been absorbed by the sample placed within the sphere. If the geometrical dimensions of the sample are taken into account then the absorption coefficient can be obtained [7].

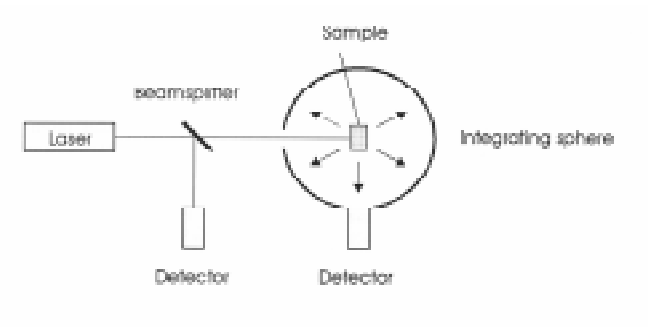

Figure 3 Experimental methods for measuring absorption [7].

Method Three – Double-Integrating Sphere Method

This method incorporates two or more identical integrated spheres (figure 4). Like method 1, these spheres have a highly reflective coating on their inner surface to reflect all scattered radiation back to the detector. These are located in front and behind the sample. One of the spheres integrates all radiation, which is either reflected or scattered backwards by the sample. The second sphere measures all transmitted and forward scatted radiation [7].

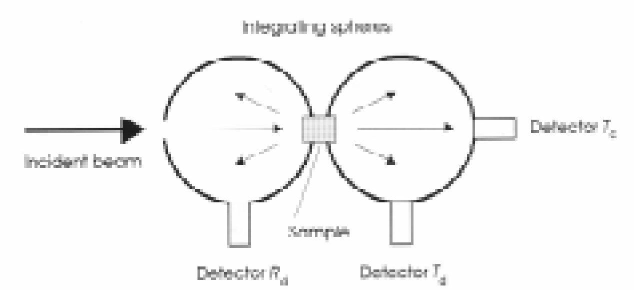

Figure 4 Double-integrated spheres Method[7].

When measuring the optical properties of acupuncture points this is not practical since these points are subcutaneous.

III. ACUPUNTURE POINTS AND THEIR PROPERTIES

Traditional Chinese medicine proposes that acupuncture points are locations on the body joined by complex meridian networks where "chi" energy can be manipulated to "balance" the system. A balanced system is free of sicknesses or diseases [10].

The properties of acupuncture points and meridians have been studied extensively over the past 50 years. Research has shown the points to exhibit unique electrical, thermal and chemical properties. These are outlined in table 1.

Table 1. Outline of acu-point characteristics [2,3,9,10].

	Acupuncture Point Characteristics
1.	Low electric resistance, explored either by DC or AC current (20 to 250 kilo-ohms).
2.	High electric capacity values (0.1-1 micro-farad).
3.	High electric potential (up to 350mV).
4.	Low threshold of painful sensitivity.
5.	High local temperature.
6.	Increased "cutaneous respiration" (great uptake of CO_2 at the level of the points).

IV. AIMS

To design a computer automated system, which is able to measure and record the absorptions of laser radiation by an area of the skin, which contain acu-points and non-points. This will allow a comparison to be made of the optical properties of each of the two areas.

II. DESIGN CONCEPTS

The most important section of this design is the creation of an accurate methodology of measuring the amount of absorbed laser radiation by an object, when exposed to laser energy.

If a focused laser beam of 1mm spot size is aimed perpendicular to the skin and all reflected radiation is collected then it is possible to calculate the amount of energy absorbed and scattered by the skin. It is however important that all the reflected radiation be captured by an appropriate means and converted to a voltage or current to be recorded and compared.

To measure the reflected radiation a new sensor will be developed. It consists of a block of aluminum of the dimensions: 15mm width x 20mm height x 15mm length.

A 1mm hole is drilled centrally in the block. From the top a 10mm hole is then drilled along the same central hole for a depth of 10mm. This hole will accommodate the lens and focusing section of the laser diode. From the bottom a 6mm hole is drill up for a depth of 6mm. This will act as the chamber where the reflected radiation will be collected. On each of the four walls a 3mm hole is drilled, centrally into the bottom chamber. These holes will accommodate the phototransistors, which will collect the reflected radiation and convert it to a current.

