FOUR LEG NEWS

Introduction -

I LOVE, LOVE, LOVE laser therapy! I use it on just about every patient! It's been for quite a while that I've wanted to check out and review NEW research in regards to laser therapy. So the search went forth to see what might come up when laser studies were look at in the last 5 - 6 years. I tried for canine-specific, but had to settle for 'animal', and then a wee review paper at the end. Anyhoo… read up and get updated!

Cheers!

Laurie Edge-Hughes, BScPT, MAnimSt (Animal Physiotherapy), CAFCI, CCRT

Laser for Hair Loss

Olivieri, L., Damiano, C., Radicchi, G., Vincenzo, M., Abramo, F., *Efficacy of low-level laser therapy on hair regrowth in dogs with noninflammatory alopecia: a pilot study* Veterinary Dermatology, vol. 26, pp. 35-e11, 2015.

Objective

To determine the efficacy of treatment with low-level laser therapy (LLLT) for hair regrowth in dogs with canine noninflammatory alopecia (CNA). The pathogenisis of CNA is poorly understood and existing therapies have shown poor results. LLLT has been used in human studies to treat noninflammatory alopecia.

Methods

Seven dogs were selected, each with one or more alopecic areas. Each dog was screened and cleared for contributing health conditions such as hypothyroidism and Cushing's and a clinical diagnosis of CNA was made via a control biopsy taken from each dog prior to the commencement of treatment. From the biopsy the percentage of a measured area that contained hair follicles was recorded, and of those follicles the percentage of haired and unhaired follicles was recorded.

Each dog was treated twice per week for a maximum of two months with a BTL 4000 therapeutic laser producing three simultaneous wavelengths of 470nm, 685nm, and 830nm, from 21 foci. Each therapeutic session the dog was treated with a dosage of 6J/cm^2 at 5Hz amplitude 25cm^2 for 1.34 minutes. The probe was held 1cm from the lesion and moved continuously over the lesion during the treatment time. (All parameters were as per manufacturer instructions).
Each dog had one area left untreated as a control. Dogs received no other treatment for their CNA at the time of the trial.

Areas were ranked subjectively as 'unchanged', 'worsened', 'improved', or 'greatly improved'.

Results

Six of the seven dogs were ranked as 'greatly improved', and one of the seven dogs was ranked as 'improved'. Biopsies were taken from the treated areas and showed that 93% of the treated area sample had hair follicles compared to 9% of the area of the untreated sample. Of the hair follicles present in each sample 18% of the treated follicles contained hair, and 11% of the untreated follicles contained hair.

YOUR CARE FACTOR…

Well the exciting thing is that now, you have another reason to use laser. I would have tried laser in these case anyways, but now I'd be backed by science! Good news!

Professor Andre Mester discovered low-power laser benefits

Wound Healing

Gagnon, D., Gibson, G., Singh, A., zur Linden, A., Kazienko, J., LaMarre, J., *An in vitro method to test the safety and efficacy of low-level laser therapy (LLLT) in the healing of a canine skin model* BMC Veterinary Research, 12(73), 2016.

Objective
When Endre Mester discovered LLLT in 1967 the first application of the therapy was wound healing, however the mechanism by which LLLT heals wounds remains somewhat speculative, while applications of LLLT have expanded. The authors evaluated the effect of LLLT on specific cellular mechanisms (keratinocyte migration and proliferation) in wound healing treatment applications to remove some of this speculation.

Method
The study used an in vitro wound healing model and cultured samples of canine epidermal keratinocytes.

A scratch migration assay was done on a selection of the samples creating a single linear, vertical, scratch through the cell. This was used to evaluate the effects of LLLT on cell migration.

A proliferation assay was then done to evaluate the effects of LLLT on cell proliferation.

In a randomized, blinded, and controlled study each sample was exposed to one of four different doses of LLLT (0.1, 0.2, 1.2, and 10 J/cm^2) using a high-power He-Ne Class IV laser under manufacturer's guidelines at a set distance from the sample. Control groups were not exposed to LLLT.

