FOUR LEG

NEWS

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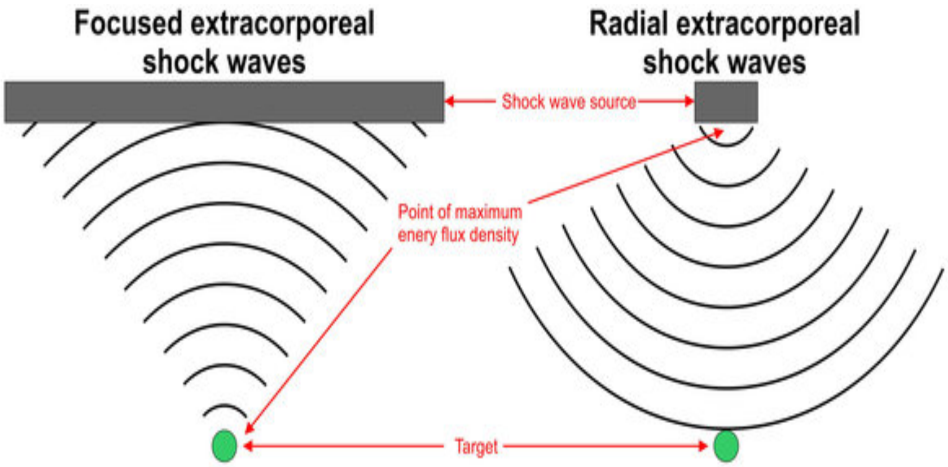
Article Accumulation!

Over any given period of time, I usually accumulate a bunch of articles. Sometimes they spark me to do an entire newsletter dedicated to one topic. Other times, (like now), I simply have an abundance of 'one-of' articles or 'two-of' articles. So, this newsletter is dedicated to those handful of articles that have been sitting on my desktop just waiting to get acknowledged and passed along to you!

So I hope you enjoy learning more about shockwave. I love these two articles! The swimming article is really great, and I think can be extrapolated to exercise in general! Then the laser articles are fairly nifty too. Use it with stem cells, and get a better understanding about superpulsed vs continuous wave laser!

Enough of my rambling… time to dive on in!

Cheers! Laurie



SHOCK WAVE

REVIEW STUDY

Efficacy and safety of extracorporeal shock wave therapy for orthopedic conditions: a systematic review on studies listed in the PEDro database

Schmitz C, Nikolaus C, Császár BM, Milz S, Schieker M, Maffulli N, Rompe J, and Furia JP
Br Med Bull. 2015 Dec; 116(1): 115–138.

Overview:
[NOTE: More information can be found in the FourLeg Jan/Feb 2015 a & b Newsletters.] Extracorporeal shock wave therapy (ESWT) is derived from extracorporeal shock wave lithotripsy (ESWL) and has been successfully used to manage a vast list of musculoskeletal pathologies. Concepts such as radial ESWT, focused ESWT, low-energy ESWT and high-energy ESWT have clinical, practical and economic implications and therefore need explanation by reviewers. The authors sought to clarify some common misconceptions regarding ESWT and compare ESWT with other forms of non-operative treatment.

Methods: This was a systematic review designed to 1) compare ESWT with other non-operative treatments for pathologies of the musculoskeletal system, 2) compare radial ESWT with focused ESWT, and 3) compare high-energy ESWT with low-energy ESWT.

The database was searched for these key terms: shock wave, shock waves, shockwave, shockwaves, lithotrypsy lithotrypter, plantar, Achilles, epicondylitis, subacromial, noncalcific and calcifying.

Studies were divided into: radial ESWT with positive (better statistics than placebo or alternative modalities) outcome, radial ESWT with negative (statistics not significantly better than placebo or alternative modalities) outcome, and focused ESWT with positive outcome and negative outcome. Also, studies with electrohydraulic, electromagnetic or piezoelectric shock wave generators were included separately for the FESWT+ and FESWT- groups.

Results: The highest number of treatment sessions in RCTs was with rESWT+ and lowest number of treatment sessions in RCTs were on fESWT+. The difference in the mean number of treatment sessions between these two groups was statistically significant.

