

It was the late 1960s. The Beatles were still the rage, the Vietnam war was in full swing, and *Star Wars* was a decade away. Theodore Maiman, utilizing a technique of concentrating and amplifying monochromatic light originally devel-

oped by two teams of researchers, produced a device known as LASER, light amplification by stimulated emission of radiation. Immediately, the term "ray gun" came to mind. The development of weapons-grade lasers became a



Lightwave

of the Future

The low-power laser for the treatment of carpal tunnel syndrome is safe, painless, and completely noninvasive.

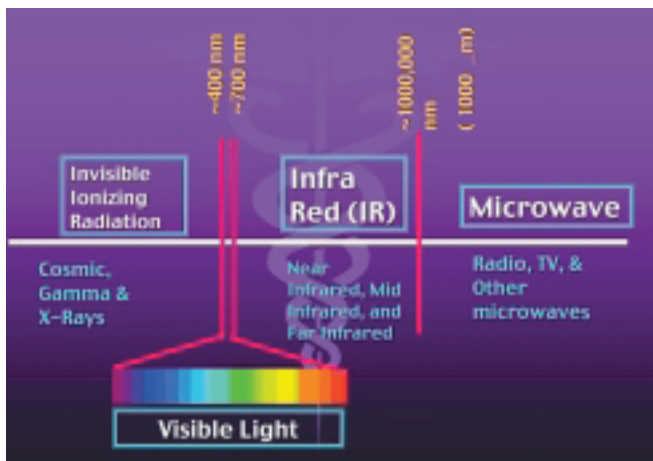
priority. Because the beam could be concentrated to cut a minute surface area, surgical applications were also developed.

But while governments and researchers were concentrating on military applications, a Hungarian physician named Endre Mester suspected that the laser might have a more humane application—the destruction of malignant tumors. Malignancies were traditionally treated with the cut/burn/poison strategy—surgery, chemotherapy, and radiation. If, indeed, the new addition to the scientific arsenal could destroy carcinomas with a minimum of damage to surrounding tissue, it would be an incredible breakthrough in cancer treatment. However, Mester concluded his research with good news and bad news.

LASER SERENDIPITY

The bad news was that his treatment was ineffective against malignancies. The good news was a curious observation in the test animals. He observed that in many cases the skin incisions he made to implant malignant cells in test animals appeared to heal faster in treated animals compared to the incisions of control animals that were not treated with light. Curious about this unexpected and unanticipated result, he designed many follow-up experiments on skin defects, diabetic ulcers, burns, infections, and decubiti. He was baffled by the discovery that they all healed more quickly when exposed to the light of his laser. Eventually, Mester discovered that his laser was underpowered, which was why it did not have a destructive effect on cancerous tissue. This led him to conclude that, just as sunlight is destructive in high amounts but beneficial in small amounts, the laser, at low power, stimulated healing in tissue.

In the decades that followed, Mester's work was adapted to numerous benign laser applications the world over. However,



The electromagnetic spectrum showing the range of wavelengths and categories of light waves.

one of the fields where the laser is one of the most beneficial, yet noninvasive, treatments available is also one of the slowest to capitalize on its advantages. This is the field of physical therapy. Chukuka Enwemeka, PhD, PT, is one of the world's foremost authorities on and advocates of low-power laser therapy. The former chair of the University of Kansas Department of Physical Therapy and Rehabilitation and current dean of the School of Health Professions, Behavioral and Life Sciences at the New York Institute of Technology, Enwemeka is also former president of the World Association for Laser Therapy. "Almost every other field of the healing professions is picking up on laser technology faster than PTs," he says. "Chiropractors, oriental medi-

cine doctors, everyone except orthopedic surgeons, who are even slower.”

