Physical Therapy Applications for Pain Management in Sports Medicine

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- MSK injuries can impede an athlete from competing in their sport
- Chronic MSK conditions (Osteoarthritis) can:
  - Impact performance, quality of life, and the ability to continue engagement in sporting activities

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- Osteoarthritis
  - Mechanical Pain
    - Abnormal loading
    - Stress on capsule, ligament and periarticular tissue.
  - Inflammatory Pain
    - Release of chemicals

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- Osteoarthritis
  - Inflammation
    - Increases responses w/in Aβ, Aδ, and type C afferent fibres to BOTH noxious & innocuous joint movement
  - Silent Nociceptors
    - Respond to BOTH noxious innocuous stimuli, movement & pressure
  - = PERIPHERAL SENSITIZATION

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- Osteoarthritis
  - Peripheral Sensitization...
  - → Central sensitization of the dorsal horn neurons
  - PLUS, there is a loss of INHIBITORY PAIN CONTROL MECHANISMS

hence PAIN & LOSS OF FUNCTION

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- Osteoarthritis clinically...
  - Aching, discomfort, & pain that increases with EXCESSIVE activity
  - Reduction in overall activity level
  - Reduced ability to perform activities
  - Poorer proprioception
  - Joint stiffness, enlargement, & effusion
  - Loss of flexibility
  - Loss of strength

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- Animals with clinically severe OA are likely best retired from sport
- What about the multitude of athletic dogs or horses with mild to moderate OA?

PT pain management may help these athletes!

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- THERMOTHERAPY (HEAT)
  - For symptomatic relief of arthritis pain & stiffness
    - (Wright & Johns 1961; Robinson et al 2002)
  - SHORT-term reductions in pain in acute/subacute low back pain
    - (French et al 2002)

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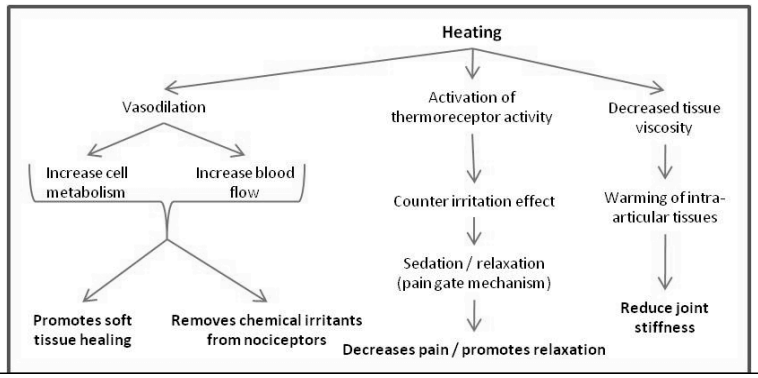
- THERMOTHERAPY
  - Proposed sequences of physiological & cellular functions... (Belanger 2004)



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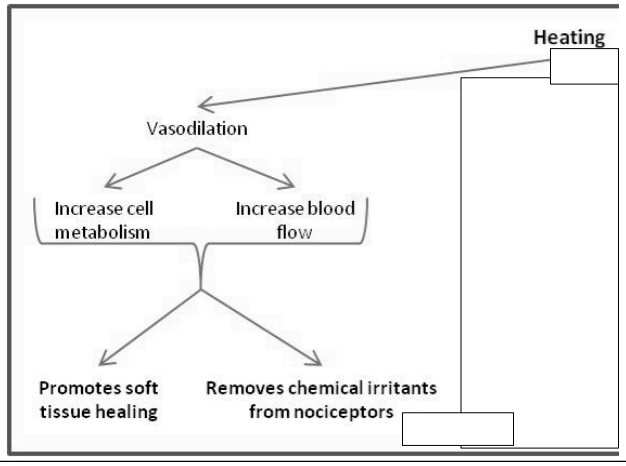
- THERMOTHERAPY



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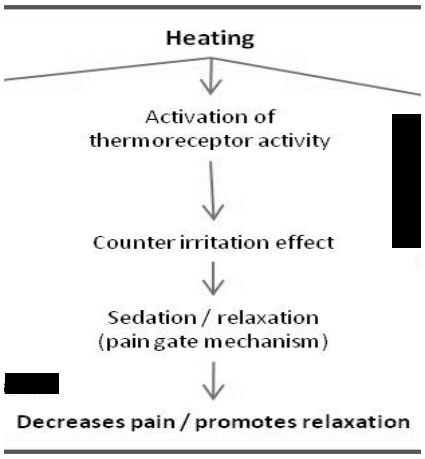
- THERMOTHERAPY



