

MODALITIES IN CANINE REHAB



MODALITIES

▣ Ultrasound

▪ Indications for the use of Ultrasound

- | | |
|-----------------------|--------------------|
| ▪ Muscle spasm | ▪ Capsulitis |
| ▪ Trigger points | ▪ Bursitis |
| ▪ Tendonitis | ▪ Contusions |
| ▪ Soft tissue healing | ▪ Fracture healing |
| ▪ Chronic synovitis | ▪ Joint Swelling |
| ▪ Adhesions | ▪ Wound healing |
| ▪ Calcification | ▪ Warts |



MODALITIES

▣ 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.



MODALITIES

▣ Ultrasound

▪ What does the literature say?

-
- ▣ (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

MODALITIES

- ▣ **Ultrasound**
 - **What does the literature say?**
 - ▣ Dosages used in OA studies
- ▣ **Cartilage effects**
 - Activation of chondrocytes to increase collagen synthesis
 -
 - 1.5MHz x 0.3W/cm² x Pulsed x 20 min

MODALITIES

- ▣ **Ultrasound**
 - **What does the literature say?**
 - ▣ Dosages used in OA 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)

MODALITIES

- ▣ **Ultrasound**
 - **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

MODALITIES

- ▣ **Ultrasound**
 - **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

MODALITIES

▣ Ultrasound

▪ 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.

MODALITIES

▣ Ultrasound

▪ 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

MODALITIES

▣ Ultrasound

▪ 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

MODALITIES

▣ Ultrasound


▪ The wrench!

- ▣ Tendons, Ligament and capsules have 3X the absorption capability of muscle
- ▣ Is it even effective to Ultrasound for muscle lesions? (because of fascia)
- ▣ Is Pulsed ultrasound still okay?



Modalities Update

MODALITIES




- ▣ **Ultrasound**
 - **DOSAGES**
 - minutes (regardless of pulsed or continuous)
 - Houghton P, Nussbaum E, Hoens A, & Rennie S. Electrophysical Agents, *Physiotherapy Canada* 62(5) Special Issue, 2010

MODALITIES


- ▣ **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.
 - **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.**

MODALITIES




- ▣ **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.
 - 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. Hmmm!

MODALITIES




- ▣ **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.
 - 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**

MODALITIES



- ▣ **Ultrasound**
 - **ANIMAL-SPECIFIC VARIABLES**
 - No pain
 - HAIR absorbs the ultrasound waves and can heat the hair and superficial skin
 - Pulsed setting?
 - Shave or clip the hair?
 - 'Lots-o-goop'




MODALITIES

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

MODALITIES




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

<ul style="list-style-type: none"> ▪ 'Persons' with cognitive or communication impairments ▪ Areas of impaired sensation ▪ Areas of impaired circulation ▪ Over areas affected by heat-sensitive skin 	<ul style="list-style-type: none"> ▪ 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
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Houghton P, Nussbaum E, Hoens A. Electrophysical Agents, *Physiotherapy Canada* 62(5) Special Issue, 2010

MODALITIES

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



<ul style="list-style-type: none"> ▪ Spinal cord or superficial peripheral nerves ▪ Regenerating nerves ▪ Active epiphysis ▪ "at risk" or fragile skin
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Houghton P, Nussbaum E, Hoens A. Electrophysical Agents, *Physiotherapy Canada* 62(5) Special Issue, 2010

MODALITIES

- ▣ **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)

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

MODALITIES

- ▣ **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

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

MODALITIES

- ▣ **Ultrasound**
 - **PHONOPHORESIS**
 - 0.05%
 - Betamethasone
 - Synalar Gel, Flurocinolone, Acetonide
 - Cortisone does not work



Next...

- Electrical Stimulation
- TENS
- Microcurrent

MODALITIES IN CANINE REHAB



MODALITIES

- ▣ Electrical Muscle Stimulation
 - The use of electrical current to stimulate a muscle contraction in the underlying muscle tissue



MODALITIES

- ▣ Electrical Muscle Stimulation

- INDICATIONS

▪ Improper muscle firing sequences	▪ Neurological atrophy
▪ Joint effusion	▪ Pain
▪ Muscle disuse atrophy	▪ Protective muscle spasm
▪ Circulatory disorders	▪ Post injury / disease muscle inhibition
▪ Tendon / Fracture healing	▪ Dermal ulcers