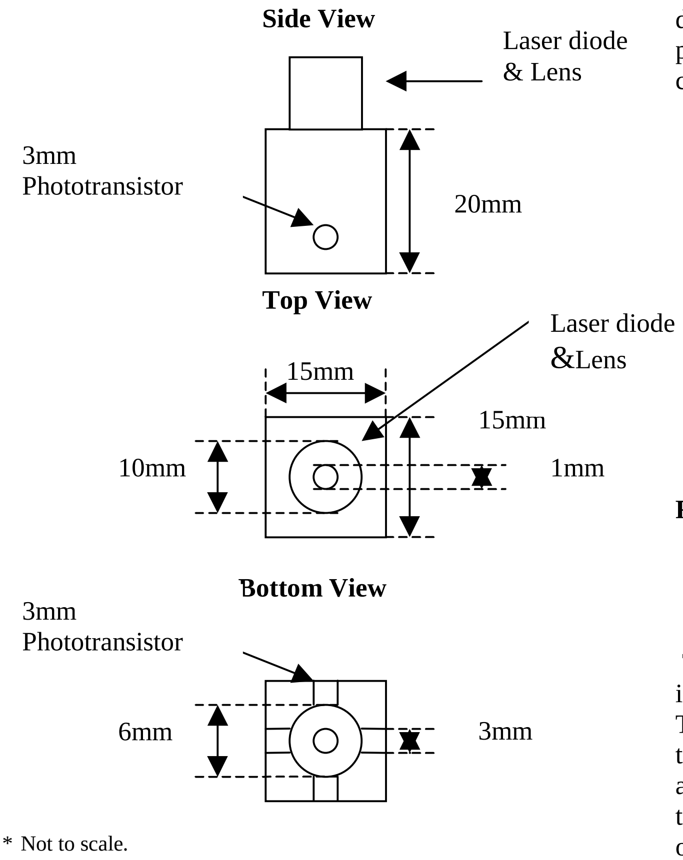

Figure 5. Sensor specifications

The laser source chosen is a 780nm laser diode manufactured by Sharp. Its maximum radiated output is 5mW but will be regulated to 3mW using an ultra precise current source and feedback circuitry. This circuitry will track thermal changes and bias changes of the laser diode. The laser diode will be collimated using appropriate lenses and attached to the new sensor.

From the new sensor, currents in the four phototransistors are summed and any high frequency noise filtered with Maxim's chopper-stabilized amplifiers. These amplifiers offer ultimate temperature stability, low noise and precision. The signal is then sampled using a micro-controller with an in-built 10-bit analog to digital converter and stored in a ring buffer. It is then uploaded via the serial uart and the personal computers communication port to recording software to be recorded and organized for data analysis.

EXPERIMENTAL PROCEDURE

To begin with, the point, Large Intestine 4 (LI4), on the right hand will be located. This point will be defined both anatomically using traditional acupuncture charts, as well as electrically by locating a point with a reduced skin resistance. The subject will then place their hand flat on a bench and absorption at this point measured over a period of 1minute.

A second point, the control, will be chosen 20mm to the direct left of LI4. Absorption will be measured over a period of 1 minute at this point also. This will allow a comparison to be made between the to area of skin.

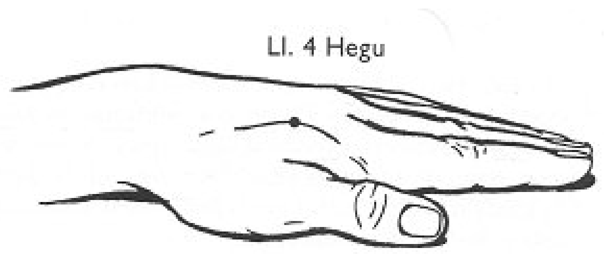

Figure 6 Large Intestine 4

IV. CONCLUSIONS

This new system will allow the accurate measurement of infra red laser light absorption at acu-points and non-points. This absorption will help characterize acu-points and verify the Tradition Chinese philosophy that suggest that acupuncture points and meridians act as pathways for the transfer of energy from the surrounding environment to the organism

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