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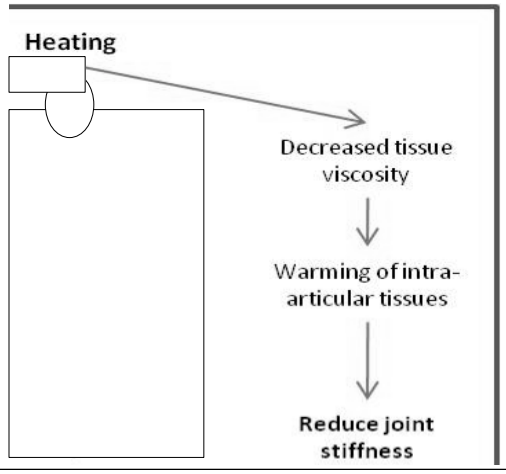
- THERMOTHERAPY



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- THERMOTHERAPY advisement
  - Heat can be utilized as part of the DAY TO DAY management of arthritic joints
  - Heat can be used PRIOR to engaging in physical activities

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- CRYOTHERAPY
  - Well supported by research for acute pain and injury
  - Ice aids with swelling reduction & improved ROM in osteoarthritis

Belanger 2004; Brosseau et al 2003

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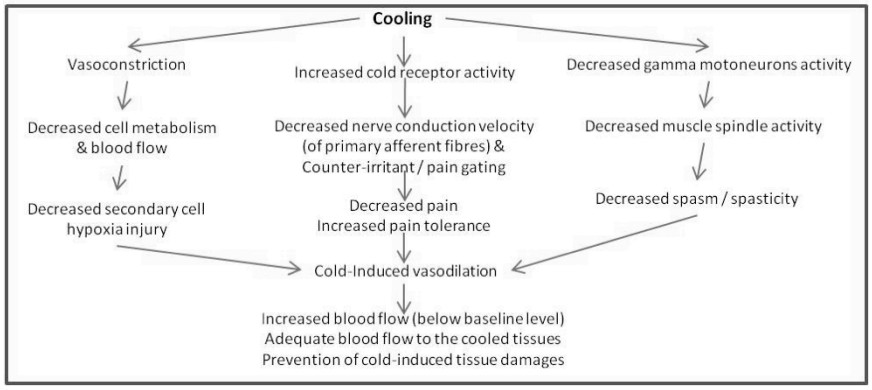
- CRYOTHERAPY
  - Physiologic effects... (Sluka 2009; Belanger 2004)



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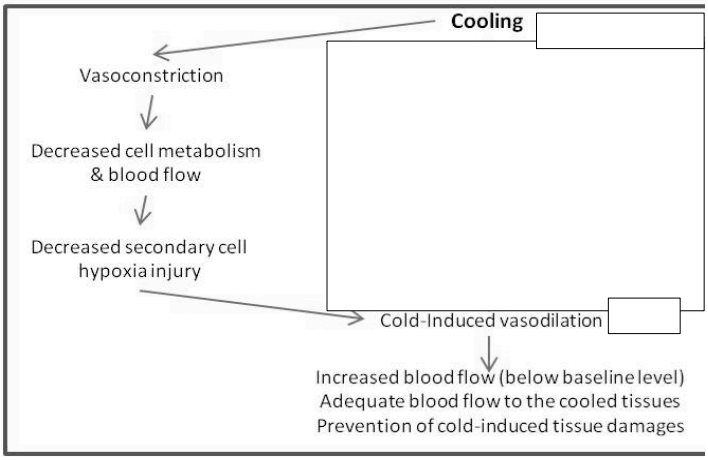
- CRYOTHERAPY



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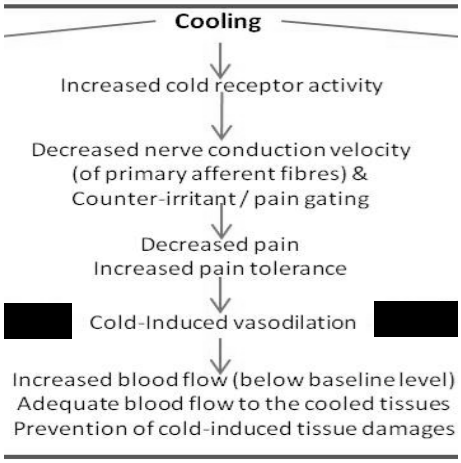
- CRYOTHERAPY