Results
In the scratch migration assays results showed significantly increased cell migration in the low dose LLLT groups (0.1, 0.2, and 1.2 J/cm^2), but that the highest dose of 10J/cm^2 significantly reduced migration on comparison to the non-irradiated control. Likewise, of the lower doses, there was a significant difference in migration between the 1.2J/cm^2 and the two lowest doses, with the lowest doses producing the greatest rate of cell migration.

The proliferation assay showed similar results. Proliferation was significantly greater in the three lower doses of LLLT when compared to the control and 10J/cm^2 group. And again, the 10J/cm^2 showed significantly less proliferation than the control group. Of the

three lower doses of LLLT the two lowest doses applied showed significantly greater cell proliferation than the 1.2 J/cm^2 dose.

These results show that low doses of LLLT significantly increase the biological mechanisms of wound healing of cellular migration and proliferation, but that a higher dose of 10J/cm^2 has an inhibitory effect on these same mechanisms.

SO WHY DO YOU CARE?

Here we can say, less is more. If you are healing a wound, keep your doses low. I would have loved to have learned at what point did the laser start to affect wound healing? Reason for a second study, I guess!

Kurach LM, Stanley BJ, Gazzola KM et al. The effect of low-level laser therapy on the healing of open wounds in dogs. Vet Surg 2015; 44: 988-996.

Right off the bat, I'm going to tell you that this study found no apparent beneficial effects of LLT on the healing of acute wounds in healthy dogs using the LLLT protocol described within the paper. But let's see why!

What was done?
10 young adult male beagles were used, treated nicely, and adopted after the study (phew, this always makes me happy to read!)

They had a surgical procedure where by a 2 x 2 cm^2 full thickness skin defect was created bilaterally (one to laser and one as a control). Note, when they lasered, they covered the other side… just in case some stray laser beams bounced over to the control side and inadvertently affected it.

LASERING
They used the Erchonia Vet Laser™ and used the manufacturers recommended guidelines for wound treatment.

The Erchonia Vet Laser is a class 2 laser with a 7.5mW emitted diode with a wavelength of 635 nm. They exposed the wound to laser light for 5 minutes for a total energy density of 1.125J/cm^2. When you do the math, they must have also pulsed the laser light (which would cut the power in half), thus making their numbers add up.

They treated the wounds ever 2 – 3 days, starting immediately post-op. The wounds were evaluated at 7 different time points and lasering continued until wounds were entirely epithelialized, ending the study at day 32 post-op.

It took me a wee bit of searching to further determine the protocol for how close the laser aperture was held away from the wound. From the looks of the picture in the paper and

other research articles that used the Erchonia Vet Laser for wound healing, it appears that the laser unit was held at approximately 3 cm away from the skin.
Houston, we have a problem!

One needs to realize that in order for you to use the calculation (1J = 1W x 1sec), you need to be in contact with the skin, in other words, if they applied the light at 3cm away from the skin, the amount of laser that actually reached the target tissue was far less than 1.125 J/cm^2. Which is hands down, NOT ENOUGH!

Results?
No difference in healing between the lasered wound and the control wound. Additionally, not only did the lasered wound not do better than the control wound, but both of them healed slower than historical controls of wound healing (i.e. both sides were delayed)!

Discussion

While the results were confounding in regards to delays in both the laser- and control-side wounds, the authors discussed that the historical wound controls subjects (from a different study) were all females. So, they threw into the mix that perhaps females healed faster as a general rule.

They also speculated that perhaps the laser had a damaging effect related to energy density, wavelength, dosing intervals etc. However, the dosages used (especially with distance from target tissue factored in) were far lower than papers that show a favourable effect. Further, they questioned whether the dosage was high enough as well. The authors discussed newer invitro papers that suggest high energy densities (around 4 – 5 J/cm^2) as compared to the lower end traditional citings of 1-2J/cm^2 are favourable and that inhibition may occur at higher yet densities (>16J/cm^2).

