



FourLegRehabInc

CANINE REHAB EDUCATIONAL RESOURCES

Modalities Update – Part 1

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Introduction

- Modalities Update
 - Laser
 - Ultrasound
 - E-Stim
 - TENS
 - Microcurrent
 - PEMF

LASER Therapy

- KEY POINTS

- $1\text{J} = 1\text{Watt} \times 1\text{ Second}$
- Depth of penetration is determined by WAVELENGTH not time.
- There are still no studies validating class 4 high powered lasers.
- Higher power buys you TIME, not depth.
- Phototherapy of any type has value however.
- Pulse frequencies (Hz) are over-rated
- Period!

LASER Therapy



- LASER: Light Amplification by Stimulated Emission of Radiation
 - The use of light energy to affect underlying tissues.
 - PHYSICS
 - A photon directed at an atom causes an absorption of energy. This excites the atom molecule, causing electrons to jump from inner orbits to outer orbits. Then when the atom falls back again it gives off energy again.

LASER Therapy

- LASER

- Attributes of LASER

- Coherence (same wavelength)
 - Monochromaticity (color of light – wavelength)
 - Collimating (parallel beams / no divergence)
 - 600nm – 1000nm is the therapeutic window
 - Tissues and cells absorb different wave lengths
 - Skin = red
 - Bone = **green**
 - Cell Membrane = **infrared**
 - Attenuation (loss of power) occurs more in darker skin or areas of more superficial circulation
 - Absorption is hindered in older more dehydrated skin



LASER Therapy

- **LASER**

- Effects of LASER

- | | |
|--|---|
| <ul style="list-style-type: none">▪ Cartilage stimulation▪ Fibroblastic production▪ Endorphin release (pain reduction)▪ Increased angiogenesis▪ Decrease micro-organisms (lymphocyte production)▪ Enhances immune cells | <ul style="list-style-type: none">▪ Healing of leg ulcers▪ Accelerated inflammation phase▪ Acceleration of collagen synthesis▪ Reduce oxidative stress▪ Inhibition of transmission at the neuromuscular jct |
|--|---|

LASER Therapy

- **LASER**
 - INDICATIONS



- | | |
|---|--|
| <ul style="list-style-type: none">▪ Arthritic Conditions▪ Bursitis, Fasciitis, Capsulitis▪ Neuralgia, Nerve/SpC lesions▪ Ligament / Tendon injuries▪ Wounds▪ Contractures / Scars▪ Fracture healing | <ul style="list-style-type: none">▪ To increase circulation▪ Pain▪ Muscle Spasm & DOMS▪ Hematomas▪ Superficial skin lesions (including warts, eczema, psoriasis)▪ Use on Acupuncture points & Myofascial TrPs |
|---|--|

LASER Therapy

▣ LASER

■ CONTRAINDICATIONS

- | | |
|---|--|
| <ul style="list-style-type: none">▪ Tissues infected with tuberculosis or other virulent bacteria▪ The low back or abdomen in pregnant patients▪ Regions known or suspected of malignancy | <ul style="list-style-type: none">▪ Regions with active DVT / thrombophlebitis▪ Over eyes▪ Over reproductive organs▪ Actively bleeding tissue or patients with untreated haemorrhagic disorders |
|---|--|

LASER Therapy

▣ LASER

■ CAUTIONS

- (Clinicians may elect to treat with caution (lower intensities &/or closer monitoring))



- Recently irradiated tissues
- Patients with photosensitivity disorders
- Persons with infections and compromised immune function

- Patients with cognitive or communication impairments
- Active epiphysis
- Anterior neck & carotid sinus

LASER Therapy

▣ LASER

■ SAFE



- Tissues infected with non-virulent bacteria
- Areas of impaired circulation
- Areas of impaired sensation
- Areas overlying regenerating nerves
- Areas of damages, 'at risk' skin, skin diseases, chronic wounds

- Patients with hypertension or cardiac failure
- Areas overlying electronic devices
- Over implants composed of metal, plastic, or cement
- Inflamed tissues d/t recent injury or flare of chronic inflammatory conditions
- Over active epiphysis

