#ChoosePT: Biophysical Agents, Effective Alternative for Opioid Reduction?

John Tawfik, DPT, GCS, CEEAA
Matthew Johnson, PT, CEEAA
Elizabeth Huller, PT, CEEAA
Kelly Contreras, PT, GCS, CEEAA

Course Objectives

- Describe the opioid epidemic and identify the need for an interdisciplinary approach including PT for Pain Management.
- Examine the physiologic mechanisms of biophysical agents as nonpharmacological interventions for pain management.
- Identify the stimulation parameters that directly influence biophysical agents efficacy and their impact on the evidence.
- Design a treatment plan that includes biophysical agents as an adjunct to optimize pain management.

Agenda

- Opioid Epidemic
- Physiologic Effects of Biophysical Agents Related to Pain
- Review of Evidence on Determinants of Efficacy
- Clinical Applications – Acute Pain
- Clinical Applications – Chronic Pain
- Lab

Disclosures

- We have relevant financial associations with some of the modalities discussed in this presentation as we are employees of Accelerated Care Plus Inc. (ACP), Reno, NV.
- ACP manufactures biophysical agents and provides education, training, and clinical support services to its customers.

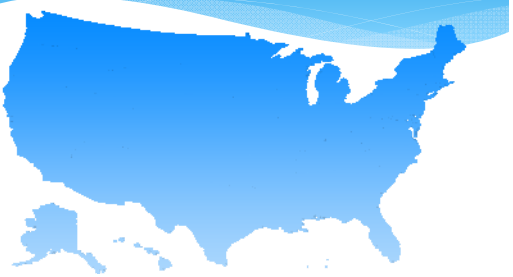
The Road to Crisis

- Pain as 5th vital sign -1990s
- Campaign touting the alleged under-treatment of pain.
- Liberalization of laws governing prescription of opioids.
- Aggressive marketing by pharmaceutical companies.
- Increase awareness and education on the inherent right of pain relief

Timeline

- **March 2016** CDC Guidelines for RX Opioid for Chronic Pain
- **June 2016** FDA immediate release opioids will carry black box warning
- **June 2016** APTA #ChoosePT
- **August 2016** Surgeon General Turn the Tide Campaign
- **Sep 2016** National Opioid and Heroin Epidemic Awareness Week
- **February 2017** American College of Physicians recommends non-pharmacological approaches first-line treatment for LBP
- **July 2017** FDA cites biggest crisis
- **August 2017** President declares opioid crisis a national emergency

Map of Crisis



Prevalence

- 2015- Estimated that 2 million Americans have opioid use disorder (addiction) related to prescription opioid use.
- 2015- 52,404 deaths related to overdose in the United States.
  - 63.1% attributed to opioids
    - 50% (approximately 15k) of the opioid related deaths are connected to prescription opioid

Prevalence

- The amount of opioids prescribed in the United States peaked in 2010 and has since decreased each year through 2015.
- Despite reductions, the amount of opioids prescribed remains approximately three times as high as in 1999

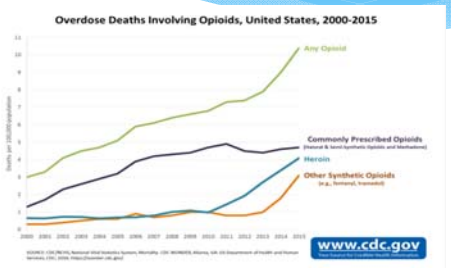
Consequences

- The majority of drug overdose deaths (more than six out of ten) involve an opioid.
- Since 1999, the number of overdose deaths involving opioids (including prescription opioids and heroin quadrupled).
- From 2000 to 2015 more than half a million people died from drug overdoses.
- 91 Americans die every day from an opioid overdose.

Consequences

- 2002-2015: number of deaths attached to Opioid overdose > 280%.
- Initial estimates from CDC indicate yet another new record of deaths in 2016.

Consequences



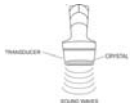
#ChoosePT

- Evidence Based Practice supports the use of biophysical agents as part of a complete and effective alternative, or at least adjunct to opioid prescription.