CONCLUDING THOUGHTS FROM LAURIE:
Sorry that I couldn't contain myself in reading this paper, to simply leave my thoughts to the end! Summary of my thoughts: 1) Use higher doses of laser for wound healing (i.e. aim for 4 -5 J/cm^2). 2) Hold the laser aperture closer to the wound. Use clear plastic food wrap to cover the wound or the aperture to avoid contamination. 3) Do not extrapolate this research paper to all lasers and it's use in all wounds. 4) Buy a stronger laser!

Perego, R., Proverbio, D., Zuccaro, A., Spada, E., *Low-level laser therapy: Case control study in dogs with sterile pyogranulomatous pododermatitis*, Veterinary World, 9(8), pp 882-887 (2016).

Objective
To evaluate the effects of LLLT on dogs with idiopathic sterile pyogranulomatous pododermatitis.

Method
Five dogs were selected with the following criteria:
Pedal lesions must have been present for at least 4 months, with the absence of lesions elsewhere on the body. Dogs must also have had a positive diagnosis of sterile polygranulomatous by a veterinarian.

Each dog had lesions divided into two groups, the control lesions did not receive LLLT, the test lesions did receive the LLLT. All lesions were scored 0-4. Test lesions were treated daily for 5 days, and all lesions were scored again at 4 days, 16 days, and two months.

Laser: This study used a GaAlAs diode laser, 808nm (infrared) wavelength, 250mW (B-808-CURE LLLT by Good-Energies). [Unfortunately, the study did not say how long they applied the laser for or to how many points… info given was: The energy density is 0.9 J/min/cm2, whereas the peak energy of 14.4 J/min is for the entire treated surface.]

Conclusion
At day 4 and day 20 the laser group showed significantly more improvement in score than the control group. In two dogs the treated lesions completely went away with the two-month follow-up period and did not recur, while untreated lesions remained the same.

WHY YOU SHOULD CARE
Well, here's another application for that laser you purchased! Laser those nasty inflamed dog feet!! I wish I could have sorted out better, how long they lasered for, which would make this study a bit more transferrable and useable, but I'd feel safe lasering at typical doses for skin and superficial tissues.

Laser for Post-Op Hemilaminectomy

Draper, W.E., Schubert, T.A., Clemmons, R.M., Miles, S.A., *Low-level laser therapy reduces time to ambulation in dogs after hemilaminectomy: a preliminary study.* Journal of Small Animal Practice, vol. 53, pp. 465-469 (2012)

Objective

To determine whether LLLT reduces the mean time to ambulation in non-ambulatory dogs that were treated for thoracolumbar disc herniation with hemilaminectomy surgery.

Method
A sample of 35 individual dogs that met the above criteria with a preliminary modified Frankel score (MFS) of 0-3 were selected and divided into two groups post surgery. The control group received no laser therapy, the test group received LLLT for 1 minute per day for the first five days after surgery. Dogs were considered ambulatory when they achieved a MFS of 4 (rise independently and walk three paces). When the study concluded 34 of 35 participants had achieved the minimum MFS score. The one dog in the study that did not achieve an MFS of 4 was in the control group and did not receive LLLT, this dog was removed from the statistical analysis of results.

Laser: LLLT was performed using a laser array with a five-diode 200mW, 810nm wavelength lasers [Thor Photomedicine Ltd Laser). Laser was applied transcutaneously over the spinal segment associated with the hemilaminectomy and the two adjacent ones (one cranial and one caudal). The laser array was applied to each area for 1 minute,

Results
The median time to achieve an MFS of 4 in the control group was 14 days. In the LLLT group this time was reduced to 3.5 days.

