Star Light, Star Bright…. Emerging Evidence that Light Therapy Can Improve Sports Performance

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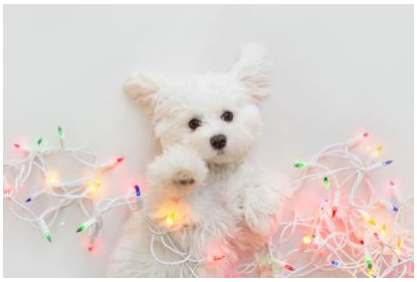

You've heard of the healing effects of laser therapy. There is strong scientific evidence that light energy in the form of photons can penetrate the skin and cell membranes and enter mitochondria (the energy producing factories of the cell). There, the light energy is converted into adenosine tri-phosphate (ATP), the form of energy that the cell uses for healing (references in blog). This is a photochemical effect comparable to photosynthesis in plants whereby light is absorbed by a leaf and undergoes a chemical change to provide the basic energy source for all plants.

In a way, we shouldn't really be surprised that light has power. We all know that sunlight can kill bacteria, for example – Niels Ryberg Finsen won the Nobel Prize in medicine and physiology in 1903 for that discovery. Although laser technology was invented in the early 1960s, recently the field has begun to explode with studies demonstrating the healing effects of light therapy, more accurately called photobiomodulation therapy (PBMT). Hundreds of peer-reviewed studies show that PBMT can promote tissue regeneration, reduce inflammation and relieve pain in soft tissues such as muscles, tendons, and ligaments (2). In the last few years numerous studies have revealed that PBMT can improve hard-to-treat neurological and psychological conditions such as stroke, traumatic brain injury, Parkinson's disease, and depression (3).

Now there is growing evidence that PBMT can actually improve muscle strength and enhance sports-related performance. That's crazy you say? Let's take a closer look at those studies.

A Bit of Background

No one hates physics more than I do, but actually it is pretty interesting (and simple) when we are talking about PBMT. So here is a quick Q & A:

1. **What forms of light can be used for PBMT?**

Only light in the infrared or near infrared wavelengths (600 to 1064 nm) can be converted by the cell into energy. These wavelengths of light can be produced by lasers or LEDs. The main difference between the two is that lasers produce more photons and they are all aimed in one direction, whereas LEDs produce fewer photons that are emitted multidirectionally.

2**. That's a wide range of wavelengths. Does it make any difference what wavelength I choose?**
In general, the longer the wavelength, the deeper into the tissue the light penetrates.

3. **Since PBMT is a type of therapy, how do we measure doses?**
When dosing with light, we use a unit of energy called the joule (J). One watt (W) or 1000 milliwatts (mW) of power produces one joule per second. So, a typical laser with a power of 500 mW will produce one joule every 2 seconds. On the other hand, one LED light in a string of holiday lights has a power of approximately 70 mW, so it will take about 14 seconds for one of those lights to produce one joule of energy. When applying light therapy to a tissue, we describe dose exposure in J/cm2.

Studies of the Effects of PBMT on Performance
Remember that Hierarchy of Evidence, in which the best evidence consists of systematic reviews of randomized clinical trials? Well it just so happens that there is one such study examining the effects of PBMT on sports performance (4). How great is that? That study reviewed 46 randomized, placebo-controlled clinical trials that included 1045 participants. It concluded that PBMT can increase muscle mass gained after training and can decrease inflammation and oxidative stress in muscles. They postulate that these effects are related to the fact that PBMT is known to increase ATP, the biological source of energy needed for muscle work. The review quotes many different studies that show improved performance of various muscle groups in humans, but let's focus on one of the most practical, real-world studies – one that examined the effects of PBMT on the performance of high-level rugby players (5).

In that study, 12 male, world-class rugby players were treated with PBMT (using both lasers and LEDs) or placebo then run 7 times through a timed sprint test that included turns, much like an agility course. PBMT significantly improved the average time for all sprints, measured and perceived fatigue, and blood lactate levels (a by-product of muscle energy metabolism).

When Can I Start Using Light Therapy?
Even though there is growing evidence of the benefits of PBMT on sports performance, there are many questions to be answered before you purchase a laser or LED therapy unit to turn your favorite canine athlete into a super-canine star. They are:

- What is the best wavelength to use?
- Is it better to apply PBMT to muscles before or after exercise?
- How long should the time interval between light therapy and exercise be?
- How many sites of irradiation should be used and on which muscle groups?
- What are the best power (mW) and dose (J/cm2) to use?

This last question is especially important because you might be thinking, "If low doses are beneficial, higher doses must be even more so!" Unfortunately, that is not the case. Numerous studies have shown that low doses of PBMT are beneficial, but higher doses can have no effect or might actually be harmful (3, 4). This biological process is called hormesis (see Figure 1 in blog), just so you can impress your friends with your vocabulary. In any case, this little detail makes knowing the appropriate dose of PBMT really important!

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Another important question to be answered is: how can we apply these bare-skinned human studies to our hairy dogs? How do we know how much of the light source will penetrate a dog's coat to get to the skin? While a laser treatment can be applied by hand, parting the coat and ensuring that the skin is exposed to the light, this is not true for LED products, which usually consist of arrays of small LEDs in a stiff or flexible casement. The internet abounds with LED products that claim to treat a variety of problems in dogs (based loosely on the effects of PBMT in humans), but not one takes into account light penetration through the fur. With so many different densities of fur in different species, this is an important issue. Perhaps we should only use LED arrays on Chinese Crested Dogs or Xoloitzcuintlis!

An additional confounding factor is the fact that the darker the skin, the less the light penetrates to the tissues below (6). This factor also has only been studied in humans, not dogs. So if you have a hairy, dark-skinned dog, how much of the light is going to penetrate to the muscles where you want it to have its effect? We don't know, but some have suggested less than 5%. So at this point, at least for dogs, PBMT to improve performance is not quite ready for primetime.

Despite all of these cautions, however, the evidence is quite convincing that, if you can get light of the right wavelength and power to penetrate to the muscle, it has the potential to significantly improve your dog's athletic performance. The data in humans are so convincing that some studies suggest that PBMT be placed on the World Anti-Doping Agency's list of prohibited substances (4), though how they will know whether a person has been treated has yet to come to light!

For blog references and photos, please go to www.AvidogZink.com/blog.