LASER Therapy

- **LASER**

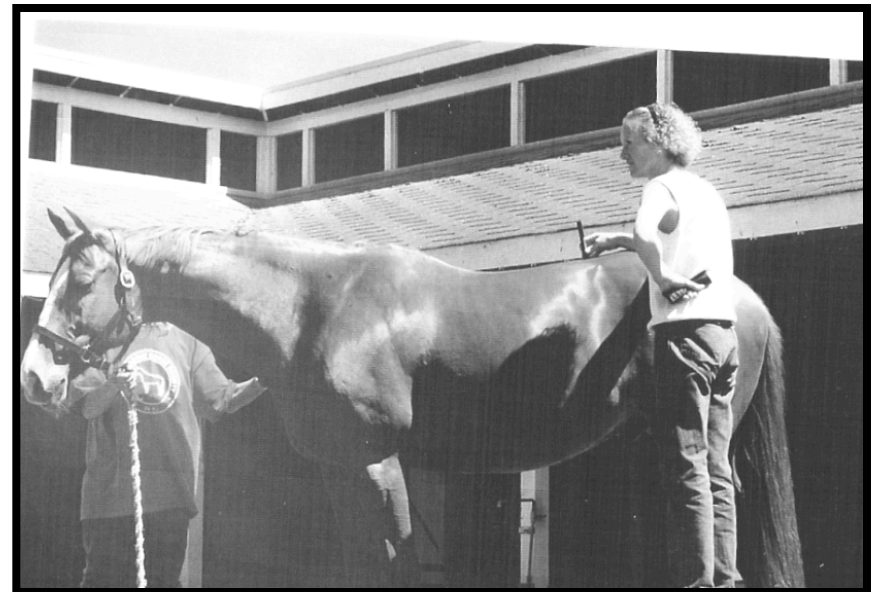
- Classification of Lasers



<p><u>Class 1 (<0.5 mW)</u></p> <ul style="list-style-type: none">▪Visible & Non-visible▪No eye or skin danger▪Some pointers, car entry and remotes▪No heating & No healing	<p><u>Class 2 (< 1mW)</u></p> <ul style="list-style-type: none">▪Visible▪Safe for short periods of time on eyes and for extended periods of time on the skin
<p><u>Class 3 (1mW – 500mW)</u> 3A <5mW and 3B >5mW lasers</p> <ul style="list-style-type: none">▪Visible & Invisible▪Hazardous to eye but not much to skin (<1 degree C.)▪Helium Neon (HeNe)▪Infra-red▪Galium Arsenide (GaAs)▪Galium Aluminum Arsenide	<p><u>Class 4 (HOT lasers)</u></p> <ul style="list-style-type: none">▪Increases tissue temp▪Dehydration of tissue and coagulation of protein▪Thermolysis▪Evaporation▪CO2 / Argon / YAG laser▪Fire Hazard

LASER Therapy

- LASER
 - PENETRATION
 - 0.5 – 1cm direct OR up to 5cm
 - 1 – 1.5 cm indirect OR up to 10cm
 - (depends on wavelength of the light)



Laser Therapy



- LASER

- ENERGY

- Measurement of power over time
 - Energy (Joules) = Watts (W) x Seconds
 - 1 Joule = 1 Watt X 1 Second
 - Lasers come in mW of power:1000mW=1W
 - To get 1J. Of energy from a 5mW laser, you would need 200 seconds of timer per point
 - To get the same effect from a 50mW laser, you would use 20 seconds of time
 - To get the same effect from a 200mW laser, you would need 5 seconds of time
 - And with a 500mW laser, it takes 2 seconds

LASER Therapy

- LASER

- DOSAGE

- For Acute Injuries: 0.05 – 2 Joules/cm²
 - For Subacute Injuries: 3 – 4 Joules/cm²
 - For Chronic Injuries: 5 – 8 Joules/cm²
 - For Bio-inhibition: 9 – 12 Joules/cm²
 - *** AT the TARGET TISSUE ***
 - Dosage time may need to be increased get the desired joules at a deeper target tissue

LASER Therapy

- What does the research validate?

SOFT TISSUES	
Encourage collagen synthesis	Stimulate metabolism of tenocytes or myocytes
Improves tensile strength (as shown in both ligament & tendon studies)	Increases fibroblastic activity
Accelerates healing processes and improves collagen bundle organization	Promotes neovascularization

DeOliveira RF et al 2008; Khan KM et al 1999; Sharma & Maffulli N 2005; Bayat M et al 2005; Salate ACB et al 2005; Demir H et al 2004; Wood VT et al 2010)

LASER Therapy

- Dosages for soft tissue healing (ligaments & tendons)
 - NEW brilliant, high quality reviews & meta-analyses!
(Tumilty et al 2010)
 - TENDINOPATHY lesions:
 - Epicondylitis: positive studies used wavelength of 904nm x3.5J/cm² and 1064nm x 150J/cm²
 - Rotator Cuff: 4.3 – 42J/cm² using 904 or 820nm lasers
 - Achilles tendinopathy: 1.8 – 3.6J/cm² x 904 or 820nm lasers
 - DeQuervains: 4J/cm² x 830nm laser.

LASER Therapy

- Dosages for soft tissue healing (ligaments & tendons)
 - NEW brilliant, high quality reviews & meta-analyses!
(Bjordal et al 2008)
 - Epicondylitis



- Wavelengths of 904 & 632nm directed at lateral elbow tendon insertions aided in pain relief, improved grip strength, increased pressure pain threshold, reduced sick days
- Dosages ranged from 0.5 and 7.2 Joules.
- Continued improvement at 3 – 8 weeks follow ups after end of Rx
- Trials that targeted acupuncture points reported negative results

LASER Therapy

- What does the research validate?