WHY YOU SHOULD CARE…
You should care because according to this study, lasering could make a dog walk earlier following a neurologic insult and hemilaminectomy! I think we would like be able to extrapolate to non-surgical disc lesions as well.

Bennaim MB, Porato M, Jarleton A, et al. Preliminary evaluation of the effects of photobiomodulation therapy and physical rehabilitation on early postoperative recovery of dogs undergoing hemilaminectomy for treatment of thoracolumbar intervertebral disk disease. Am J Vet Res 2017; 78(2): 195-206.

Introduction
These researchers wanted to evaluate laser and rehabilitation on early recovery following hemilaminectomy for the treatment of IVDD.
(They cite research in the introduction about laser and rehab's effectiveness for post-op TPLO's and of laser for nerve or spinal cord injuries in rats. They mention two studies of its use for spinal cord injuries – one effective and one not – but the laser parameters are night and day between the two studies quoted. One thing that struck me as odd was their hypothesis that dogs undergoing physical rehabilitation would require a longer post-op duration for the administration of IV opioid analgesics. They stated that rehab was likely

to cause pain. I ask, what kind of rehab would they be doing so early that would be likely to cause pain????)

Materials & Methods
32 Non-ambulatory client owned dogs were used in the study, conducted at a university veterinary hospital. Dog were randomly assigned to one of three groups: 1) Laser group, 2) Rehab group, or 3) Sham laser group.

All dogs were hospitalized for 10 days or until they could walk more than 3 steps without assistance. All dogs received nursing care and postop analgesia (primarily methadone and carprofen).

The laser group received daily laser for 5 days using an 810nm laser, with 5 x 200mW power, 2.5 Hz pulsed mode. They applied it to 3 points (one directly over the hemilaminectomy site, and one each cranial and caudal over the adjacent spinal segments) and held it in place for 1 minute per location. (MY calculations for this would say that they are delivering 6J/cm^2 or rather 6 J per diode.) The paper states they are delivering: peak power, 227 mW; duty cycle, 88%; beam area, 0.0364 cm2; irradiance, 5.5 W/cm2; energy, 12 J; fluence, 329.7 J/cm2.

Rehab (for the rehab group) was divided into 3-phases:
Phase A: Cold pack; ROM; Toe pinches
Phase B: (when the animal was able to support some weight in standing, but had no voluntary pelvic limb movement) Continuation of exercises in phase A; Assisted standing as an exercise; Hydrotherapy; Electrical muscle stimulation to the quads & hams
Phase C: (when voluntary pelvic limb movements were first observed) ROM; Hydrotherapy, Electrical muscle stimulation (a/a); Assisted standing & weight shifting (using perturbations or an unstable surface); Walking

Results
There was no significant difference amongst groups for the time to reach each recovery gradation.
Four grades used for recovery assessment were defined as follows: paraplegic and unable to support any weight (grade A), able to support weight with some help (grade B), initial voluntary pelvic limb movements present (movement of > 1 joint; grade C), and ambulatory (able to rise and walk ≥ 3 steps without assistance; grade D).

Nine of 11 dogs in the photobiomodulation group, 5 of 11 dogs in the physical rehabilitation
group, and 6 of 10 dogs in the sham treatment–only group had recovered ambulation by postoperative day 10; these proportions were not significantly (P = 0.21) different.

At last follow-up, 11 of 11 dogs in the photobiomodulation group, 9 of 11 dogs in the physical rehabilitation group, and 10 of 10 dogs in the sham treatment–only group had recovered ambulation (*P* = 0.31). (One dog was lost to follow-up)

REASONS TO GO HMMM…

I have to admit that I'm a bit disappointed with their results. I would have used a higher dose of laser, as attenuation of the laser energy through the tissues would likely mean that next to nothing was actually reaching the spinal cord. As for the rehabilitation, I would have used laser with the rehab, I would NOT have used ice, I'd have used TENS adjacent to the spine and not used e-stim on the limbs at all. Unfortunately, setting a protocol to neuro rehab is tricky. In clinical practice, you capitalize on the function you have, and may work more in one area than another on any given day. Additionally, capitalizing on reflexes, volitional disturbances, manual cueing, etc are typically part of neurological therapy. More than any other target patient group, neuro rehab is the most dynamic and least likely to follow a set protocol. Beyond these thoughts, I don't know what to say!