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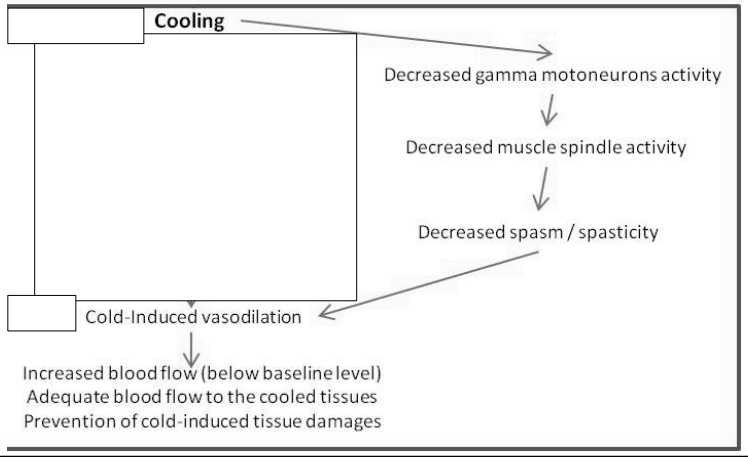
- CRYOTHERAPY



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- CRYOTHERAPY advisement
  - ICE maybe utilized post-activity to aid in pain relief
  - ICE can be used for control of acute inflammation (i.e. injuries)
  - ICE can be used for OA 'flare-ups'



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- THERAPEUTIC LASER
  - Low level laser therapy (LLLT)
    - Aids tissue repair
    - Relieves pain
    - Can be used to stimulate acupuncture points


Woodruff et al 2004; Enwemeka et al 2004; Siendentopf et al 2002

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- THERAPEUTIC LASER
  - General effectiveness 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)

Bjordal et al 2006; Chow et al 2009

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- 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!

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- 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)

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- THERAPEUTIC LASER
  - NEW-'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)

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- THERAPEUTIC LASER advisement:
  - Athletic animals with OA may be well served by semi-regular, pro-active LASER sessions
  - Injuries or OA flare-ups can also be managed with this modality.

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- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - Mechanism for pain relief with TENS
    - Segmental inhibition through pain-gating mechanisms
    - Via descending inhibitory mechanisms.
    - Different frequencies of TENS produce analgesia through action on different neurotransmitters and receptors

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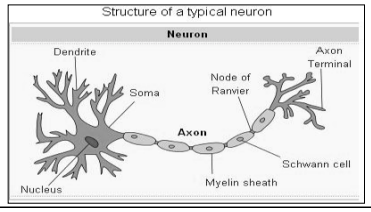
- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - High frequency / conventional TENS (>60Hz)
    - Selective stimulation of larger diameter fibres in peripheral nerves
    - Which helps to 'block' nociceptive activity in smaller afferents at segmental levels



Baxter & McDonough 2007; Sluka & Walsh 2009

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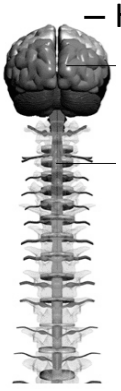
- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - High frequency / conventional TENS (>60Hz)
    - Increases the concentration of β endorphins in the bloodstream and cerebrospinal fluid
    - Increases methionin-enkephalin in the cerebrospinal fluid
    - also reduces release of the excitatory neurotransmitters glutamate and substance P in the spinal cord dorsal horn in animals with inflammation



Baxter & McDonough 2007; Sluka & Walsh 2009

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- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - Low frequency TENS (<10 Hz)
    - Stimulates a release of endogenous opiates
    - Often referred to as acupuncture-like TENS (mechanism for pain relief is similar to acupuncture)

Baxter & McDonough 2007; Sluka & Walsh 2009

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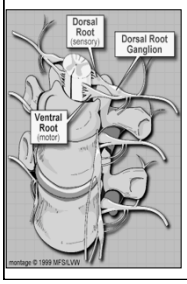
- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - Low frequency TENS (<10 Hz)
    - Primarily affects the relevant spinal segmental level



  - Opioid, GABA, serotonin, and muscarinic receptors are activated by low-frequency TENS to reduce dorsal horn neuron activity,
  - Reducing nociception and the consequent pain

Baxter & McDonough 2007; Sluka & Walsh 2009

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- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - Low frequency TENS (<10 Hz)

- Peripheral opioid receptors are also responsible for low-frequency (but not high-frequency) TENS analgesia.
- The proposed mechanisms for pain relief utilizing electroacupuncture at different frequencies is similar (if not the same) to those demonstrated following TENS stimulation at similar frequencies

Baxter & McDonough 2007; Sluka & Walsh 2009

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- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - Applications **(you can use other modalities this way too!)**
    - LOCAL to the site of the lesion
    - Dermatomes
    - Myotomes
    - Segmental nerve roots

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- Transcutaneous Electrical Neuromuscular Stimulation (TENS)