On average, the longest intervals between treatment sessions were reported for Group fESWT− and the shortest intervals for Group rESWT−. However, there were no statistically significant differences between the groups.

The average number of impulses per treatment session among all RCTs on ESWT varied only slightly among the groups rESWT+, rESWT−, fESWT+ and fESWT−, with no statistically significant differences between the groups.

Among all RCTs on ESWT in PEDro, the total energy flux density (EFD) applied (calculated as the product of the number of treatment sessions, the number of impulses per treatment session and the EFD of the impulses) had the highest mean value in Group fESWT+ and the lowest mean value in Group rESWT+ with no statistically significant difference between the groups.

In 17 RCTs on fESWT+ an electrohydraulic (EH) device was used, in 42 RCTs an electromagnetic (EM) device and in 6 RCTs a piezoelectric (PE) device (in 1 RCT both EH and EM device were used). For the RCTs on fESWT-, the corresponding numbers were 1 (EH), 13 (EM) and 2 (PE) (1 study with both EH and EM devices).

Discussion: The efficacy of ESWT is clearly supported by this review's results. More than 80% of all RCTS on rESWT and fESWT had postive outcome (significantly better statistics than placebo or alternative modalities).

The safety of ESWT was also clearly supported. There were no reports of serious adverse events in any of the studies included in this analysis.

For certain orthopedic conditions, RCTs on ESWT were predominately listed in the database and had the highest scores among all treatment modalities. This was also true for plantar fasciopathy, noncalcific supraspinatus tendinopathy and calcifying tendonitis of the shoulder. For other indications (greater trochanteric pain syndrome, patellar tendinopathy, knee osteoarthritis, long bone fracture, osteonecrosis of the femoral head, proximal hamstring tendinopathy, primary long bicipital tenosynovitis, myofascial pain syndrome, myogelosis of the masseter muscle and spasticity), there are not enough RCTs on rESWT and fESWT in the database to draw meaningful conclusions regarding the significance of ESWT for the corresponding conditions.

Two studies demonstrated that application of local anesthesia in the area of treatment adversely affects outcome of ESWT. The molecular mechanisms underlying this phenomenon are not yet fully understood, but substantial evidence points to a central role of the peripheral nervous system in mediating molecular and cellular effects of shock waves applied to the musculoskeletal system. These effects could be blocked by local anesthesia. Thus, it is now generally recommended to apply shock waves without local anesthesia to the musculoskeletal system.

Application of insufficient energy adversely affects outcome of ESWT. The EFT applied in a postive RCT was more than two times the EFT applied in a negative RCT in the studies on rESWT and fESWT for calcifying tendonitis of the shoulder and plantar fasciopathy.

"An animal's eyes have the power to speak a great language."

— Martin Buber

There is no scientific evidence in favor of either rESWT or fESWT with respect to treatment outcome.

There are very few studies comparing the two techniques. In one such study, better results were reported with fESWT than with rESWT for treating patients with plantar fasciopathy. However, other authors found no difference in effectiveness between rESWT and fESWT for patients with patellar tendinopathy.

It is not correct to characterize rESWT as low-energy shock wave treatment and fESWT as high-energy shock wave treatment, as different authors have used different thresholds for this distinction. Because there is no consensus in the literature about the difference between low- and high-energy ESWT, this distinction appears arbitrary and should be abandoned.

There is no scientific evidence that a certain fESWT technology is superior to other technologies. Focused shock waves can be produced by electrohydraulic, electromagnetic and piezoelectric shock wave generators. The RCTs on fESWT in this database do not indicate an advantage of a certain fESWT technology over other technologies.

An optimum treatment protocol for ESWT appears to be three treatment sessions at 1week intervals, with 2000 impulses per session and the highest EFD that can be tolerated by the individual patient without local anesthesia. This recommendation is based on the quantitative analysis that reflects the average number of treatment sessions and the average interval between treatment sessions among all RCTs on ESWT in this database. There is not a single RCT on ESWT in PEDro, contradicting this ‘more is better’ recommendation.

There are three main limitations inherent to the present systematic review on ESWT. First, only RCTs on ESWT in PEDro were investigated. Second, no meta-analysis was performed due to the substantial differences among RCTs on ESWT in PEDro with regard to clinical condition, study design, ESWT technology and device, treatment protocol and follow-up period.