Physiologic Effects of Biophysical Agents Related to Pain

Guide to Physical Therapist Practice

- *Biophysical agents* are a broad group of agents that use various forms of energy and are intended to assist muscle force generation and contraction; decrease unwanted muscular activity; increase the rate of healing of open wounds and soft tissue; maintain strength after injury or surgery; modulate or decrease pain; reduce or eliminate edema; improve circulation; decrease inflammation, connective tissue extensibility, or restriction associated with musculoskeletal injury or circulatory dysfunction; increase joint mobility, muscle performance, and neuromuscular performance; increase tissue perfusion and remodel scar tissue; and treat skin conditions.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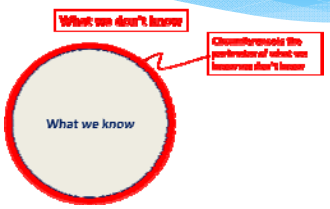
Physiologic Effects of Biophysical Agents



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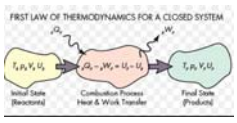
First Law Of Thermodynamics

- Energy can never be destroyed, only converted
  - No energy conversion is ever 100% efficient, by-product is often thermal
  - Selecting type of energy being delivered contributes to the success of the process being attempted



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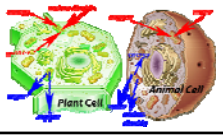
Why Do Cells Need Energy?

- Cells need energy to do work:
  - Chemical: building, rearranging, breaking apart molecules
  - Mechanical: moving muscle actin-myosin, cell protein transport, cardio-vascular respiratory as well as the whole body movement
  - Electrochemical: moving charged substances across membranes for polarization, repolarization and stabilization



Biophysical Agents Physiologic Effects Related to Pain

Address cause of pain (Electric Stimulation, PSWD, ultrasound)

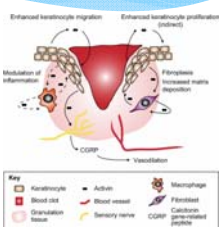
- **Cell Membrane Permeability/Energy Transfer**
- **Tissue Healing and Growth Factor**
- **Vasodilation**

Reduce sensation of pain (Electric Stimulation)

- **Inhibitory Neurochemical Response**
- **Modulate Cortical Interpretation of Pain**

Address Cause Of Pain

- Edema
- Tissue Injury
- Decreased Circulation



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Edema - Cell Membrane Permeability

Ultrasound:

- Mechanism of action is increasing cell membrane permeability to enhance intra and extra cellular transportation, and increasing micro circulation

Shortwave Diathermy (Pulsed Electromagnetic Energy):

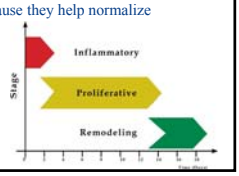
- Mechanism of action is that the photonic energy can supplement the energy that ATP usually provides (which is the essential" priming the pump" action necessary to maximize cellular activity), and increasing micro circulation

Electrical Stimulation:

- Unidirectional ionic flow (either negative ions flow into the wound to restore neutral pH by balance the excessive H^+ ions and thus enable the inflammatory process to complete its cycle and move on to proliferation), or positive ions flow into the wound (to further inhibit the inflammatory phase if the area is already over inflamed)[22] and increasing micro circulation.

Tissue Healing & Growth Factors

- If cells are damaged beyond repair, the body responds with sequential phases of healing (Inflammatory – Proliferative – Remodeling)
- All phases are required for healing
- The length of time to heal tissue depends on the volume of tissue involved, the health of the individual, and the quality of care provided to the patient
- Biophysical Agents aid in tissue healing because they help normalize cellular activity and increase circulation.



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Vasodilation - Microcirculation

- Impacts from edema resolution, angiogenesis, microcirculation and tissue heating
- Conducted vasodilation - electrical signaling from cell to cell along vessel walls through gap junctions creating smooth muscle relaxation
  - Impairment of sympathetic conduction during aging and disease can restrict blood flow (Bagher et al, Acta Physiologica, 2011)
- Therapeutic ultrasound significantly increased at high and low doses increased oxygen saturation in Achilles Tendon post treatment (Yi-Ping et al, Journal of Orthopaedic & Sports Physical Therapy, 2015)