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
Musculocutaneus Nerve	C7 (C8)	Coracobrachilis, 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 Tibial Peroneal Supf & Deep	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
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 glutes

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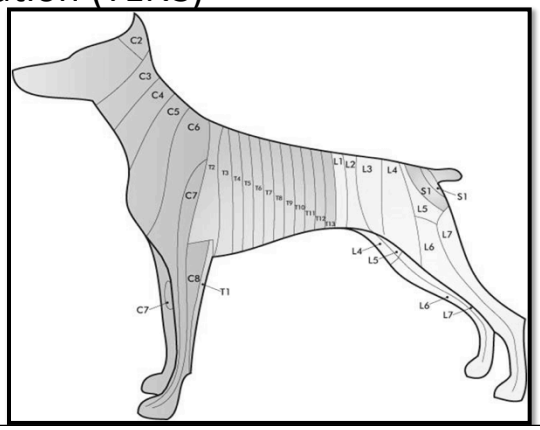
- Transcutaneous Electrical Neuromuscular Stimulation (TENS)



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- Transcutaneous Electrical Neuromuscular Stimulation (TENS)
  - Advisement:
    - This might be a useful modality to use as therapy during OA flare ups
    - Owners may want to purchase a TENS machine to use more regularly for day to day aches & pains

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- Pulsed Electromagnetic Field
  - Conflicting results exist for its use in the treatment of osteoarthritis pain. (Hulme et al 2002; McCarthy et al 2006)
  - Vavken et al (2009) reviewed relevant RCTs and concluded that PEMF improved clinical scores and function in patients with osteoarthritis of the knee.

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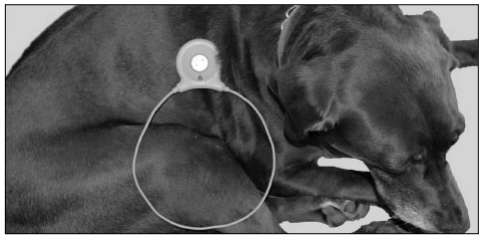
- Pulsed Electromagnetic Field
  - A handful of studies (industry funded) have looked at post-operative pain and found PEMF to be useful
    - Decreased pain meds & Visual Analogue Scales



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- Pulsed Electromagnetic Field
  - Advisement:
    - It has potential...
    - Regular maintenance or flare-up treatment modality.
    - If useful, owners can purchase inexpensive units for home use.

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- ULTRASOUND
  - 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)

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- ULTRASOUND
  - Studies most extensively on human knee OA
  - = increases the effectiveness of exercise therapies (thus yielding functional improvements)
  - = improvements in joint ROM
  - = reduced pain & improved walking endurance

Huang, Lin et al 2005; Huang, Yang et al 2005; Ozgonenel et al 2009; Tascioglu et al 2010; Loyola-Sanchez et al 2010

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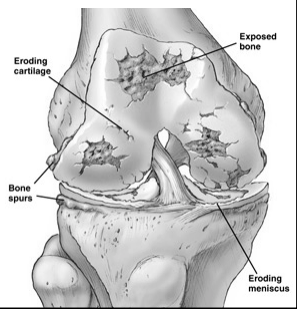
- ULTRASOUND
  - Intra-articular studies on the knee (human & rat)
    - Enhances cartilage repair
    - Stimulate collagen synthesis in articular cartilage



Huang, Ding et al 1997; Naito et al 2010; Korstjens et al 2008

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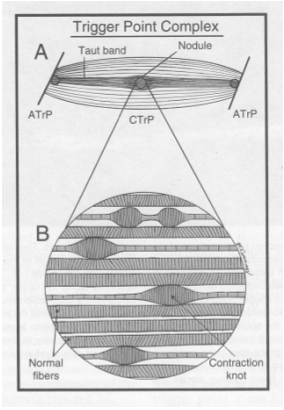
- ULTRASOUND
  - Shown to be beneficial for myofascial trigger points (MFTrPs)
    - (which may be present with OA joints d/t central sensitization)



(Majlesi et al 2004; Srbely & Dickey 2007; Srbely et al 2008; Aguilera et al 2009)

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- ULTRASOUND
  - How does it work??
    1. THERMAL (continuous ultrasound)
       - Improves peripheral nerve function
       - Increase in blood flow
       - Creation of a counter-irritant thus activation of spinal gating mechanisms

Sluka 2009

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- ULTRASOUND
  - How does it work??
    2. NON-THERMAL (pulsed ultrasound)
       - Acoustic streaming (movement of fluids across cell membranes)
       - Stable cavitation (creation of transient gas bubbles in the sound field)... Which may cause cell membrane disruption... Which may enhance cellular permeability... And even better utilization of anti-inflammatory medications