Conclusion: ESWT has been proven as effective and safe noninvasive treatment option for tendon and other pathologies of the musculoskeletal system in a multitude of high quality RCTs. ESWT should be considered by medical doctors, therapists, patients and payers when discussing treatment options for certain musculoskeletal pathologies. Future RCTs on ESWT should primarily address systematic tests of the optimum treatment protocol identified in this systematic review (three treatment sessions at 1week intervals, with 2000 impulses per session and the highest EFD that can be applied) and direct comparisons between radial and focused ESWT.

"Compassion for animals is intimately associated with goodness of character, and it may be confidently asserted that he who is cruel to animals cannot be a good man." — Arthur Schopenhauer

RADIAL SHOCKWAVE for HIP OA

Radial shock wave therapy in dogs with hip osteoarthritis

Souza ANA, Ferreira MP, Hagen SCF, Patricio GCF, Matera, JM.
Vet Comp Orthop Traumatol 2016, 29 (2): 108 -114.

Overview: Shock wave therapy has beneficial chondroprotective effects such as decreased metalloproteinase and increased type II collagen synthesis, anabolism, and increased blood flow to the subchondral bone. Pain alleviation through nociceptive inhibition or selective denervation of unmyelinated fibres has also been reported. Based on these beneficial effects, improvement of clinical signs following shock wave therapy has been suggested in objective, quantitative, kinetic, as well as clinical studies.

The aims of this study were to evaluate the effects of radial shock wave therapy (RSWT) in dogs with hip osteoarthritis (OA) using clinical assessment and kinetic analysis. This study was based on the premise that the RSWT protocol selected for treatment of hip joint osteoarthritis would improve locomotion and reduce signs of pain in dogs.

Methods: Thirty dogs diagnosed with bilateral hip OA and 30 healthy dogs were used. In OA dogs, one limb was randomly selected for treatment with RSWT while the contra - lateral limb served as an untreated control. Dogs were evaluated while walking on a pressure walkway. Peak vertical force (PVF) and vertical impulse (VI) were documented; symmetry index (SI) was also calculated. Blinded clinical evaluation was performed using a visual analogue scale (VAS). Pain and crepitus were assessed during hip joint flexion/extension and limb abduction and adduction. Lameness evaluation was performed during kinetic gait analysis, with the examiner blinded to the computer monitor. The blinded examiner in this study was blind to patient data regarding treated limb or follow-up phase. Data on previous treatments were obtained from the clinical history of each patient. Comprehensive clinical examination was conducted to assure satisfaction of the selected inclusion and exclusion criteria. Owner perception data regarding levels of physical activity were also collected.

The RSWT protocol (2000 pulses, 10 Hz, 2-3.4 bars) consisted of three weekly treatment sessions (days 1, 8 and 16). A radial 15 mm pneumatic generator was used. Pain, haematoma formation and petechial haemorrhage can result from superficial tissue damage following radial shock wave application; therefore the treated area was inspected and palpated by the operator upon conclusion of the procedure and anaesthetic recovery. Follow-up data were collected 30, 60 and 90 days after the first session. Data were compared between time points, groups and limbs pairs.

Results: At the end of the experimental period, mean PVF and VI values had increased (25.9 to 27.6%BW and 2.1 to 12.7%BW × s respectively) in treated limbs, with no significant differences in control limbs; SI values suggest improvement. Mean PVF and VI remained lower in the treated compared to the healthy group following treatment. The VAS scores suggested improvement in pain and lameness in treated dogs. Owner perception data suggested improved levels of physical activity following treatment.

Discussion: In this trial, RSWT was employed to reproduce the clinical benefits reported in other studies in animals. However, a higher level of energy (up to 3.4 bars) was used. This trial was aimed at testing the value of a RSWT protocol using higher energy doses than those previously tested in dogs, albeit below energy levels (0.6 mJ/mm2) known to cause tendon tissue damage in laboratory animals. Small sample size limited the number of groups in our study; therefore comparison of different protocols was not feasible. Placebo effect is known to impact PVF in dogs with osteoarthritis and may mimic well-documented beneficial effects of drugs such as carprofen and tramadol. Although shock waves indirectly benefit tissue repair, high energy levels may cause cellular damage. However, no signs of discomfort or deterioration of the condition were noted following treatment using intermediate energy levels (0.18 to 0.3 mJ/mm2).