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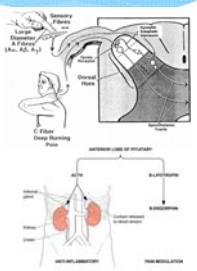
Reduce Sensation Of Pain - Inhibitory Neurochemical Response

- Electrical Stimulation
  - Sensory stimulation ("pain gate theory"): "TENS produces anti-hyperalgesia by activation of μ and δ opioid receptors in the rostral ventral medulla" (Karla, A. J Pharmacol Exp Ther, Motor stimulation
  - Endorphin release: "TENS demonstrated a significant benefit in pain relief of the knee OA over placebo." (Osiri M., Cochrane Database, 2000)
  - Nerve block ("electro-analgesia"): "thus it appears that analgesic electrical stimulation can be used as a method of alleviating pain". (Gulick DT, 2004)



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Inhibitory Neurochemical Response

- C-fiber nociceptor fibers are malleable and need to be blocked or inhibited in order to prevent increased excitability. Brief repetitive stimulation that activates mechanoreceptors but don't over-activate C-fibers helps reduce super-excitability. (Tigerholm et al, Biophys J, 2015).

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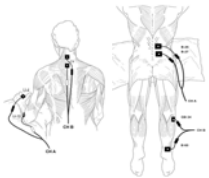
Modulate Cortical Interpretation of Pain

- "Cortical remapping": Acu point stimulation: "although the mechanisms of pain relief for these treatments are not fully understood, there are promising results that warrant further studies". (Weeks, Neurologist, 2010)
- Normal afferent input: "Because peripheral electrical nerve stimulation directly opposes the central nervous system alterations that occur with causalgia, it seems an ideal treatment for this debilitating syndrome". (Somers, Phys Ther Reviews, 2015)



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Physiologic Effects of Biophysical Agents – Key Takeaways

- Understanding of physiologic impacts from Biophysical Agents is still emerging as science progresses
- Biophysical Agents induce energy into cells
- Cellular energy is good…causes other things to happen

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Review of Evidence on Determinants of Efficacy

Electromagnetic Therapy

Clinical Indication	Highest Level of Available Evidence
Treatment of chronic inflammatory conditions: tenosynovitis, bursitis, synovitis, pelvic	Systematic Review/ RCT
Increasing circulation (local)	Systematic Reviews
Relieving pain and post traumatic/ post surgical edema	Clinical Practice Guideline and Systematic Review
Increasing the extensibility of collagen tissues, decreasing joint stiffness and contractures	RCTs
Reduction of muscle spasm	Background Information/ Expert Opinion

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Electromagnetic Therapy: Ankle Sprains Clinical Practice Guideline

- **Journal of Orthopedic and Sports Physical Therapy: *Interventions in the acute/protected motion phase- physical agents*** (2013)
  - **Diathermy:** Level C recommendation → Clinicians can utilize pulsating SWD for reducing edema and gait deviations associated with acute ankle sprain

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Electromagnetic Therapy: Knee OA Systematic Review *(Li, 2013)*

- Nine RCTs with n= 636
- Pain relief of 15 points (scale of 0 to 100) more when compared to placebo treatment
- Key results (other outcomes):
  - *Physical Function:* EMF may improve physical function but this may have happened by chance
  - *Overall Health and well-being:* No difference
  - *X-ray changes:* No info available to show any improvements on an OA joint x-ray
- "Current evidence suggests that electromagnetic field treatment may provide moderate benefit for OA in terms of pain relief."

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Electromagnetic Therapy: Shoulder Pain Systematic Review *(Yu, 2015)*

- Purpose: to evaluate the effectiveness of passive physical modalities for the management of soft tissue injuries of the shoulder.
- Twenty-two trials with 11 trials deemed to have low risk of bias.
- Findings:
  - Pre-tensioned tape, US, and IFC are not effective to manage shoulder pain from sub acromial impingement syndrome.
  - Diathermy and corticosteroid injections lead to similar, positive outcomes
  - Low level laser therapy provides short term pain reduction
  - Extracorporeal shock-wave therapy provides benefits for persistent shoulder calcific tendonitis

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Electromagnetic Therapy: Knee OA RCT *(Atamaz, 2012)*

Comparison of the Efficacy of Transcutaneous Electrical Nerve Stimulation, Interferential Currents, and Shortwave Diathermy in Knee Osteoarthritis: A Double-Blind, Randomized Controlled, Multicenter Study.