Enwemeka expands his comments to include the fact that the United States, in general, is “last on the block” as far as utilization of laser therapy. “It’s been utilized much longer just about everywhere,” he states, “Europe, South America, Asia ... processes are much slower to catch on here. Part of this is because the approval process takes so long, and part of it is that we PTs seem

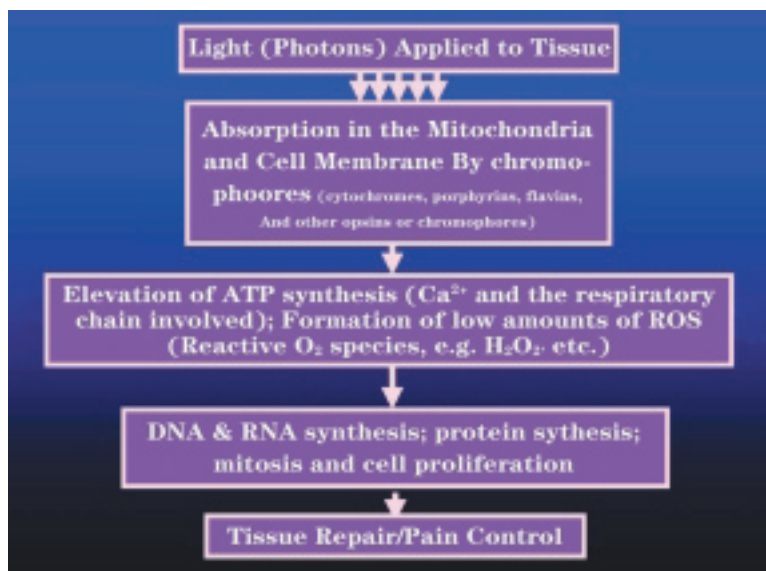
to be skeptical about anything new. The other problem is that there are so many innovations being developed in the United States, anything developed here gets priority in the approval process and anything developed in other countries gets moved to the back of the line.”

Ironically, a staple of the physical therapy profession is one single area where the laser has proven to be highly effective: the treatment of carpal tunnel syndrome (CTS). “It was the first physical therapy protocol for which the low-power laser, or ‘cold’ laser, was approved by the FDA,” Enwemeka says. “In fact, it’s one of the most effective interventions in the PT’s arsenal. In many cases, lower power laser treatment has been effective when even surgery has failed.

HEALING MECHANISM

“All cells, or should I say most cells, have chromophores,” says Enwemeka, “which are like chlorophyll. They absorb light and transform it to ATP, which can be used, for example, to create more collagen or induce homeostasis to reduce inflammation. The light, basically, supplies energy to the cells. Cells absorbing light stimulate the metabolic process on the cellular level.

“ATP is used to power many metabolic processes; synthesize DNA, RNA, proteins, enzymes, and other biological materials needed to repair or regenerate cell and tissue components; enhance mitosis or cell proliferation; and/or restore homeostasis. The result is that the absorbed energy is used to repair the tissue, reduce pain, and/or restore normalcy to an otherwise



Schematic showing how light is absorbed by cells and the cascade of events resulting from light absorption. ATP is produced in this process and used to synthesize needed proteins, enzymes, and other tissue components.

impaired biological process. We experience this ourselves. When it is overcast or dark, you don't feel as good as you do when the day is bright and sunny. If you are out of the light for a while, you feel lethargic and depressed. It demonstrates the role light plays in stimulating ATP production.

"An additional benefit for employing the cold laser in treating carpal tunnel is

pain relief. Reports indicate that light therapy can modulate pain through its direct effect on peripheral nerves as evidenced by measurements of nerve conduction velocity and somatosensory evoked potential. Other reports indicate that light therapy modulates the levels of prostaglandin in inflammatory conditions, such as osteoarthritis, rheumatoid arthritis, and soft tissue trauma."

Additionally, other forms of light therapy have been found to be extremely effective in carpal tunnel treatment. "Light technology continues to advance. Other monochromatic light sources with narrow spectra and the same therapeutic value as lasers are now available. These include light-emitting diodes (LEDs) and superluminescent diodes (SLDs). As the name suggests, SLDs are generally brighter than LEDs; they are increasingly becoming the light source of choice for manufacturers and researchers alike. The light source does not necessarily have to be a laser in order to have a therapeutic effect. It does have to be light of the right wavelength. It has been demonstrated that lasers, LEDs, SLDs, and other monochromatic light sources all produce beneficial effects. Preferences vary from therapist to therapist. However, it is the dose and wavelengths that are critical. At present, it is believed that appropriate doses of 600 to 1,000 nm light promote tissue repair and modulate pain," Enwemeka says.