BONE HEALING	
Increased osteoblastic proliferation	Increased collagen deposition
Increased bone neoformation	Increased amount of well organized bone trabeculae
Increased bone stiffness	Creation of a smaller, stronger callus

Luger EJ et al 1998; Lirani-Galvao AP et al 2006; Gerbi MEM et al 2005; Pinheiro ALB et al 2006; Weber JBB et al 2006

LASER Therapy

- Dosages for bone healing
 - GaAlAs laser, 780 nm, 30 mW, 112.5 J/cm² – cumulative over 12 session (appx 4.5J/cm² per day over 2 spots) (Lirani-Galvao et al 2006)
 - 830nm, 40mW, CW x 16J/cm² / session, divided into 4 points around the defect (4J/cm²) – starting immed after Sx and repeated 7 times, Q48hours. (Gerbi et al 2005)
 - 830nm, 0.5cm² area x 50mW x 10J/cm² (fractioned into 4 points), Q48 hrs. (Weber et al 2006)
 - 632.8nm laser, 35 mW, for 30 mins, delivering 892J/cm² cumulative over 14 days (63J/cm² per day. Note direct penetration is only 1.5cm) (Luger et al 1998)

LASER Therapy



- NOTE about Bone Healing
 - Effect of laser therapy is more effective if the treatment is carried out at early stages when high cellular proliferation occurs
 - It is possible that the laser therapy effect on bone regeneration depends not only on the total dose of irradiation, but also on the irradiation time and the irradiation mode.

LASER Therapy

- What does the research validate?

PAIN RELIEF is due to the following:

Anti-inflammatory mechanisms similar to pharmacological agents (celecoxib, meloxicam, diclofenac, & dexamethasone)

Ability to reduce oxidative stress

Improved angiogenesis

Augmentation of collagen synthesis & skeletal repair

Inhibition of transmission at the neuromuscular junction (reduced nerve firing)

LASER Therapy



- Dosages for PAIN

- NEW brilliant, high quality reviews & meta-analyses!

- (Chow et al 2009)

- Acute and chronic NECK PAIN:

- Optimum dose per point for an *820-830nm* laser was **5.9 Joules** and
 - Using a *904nm* super-pulsed laser, it was **2.2 Joules**.
 - Number of reps and Rx / week were variable.
 - Positive effects were immediate and could be maintained for up to 3 months after treatment ended!

LASER Therapy

- Dosages for PAIN
 - Recent-‘ish’ brilliant, high quality reviews & meta-analyses! (Bjordal et al 2003)
 - Low level laser therapy significantly reduces pain and improves health status in chronic joint disorders
 - Knee doses: **2.1 – 12 Joules** (total per session)
 - Lumbar spine doses: **16 – 60 Joules** (per session)
 - TMJ doses: **0.7 – 2.1 Joules** (per session)
 - Cervical spine: **10 – 60 Joules** (per session)



LASER Therapy

- A couple of cool RCT studies regarding PAIN:
 - Chow et al 2006
 - 830nm laser, 300mW, 10J/cm²per pt (30 sec/pt as per this laser), x up to 50 points (depending upon number of tender points) x 14 session x 7 wks = PAIN RELIEF in chronic neck pain patients. Effects were immediate & lasting up to 3 months!
 - Chow et al 2007
 - 830nm laser, 300mW, 8J/cm² directly over the DRG in RATS = **reduced mitochondrial membrane potential** and **decreased the available ATP** for nerve function **THUS blocked fast axonal nerve flow**
 - Resulting in a laser-induced neural blockade & subsequent pain relief!

LASER Therapy

- What does the research validate?

JOINT ARTHROPATHIES

Enhance biosynthesis of cartilage

Stimulation of microcirculation

Reduce inflammation by reducing PGE2 & COX2 (in the synovium & synovial fluid)

Cho HJ et al 2004; Soriano F et al 2006; Lin YS et al 2005; Bjordal et al 2003; Hegedus et al 2009;

LASER Therapy

- Dosages for OA
 - Recent-‘ish’ brilliant, high quality reviews & meta-analyses! (Bjordal et al 2007)
 - For Osteoarthritic knee pain
 - 904nm super-pulsed lasers = 2 – 12 J / session (Total Joules)
 - 780 – 860nm lasers = 20 – 48 J / session (Total Joules)
 - When applied 2 – 8 points over the joint capsule

(And just in case, you’re interested, this paper found that only TENS, electro acupuncture, and LLLT with optimal doses were clinically effective for short term pain relief for OA knees.)