MODALITIES

- ▣ Electrical Muscle Stimulation


- CONTRAINDICATIONS




▪ Near electrical devices	▪ To regions of known or suspected malignancy
▪ To the low back / abdomen in pregnant women	▪ To areas of active DVT / thrombophlebitis
▪ To acupuncture points on pregnant women	▪ To actively bleeding tissues or persons with untreated hemorrhagic disorders
▪ Anywhere on a pregnant woman	

<h2>MODALITIES</h2>		
<p>▣ Electrical Muscle Stimulation</p> <p>▪ CONTRAINDICATIONS</p>		
<ul style="list-style-type: none"> ▪ To infected tissues, tuberculosis, or wounds with underlying osteomyelitis ▪ To the chest in patients with cardiac disease, arrhythmias, or heart failure ▪ To the neck or head region of patients known to have seizures 	<ul style="list-style-type: none"> ▪ Transcranially w/o specialized training ▪ To areas near reproductive organs or genitalia w/o specialized training ▪ To areas near /over eyes ▪ To the anterior neck / over the carotid sinus ▪ To open areas of skin 	

<h2>MODALITIES</h2>	
<p>▣ Electrical Muscle Stimulation</p>	
<p>CONTRAINDICATIONS</p>	<p>PRECAUTIONS</p>
<ul style="list-style-type: none"> ▪ Areas of impaired circulation ▪ The area unstable d/t recent surgery, bone fracture, or osteoporosis ▪ The crest or the intercostal muscles ▪ The lower abdomen ▪ To recently radiated tissues 	<ul style="list-style-type: none"> ▪ (e.g. clinicians may treat these with caution – lower intensities and/or more monitoring) ▪ Active epiphysis ▪ Over skin conditions (e.g. eczema, psoriasis) ▪ Over areas with impaired sensation ▪ Patients with cognitive / communication problems

<h2>MODALITIES</h2>	
<p>▣ Electrical Muscle Stimulation</p>	
<p>SAFE</p>	
<ul style="list-style-type: none"> ▪ Over intact skin overlying metal, plastic, or cement implants ▪ Over inflamed tissues (d/t recent injury or exacerbation of a chronic inflammatory condition) 	
	

<h2>MODALITIES</h2>		
<p>▣ Electrical Muscle Stimulation</p>		
<p>▪ PARAMETERS</p>		
<ul style="list-style-type: none"> ▣ Frequency: (Hertz, Pulses per second, Pulse rate) ▪ For tetanic muscle contraction used for strengthening 30 – 60 Hz is usually recommended. (I use 5Hz!) ▪ 20Hz has been shown to <i>prevent atrophy of slow-twitch muscle fibers</i> ▪ 30 Hz has been shown to <i>prevent atrophy of fast-twitch muscle fibers</i> ▪ 2Hz & 10Hz are best for remediation of <i>disuse atrophy</i> 		
<p><small>Dupont Salter et al 2003; Boonyarom et al 2009</small></p>		

MODALITIES

- ▣ ELECTRICAL MUSCLE STIMULATION
 - Dosages in studies
 -
 - diseases.
 - EMS at 50 Hz, 50 reps total, 5 sec on, 2 sec off, 2 second rise, was a viable treatment for disuse atrophy

MODALITIES



- ▣ Electrical Muscle Stimulation
 - PARAMETERS
 - **Phase / Pulse Duration:** (Selections of 100, 200 or 300 microseconds)
 - Humans report than 100 usec is more comfortable. 800 usec will recruit small pain fibers

MODALITIES



- ▣ Electrical Muscle Stimulation
 - PARAMETERS
 - **Waveform:** who cares! There are no good studies to prove the value of one over the other.
 - **ON / Off Times:** Duty cycle: suggested is 1:2 or up to 1:5.
 - I use 1:1 or continuous if the animal is not working with the EMS
 - I use 1:2 if weight shifting while using the EMS

MODALITIES



- ▣ Electrical Muscle Stimulation
 - ELECTRODE PLACEMENT
 - Motor Points:
 - Usually mid belly where a nerve fiber ends
 - The black electrode is the best one to place over the motor point and the red electrode distal or at opposite end.
 - Clinically, just get two electrode over the same muscle = good enough!!!
 - **SHAVE or 'Spot Goop' ?**

MODALITIES

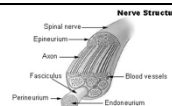
▣ Electrical Muscle Stimulation

▪ UTILIZATION

- Co-contractions
- Post-op in first 4 weeks
- Passive modality in animals
 - Early on
 - Active - Assisted
 - Later on
- Warm up needed???