"The results of your physical exam are fine, except for your reflexes: They're more 'dog-like' than 'cat-like'."

Pre-Op TPLO

Rogatko CP, Baltzer WI, Tennant R. Preoperative low level laser therapy in dogs undergoing tibial plateau levelling osteotomy: A blinded, prospective, randomized clinical trial. Vet Comp Orthop Traumatol 2017; 30: 46-53.

The question:
Can pre-operative low-level laser therapy (LLLT) affect therapeutic outcomes of dogs undergoing a tibial plateau levelling osteotomy?

Why?
Human studies have shown that preconditioning with LLLT prior to surgery has resulted in decreased inflammation, increased analgesia, vascularization and tissue healing. Increased cell survival rates and decreased apoptosis have also been demonstrated.

Methods:
27 healthy client-owned dogs were randomly assigned to the LLLT or sham treatment group. The LLLT group has 12 subjects and the sham group had 15. The surgeon and owner were blinded to the treatment assignment.

Laser was delivered pre-operatively (to the LLLT group) while the dogs were anaesthetized prior to the TPLO procedure.

Laser:
Gallium-aluminium-arsenide, 800 nm & 970 nm dual wavelength, totaling 6 W, for a unified dose of 3.5 J/cm2 administered over a 100 cm2 area on the proximal tibia. (K-series 1200: K-Laser)

Lasering Protocol:
3 Watts at continuous wave for 30 seconds
4 Watts at 2Hz for 45 seconds
4 Watts at 5Hz for 30 seconds
3 Watts at 500 Hz for 30 seconds

(Based on this protocol, I disagree with their math… I think they delivered 2.9J/cm^2 at the surface only - LEH)

Dogs were evaluated by force plate analysis for PVF and VI, which were tested preoperatively, 24-hours post-operatively, 2-weeks post-op, and 8-weeks post-op. Manual evaluations were also conducted, and a radiograph was taken and assessed at the 8-week post-op mark.

Post-Op Care:
I didn't see where rehabilitation was conducted or advised post-op. Mention was made of the administering of cryotherapy every 4-hours for 24 hours.

Outcome Assessments
Radiographs, Lameness evaluation, behaviour and response to manipulation assessment, and force plate gait analysis was conducted.

Results:
Gait analysis revealed that PVF and V were not significantly different between the two groups at 24-hours and 2-weeks post op, however at 8-weeks post op the PVF was significantly different between the LLT and sham groups, but there was no difference in VI.

Bone Healing was not significantly different (statistically) however 5/8 in the LLLT group and only 3/12 in the sham group showed radiographic signs of osteotomy healing.

Lameness scores were not significantly different between the two groups at any point in time pre-op or post-op.

WHY DO YOU CARE?

Peak Vertical Force = The greatest / highest force exerted by the ground on a body in contact with it.
Vertical Impulse = Impulse describes the force applied over a period of time. (In other words: the product of force, multiplied by the time that a force acts.)

It is surprising that a single dose of laser pre-op had ANY effect what-so-ever, but since it did, I think this paper justifies that use. I would speculate that additional pre-operative doses could have had an even bigger effect, and based on what we know about laser and its impact on healing, additional post-operative doses may have had an even greater effect.
I'd say, go ahead and laser, laser, laser!

Stem Cell Activity

Kim H, Choi K, Kweo O-K, Kim WH. Enhanced wound healing effect of canine adipose-derived mesenchymal stem cells with low-level laser therapy in athymic mice. J Dermatol Sci 2012; 68: 149-156.

