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The History of Laser Therapy

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Introduction

Various forms of heliotherapy (light therapy) have been practiced around the world for centuries. Physicians and healers in Ancient Greece, Egypt, and Rome – including renowned Greek historian Herodotus in the 6th century B.C. – all realized the benefits of such therapy (Ellinger, 1957). Likewise, the Inca and Assyrian cultures worshiped the sun with the belief that it would bring them health. Around 1500 B.C., Indian medical literature described treatments combining herbal medicine with natural sunlight to treat non-pigmented skin. There are records in the Buddhist literature from around 200 A.D. and Chinese documentation from the 10th century recording similar therapeutic effects from light.

In the 17th century, Sir Isaac Newton discovered that prisms could disassemble or separate white light, a phenomenon he described in his book *Opticks,* originally printed in 1704 (Newton, 1704). He was also the first to use the word "spectrum" (Latin for "appearance" or "apparition") in 1671.

Heliotherapy in the Modern World

Niels Ryberg Finsen, a Faroese physician and scientist of Icelandic descent, is widely regarded as the original proponent of phototherapy. In 1903, he was awarded the Nobel Prize in Medicine and Physiology for the successful treatment of diseases using phototherapy; specifically, lupus vulgaris, a skin infection caused by *Mycobacterium tuberculosis* (Nobel Prize, 2014b). He also famously utilized ultraviolet light to treat smallpox lesions (Nobel Lectures, 1967).

Shortly thereafter, in 1916, Albert Einstein postulated the theory of lasers to support his Theory of Relativity. First, Einstein proposed that an excited atom in isolation can return to a lower energy state by emitting photons, a process he termed "spontaneous emission." Spontaneous emission sets the scale for all radiative interactions, such as absorption and stimulated emission. Atoms will only absorb photons of the correct wavelength; the photon disappears and the atom goes to a higher-energy state, setting the stage for spontaneous emission. Second, his theory predicted that as light passes through a substance, it stimulates the emission of more light (Hilborn, 1982).

Einstein hypothesized that photons prefer to travel together in the same state. If one has a large collection of atoms containing a great deal of excess energy, they will be ready to emit photons randomly. If a stray photon of the correct wavelength passes by (or, in the case of a laser, is fired at) an atom already in an excited state, its presence will stimulate the atom to release its photons early. The new photons will then travel in the same direction as the original stray photon, with identical frequency and phase. A cascading effect ensues: as the identical photons move through other atoms, ever more photons are emitted (Pais, 1982).

The Laser is Born

On May 16, 1960, Theodore Maiman produced the first ruby laser at the Hughes Aircraft Research Laboratory in Malibu, California, basing his new creation on Albert Einstein's explanation of stimulated emission of radiation, coupled with Townes' and Schawlow's 1958 work with optical masers (Schawlow and Townes, 1958; Itzkan and Drake, 1997).

Several years after the invention of the laser, Dr. Endre Mester – considered the founding father of laser therapy – became the first to experimentally document the healing effects of lasers. Because he used mice as

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his experimental model, this is also the first documented use of lasers to accelerate healing in veterinary medicine (Mester *et al.*, 1967). His experiments would also later prove that the acceleration of healing was a systemic – not just localized – event (Perera, 1987). Mester's work had a cascading effect, motivating other researchers in Western and Eastern Europe to recognize the value of laser therapy and initiate studies of their own.

Early in the 1970's, the use of laser therapy was documented not only in Eastern Europe, but also in China and the Soviet Union; all of the early research emanates from these geographical regions. Over the next decade, the use of laser therapy spread to Western Europe and became accepted as an effective physical therapy modality (Goodson and Hunt, 1979). Unfortunately, the lasers used were only capable of 5–50 mW of power and didn't generate the consistent clinical results that we have since witnessed with higher-powered lasers.

Yo Cheng Zhou, an oral surgeon in China, was the first to stimulate an acupuncture point with a laser. He used laser stimulation instead of standard local anesthetic protocols during routine dental extractions. A beam from a 2.8–6.0 mW helium-neon laser apparatus (Model CW-12, Chengdu Thermometer Factory) was applied for 5 minutes before the removal of a tooth (Zhou, 1984). Photonic stimulation was then applied to LI-4 Hegu. This acupuncture point has long been recognized to produce systemic analgesia.

From the mid 1970's to the early 1980's, laser therapy became an accepted physical therapy modality throughout Western European and several Asian countries. It finally appeared in the United States around 1977, but there were only a small number of therapists that understood its potential. All of the equipment in the United States during this time frame was in the 1–5 mW range, and acceptance by medical and veterinary professions was very limited due to the inconsistent clinical results.

The first Independent Institutional Review Board for Laser Acupuncture Research was established in 1993, based on research comiled by Margaret Naeser, Ph.D., Lic.Ac. through the Robert Wood Johnson Foundation of Princeton, New Jersey. This initiated the effort and motivation of several colleagues to compile enough current information and research to be in compliance with US Food and Drug Administration (FDA) regulations. Dr. Naeser is currently involved with a large number of research projects, including "Neural Networks and Language Recovery in Aphasia from Stroke victims" (Naeser, 2007). She has published papers on utilizing laser therapy in stroke cases (Naeser and Hamblin, 2011).