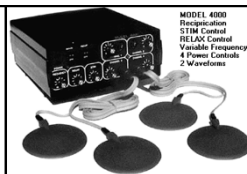
MODALITIES



▣ Electrical Muscle Stimulation

- **USE IN Lower Motor Neuron Lesions**
- **Neuropraxia:** (temporary bruising and inflammation or damage to the nerve)
 - You can stimulate below the lesion to get a muscle twitch
- **Axonotmesis:** (damage to the axon with severance or blockage, but neural sheath is still intact. Nerve may grow together)
 - Grows at 1mm per day or 1 inch a month for up to 2 yrs
 - You are unable to stimulate a muscle twitch below the lesion
- **Neurotmesis:** (severance or crushing completely)
 - The nerve will die unless surgically reattached and even then the individual nerve fibers must reconnect
- ▣ **Pulse Widths of 300 usec might be better at recruiting more muscle fibers and actually get a twitch from a denervated muscle**

MODALITIES



▣ Electrical Muscle Stimulation

- **IONTOPHORESIS:** The use of an electrical current to drive a medication transdermally into the underlying tissue.
- **Know the polarity of the compound and under which electrode to put it**
 - Principle: that like charged ions repel each other... (ie. Put a positively charged solution under the Red / Positive / Anode.)


MODALITIES

▣ TENS : Transcutaneous Electrical Neuromuscular Stimulation

- An electrical current (much like EMS, but utilizing higher or lower frequencies) for pain relief.
- **Analgesic Mechanisms**
 - Descending inhibitory pathways
 - Pain Gating at the spinal cord level
 - Release of endogenous opiates




MODALITIES



- ▣ **TENS**
 - **SETTINGS**
 - For Acute Pain: 60 – 200 Hz and lower pulse widths produce a fast acting pain relief. The relief is short lasting however
 - For Chronic Pain: 2 – 4 Hz with a higher pulse width produces longer lasting pain relief.


MODALITIES

- ▣ **Transcutaneous Electrical Nerve Stimulation**
 - **HIGH-frequency TENS**
 - Selectively stimulates larger diameter peripheral nerve fibres which in turn helps to 'block' nociceptive activity in smaller afferents at segmental levels.
 - ↑↑ endorphins in the bloodstream & CSF, and ↑ enkephalins in the CSF
 - ↓↓ release of the excitatory neurotransmitters glutamate and substance P in the spinal cord dorsal horn in animals with inflammation




MODALITIES

- ▣ **Transcutaneous Electrical Nerve Stimulation**
 - **LOW-Frequency TENS (acupuncture-like TENS)**
 1. Stimulates a release of endogenous opiates
 2. Activates opioid, GABA, serotonin, and muscarinic receptors to reduce dorsal horn neuron activity & nociception
 3. It has also been shown that peripheral opioid receptors are also responsible for low-frequency (but not high-frequency) TENS analgesia.



MODALITIES

- ▣ **TENS**
 - **CONTRAINDICATIONS**
 - As per Electrical Muscle Stimulation
 - **CAUTIONS**
 - Anterior chest wall or lower abdomen
 - Areas of impaired circulation
 - **SAFE**
 - Over areas unstable due to recent surgery, bone fracture, or osteoporosis
 - Areas around or within chronic wounds of known etiology or open wounds with localized infection



MODALITIES



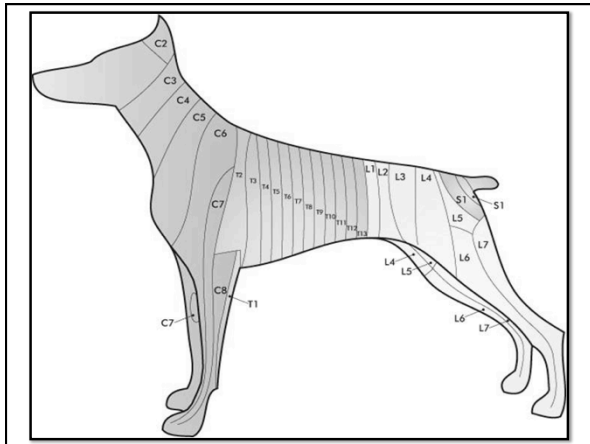
▣ TENS

▪ APPLICATION

- Application of electrode placement is a mix of art and science. Knowledge of the neuromuscular anatomy is helpful.
- Incorporate acupuncture points
- Localized areas of pain
- Over a nerve
- Over a nerve root (that supplies a dermatome / myotome in the painful area)