- 203 patients with OA
- Randomized into 6 treatment groups
  - TENS
  - Sham TENS
  - IFC
  - Sham IFC
  - SWD
  - Sham SWD

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Electromagnetic Therapy: Knee OA (cont'd) RCT *(Atamaz, 2012)*

- Primary outcome measure: VAS (0 – 100 mm)
- Results:
  - All groups showed improvement
  - All intervention groups had significantly lower paracetamol (Tylenol) intake compared to sham groups at 3 months.

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Electromagnetic Therapy Dosing RCT (*Fukuda, 2011*)

Diathermy Dose and Desired Effect for pain relief

- Low dose diathermy(14.5W x 19 min total energy of 17kJ) vs.. high dose diathermy (14.5W x 38 min total energy of 33kJ) vs. placebo vs. control.
- Both low and high dose diathermy groups showed a significant reduction in pain and improvement in function when compared to control and placebo groups.
- There were no differences in results between low and high doses, however lower dose appears to be more effective in the long term.

Electromagnetic Therapy Determinants of efficacy

No specific guidance, but key parameters and factors to consider:

- The patient's diagnosis, specific condition, contributing medical factors (e.g., chronicity)
- Thermal v. subthermal treatment
- Desired tissue temperature response, if any
- Tissue exposure time (e.g., 20 minutes)
- Treatment frequency (e.g., QD, 3x/week)
- Outcome measure specifics (e.g., appropriate test, correct time-points) dictate the total number of treatments

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Ultrasound

Clinical Indication	Highest Level of Available Evidence
Pain	Clinical Practice Guideline
Musculoskeletal conditions	RCTs (very limited diagnoses)
Collagen extensibility and Tissue heating	Clinical Practice Guideline
Increasing circulation (local)	Systematic Review
Relaxing muscle spasm	RCT

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Ultrasound: Early RA Pain Clinical Practice Guideline

Scottish Intercollegiate Guidelines Network (SIGN), Management of Early RA (2011)

- Simple dynamic exercises (Level B recommendation)
- Limited evidence showing symptomatic benefits from Ultrasound.
- Resting and working splints can be used to provide pain relief (level C recommendation)

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Ultrasound: Musculoskeletal Conditions & Pain. Systematic Reviews

Cochrane Systematic Reviews:

- Carpal Tunnel Syndrome: not recommended based on 11 RCTs, n=414 participants *(Page, 2013)*
- Ankle Sprain: not recommended based on 6 RCTs, n=606 subjects *(van den Bekerom, 2011)*
- Low Back Pain: small effect on short term pain relief, therefore not recommended. Based on 7 RCTs, n=362 *(Ebadi, 2014)*

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Ultrasound: Calcific Tendinitis RCTs

Supraspinatus (*Rahman, 2007*)

- Twenty-six patients received 12 ultrasound treatments at 1.0 to 1.5 W/cm^2 x 10 minutes each
- All patients became pain-free and regained range of motion
- In 24 of the cases radiographs showed no calculi

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Ultrasound: Calcific Tendinitis (Cont.) RCTs

Double-Blind, Shoulder (*Ebenbichler, 1999*)

- Thirty-two shoulders were treated 24 times with pulsed US at 2.5 W/cm^2 for 15 minutes each
- Twenty-nine shoulders received sham US
- For the US treatment group, calcium deposits were completely resolved in 6 of the shoulders and reduced by at least 50% in nine additional shoulders with no change in the sham US shoulders
- In addition, US treated patients reported less pain and had greater improvements in quality of life

Ultrasound Application Issues: False Negatives?