LASER Therapy

- ACUTE Pain relief vs TISSUE Repair
 - NEW-ish brilliant, high quality reviews & meta-analyses! (Bjordal et al 2006)
 - LLLT at high doses (7.5 J/cm²) at the target tissue in the first 72 hours (to reduce inflammation)
 - Followed by the lower doses (2 J/cm²) at target tissues in subsequent days (to promote tissue repair)



LASER Therapy

- LASER - dosage
 - Depth of Penetration
 - **Irradiation Time [secs] = ((D x A) / P) x (1 + d)**
 - » D = Desired Dose at Target Tissue [Joules/cm²]
 - » A = Area of Target Tissue [sq cm]
 - » P = Power of Incident Beam (Watts)
 - » d = Depth of Target Tissue (cm)
 - Note: the parameter 'd' is limited to a range of 0-4cm, with values 1-4 only applicable to the deeper-penetrating wavelengths (approx. 760-860nm GaAlAs and super-pulsed 904nm GaAs).
- So.....

LASER Therapy

- LASER – dosage
 - Depth of Penetration
 - So, If I treat a chronic 2 cm² tendon lesion 2 cm deep, with the goal to deliver 8 J/cm², with my 500mW laser, then I would laser for 96 seconds per point
 - (the equivalent of 48 J/cm² at the surface!!).

Laser Power Per Emitter = 500mW (2000mW Cluster Probe has 4x 500mW Emitters so Treats 4 Points)

Tissue Depth (cm)		0	0.5	1	1.5	2	2.5	3	3.5	4
Duration (Secs)		Dose (J) Per Point @ Target Depth (cm)								
1 x	4	2.0	1.3	1.0						
1 x	8	4.0	2.7	2.0	1.6	1.3	1.1	1.0		
1 x	12	6.0	4.0	3.0	2.4	2.0	1.7	1.5	1.3	1.2
1 x	16	8.0	5.3	4.0	3.2	2.7	2.3	2.0	1.8	1.6
1 x	20	10.0	6.7	5.0	4.0	3.3	2.9	2.5	2.2	2.0
1 x	24	12.0	8.0	6.0	4.8	4.0	3.4	3.0	2.7	2.4
1 x	32	16.0	10.7	8.0	6.4	5.3	4.6	4.0	3.6	3.2
1 x	40	20.0	13.3	10.0	8.0	6.7	5.7	5.0	4.4	4.0
1 x	48	24.0	16.0	12.0	9.6	8.0	6.9	6.0	5.3	4.8
1 x	64	32.0	21.3	16.0	12.8	10.7	9.1	8.0	7.1	6.4
1 x	80		26.7	20.0	16.0	13.3	11.4	10.0	8.9	8.0
1 x	96		32.0	24.0	19.2	16.0	13.7	12.0	10.7	9.6
2 x	64			32.0	25.6	21.3	18.3	16.0	14.2	12.8
2 x	80				32.0	26.7	22.9	20.0	17.8	16.0
2 x	96					32.0	27.4	24.0	21.3	19.2
3 x	80						34.3	30.0	26.7	24.0
3 x	96							36.0	32.0	28.8

- 1 Biostimulation; Tissue Repair; Wound Healing.
- 2 Sub-Acute Inflammation; Chronic Pain.
- 3 Acute Inflammation; Acute Pain.

Notes:

1. First, select the Depth of the injured tissue under the skin (Blue Numbers from 0-to-4).
2. Then, choose a Dose from within the appropriate color-coded cells.
3. Look to the left to find the applicable Duration (Red Number), and set the Control Unit accordingly.
4. The black numbers in the left-most column refer to the number of times you will treat the same point at the same timer setting, to achieve the required dose at the target depth in the tissue.

Note: Based on a 1cm² lesion
 Source: Spectravet User's Guide

LASER Therapy

- What does the research validate?

WOUNDS	
Acceleration of inflammation phase	Augmentation of collagen synthesis
Increased tensile strength	Reduced healing time
Diminution of wound size	Stimulated regeneration of injured epidermis
Accelerated the proliferative and maturation phase of the wound	

LASER Therapy

- Dosages for wounds
 - Energy densities from 19 to 24 J/cm² were more effective than energy densities at or below 8.25 J/cm² and at or above 130 J/cm².
 - Energy densities ranging from 19 to 24 J/cm² had more positive effects than other dose levels.

Woodruff LD, Bounkeo JM, Brannon WM et al. (2004) 'The efficacy of laser therapy in wound repair: A meta-analysis of the literature.' *Photomed Las Surg.* 22(3): pp 241 – 247.

LASER Therapy

- Dosages for wounds
 - Evidence from the studies reviewed suggested that use of red or infrared wavelength at a range of dosage parameters (median 4.2 Jcm₂) results in significant benefits in measured parameters of wound healing.
 - Both visible red spectrum (630–685nm), and infrared (7000 – 1000nm) wavelengths were beneficial

Peplow PV, Chung TY, Baxter GD, et al. Laser photobiomodulation of wound healing: A review of experimental studies in mouse and rat animal models. *Photomed Laser Surg* 2010; 28(3): 291 – 325.

LASER Therapy

- Laser therapy may have a protective application against delayed onset muscle soreness (DOMS) and may enhance muscular performance.