MODALITIES

Canine Nerves, Nerve Roots, and Muscle Innervation		
Nerves	Root	Muscles
Radial Nerve	C7 – T2	All extensor muscles of the elbow & carpus & digits, supinator, brachioradialis, APL, EPL
Median Nerve	C8 – T2	Pron. Teres, Pron Quad., FCR, SDF, Radial head of DDF
Ulnar Nerve	C8 – T2	FCU, Ulnar & Humeral heads of DDF, Lumbricals, Interossei & elbow jt
Musculocutaneous Nerve	C7 (C8)	Coracobrachialis, biceps, brachialis
Axillary Nerve	C7, (C6 & C8)	Teres major, teres minor, deltoid (and subscapularis)
Subscapular Nerve	C6 – C7	Subscapularis
Suprascapular Nerve	C6, (C7)	Supraspinatus & infraspinatus
Pectoral Nerve	C7, C8	Superficial & deep pectorals
Thoracodorsal Nerve	C8, (C7, T1)	Latissimus dorsi
Femoral Nerve	L4 – L6, (L3)	All of the Quadriceps complex, iliopsoas, Sartorius
Sciatic Nerve	L6, L7, (S1, S2)	Hamstrings, quadratus femoris, gemelli, obturator internus, gastrocs, popliteus, tibialis posterior, tibialis anterior, digital flexotrs and extensors, Fibularis brevis, EHL., muscles of the foot
Tibial		
Peroneal		
Supf & Deep		
Obturator Nerve	L5, L6	Obturator externus, pectineus, adductor, gracilis
Anterior Gluteal Nerve	L7, S1	Glutei, TFL, capsularis
Posterior Gluteal Nerve	S1 – S3	Biceps femoris, Middle & Superficial ghtes



MODALITIES

▣ Microcurrent Electrical Stimulation (MES) (MENS) (MET)

- Electrical current at very low levels – often at below perceivable levels
- Current less than 1 mA / 1000µA



MODALITIES



▣ Microcurrent

▪ Shown to be beneficial for:

- Resistant trigger points over head, neck, & face
- TMJ disorders
- Epicondylitis & shoulder peritendinitis
- Low back disorders
- Wounds / Ulcers
- Neuropathic pain / Post-operative pain

MODALITIES



▣ Microcurrent

▪ In the literature:

- Reduction in DOMS (applied immed post-Ex) – Curtis et al 2010
- Improved function after TKR at 3 mo mark following immed post-op MENS Rx x 10 apps – Rockstroh et al 2010
- MET 0.5Hz x 1000muA x 20 mins/d x 7 days= better than TENS & helps with bruxism pain – Rajpurohit et al 2010

MODALITIES

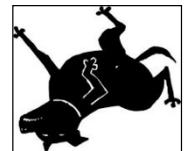


▣ Microcurrent

▪ In the literature: (Rexing et al 2010)

- Cold compress, MET with bandage, or cold compress with bandage = effective in reducing swelling 72 hours post CCLR in dogs vs bandage alone.
- MET - Alpha Stim 600uA used a) crossing the joint in a large X, crossing in a small X and crossing both rear limbs. 0.5Hz (50% duty cycle, bipolar asymmetrical rectangular wave).
- Using 2 probes (2 pairs with small X, 3 pairs with large X, and 3 pairs) 30 - 45 sec per pair with a total time of 5 - 7 minutes.

MODALITIES



▣ Microcurrent

▪ In the literature: (Tan et al 2006)

- Cranial Electrical Stimulation (CES = Microcurrent delivered via earclips to affect the brain) resulted in significant decrease in pain intensity in pts with SCI
- 100uA - 500uA x 1 hr/day x 21 days (Alpha-Stim)

Next...

- LASER
- & LEDS



MODALITIES IN CANINE REHAB



MODALITIES



- ▣ **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 orbit to outer orbits. Then when the atom falls back again it gives off energy again.

MODALITIES




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

MODALITIES

▣ **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
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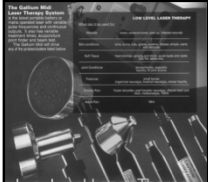


MODALITIES

▣ **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 & Myofacial TrPs
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MODALITIES

▣ **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
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MODALITIES

▣ **LASER**

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

<ul style="list-style-type: none"> ▪ Recently irradiated tissues ▪ Patients with photosensitivity disorders ▪ Persons with infections with a compromised immune function 	<ul style="list-style-type: none"> ▪ Patients with cognitive or communication impairments ▪ Active epiphysis ▪ Anterior neck & carotid sinus
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Houghton P, Nussbaum E, Hoens A. Electrophysical Agents, *Physiotherapy Canada* 62(5) Special Issue, 2010