Petechial haemorrhage may also occur following shock wave therapy and it was observed in some dogs in this trial. Despite potential benefits, patients suffering from coagulation disorders should not be treated with shock waves. Energy intensity is known to decrease in proportion to the square of the distance from the source in radial shock wave therapy; therefore, effective doses may lead to increased incidence of minor adverse effects. Besides tissue repair, RSWT is employed for pain control. In this study, the degree of pain decreased in most patients. Radial shock wave therapy does not restore articular congruence; hence, the biomechanics of the hip joint remains abnormal in dogs with hip osteoarthritis following application of RSWT. However, well-established analgesic and reparative effects support the use of shock waves as a supplementary treatment for dysplastic dogs.

Anatomical limitations preclude precise location of the site of pain in dogs with hip osteoarthritis, given only general hip joint pain can be detected by palpation. Hence, RSWT was applied using circular movements in an effort to encompass all structures in the affected joints.

"Such short little lives our pets have to spend with us, and they spend most of it waiting for us to come home each day." — John Grogan

Conclusion: Outcomes of this study suggested beneficial effects of RSWT in dogs with hip osteoarthritis.

Effect of Swimming on Clinical Functional Parameters and Serum Biomarkers in Healthy and Osteoarthritic Dogs

Nganvongpanit K, Tanvisut S, Yano T, and Kongtawelert P.
ISRN Veterinary Science, Volume 2014, Article ID 459809, 8 pages

Introduction: Current guidelines recommend rehabilitation methods as a first-line option for management of OA. Aquatic exercise is suitable for OA patients (dogs and humans). The buoyancy, hydrostatic pressure, viscosity, resistance, and surface tension of water increase the efficacy of the exercise. These properties of water have a positive effect, resulting in increased muscle mass, strength, and endurance, as well as decreased pain during movement. Water buoyancy significantly decreases contact force and stress on weight-bearing joints, bones, and muscles, which in turn reduces pain.

Due to the lack of effective monitoring methods of joint homeostasis during swimming in OA dogs, this study aimed to determine if swimming could improve the function of OA in canine hip joints. The biomarkers selected for this study have been studied as biomarkers of disease progression in cases of osteoarthritis. The researchers hypothesized that if swimming can improve function of OA joints, then clinical signs and biomarker level should also improve.

"I plucked myself. It reduces drag in the water."

Materials and Methods: 55 dogs were randomized into three different groups: 22 in the OA plus swimming group (OA-SW); 18 in the healthy (non-OA) plus swimming group (H-SW); 15 in the healthy (non-OA) without swimming group (HNSW). Dogs with clinical signs of chronic lameness (more than 1 month), stiffness and joint pain, and radiological evidence of OA of the hip confirmed by an orthopedic veterinarian were eligible. Dogs with illness and infection, as well as grade 4 OA dogs, and those who had received previous drug or dietary treatment, were excluded. If they could not swim with sufficient frequency, they were also withdrawn from this study.

All dogs were allowed to swim in an outdoor pool for a total of 8 weeks in order to collect the data. Three cycles of 20-minute swims followed by 5-minute rests were done on each day twice a week.

Assessment of clinical signs, range of motion using a goniometer, and blood collection were performed before starting this exercise program and repeated every 2 weeks until week 8. Radiographs of the hip joints were taken prior to the study and at the end of the study period at week 8. Ventrodorsal radiographs were obtained with the dog's hip and leg in the full extension position. All 22 dogs in the OA-SW group had been diagnosed with OA of the hip joint and were classified as grade 1.95 ± 0.67 via a radiographic scoring system.

Efficacy of the treatment was assessed by means of a clinical scoring system, which assessed a specific animal's lameness, joint mobility, pain on palpation, weight-bearing, and overall score of clinical condition, by observing the dog walking and trotting. This was followed by palpation of the hip joint for joint mobility and pain evaluation.