Pre-exercise use of laser increased endurance, and decreased post-exercise blood lactate, creatine kinase, and C-reactive protein	6 Joules / point, applied in 2 locations on biceps brachii 810nm x 200mW	Basso et al 2010
Pre-test laser inhibited the expected post-exercise increase in creatine kinase levels and accelerated post-exercise lactate removal	3 – 4 Joules / point applied to rectus femoris x 5 points 830nm x 100mW	Leal Jr et al 2009
Strength training associated with laser therapy can increase muscle performance compared to strength training alone	8.4 Joules / point applied to 6 points (cluster probe) 808nm x 60mW to Quads	Ferraresi et al 2010

LASER Therapy



- **Nerves** (Shamir... 2001; Rochkind... 2001; Rochkind... 2007; Rochkind... 2007)
 - Rat sciatic nerve, 780nm x 30min x 21 days, to SpC segments corresponding to nerve and to injured nerve.
 - LLLT to SpC segments corresponding to the crushed sciatic N. 16mW x 632nm He-Ne laser x 30 mins x 21 days
 - Laser: 780 nm x 250 mW x 3hrs x 21 days to the injured peripheral nerve & 2 h to the corresponding SPc segments
 - Laser: 200 mW x 780-nm x 14 days to the corresponding SpC segments (15 min) & reconstructed nerve (15 min)

Improvements observed in voluntary muscle recruitment, somato-sensory evoked responses, electrophysiologic activity, Sciatic Functional Index, & more myelinated axons,.

LASER Therapy



- Spinal Cord

- Laser: 810nm x 150mW x 1589 J/cm² daily (administering LLLT for 2997 seconds/day) x 14 days – (first 2 studies below)
- Laser: 780nm x 250mW x 30 min/day x 14 days (also used embryonal nerve cells)

Byrnes et al 2005	Significantly increased axonal number and distance regrowth. Suppressed immune cell activation and cytokine/chemokine expression. Return of some aspects of function to baseline levels.
Wu et al 2009	Outcome: The length of axonal regrowth was significantly higher in LLLT vs control The NUMBER of axons was significantly higher in LLLT group vs control LLT had significant functional recovery vs control.
Rochkind et al 2002	Outcome: 11/15 (73%) LLLT + implant showed different degrees of active leg movements and gait performance, compared to 4/9 (44%) rats with implantation alone. Control group 6/8 (86%) remained completely paralyzed.

LASER Therapy

▣ CONTRAINDICATIONS

- | | |
|---|--|
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LASER Therapy

▣ CAUTIONS

- (Clinicians may elect to treat with caution (lower intensities &/or closer monitoring))



- Recently irradiated tissues
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- Persons with infections with a compromised immune function

- Patients with cognitive or communication impairments
- Active epiphysis
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LASER Therapy

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|---|---|

Light Emitting Diodes

- LED: Light Emitting Diodes
 - Not quite LASERS
 - Monochromatic
 - Brilliant
 - Non-coherent
 - Usually cheaper
 - May allow for treatment of a broader range of tissue types and photochemical reactions
 - Various Visible and Invisible light



Ultrasound Therapy

- Ultrasound
 - Sound Waves are pressure waves
 - Reverse Piezoelectric Effect
 - Heating or Mechanical effects



Ultrasound Therapy



- Ultrasound
 - Effect of Continuous Ultrasound
 - Heating of tissues to 104 ° – 112° F / 40° – 45 ° degrees Celsius for at least 5 minutes.
 - Heating of tissues may last only 5 – 8 mins after Rx

Ultrasound Therapy

- Ultrasound
 - Effects of Pulsed Ultrasound
 - **Acoustic Streaming** (pushing of fluids along boundaries of cell membranes)
 - **Stable Cavitation** (Cells bump, give and receive energy and allow passive or active transport of substances through the cell membrane)
 - **Unstable Cavitation** (violent collapse of bubbles in sound field...blood vessel damage)

Ultrasound Therapy

- Key Points

EFFECTS	
PULSED Ultrasound	CONTINUOUS Ultrasound
Tissue Repair	HEATING of tissues to 104 ° – 112° F / 40° – 45 ° degrees Celsius for at least 5 minutes. (lasting only 5 – 8 minutes after Rx)
Bone Repair	Heating causes a MILD INFLAMMATORY RESPONSE due to increased blood flow
Reduce Swelling	Increased soft tissue extensibility
😊	MAY aid in pain relief (THEORIES) ~ pain gating ~ increased nerve function ~ increased blood flow

1MHz penetrates 2 cm – 5 cm

3MHz penetrates .5 cm – 2 cm

Ultrasound Therapy

▣ Ultrasound

■ FREQUENCY

- ▣ **1MHz (penetrates 2 – 5 cm)**
 - Longer wave length
 - Poorer absorption due to attenuation
 - Need to use higher intensity to affect the target site deeper to the surface
- ▣ **3MHz (penetrates .5 – 2 cm)**
 - Shorter wave length
 - Better absorption
 - Used at lower intensities, as sound waves do not travel as far, and are absorbed better at the superficial site.