- "Ten Mistakes Commonly Made with Ultrasound Use: Current Research Sheds Light on Myths". *(Draper, 1996)*
- "Ultrasound is one of the most misused therapeutic modalities"
- Mistakes include:
  - Treating Too Large an Area
  - Inappropriate Treatment Duration
  - Preset Intensities
  - Ignoring The Stretching Window
  - Moving the Sound Head Too Rapidly
  - Un-calibrated devices

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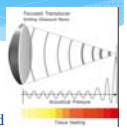
Ultrasound Dosing Literature Review *(Itakura, 2012)*:



Summary of Variables:

- 3MHz had avg increase of 2.6 °C in superficial tissues
- 1MHz had avg increase of 1.7 °C in deep tissues
- Area of 2x ERA resulted in higher heating of tissue
- Intensities ranging from 0.5W/cm2 to 3w/cm2 have resulted significant increase in temperature
- Application time depends on treatment area and power density
- Speed of application appears to modify heating up to 7-8 cm/s
- Different ultrasound devices produce heat differently
- "Parameters for ultrasound application must be controlled and adjusted to generate deep heating of tissues considering that it may vary among devices"

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Electrical Stimulation

Clinical Indication	Highest Level of Available Evidence
Pain	Systematic Review
Neuromuscular re-education	Numerous Clinical Practice Guidelines and Systematic Reviews
Increase local circulation	Clinical Practice Guidelines and Systematic Reviews
Relaxation of muscle spasms and ROM	Systematic Review

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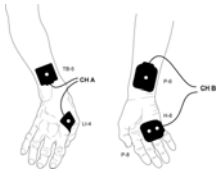
Rheumatoid Arthritis Pain Clinical Practice Guideline



Ottawa Panel, 2004:

- Evidence-based practice guidelines recommend the use of TENS for pain and joint swelling in RA patients

Electrical Stimulation: OA Knee Pain Systematic Review (*Bjordal, 2007*)

- Thirty-six RCTs were included with total of 2434 patients, of whom 1391 patients received the active treatment
- Short term effect within 1 to 4 weeks, and follow up effect in 1 to 12 weeks
- Favorable impact (offered clinically relevant pain relief, VAS effect size difference when compared to placebo):
  - TENS (18.8 mm)
  - Electro-acupuncture (21.9 mm)
  - Low Level Laser Therapy (17.3 mm)

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Electrical Stimulation Considerations for Pain Management

What makes TENS work? Making sense of the mixed results in the clinical literature *(Sluka, PTJ, 2013:*

TENS Parameters:

- Intensity
- Frequency of Application
- Waveform Frequency (Hz)
- Electrode Placement

Electrical Stimulation Essential Considerations: Intensity

Whenever possible, administer an e-stim intensity greater than 15mA

- TENS studies with efficacious outcomes employed subjective intensity ratings such as "strong," "maximal non-painful," "maximally tolerable". Use similar intensities with therapy patients.
  - Low Frequency: Set intensity at levels that produce strong and tolerable motor responses
  - High Frequency: Set intensity at levels that generate non-painful paresthesia, just below pain threshold
- Conversely, a common methodological flaw of TENS studies that did not demonstrate efficacy was insufficient current intensity

Electrical Stimulation Essential Considerations: Intensity (Cont.)

- Research shows that there is a greater analgesic effect when TENS intensity was increased during treatments in response to subject accommodation to the stimulation. Periodically, throughout the treatment, re-assess the patient's subjective rating of intensity and when needed, increase the current amplitude to return it to a strong/ maximal level.
- Most patients accommodate to the stimulation as the treatment proceeds. Periodically, throughout the treatment, re-assess the patient's subjective rating of intensity and when needed, increase the current amplitude to return it to a strong/ maximal intensity.

Electrical Stimulation Essential Considerations: Frequency of Application

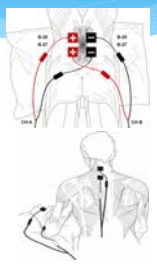
- Research suggests that repeated TENS applications decreases sensitivity of sensory fibers and neurons, centrally and peripherally
- With repeated TENS stimulation, sensory neurons show reduced spontaneous firing, lesser response to noxious and non-noxious stimuli
- In essence, TENS can re-boot the pain sensory pathways and return them to their normal pain signal inhibitory levels
- Frequency of application may vary according to chronicity of pain. More frequent applications for acute conditions (e.g., QD) and less frequent for chronic conditions (e.g., 2x/week). If using daily, be mindful of increasing intensity steadily to prevent analgesic tolerance.