Belanger 2004

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- ULTRASOUND
  - Pitfalls
    - **HAIR…**
      - Absorbs, heats, impedes (Steiss et al 1999)
  - Advisement:
    - Ultrasound therapy may be utilized as a maintenance treatment and/or for OA 'flare-ups'
    - Ultrasound can be utilized on joints that are accessible in location, but hair-cover may need to be addressed
    - Ultrasound can be utilized on secondary MFTrPs

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- Mobilizations
  - Mobs & Manips affect pain via different mechanisms that originally thought:
    - Research cannot validate a biomechanical effect (i.e. Correction of a position fault)
  - Neurophysiological effects = a reduction in pain and inhibition of reflex muscle contractions

(Zusman 1986; Katavich 1998; Björnsdóttir & Kumar 1997; Zelle et al 2005)

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- Mobilizations
  - To achieve neurophysiologic effects requires:
    - Repetitive oscillatory movements
    - Sustained manual stimulation
  - This results in a hysteresis effect
    - **(involves inhibition of low threshold mechanoreceptors (group I & II), inhibition of high threshold nociceptors (group III & IV)**
    - Both of which result in a reduction of intra-articular pressure and peripheral afferent discharge

(Zusman 1986; Katavich 1998; Conroy & Hayes 1998; Sterling et al 2001)

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- Mobilizations
  1. A mechanical force is needed to initiate a chain of neurophysiological effects
  2. Neurophysiologic responses are both peripheral & central
  3. Manual therapy may directly affect inflammatory mediators and peripheral nociceptors. (reduction in blood & serum level cytokines)

Schmid et al 2008 & Bialosky et al 2009

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- Mobilizations
  4. Spinal Mechanisms: Manual therapy may act as a counter-irritant to modulate pain and "bombard the CNS with sensory input from the muscle proprioceptors".
  5. Supraspinal mechanisms have been shown to be activated with manual therapy to modulate pain.
  6. Other mechanisms: autonomic responses, opioid responses, placebo effect, expectation, and psychosocial factors

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- Mobilizations
  - Advisements:
    - Maintenance therapies for OA joints should include mobilizations
      - (to the affected joint and potentially the adjacent joints)
      - (potentially to the spinal vertebral segments as they relate to the dermatomes overlying the affected joint!)

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- Massage
  - Neurophysiological effects
  - Neuropsychological effects
  - Mechanical effects

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- Massage
  - And PAIN relief:
    - Increase plasma concentrations of β-endorphins,
    - Decrease systolic blood pressure
    - Reduce cortisol levels

Holst et al 2005; Olney 2005; Field 2005

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- Massage
  - Assists in Pain reduction & increases pain tolerance
  - ...but only for as long as a REGULAR massage routine is maintained
    - Q 3 weeks

Plews-Ogan et al 2005; Aourel et al 2005

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- Massage
  - Bonus impact...
    - Massage-like-stroking has also been found to optimize digestion and improve nutrient assimilation
  - The neuropsychological benefits
    - improve mood
    - reduce anxiety and depression
    - improve sleep

Holst et al 2005; Field 2005; Corbin 2005; Bastard & Tiran 2006

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- Massage
  - Advisement:
    - Regular massage may be beneficial for OA pts
    - In-clinic &/or home-management strategy

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- Stretching
  - As it relates to OA pain has not been studied
  - May increase the effectiveness of isokinetic exercise in terms of functional improvement in human patients with knee osteoarthritis
  - Increase in OA joint ROM utilizing daily passive stretching in dogs

Wend et al 2009; Crook et al 2007

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- Stretching
  - Do these functional improvement equate to a decrease in pain.
  - ???

Advisement:

- Owners could incorporate stretching as part of their home management routine, along with massage.

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- Exercise Therapy
  - Systematic reviews show pain improvement with exercise in:

Neck pain	**Intermittent claudication**
Chronic low back pain	**Fibromyalgia**
Pelvic pain	**Rheumatoid arthritis**
Osteoarthritis	**Tendinopathies**
Patellofemoral pain	

Bement 2009

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- Exercise Therapy
  - Advisement:
    - Allow the animal to maintain participation in sports at some level
    - Prescribe exercises specific to the affected joint in order to further improve function
    - (And subsequently reduce pain).

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- Conclusion
  - Mild and moderate osteoarthritis is often common in sporting animals.
  - Physical therapies can be part of a multimodal treatment regimen for the canine athlete
    - Enabling animals to enjoy participation in sports as they age.

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Pain management is no
longer just about medication

Thank you for listening!

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