Ultrasound Therapy

- **Ultrasound**

- **Indications for the use of Ultrasound**

- | | |
|--|--|
| <ul style="list-style-type: none">▪ Muscle spasm▪ Trigger points▪ Tendonitis▪ Soft tissue healing▪ Chronic synovitis▪ Adhesions▪ Calcification | <ul style="list-style-type: none">▪ Capsulitis▪ Bursitis▪ Contusions▪ Fracture healing▪ Joint Swelling▪ Wound healing▪ Warts |
|--|--|



Ultrasound Therapy

- Comparing US & LASER
 - LLLT significantly increases fibroblastic activity more than low intensity pulsed ultrasound (DeOliveira RF et al 2008)
 - LIPUS enhanced bone repair by promoting bone resorption in the osteotomy area, while LLLT accelerated this process through bone formation. (Lirani-Galvao et al 2006)
 - US, LLLT, US & LLLT all resulted in greater type 1 collagen synthesis. US also helped with collagen organization. (Wood et al 2010)
 - US, LLLT, US & LLLT all increase tendon healing, combining treatments does not result in cumulative benefits (Demir H et al 2004)

Ultrasound Therapy

- **Ultrasound**
 - **What does the literature say?**
 - Is a highly utilized modality in human physical therapy practice.
 - Clinically, it has been shown to be of benefit for pain relief and improved function in osteoarthritis. (Srbely 2008; Rutjes et al 2010)



Ultrasound Therapy

- **What does the literature say?**
- Dosages used in **Osteoarthritis** studies
- (Ozgonenel et al 2009)
 - 1 MHz frequency or 1 watt/cm² power continuous ultrasound for 5 min
- (Tascioglu et al 2010)
 - CW U/S x 1Mhz x 2W/cm² x 5 min/session x 5 days/week x 2 weeks
 - Pulsed US x 1MHz x 2W/cm² x 25% x 5 min/session x 5 days/week x 2 weeks

Ultrasound Therapy

- **What does the literature say?**
- Dosages used in **Osteoarthritis** studies
- Cartilage effects
 - Activation of chondrocytes to increase collagen synthesis
 - (Korstjens et al 2004 & 2008; Naito et al 2010)
 - 1.5MHz x 0.3W/cm² x Pulsed x 20 min

Ultrasound Therapy

- **What does the literature say?**

Dosages used in **Osteoarthritis** studies

- ▣ (Huang & Yang et al 2005; Huang & Lin et al 2005)
- ▣ US improves strengthening benefits when combined with exercise in OA knees
- 2.5W/cm² x 25% Pulsed x 15 min x 24 sessions in 8 weeks
- Either CW x 1.5W/cm² CW or 2.5W/cm² x Pulsed 25% x 15min x 24 reps for 8 weeks. (NOTE: Pulsed was superior)

Ultrasound Therapy

- **What does the literature say?**

- ▣ **Dosages used in Fracture Healing studies**

- ▣ (Santana-Rodriguez et al 2010; Shakouri et al 2010; Esteki et al 2010; Korstjens et al 2004; Gebauer et al 2002)
- ▣ 0.05W/cm x 3 min x 10+ days
- ▣ 1.5MHz x 0.03W/cm² x pulsed x daily x 1 month
- ▣ 1.5MHz x 0.03W/cm² x pulsed x 20 min x 5days /week for ? weeks

Ultrasound Therapy

- **What does the literature say?**

- ▣ **Dosages used on Myofascial Trigger Points**

- ▣ (Majlesi et al 2004)

- ▣ Conventional: 1.5W/cm² x CW x 5 min x 10 – 15 sessions

- ▣ High Powered: CW & gradually increasing intensity, motionless – held to pain tolerance (4 – 5 sec), then ½ intensity for 15 sec, 3reps.

- ▣ Both groups improved, high power was better for pain relief faster

Ultrasound Therapy

- **What does the literature say?**

Dosages used on **Myofascial Trigger Points**

- ▣ (Srbely et al 2007 & 2008)

1MHz x CW x 1.0W/cm² x 5 mins x area covered was twice the transducer head

- ▣ Significant improvement

1MHz x 12% x 0.52W/cm² x 10 min

- ▣ Significant differences at 1 – 3 mins post-RX but not at 10 – 15 mins.