Introduction:
Mesenchymal stem cells (MSC) are an attractive cell therapy source for the regeneration of damaged tissues. They self-renew and can differentiate into various cells and tissues. MSCs can significantly accelerate wound repair, however several studies point out that the effects of stem cell therapy are not dramatic in the absence of a scaffold or stimulators.

Laser therapy (LLLT) is pretty groovy and does a multitude of things that also help with healing *(my words, not a quote from the paper - LEH),* and can improve the function of MSC.

So, what might happen if one uses LLLT on transplanted stem cells in an animal model? (i.e. put canine adipose-derived MSCs into a wound of a mouse, then laser!)

Note: Athymic mice are laboratory mice lacking a thymus gland and therefore have no T-cell function and do not reject tumour or transplanted cells from other mice, humans, or other species. I had to look that up!

Method:
The canine MSCs were collected and supplied and things done to them that I guess are typically done to stem cells, resulting in a final concentration of 0.2 mg/ml.

36 female (6-week old) mice underwent surgery to create two 6mm circular full thickness skin wounds on their backs. Wounds were randomly classified into four groups: control, LLLT, MSC, MSC + LLLT.
In the MSC and MSC + LLLT groups, 1 x 106 MSC in 20 μL of phosphate buffered saline were transplanted intradermally at four injection sides on the border between the wound and the normal skin.

Laser:
A 632.8 nm, 17 mW output, HeNe laser was applied 20 seconds daily from day 0 to 20, at a distance of 1cm away from the wound bed, delivering 0.34J/defect, and approximately 1.2J/cm2 (in total to the entire wound over the period of the study).
(I can't make that last calculation add up…LEH)

Results:
The MSCs and MSCs + LLLT showed accelerated wound closure at days 3, 7, 10 and 14 after surgery, and at day 10, the MSCs + LLLT group had a significantly smaller wound area than the MSCs group.

No significant differences were seen at any time between the LLLT group and the control group.

Based on the testing measures used, (using tests that I don't understand and therefore cannot relay – LEH), the authors further determined that LLLT enhanced the survival time of the MSCs by the inhibition of apotosis and stimulating the secretion of growth factors in the wound bed.

Discussion:
This study demonstrated that MSCs accelerated wound closure with increase re-epithelialization, granulation, neovascularization, and regeneration of skin appendages. The addition of LLLT further demonstrated a longer 'life' to the MSCs as compared to other studies that show a significant decline within the initial 2weeks post transplantation.

WHAT TO THINK…
So, I still think that this paper used too low of a laser dose for the LLLT-alone group to have had benefits. However, it does demonstrate that even that little bit of laser can be beneficial to stem cell functioning. It does not tell us what an optimal laser dosage would be, just that even this little bit of laser helped. (Yup, further research is needed.) What it tells me is that I should be safe to laser joints & tissues that have been injected with stem cells. At what dose? That part is unclear! But I could find a paper (Rochind et al 2002) that used laser and stem cells with a positive effect for spinal cord injury, which delivered a daily total of 450 Joules for 14 days. As such, I feel that we have very wide margins of error with using laser and stem cells!

Musculoskeletal Pain

Cotler HB, Chow RT, Hamblin MR, Carroll J. The use of low level laser therapy (LLLT) for musculoskeletal pain. MOJ Orthop Rheumatol 2015; 2(5): 1 – 16.

I am going to simply cut and paste the most relevant pieces of this review paper.

There are four clinical targets for LLLT:

a) The site of injury to promote healing, remodeling and reduce inflammation.
b) Lymph nodes to reduce edema and inflammation.
c) Nerves to induce analgesia.
d) Trigger points to reduce tenderness and relax contracted muscle fibers.

Treatment times per point are in the range of 30 seconds to 1 minute. As little as one point may be treated in simple cases, but as many as 10 to 15 points may be treated for more complex dysfunction such as cervical or lumbar radiculopathy.