Electrical Stimulation
Essential Considerations: Waveform Frequency

Medication Status	Patient Pain Relief Need	E-Stim Protocol
Taking opiate-based	Immediate to 1 hour	Sensory nerve Block
Taking opiate-based	½ to 2 hours minimum	Sensory
Weaning from opiate-based	Immediate to 1 hour	Sensory nerve Block
Weaning from opiate-based	2 to 8 hours minimum	Sequential or Sensory Motor
Taking non-opiate-based	Immediate to 1 hour	Sensory Nerve Block
Non-opiate-based	**2 to 8 hours minimum**	**Sequential or Sensory Motor**

Electrical Stimulation
Essential Considerations: Electrode Placement

- Preferentially, place the electrodes around the local, painful area to provide other benefits (i.e., facilitate tissue healing and promote increase circulation/ edema reduction)
- Other electrode placement options include:
  - Over acupuncture & trigger points
  - Segmental: 1.5 or 3 body inches lateral to the spinous process(es) of the involved segmental level(s) and/or
  - Over the nerve(s) innervating the painful area



Electrical Stimulation
Essential Considerations: Methods

- Opioids primarily inhibit C-fiber nerve conduction. However, painful stimuli from the large, myelinated sensory receptors are poorly controlled by opioids.
- E-stim stimulates A-delta (sensory) and A-beta (motor) fibers and decreases the activity of noxiously evoked dorsal horn cells located in the spinal cord
- E-stim reduces hyperalgesia in damaged tissues thereby decreasing the amount and intensity of pain signals and increasing patient pain thresholds
- Some Clinical Practice Guidelines advise properly-administered pain medications and adjunctive, properly-dosed electrical stimulation
- Research demonstrates that electrode placement and current intensity are key factors that differentiate between e-stim studies that demonstrate efficacy and those that do not

Clinical Applications Acute Pain

Biophysical Agent Treatments

- Therapy treatment opportunities for Acute Pain as identified in the literature:
  - Reduce pain with adjunctive, non-pharmacologic treatments
  - Decrease post-traumatic edema
  - Facilitate tissue healing
- Biophysical agents can simultaneously provide the three benefits listed above
  - Electrotherapy: LVPC or IFC
  - Shortwave Diathermy: Subthermal & thermal
  - Ultrasound: Subthermal & thermal
- There are practical, interdisciplinary considerations when incorporating modalities into pain treatment pathways:
- Pharmacological therapy is always more effective when combined with nonpharmacological therapies and should be viewed as a means of facilitating movement and engagement in other rehab interventions.

FDA Indications for Use: Electromagnetic Energy

Clinical Indications
Relieving pain and post traumatic/ post surgical edema
Increasing the extensibility of collagen tissues, decreasing joint stiffness and contractures
Treatment of chronic inflammatory conditions: tenosynovitis, bursitis, synovitis, pelvic
Increasing circulation (local)
Reduction of muscle spasm

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FDA Indications for Use: Ultrasound

Clinical Indications
Pain management and acute injury
Treatment of joint structures; tendinitis, arthritis and periarthritis, decreased joint stiffness, bursitis, heating of joint structures
Stretching of collagenous tissue, increased extensibility, treatment of contractures
Increasing circulation (local)
Reduction of muscle spasm

FDA Indications for Use: Electrical Stimulation

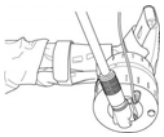
Clinical Indications
Chronic intractable pain, acute pain, and post-traumatic and post-surgical pain
Relaxation of muscle spasms
Prevention or retardation of disuse atrophy, muscle re-education, stimulation of muscles to prevent deep vein thrombosis
Increase local blood circulation
Maintaining or increasing range of motion

Joint Pain Subthermal SWD

- RCTs support subthermal pulsed shortwave for decreasing joint pain and tenderness at rest and during motion

Van Nguyen J, Physiotherapy , 2002

Ligament Pain
Subthermal SWD



LATERAL ANKLE SPRAIN

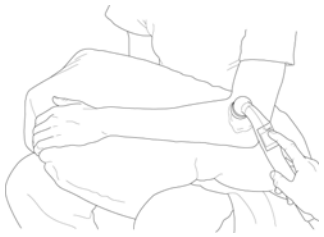
- In a double-blind RCT just one application of subthermal SWD within 72 hours post injury reduced ankle edema 4-fold over placebo treatment
- There was a significant reduction in pain associated with standing or walking on a sprained ankle
- Twice as many people receiving subthermal SWD had subjective improvement compared to the placebo group