Three mL of blood was collected from each dog's cephalic vein every 2 weeks for evaluation of the level of biomarkers for OA, in the morning before breakfast. 1 mL was used for a complete blood count (CBC), and 2 mL was kept frozen for biomarker assay. The two biomarkers (CSWF6 and HA) were also used to confirm OA by comparing OA and non-OA groups.

***Results**:* Out of 55 dogs that served as subjects in this study, clinical evaluation of the OA-SW group found that nearly all parameters (lameness, joint mobility, weight bearing, and overall score) showed significant improvement at week 8 compared to pretreatment, while pain on palpation was significantly improved at week 6.

For range of motion (ROM) evaluation, both extension and flexion of the hip joint were found to be significantly improved in the OA-SW and H-SW groups at week 8 compared to pretreatment, while the control group (H-NSW) showed no difference.

The OA group showed significantly lower HA and higher CS-WF6 levels compared to the non-OA group. The relative level of serum CS-WF6 in the OA-SW group was dramatically decreased beginning at week 4, but it was found to be significantly different compared with pre-exercise level at weeks 6 and 8. On the other hand, the relative expression of serum CS-WF6 in the other two groups (H-SW and HNSW) showed no significant change over the 8-week exercise. The relative level of serum HA in the OASW group increased beginning at week 2, and then continued to rise steadily.
Moreover, the levels of serum HA of the H-SW group were significantly higher than pre-exercise level beginning at week 2.

***Discussion**:* The study design had several

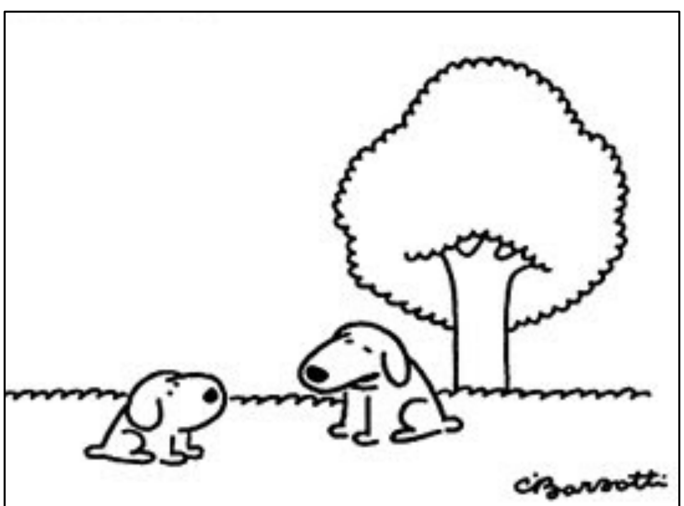
limitations. First, because this was a clinical study the types of animals and OA grade could not be controlled. We maximized the number of dogs in the OA with swimming group. Second, this study idd not include an OA with non-swimming group. This is because all dogs in this study were pets with OA hip problems. Third, since this study used an outdoor swimming pool, we were unable to do a long-term study. Fourth, the total number of animals in this study was not large. Another possible limitation of the study is that we measured only the hip and no other joints.

Although there are no existing reports on the effect of water temperature on canine physiology during swimming, our study was performed in water with a temperature between 30–35°C to avoid any effect of water temperature. Evaluation of clinical signs and range of motion of the hip joint were performed by two veterinarians via blind technique. To evaluate the motion of the hip joint, two independent veterinarians measured passive ROM every 2 weeks. Swimming was found to improve the ROM of the hip joint not only in OA dogs but also in healthy dogs as well, with a significant improvement shown at week 8.