Modalities Update

MODALITIES

▣ **LASER**

- SAFE




<ul style="list-style-type: none"> ▪ 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 	<ul style="list-style-type: none"> ▪ 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
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MODALITIES

▣ **LASER**

- Classification of Lasers




<p>Class 1 (<0.5 mW)</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>Class 2 (< 1mW)</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>Class 3 (1mW - 500mW)</p> <p>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 • Gallium Arsenide (GaAs) • Gallium Aluminum Arsenide 	<p>Class 4 (> 500mW)</p> <ul style="list-style-type: none"> • 4a(NEW 'cold' lasers) / 4b (surgical) • Increases tissue temp • Surgical = Dehydration of tissue and coagulation of protein • Thermolysis • Evaporation • CO2 / Argon / YAG laser • Fire Hazard

MODALITIES

▣ **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)




MODALITIES

▣ **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




MODALITIES



- ▣ **LASER**
 - **Traditional 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


Modalities

- ◎ **THERAPEUTIC LASER**
 - > **General effectiveness for PAIN RELIEF due to:**
 - 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)




Bjorndal et al 2006; Chow et al 2009

MODALITIES



- ▣ **THERAPEUTIC LASER**
 - **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.

MODALITIES



- ▣ **THERAPEUTIC LASER**
 - **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!

MODALITIES

- ▣ THERAPEUTIC LASER
 - **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)



MODALITIES

- ▣ THERAPEUTIC LASER
 - **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)



MODALITIES

- ▣ THERAPEUTIC LASER
 - **Nerves** (Shamir... 2001; Rochkind... 2007; 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)



MODALITIES

- ▣ THERAPEUTIC LASER
 - **Spinal Cord** (Byrnes...2005; Wu... 2009; Rochkind...2002)
 - Laser: 810nm x150mW x 1589 J/cm² daily (administering LLLT for 2997 seconds/day) x 14 days)
 - Laser: 780nm x 250mW x 30 min/day x 14 days



Modalities Update

MODALITIES

- ▣ **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 GaAIs and super-pulsed 904nm GaAs).
- ▣ **So.....**

MODALITIES

- ▣ **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)	Dose (J) Per Point @ Target Depth (cm)								
	0	0.5	1	1.5	2	2.5	3	3.5	4
4	2.0	1.3	1.0						
1 x 4	2.0	2.7	2.0	1.6	1.3	1.1	1.0		
1 x 8	6.0	4.0	3.0	2.4	2.0	1.7	1.5	1.3	1.2
1 x 12	10.0	7.3	4.0	3.2	2.7	2.3	2.0	1.8	1.6
1 x 16	14.0	6.7	3.0	4.0	3.3	2.9	2.5	2.2	2.0
1 x 20	18.0	8.0	6.0	4.8	4.0	3.4	3.0	2.7	2.4
1 x 24	22.0	10.7	8.0	6.4	5.3	4.6	4.0	3.6	3.2
1 x 28	26.0	13.3	10.0	8.0	6.7	5.7	5.0	4.4	4.0
1 x 32	30.0	16.0	12.0	9.6	8.0	6.9	6.0	5.3	4.8
1 x 36	34.0	18.7	14.0	11.2	9.1	8.0	7.1	6.4	5.6
1 x 40	38.0	21.3	16.0	12.8	10.4	9.1	8.0	7.1	6.4
1 x 44	42.0	24.0	18.0	14.4	11.7	10.4	9.1	8.0	7.1
1 x 48	46.0	26.7	20.0	16.0	13.0	11.7	10.4	9.1	8.0
1 x 52	50.0	29.3	22.0	17.6	14.3	13.0	11.7	10.4	9.1
1 x 56	54.0	32.0	24.0	19.2	15.6	14.3	13.0	11.7	10.4
1 x 60	58.0	34.7	26.0	20.8	16.9	15.6	14.3	13.0	11.7
1 x 64	62.0	37.3	28.0	22.4	18.2	16.9	15.6	14.3	13.0
1 x 68	66.0	40.0	30.0	24.0	19.5	18.2	16.9	15.6	14.3
1 x 72	70.0	42.7	32.0	25.6	20.8	19.5	18.2	16.9	15.6
1 x 76	74.0	45.3	34.0	27.2	22.1	20.8	19.5	18.2	16.9
1 x 80	78.0	48.0	36.0	28.8	23.4	22.1	20.8	19.5	18.2
1 x 84	82.0	50.7	38.0	30.4	24.7	23.4	22.1	20.8	19.5
1 x 88	86.0	53.3	40.0	32.0	26.0	24.7	23.4	22.1	20.8
1 x 92	90.0	56.0	42.0	33.6	27.3	26.0	24.7	23.4	22.1
1 x 96	94.0	58.7	44.0	35.2	28.6	27.3	26.0	24.7	23.4
1 x 100	98.0	61.3	46.0	36.8	29.9	28.6	27.3	26.0	24.7