Pilla AA, J Ath Train , 1996

Elbow Epicondylitis Pain
Subthermal US

RCT combining mobilization and subthermal US applied 3Rx / 3 weeks markedly reduced pain, improved grip and wrist extension strength

Kochar, Physio, 2002



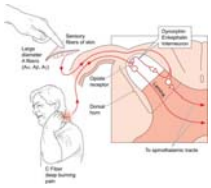
Knee – Pain
Subthermal US

Pulsed Ultrasound is more effective in both pain relief and function improvement when compared with the control group

Zeng, Osteoarthritis and Cartilage, 2014

Electrical Stimulation Physiology To Treatment: Sensory Frequency

- E-stim frequencies from 80-120 Hz activate A beta fibers
- Dynorphin (an endogenous opiate) is released and attaches to Kappa receptors located in the brain and spinal cord
- If stopping the use of opiate-based medications and replacing them with e-stim, use IFC or LVPC motor to activate endogenous endorphin systems or use a sequential protocol (e.g., Sensory Motor)



TENS For Post-Operative Pain

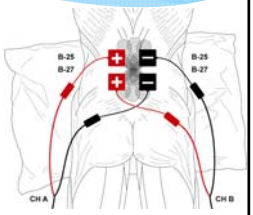
- RCT with 66 patients who underwent hernia repair.
- TENS treatment 1 hr before surgery reduced pain at 2 and 4 hours after surgery

Eidy, Iran Red Crescent Med J, 2016

Acute Low Back Pain Sensory IFC

After 4 to 10 IFC treatments there was a significant reduction in functional disability, pain and an increased quality-of-life that maintained for 6 to 12 months.

Hurley, *Spine*, 2004



Clinical Applications Subacute and Chronic Pain

Biophysical Agents Treatment Goals

- Therapy goals based on the needs identified in the literature -
  - Decrease post traumatic pain and edema
  - Decrease incisional pain
  - Decrease muscle disuse atrophy/guarding/spasm
  - Reduce subacute and residual muscle/deep tissue pain with adjunctive, non-pharmacologic treatments
  - Decrease dependent edema
  - Facilitate tissue healing
  - Activate key muscle groups
  - Improve mobility, gait, ADLs

Biophysical Agents Trigger Points

- There is a long history of myofascial trigger points. They were originally described by ancient Greek texts and were noted throughout the Middle Ages, however they were known as many different names including fibrositisnodule, myelogenosis, non-rheumatic arthritis etc.
- They were finally codified by Dr. Janet Travell in the 1980's. She created the name of 'myofascial trigger points' and with Dr. David Simons, mapped out the many myofascial trigger points over the body.
- They define a trigger point as a "hyperirritable locus within a tight band of skeletal muscle".

Biophysical Agents Trigger Points Mechanisms Of Action

- It is theorized that by treating the trigger point directly, the localized muscle spasm relaxes and the local pressure or stress on sensitive tissue(s) is thus reduced, reducing nociceptive input
- The spasm, which in of itself is painful, is relaxed and that pain is also diminished (and so reducing nociceptive input further)
- Reducing nociceptive input reduces the need for "protective" muscle spasm, and thus the muscle fully relaxes
- Any residual pain is likely to be the residual effects of the prolonged spasm and/or tensions on sensitive tissues

Traditional Chinese Medicine

Traditional Chinese medicine (TCM) originated in ancient China and has evolved over thousands of years. TCM practitioners use herbal medicines and various mind and body practices, such as *acupuncture* and *tai chi*, to treat or prevent health problems, as well as diagnostic tools that utilize such approaches as assessing ying and yang, localized pulses for abnormalities etc.

Acupuncture Points

Biological Characteristics:

- Higher electrical conductivity
- Lower electrical resistance
- Increased spontaneous discharge
- Twice as many capillary loops with sympathetic wrappings

Location:

- Where the peripheral nerve branches.
- The entry of the motor-sensory nerve into muscle and are the same as trigger points.
- Other acupuncture points correspond to a sympathetic or parasympathetic plexus or to motor points.
- 361 acupuncture points that lie on 14 meridians (12 paired, 2 unpaired).