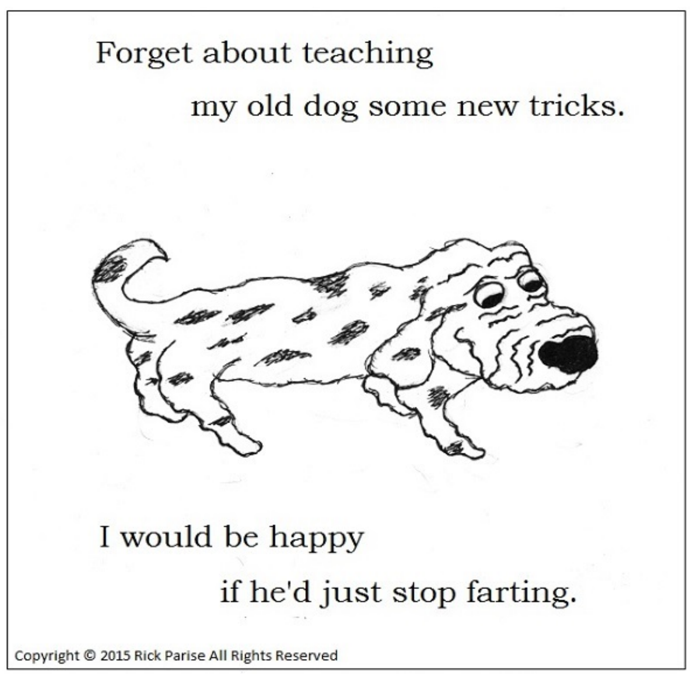
Radiographic findings between weeks 0 and 8 in the OA-SW group showed no significant change. However, radiographic images cannot provide as much information as an MRI or CT, but we did not have these facilities for animal use at our institute.

The finding of decreased levels of serum CS-WF6 after exercise reflects an alteration in the metabolism of the cartilage. In chronic OA, the level of CS-WF6 is higher than normal because the native CS chain in cartilage is degraded and released into the blood stream. The decrease of CS-WF6 in this study indicated that swimming could increase the anabolism and decrease the catabolism in OA joints. It is also possible that swimming could increase the blood supply to the joint, thus increasing the metabolism in cartilage and surrounding tissue. This is supported by the serum HA results in the present study; HA levels increased in both swimming groups, but to a greater extent in OA dogs than in normal dogs. Although HA is widely distributed throughout the body, the highest concentration is found in synovial fluid and connective tissue. Our results found that, after 8 weeks of a swimming regimen, the rate of HA synthesis was higher in OA dogs than in normal dogs. It is possible that swimming induced HA synthesis by synoviocytes and chondrocytes from increased blood supply to the joint. One disadvantage of this study was that we could not measure biomarker levels in synovial fluid during swimming, which could provide useful information for further research, for example, on the levels of other serum biomarkers or gene expression.

In conclusion, the present study demonstrates that it is possible to evaluate the effects of exercise on articular cartilage. We discovered a significant change in serum biomarker levels in the group that performed swimming compared to the non-swimming group. This result shows the beneficial effect that exercise has on patients with OA. Swimming appears to be a useful strategy for regaining movement and function in with OA joint.



"My advice is to learn all the tricks you can while you're young."



Influence of laser radiation on migration of stem cells

Gasparyan L., Brill G, and Makela A
Mechanisms for Low-Light Therapy, Proc. of SPIE Vol. 6140, 61400P, (2006).

Introduction: Low level laser therapy (LLLT) exhibits positive effects for the treatment of disorders, having in common failure of blood supply with development of acute or chronic tissue hypoxia, different level of destruction of tissues, following decreased regenerative abilities of tissues and organs, defects in immune system, and altered cell metabolism.

Recent studies discovered important role of bone marrow hematopoetic stem cell (HSCs) for naturally occurred recovery and regeneration processes, following tissue hypoxia and injury. The three clinically important steps in this natural process are mobilization of stem cells from the bone marrow, homing of these cells to the site of injury, and differentiation of the stem cell into a functional cell of the injured tissue.

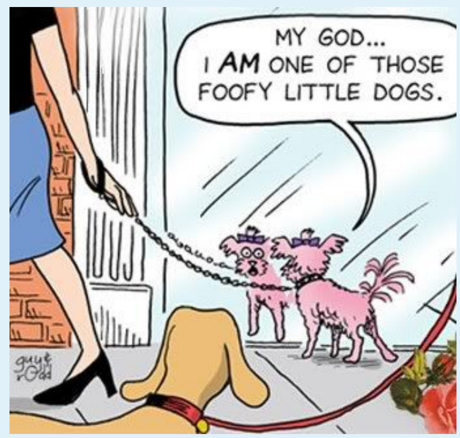
We proposed a hypothesis that wide range of positive effects following laser therapy can be connected to increased activity of stem cells in damaged tissues. To test that, we examined in vitro the influence of laser light on migration of stem cells in absence and in presence of a potent chemoattractor (SDF-1α) for lymphocytes, monocytes, HSCs, which plays a critical role in the stem cell migration towards areas of tissue injury and hypoxia.