Three associations have formed over the years to encourage scientists and practitioners to exchange knowledge and information. The American Society for Laser Medicine and Surgery (ASLMS), formed in 1981, was the first (www.aslms.org). It was the dream of its founders that this organization be unique and include physicians, clinicians, and outstanding researchers in the areas of biophysics, biochemistry, biomedical engineering, laser biology, and laser safety. In 1994, the World Association for Laser Therapy (WALT) was formed by combining the International Laser Therapy Association (ILTA) and the International Society for Laser Applications (ISLAM) (www.waltza.co.za). The North American Association for Laser Therapy (NAALT) was established in 1998. It included the regions of Mexico, Canada and the United States of America. In 2015, NAALT changed its name to the North American Association for Photobiomodulation Therapy (www.naalt.org). All three of these organizations have the common goals of promoting research, improving the understanding of photobiological mechanisms, providing education, clinical applications, and new clinical techniques, and establishing treatment and regulatory guidelines.

The Evolution of Laser Therapy Equipment

The first laser diode, utilizing coherent light emission from a gallium arsenide (GaAs) semiconductor diode, was revealed in 1962 by two groups: Robert N. Hall at the General Electric research center (Hall *et al.*, 1962) and Marshall Nathan at the IBM T.J. Watson Research Center (Nathan *et al.*, 1962).

Later in 1962, other teams at the MIT Lincoln Laboratory, Texas Instruments, and RCA Laboratories also demonstrated the emission of light and lasing in semiconductor diodes. Early in 1963, a team led by Nikolay Basov in the Soviet Union utilized GaAs lasers to achieve emission of light (Nobel Prize, 2014a).

In 1970, the first laser diode to achieve continuous-wave (CW) emission was revealed simultaneously by Zhores Alferov and collaborators in the Soviet Union, and Morton Panish and Izuo Hayashi in the United States (Ghatak, 2009). However, it is widely accepted that Alferov and his team reached the milestone first, and they were consequently awarded the Nobel Prize in Physics in 2000.

While many types of therapeutic lasers were in use around the world, it was not until 2002 that Class IIIb lasers gained FDA approval for therapeutic purposes in the United States. These lasers are commonly referred to as "cold lasers" or "low-level laser therapy" (LLLT) devices. They are limited to 500 mW and are considered effective in the treatment of superficial conditions. The term "cold lasers" refers to the lack of a heating effect on tissue cultures in early experiments. The description

"LLLT" differentiates low-power therapeutic lasers from surgical or cutting lasers.

Class IV therapy lasers, operating above 500 mW, were approved by the FDA in 2006. This was the dawn of "high-power laser therapy" (HPLT). Delivery systems and precise dosage software have evolved through the years to allow the safe and effective delivery of 500 mW–60 W to target tissues.

Photobiomodulation: A New Name

The history of laser therapy and the evolution of laser therapy devices have produced confusing terminology. Multiple terms have been used to describe the technology. Many are more descriptive of the devices being used than of the therapy they deliver.

Recognizing that an accurate, clear, and unambiguous name was needed, 15 international participants joined in a nomenclature consensus meeting at the joint conference of NAALT and WALT in September 2014 (Anders *et al.*, 2015). Respected authorities Dr. Jan Bjordal and Dr. Juanita Anders co-chaired the meeting. The term "photobiomodulation therapy" (PBMT) was recognized as being most descriptive of a science that involves complex mechanisms, some which are stimulatory, some inhibitory. Since that meeting, the National Library of Medicine (United States) has added the term "photobiomodulation therapy" to the MeSH database (MeSH, 2016).

The committee suggested a "definition for the term photobiomodulation therapy as 'A form of light therapy that utilizes non-ionizing forms of light sources, including lasers, LEDs, and broadband light, in the visible and infrared spectrum. It is a nonthermal process involving endogenous chromophores eliciting photophysical (i.e., linear and nonlinear) and photochemical events at various biological scales. This process results in beneficial therapeutic outcomes including but not limited to the alleviation of pain or inflammation, immunomodulation, and promotion of wound healing and tissue regeneration'" (Anders *et al.*, 2015).

Older terminology continues to be used even as the term "photobiomodulation therapy" becomes more commonplace in publications and practical applications. In this text, the terms "laser therapy" and "photobiomodulation therapy" will be used interchangeably.

Conclusion

The historic development of this new technology is in the past. There has now been a wealth of scientific and clinical evidence published. Thousands of veterinary practitioners around the world have adopted laser therapy into their practices. We, as veterinarians, should be at the forefront of this scientifically and clinically proven modality. Continued collaboration and sharing of information between us is essential to the future development of this 21st-century medical technology. The previous history has been written; be a part of the history other veterinarians quote 10 years from now.

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