Ultrasound Therapy

- **What does the literature say?**
 - ▣ **Dosages used on Pain**
 - ▣ (Hsieh 2005; Mardiman et al 1995)
 - ▣ 1MHz x 50% x 1.0W/cm² x 5 min
 - ▣ 1.1MHz x CW x 1.0W/cm² x 5 min

Ultrasound Therapy

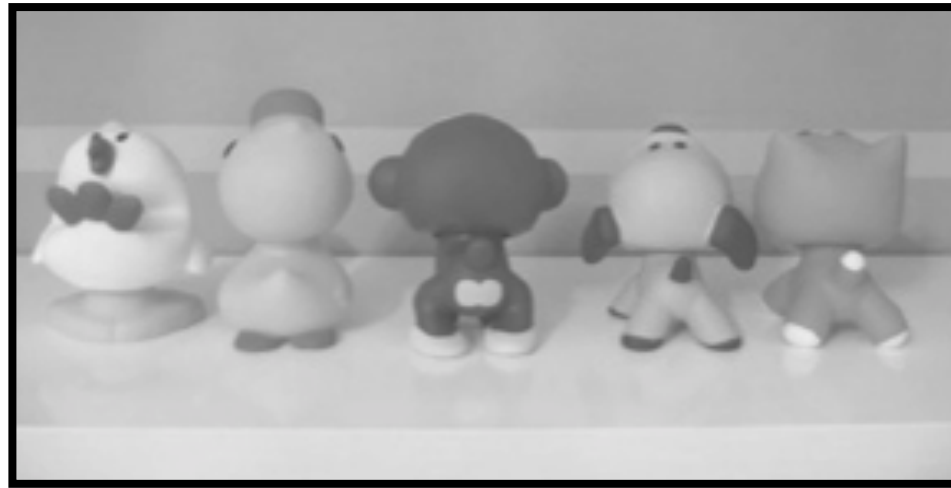
- **What does the literature say?**
 - ▣ **Dosages used on **Calcification Lesions****
 - ▣ (Rahman 2007; Ebenbichler et al 1999)
 - ▣ 1- 1.5 W/cm² x 10 mins x 12 doses
 - ▣ 0.89MHz x 2.5W/cm² x 25% x 15 min x 24 sessions

Ultrasound Therapy

- **DOSAGES**

- Ultrasound should be delivered for a minimum of 10 minutes (regardless of pulsed or continuous)

- Houghton P, Nussbaum E, Hoens A, & Rennie S. Electrophysical Agents, *Physiotherapy Canada* 62(5) Special Issue, 2010



Ultrasound Therapy

- Ultrasound

- **New Research**

- Alexander LD et al. Exposure to low amounts of ultrasound energy does not improve soft tissue shoulder pathology: a systematic review. *Phys Ther*, 90 (1), 2010: pp 14 – 25.

- Studies that show a benefit with ultrasound therapy for shoulder pathologies typically utilized 4x longer total exposure time and applied more U/S energy per session – as compared to studies that showed no benefit.

Think **TENDON** lesions when translating this literature for an animal correlation

Ultrasound Therapy



- New Research (brain twister!)

- Houghton P. Ultrasound treatments involving 0.5 W/cm², 20% duty cycle, for 5 minutes are not enough. Orthopaedic Division Review, September/October 2009, pp 35 – 36.
 - $W/cm^2 \times \text{duty cycle (pulsing \%)} = \text{spatial average temporal average (SATA)}$.
 - $SATA \times \text{ultrasound head size (cm}^2) \times \text{Treatment Time (seconds)} = \text{Total Energy Exposure (Joules)}$.
- Research papers that demonstrate efficacy in the use of ultrasound in soft tissue shoulder disorders deliver at least 2250 Joules per session and average exposure times over 4 weeks of 5 hours total.

Hmmmm!

Ultrasound Therapy

- New Research (brain twister!)
 - Houghton P. Ultrasound treatments involving 0.5 W/cm², 20% duty cycle, for 5 minutes are not enough. Orthopaedic Division Review, September/October 2009, pp 35 – 36.
 - So, if I treat a chronic biceps tendon at 1.0W/cm², 100%, x 10 minutes (600sec)... I am only delivering 600 Joules.
 - THEREFORE: I could choose to use 5cm sound head to deliver 1.0 W/cm² continuous for 7.5 minutes to reach the desired dose!
 - Or use a 1 cm sound head at 2.0 W/cm² continuous for 18.75 minutes

Ultrasound Therapy

- The Bloody Hair!!! (Steiss & Adams 1999)
 - Hair coat impedes heating at deeper levels
 - Any temperature increases were only seen with 1.5 – 2.0 W/cm² and only as deep as 5cm (not 10cm)
 - Hair will heat with continuous ultrasound and can cause superficial burns.

Do we use pulsed ultrasound?

Do we even try to treat deep tissues?