Blue: Biostimulation; Tissue Repair; Wound Healing.
 Yellow: Sub-Acute Inflammation; Chronic Pain.
 Red: 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 settings, to achieve the required dose at the target depth in the tissue.

Note: Based on a 1cm² lesion

Courtesy of SpectraVet

MODALITIES

- ▣ **LASER**
 - **Techniques**
 - Points should be spaced 1cm² apart when covering a large expanse
 - For open lesions, treat with the probe being 1cm away or less. Clear plastic food wrap over the lesion will avoid direct contact as well.



MODALITIES

▣ LASER

▪ Techniques

- Some laser machines allow for the selection of Hertz. Follow the manufacturers guidelines when selecting dosage & settings. (No studies) (Most research is done with continuous wave)
- Machines should be calibrated regularly
- (Protective eye goggles should be used by the practitioner and animal owner. The dog's eyes should be shielded.)

MODALITIES

▣ 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




Next...

- Pulsed Electromagnetic Field

MODALITIES IN CANINE REHAB



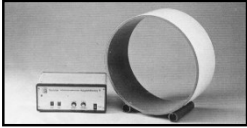
MODALITIES



▣ **Magnetic Field Therapy**

- To create a magnetic field a current must flow through a conductor such as wire.
- When current flows through a wire a magnetic field is induced at right angles to the wire.

MODALITIES




▣ **Magnetic Field Therapy**

- **Theoretic Mechanism of Action**
 - Damaged / Diseased cells have altered rest potentials (permeability to Na⁺ and K⁺). The rest potential of the cell is proportional to the ion exchange occurring at the cell membrane.
 - Ions are affected by the rhythm of the pulsation when introduced to a PEMF
 - Ion exchange is responsible for O₂ utilization of the cell
 - Lack of O₂ utilization is a problem with delayed healing and arthritic joints

MODALITIES

▣ **Pulsed Electromagnetic Field Therapy**

- **EFFECTS OF PEMF**
 - Enhanced cartilage repair
 - Stimulation of chondrocytes
 - Increase in collagen synthesis
 - Increase in osteogenesis



MODALITIES

▣ **Pulsed Electromagnetic Field Therapy**

- **INDICATIONS**

<ul style="list-style-type: none"> ▪ Bone Healing ▪ Inflammation ▪ Muscle Spasm ▪ Pain ▪ Disorders of the Neuro system ▪ Rheumatology ▪ Coronary / Circulatory diseases ▪ Post-Operative 	<ul style="list-style-type: none"> ▪ Degenerative diseases of the musculoskeletal system ▪ Infection ▪ Poor circulation ▪ MS ▪ Parkinsons ▪ Post-trauma ▪ Burns & Wounds ▪ Tendon healing
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MODALITIES

▣ Pulsed Electromagnetic Field Therapy

▪ CONTRAINDICATIONS

- Hemorrhage
- Electrical implants
- Cancer



MODALITIES

▣ Pulsed Electromagnetic Field Therapy

▪ PARAMETERS

- Magnetic field is measured in Gauss (G) or Tesla (T)
- PEMF have a maximum power of 100 G and utilize DC current. (This is far less than external field powers that can have a negative biological effect such as cell phone, power lines, transformers, appliances and medical devices which utilize AC)
- Static Magnets are at least 500G



MODALITIES

▣ PEMF

▪ PARAMETERS

- Frequency Cycle (Hertz)
 - 0.5 Hz may cause vasoconstriction
 - 18 Hz may cause vasodilation
- Centurion PEMF setting
 - 2Hz (acute)
 - 15Hz (subacute)
 - 30Hz (chronic)



MODALITIES

▣ PEMF

▪ PARAMETERS

- CARTILAGE
- In the Literature: (Fini...2005; Zorzi...2007)
- PEMF x 3 months x 6hr/day x 75Hz x 1.6mT = increased cartilage thickness
- PEMF x 75Hz x 1.5 mT x 90 days x 6 hours / day = reduced NSAID use & increased knee Fx/pain scores