Materials and Methods: To investigate the light influence on stem cells, we analyzed factor-dependent multipotent progenitor cells. Group 1 cells served as a control group, group 2 cells received only red light irradiation, while group 3 cells – only infrared (IR) light irradiation. Group 4 cells received no laser irradiation, but the medium contained 150 ng/ml SDF-1α. Cells in groups 5 and 6 were irradiated with red or infrared laser light accordingly, while the connected well contained 150 ng/ml SDF-1α.

Results: Stem cells can move spontaneously without SDF-1α or laser light influence. Red and IR laser light increased motility of stem cells. It is important to mention, that the directed stem cell migration towards SDF-1α concentration gradient was much higher after laser irradiation of stem cells for red laser light, and for IR laser light irradiation.

Discussion: The main scientific result of this study is the fact, that red and infrared laser light irradiation can activate motility of stem

LASER
And STEM CELLS



(Continued)

cells in vitro. Moreover, red and IR laser radiation can up-regulate the rate of stem cell migration towards higher SDF-1α gradient. This finding can be relevant for methods of therapy with transplantations of stem cells.

Conclusion: The main finding on this study is that red and IR laser light can stimulate stem cell motility in vitro, and especially increase migration towards SDF-1α gradient. Stem cell ability to migrate towards tissues with higher SDF-1 concentration is one of the key mechanisms of stem cell homing. These results are giving ground to speculate that activation of stem cell migration can be one of the mechanisms of low-level laser therapy. Taking into consideration that the combined of SDF-1 and laser irradiation had the strongest effect on stem cell homing, it would be reasonable to assume that this combination could be used in not only increasing the activity of stem cells but also in determining the main area of stem cell mobilization and homing.

More studies are required to test if the laser light irradiation in vivo is able to make homing of transplanted stem cells to the area of damage more efficient, to check the influence of laser light on the mobilization rate of stem cells from bone marrow, to investigate if laser light can enhance functional abilities of stem cells.

Skin Penetration Time-Profiles for Continuous 810 and Superpulsed 904 nm Lasers in a Rat Model

Joensen J, Øvsthus K, Reed RK, Hummelsund S, Iversen VV, lvaro Branda RA, Lopes-Martins O, and Bjordal JM.
Photomedicine and Laser Surgery, Volume 30, Number 12, 2012, Pp. 688–694.

Objective: The purpose of this study was to investigate the rat skin penetration abilities of two commercially available low-level laser therapy (LLLT) devices during 150 sec of irradiation.

Background data: The few existing LLLT studies that deal with penetration issues have focused either on energy loss or on penetration depth. In LLLT treatment, an irradiation dose is typically administered during periods lasting from 20 to 30 sec up to a few minutes. No studies have yet investigated the time-profiles for skin penetration of energy from LLLT devices.

Materials and methods: Sixty-two skin flaps overlaying rats' gastrocnemius muscles were harvested and immediately irradiated with LLLT devices. Irradiation was performed either with an 810 nm, 200mW continuous wave laser, or with a 904 nm, 60mW superpulsed laser, and the amount of penetrating light energy was measured by an optical power meter and registered at seven time points (range, 1–150 sec).

Results: With the continuous wave 810nm laser probe in skin contact, the amount of penetrating light energy was stable at 20% of the initial optical output during 150 sec irradiation. However, irradiation with the superpulsed 904 nm, 60mW laser showed a linear increase in penetrating energy from 38% to 58% during 150 sec of exposure. The skin penetration abilities were significantly different ($p < 0.01$) between the two lasers at all measured time points.

Discussion: LLLT has poor penetration ability when compared with other energy forms such as electromagnetic and ultrasound radiation. Nonetheless, it is important to emphasize that the current study demonstrates that between 20% and 58% of the energy delivered to the skin surface is penetrating the rat skin barrier during LLLT irradiation. The important conclusion is therefore that this residual energy should be more than enough to reach the dose threshold for stimulating physiological and tissue repair processes. Our current findings contribute to a plausible explanation for different effective doses from 904nm and 780–860nm lasers, found in clinical studies and reflected in WALT guidelines.