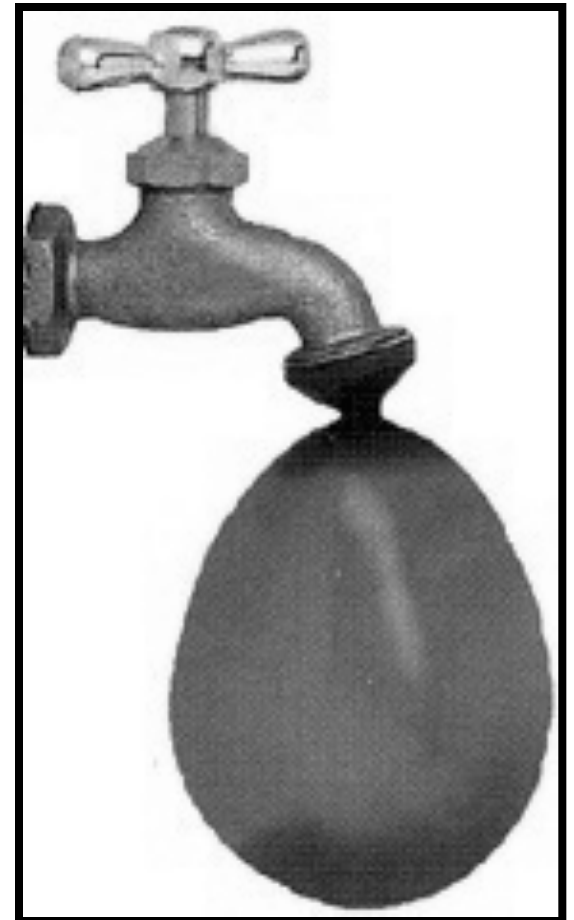
Ultrasound Therapy



- Ultrasound
 - VARIABLES
 - Rx area should be 2 – 3 times the size of the transducer head
 - Movement at 4cm² / second
 - » (prevent burns and unstable cavitation)
 - Need for sound medium (gel or water)
 - No pain
 - HAIR absorbs the sound waves and can heat
 - » (? Pulsed setting or Shaved)
 - Calibration of machines (Q 6 – 12 months)

Ultrasound Therapy

- Ultrasound
 - Technique
 - **Water soluble gels required as a medium**
 - **Immersed under water and held half a cm or less from the skin**
 - **A water filled balloon with gel on both end**



Ultrasound Therapy

- Ultrasound
 - Treatment Schedule
 - **ACUTE:** can treat daily or every second day on a PULSED setting
 - Note Daily treatment with ultrasound requires a rest period for the body (treat 7 days needs 7 days rest)
 - **SUBACUTE:** can treat daily with low intensity on a continuous setting
 - **CHRONIC:** can treat daily with mild to high intensity continuous
 - Note: Daily treatment not always advisable or feasible

Ultrasound Therapy

- **Continuous or Pulsed Ultrasound**
 - **Contraindications**

- | | |
|---|---|
| <ul style="list-style-type: none">▪ Near a pregnant uterus▪ Over a malignancy▪ Over electronic devices▪ To actively bleeding tissues or persons with untreated hemorrhagic disorders▪ Regions with DVT or thrombophlebitis▪ Over recently irradiated tissues | <ul style="list-style-type: none">▪ Over myositis ossificans▪ Over areas of reduced circulation▪ Over eyes▪ Over cervical ganglia or carotid sinus▪ To testes▪ Over areas infected with tuberculosis |
|---|---|

Ultrasound Therapy



- **Continuous Ultrasound**
 - **Contraindications**

- 'Persons' with cognitive or communication impairments
- Areas of impaired sensation
- Areas of impaired circulation
- Over areas affected by heat-sensitive skin

- To infected tissues under tension (i.e. abscess)
- Inflamed tissues (from recent injury or exacerbation of chronic inflammatory condition)
- To areas overlying cemented or plastic implants

Ultrasound Therapy

- **Pulsed or Continuous Ultrasound**
 - **Can be used with caution**
 - Be cautious of your settings (lower intensity, & more frequent monitoring)



- Spinal cord or superficial peripheral nerves
- Regenerating nerves
- Active epiphysis
- "at risk" or fragile skin

Ultrasound Therapy

- **Pulsed Ultrasound**

- **Can be used with caution**

- Be cautious of your settings (lower intensity, & more frequent monitoring)

- Over cemented or plastic implants
- To areas of impaired sensation
- To areas of impaired circulation
- Over heat sensitive skin
- To infected tissues with open drainage
- To areas with regenerating nerves
- 'Persons' with cognitive or communication impairments
- Inflamed tissues (a/a)

Ultrasound Therapy

- **Pulsed or Continuous Ultrasound**

- **SAFE**

- Over metal implants (with intact overlying skin)
 - The head
 - The chest wall (providing the rib case is intact)
 - Persons with cardiac failure or hypertension

- ▣ **Pulsed Ultrasound**

- **SAFE**

- Areas near or over Chronic wounds

Ultrasound Therapy

- Ultrasound
 - PHONOPHORESIS
 - Lidex Gel = Fluocinonide 0.05%
 - Betamethasone
 - Synalar Gel, Flurocinolone, Acetonide

 - Cortisone does not work



And that's about all I have to say
about that!

[Go to Part 2 – handouts...](#)