Modalities Update

MODALITIES

▣ PEMF

▪ PARAMETERS

- ▣ BONE
- ▣ In the Literature: (Ibiwoye... 2004; Matsumoto...2000)
- ▣ PEMF 15Hz x 3hrs/day x 7 days a week x 10 weeks = reduced osteotomy gap size
- ▣ PEMF 100Hz, pulse width of 25usec (x lower Teslas) = increased bone contact ratios & bone area ratios



MODALITIES

▣ PEMF

▪ PARAMETERS

- ▣ Tendons
- ▣ In the Literature: (Strauch...2006; Robotti...1999; Lee...1997)
- ▣ PEMF 30 mins/day x 27.12Mhz = 69% increase in tensile strength of repaired tendons in rat Achilles)
- ▣ 15Hz, peak amplitude 12mW x 8 hours daily = decrease in tensile strength and an increase in peritendinous adhesion (chick tendons).
- ▣ 17Hz x 15-min sessions x 5.1 mT = increased physiological alignment of collagen fibres in Achilles of rats



MODALITIES

▣ PEMF

▪ PARAMETERS

- ▣ In the Literature: (Walker...1994; Crowe...2003)
- ▣ NERVE
- ▣ PEMF: 2 Hz x 0.3 mT x 4 h/day during Days 1-5 post-injury = Increase in functional recover (assess day 43)
- ▣ SPINAL CORD
- ▣ PMF may help with motor function recovery and lesions volume size after acute SpC Injury (applied x 12 weeks mid-thoracic spine - cats)




And that's it!!!

- ▣ Maybe you learned something from all of this...
- ▣ Or maybe you got your laundry done with me yammering in the background!
- ▣ Either way... good on ya! See you at the course!

Cheers! Laurie


MODALITIES

- ▣ Thermal Therapies (HOT)
 - Mechanisms of Heat Exchange
 - Conduction (direct contact) ie hot packs
 - Convection (directing air or liquid) ie dryers
 - Radiation (from warm to cool) ie lamps
 - Conversion (altering energy) ie Ultrasound
 - Evaporation (fluid changes to vapor) ie perspiration



MODALITIES


- ▣ Thermal Therapies (HOT)
 - INDICATIONS
 - Pain Relief
 - To increase circulation
 - Muscle spasm
 - Facilitate tissue healing
 - Prepare a stiff joint or muscle for exercise
 - Chronic swelling
 - Tissue scarring



MODALITIES

- ▣ Thermal Therapies (HOT)
 - CONTRAINDICATIONS


<ul style="list-style-type: none"> • Large area or high enough temps as to raise core body temps in pregnant patients, or patients with cardiac issues • Patients with DVT/ thrombosis/ thrombophlebitis • Patients infected with TB • Areas of impaired sensation • Actively bleeding tissues • Over reproductive organs (testes) 	<ul style="list-style-type: none"> • Recently irradiated tissues • In patients unable to give accurate / timely feedback • Areas of impaired circulation • Inflamed tissues (d/t recent injury or chronic flare-up) • Over heat sensitive skin • Over areas of skin breakdown • Areas of edema
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MODALITIES


- ▣ Thermal Therapies (HOT)
 - CAUTIONS

<ul style="list-style-type: none"> • Areas near or over eyes • Anterior neck & carotid sinus • Pregnant women • People with cardiac failure



Modalities Update


MODALITIES



- ▣ Thermal Therapies (HOT)
 - SAFE

<ul style="list-style-type: none"> • Over implants containing metal, plastic, or cement • Over electronic devices • Near chronic wounds • Over superficial or regenerating nerves 	<ul style="list-style-type: none"> • Near the head, chest, or heart • Over active epiphysis • To patients with hypertension
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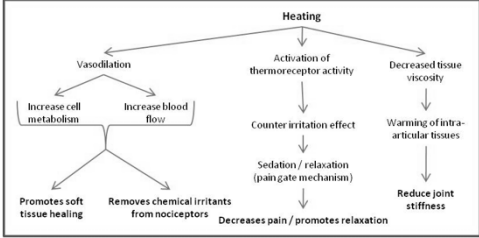
MODALITIES



- ▣ Thermal Therapies (HOT)
 - PHYSIOLOGICAL EFFECTS
 - Increased local circulation
 - Decreased pain
 - Increased tissue extensibility
 - Decreased muscle spasm
 - Muscle relaxation
 - ▣ Via dilation of blood vessels and stimulation of local circulation, heat helps to mobilize tissue & metabolites, increase tissue oxygenation and increase metabolic rate of cells and enzyme systems.