CARPAL TUNNEL PROCEDURES

"It should be pointed out that, while it certainly is one of the most exciting advances in the history of physical therapy, light therapy is not a panacea," says Enwemeka. "Certain cases of CTS do not respond. However, the most common forms of repetitive strain injuries are very responsive to light therapy. Because it is completely noninvasive, clinically, the PT really should give serious consideration to this procedure." Enwemeka also believes light therapy is contraindicated in certain cases, including the following:

- The presence of any malignancies.
- Irradiation of the eyes.
- Patients with a high degree of light sensitivity.
- Patients who have been pretreated with photosensitivity-enhancing agents, for example, patients undergoing photodynamic therapy.
- Patients on medications that may enhance photosensitivity or patients using the herb Saint-John's-wort.
- Irradiation over the uterus during pregnancy.
- Irradiation of the thyroid gland.

Since light is destructive at high doses but very therapeutic at appropriately low doses, it is important to use the right dose (fluence or energy per unit area treated), and frequency of treatment appropriate for each condition. The dosage is, of course, determined by a ratio of power to duration. Generally, according to

Enwemeka, the dosage is at 3 J/cm² to 5 J/cm² two to three times a week. Often, patients begin to note rapid improvement within three to five visits. The entire course of treatment ranges from eight to 10 visits.

TIME TO SEE THE LIGHT

Many practitioners in Europe believe that light therapy will eventually replace most other forms of carpal tunnel treatment. However, as previously stated, Enwemeka still believes many American PTs need some urging to move in this direction. "A mind-set has developed in our profession that is what I can best describe as a resistance to anything new.



Chukuka Enwemeka, PhD, PT, believes that the low-power laser can revolutionize carpal tunnel treatment.

There is a certain skepticism about newer treatment protocols. While this is good in the fact that it has helped physical therapists avoid quackery and maintain a reputation as the most reliable rehabilitation specialists, it's a double-edged sword because it also allows other countries and practitioners to get a head start on us.

"The low-power laser has received a lot of press and news coverage. It has established a reputation with the public for being quick and painless, so a patient who is able to make his or her own determinations might seek out a rehab specialist who uses light therapy. The PT who does not utilize light therapy may soon, if not already, be losing business to chiropractors and acupuncturists. Aside from a business standpoint, the treatments really are in the patient's best interest for the same reasons.

"A lot of PTs also balk at the thought that they have to purchase the equipment. But the truth is that while the

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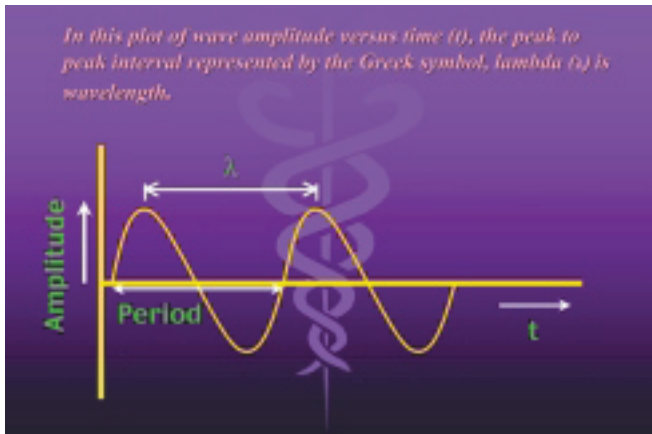


Illustration of the wave nature of light. Light is transmitted as sinusoidal wave. A plot of the amplitude and time is shown.

equipment can be over \$20,000, the light equipment used in physical therapy begins at around \$5,000 or \$6,000. And there's almost never a problem with insurance providers as long as the treatments are coded properly.

"The low-power laser could revolutionize treatment of carpal tunnel syndrome," concludes Enwemeka. "It would be a shame if PTs continue to take a 'wait-and-see' attitude toward this therapy and allow other professionals to continue to take the lead." □

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