Conclusions: In clinical practice, the different skin penetration profiles for superpulsed and continuous lasers will have some clinical implications. In addition to different optimal doses as reflected in WALT guidelines, the penetration profile influences skin temperature during LLLT treatment. We found lower thermal effects in dark skin from 904nm superpulsed laser than from 810nm continuous laser in one of our earlier studies. This difference in thermal effects from these two lasers can be explained by skin penetration profile. The percentage of energy absorbed in skin during processing time is decreased for superpulsed lasers, whereas it is constant for continuous lasers. In addition, 904nm superpulsed lasers have better skin penetration initially than do 810nm continuous lasers.

Other important questions, are ‘‘What happens to the skin during LLLT irradiation?’’ and ‘‘Are results from lasers’ rat skin penetration applicable to humans?’’ Few LLLT-studies are concerned with sequelae in the skin during irradiation aiming at tissues beneath the skin. This might be because of the absence of side effects such as skin damage or ablation from LLLT treatment. To the latter issue, the photoacceptor processes from irradiation by near infrared light are believed to be the same in all mammalian cells. Most irradiation of the skin is absorbed or scattered in stratum corneum of epidermis. Further histology investigations after single and repeated LLLT irradiation of rat and human skin flaps are recommended to elucidate if the observed changes over time in 904nm penetration are irreversible or permanent.

US Presidential Dog Facts

George Washington had thirty-six dogs – all foxhounds – with one named Sweetlips

Teddy Roosevelt’s dog, Pete, ripped a French ambassador’s pants off at the White House

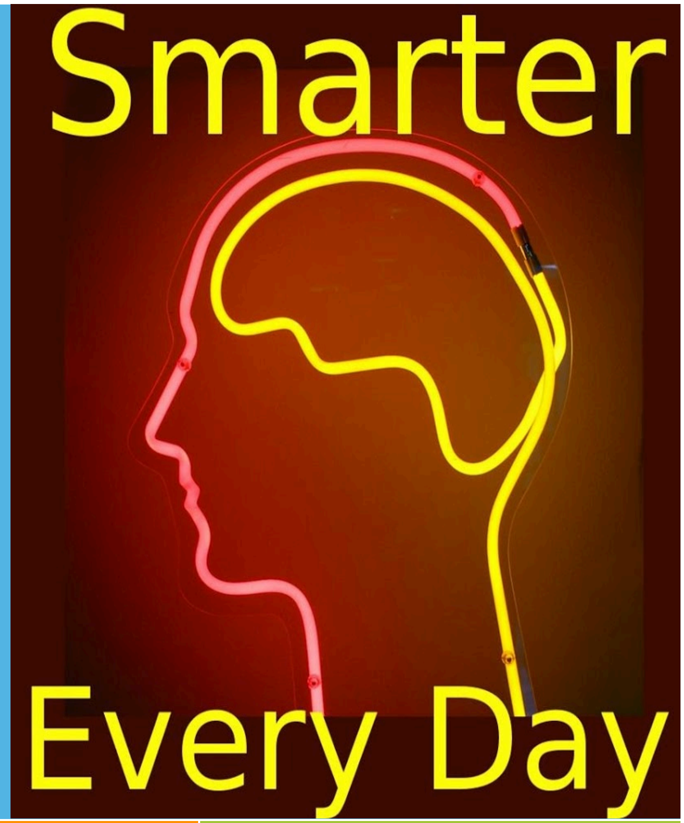
Franklin Roosevelt spent $15,000 for a destroyer to pick up his Scottie in the Aleutian Islands

President Lyndon Johnson had two beagles named Him and Her

Other Dog Facts

- 58% put pets in family and holiday portraits
- 70% of people sign their pet’s name on greeting and holiday cards
- 87% of dog owners say their dog curls up beside them or at their feet while they watch T.V.

"Petting, scratching, and cuddling a dog could be as soothing to the mind and heart as deep meditation and almost as good for the soul as prayer." — Dean Koontz



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