MODALITIES

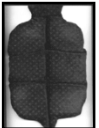
- ◎ THERMOTHERAPY
 - > Proposed sequences of physiological & cellular functions... (Belanger 2004)



```

graph TD
    Heating --> Vasodilation
    Heating --> Activation[Activation of thermoreceptor activity]
    Heating --> Viscosity[Decreased tissue viscosity]
    
    Vasodilation --> Metabolism[Increase cell metabolism]
    Vasodilation --> BloodFlow[Increase blood flow]
    Metabolism --> Healing[Promotes soft tissue healing]
    BloodFlow --> Irritants[Removes chemical irritants from nociceptors]
    
    Activation --> Counter[Counter irritation effect]
    Counter --> Sedation[Sedation / relaxation (pain gate mechanism)]
    Sedation --> Pain[Decreases pain / promotes relaxation]
    
    Viscosity --> Warming[Warming of intra-articular tissues]
    Warming --> Stiffness[Reduce joint stiffness]
  
```

MODALITIES




- ▣ Thermal Therapies (HOT)
 - APPLICATION
 - ▣ Best AFTER the acute inflammation stage
 - ▣ Superficial heat directly penetrates only 1cm
 - ▣ Most profound physiological effects are when tissue temps are raised to 105 - 113 degrees F.
 - ▣ Skin & subQ fat will rise to these temps after 5 mins of superficial heat
 - ▣ Deeper tissues need 15 - 30 mins to achieve the same (with superficial heat)
 - ▣ Water as hot as the hand can tolerate is 101 - 105 F.
 - ▣ Heat in one location may cause reflex vasodilation at a distal site.

MODALITIES

▣ **Cryotherapy (COLD)**

- **INDICATIONS**
 - Pain relief
 - Inflammation
 - Reduce swelling
 - Hemorrhage
 - Fever
 - Muscle guarding spasm
 - Control bleeding




MODALITIES

▣ **Cryotherapy (COLD)**

- **Contraindications**


Impaired circulation Over chronic wounds Over regenerating nerves Patients with cold sensitivities	To patients with DVT / thrombosis / thrombophlebitis To anterior neck & carotid sinus To tissues affected with tuberculosis
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MODALITIES

▣ **Cryotherapy (COLD)**

- **PRECAUTIONS** (may treat this condition with lower intensities and/or more monitoring)
 - To areas of impaired sensation
 - Tissues near / over eyes
 - Damaged or at risk skin
 - To patients with cardiac failure (reduce intensity or size of application)
 - To patients with hypertension (reduce intensity or size of application)



MODALITIES

▣ **Cryotherapy (COLD)**

- **SAFE**
 - Over active epiphysis
 - Over metal, plastic, or cement implants
 - Over electronic devices
 - Over areas of known malignancy
 - Over low back or abdomen of pregnant patients
 - Over recently irradiated tissues
 - Over reproductive organs
 - Skin diseased areas
 - Over the chest, heart, head
 - Any inflamed tissues



Modalities Update

MODALITIES

▣ Cryotherapy (COLD)

▪ EFFECTS

- Decrease in local circulation
- Decrease in pain
- Decrease in tissue extensibility

▪ MECHANISMS OF ACTION

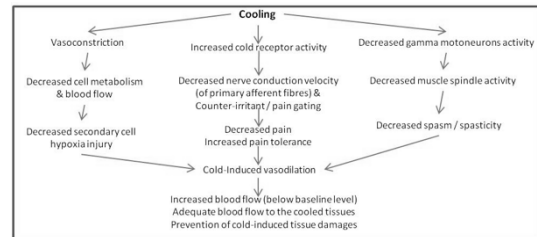
- Constriction of blood vessels
- Decreased tissue metabolism
 - (inhibits inflamm. mediators)
- Affects small myelinated nerve fibres
 - (reduce nerve conduction)
- Cold can directly affect 1 – 4 cm depths



MODALITIES

▣ CRYOTHERAPY

▪ Physiologic effects... (Sluka 2009; Belanger 2004)



MODALITIES

▣ Cryotherapy (COLD)

▪ APPLICATION

- Apply in the first 48 hrs following acute musculoskeletal injuries or any time there is heat and swelling
- Application is generally for 10 – 20 minutes with a re-warming period of twice the time of the ice application = 1:2 ratio on/off time.
- Effects occur when tissue temp gets between 59 – 66 degrees F.
- Do not allow for an airspace between the skin and cold medium (air gets colder and can damage the skin)



MODALITIES

▣ Time to Play!!