The potential hazards are mostly ocular, as some LLLT devices are lasers, though increasingly LLLT devices have become LEDs. In most cases, LLLT devices emit divergent beams (not focused or collimated), so the ocular risk diminishes over distance. Manufacturers are obliged to provide the nominal ocular hazard distance (NOHD) within their user instructions.

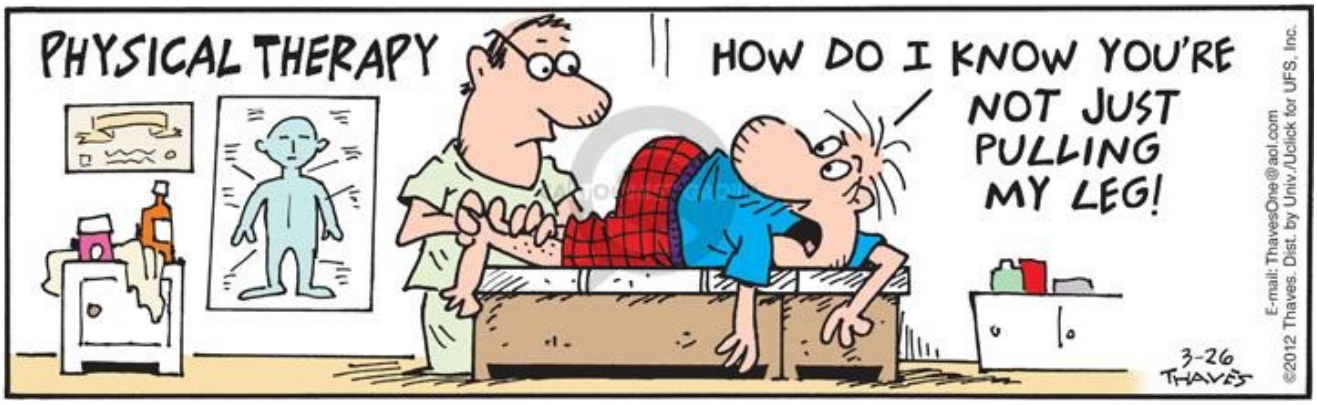
The North American Association for Laser Therapy conference in 2010 held a consensus meeting on safety and contraindications. Their main recommendations were:

I. Eyes - Do not aim laser beams into the eyes and everyone present should wear appropriate safety spectacles.
II. Cancer - Do not treat over the site of any known primary carcinoma or secondary metastasis unless the patient is undergoing chemotherapy when LLLT can be used to reduce side effects such as mucositis. LLLT however can be considered in terminally- ill cancer patients for palliative relief.
III. Pregnancy- Do not treat directly over the developing fetus.
IV. Epileptics - Be aware that low frequency pulsed visible light (<30Hz) might trigger a seizure in photosensitive, epileptic patients.

The adverse effects of LLLT have been reported to be no different from those reported by patients exposed to placebo devices in trials.

THOUGHTS:

I like that the different target tissues are described here. So, not only would you laser the suspected injury, but you could laser so much more (nerve, lymph nodes, etc). I still don't wear goggles with my class 3B lasers. Given that there is such a significant loss of power as a light beam travels a distance AND I'm not looking directly at the light, I feel there is little risk (and I know laser gurus who agree with me). I believe the statement to mandate goggle use is a "cover your behind" statement, and I find them cumbersome and annoying! Likewise, for pregnancy (it's a cover your butt statement). That being said, I don't laser over the back or abdomen of a pregnant dog (just in case). And seizures, the statement says 'be aware'… I suppose if you know the dog to be photosensitive, then that might be the deciding factor for sure! And as for cancer patients, I will laser them palliatively, and especially along nerves and nerve roots to help with pain.



Please feel free to leave this newsletter sitting out in your lunch room, or distribute it within your clinic or to your referring veterinarians. And if you have any ideas for a future Newsletter topic, just send me an e-mail!

Cheers! Laurie

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