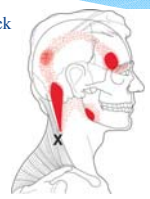
Acupuncture Points (Cont.)

Sensitivity:

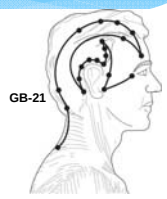
- Are always more sensitive (to pressure, electrical stimulation, temperature, ultrasound, etc) than the surrounding tissue.
- They become hypersensitive when related to the pain problem.

Trigger Point vs. Acupuncture Point

SJ Liao in 1973 and R Melzack in 1975 demonstrated a remarkably high degree of correlation (80% and 71%, respectively) between trigger and acupuncture and motor points



Upper Trapezius Trigger Point



Gall Bladder Meridian Acupuncture Point

Shoulder Pain Thermal SWD

- Impairment - Pain and decreased function with rotator cuff tendinopathy diathermy treatment showed similar benefits as with subacromial corticosteroid injections for pain and shoulder function.

Rabini et al, 2012

- Diathermy and corticosteroid injections lead to similar, positive outcomes.

Yu, et al, 2015

Carpal Tunnel Syndrome Thermal SWD

- Fifty-eight wrists in 31 subjects randomized to 1 of 2 groups
- Control group received nerve and tendon gliding exercises, hot packs and sham SWD. Experimental group received nerve and tendon gliding exercises, hot packs, and SWD.
- Frequency: 5X/week for a total of 15 sessions
- "SWD provided short-term improvements in pain, clinical symptoms, and hand function in patients with mild to moderate CTS."

(Incebiyik, J Back Musculoskelet Rehabil, 2015

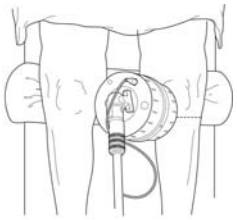
Chronic Pain Moderate To Vigorous Thermal SWD

- RCTs support thermal pulsed shortwave for decreasing pain

Fukuda, Physical Therapy, 2011

- Impairment - Pain and decreased function with knee OA (SWD)
- Improved pain, muscle strength and physical function with thermal diathermy

Rabini et al, European Journal of Physical and Rehabilitation Medicine, 2012



Hip OA - Pain Moderate Thermal US

- The hip joint was treated with continuous US over anterior, posterior, and lateral fields, 5 min for each field for a total of 15 minutes
- Results:
  - Function: SF-36 physical sub-scores improved and were maintained in the US Group at the 3 month follow-up
  - "The addition of therapeutic ultrasound to traditional physical therapy showed a longitudinal effect on pain, functional status and quality of life"

Koybasi, Clin Rheumatol , 2010

Knee OA Pain
Thermal US

- Impairment - Pain and decreased function with knee OA
  - Improved pain, stiffness and function with continuous ultrasound

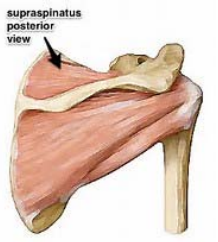
  Basic-Kapidzic; Annals of Rheumatic Disease, 2013
  - Literature review of 9 research articles related to ultrasound in management of osteoarthritis found that 5 studies reported positive cartilage healing properties

  Srbely, Journal of the Canadian Chiropractic Association, 2008

Supraspinatus – Calcific Tendinitis

- Twenty-six patients received 12 ultrasound treatments at 1.0 to 1.5 W/cm^2 x 10 minutes each
- All patients became pain-free and regained range of motion
- In 24 of the cases radiographs showed no calculi

Rahman, MMJ, 2007

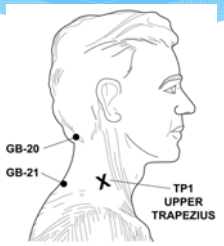


Neck Pain
Thermal US

- When combined with neck stretches, US or trigger point injection were equally effective in reducing pain and increasing ROM

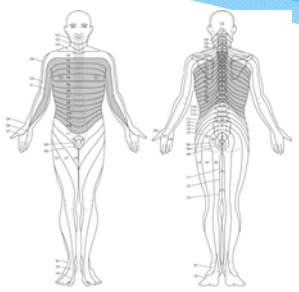
  Mailesi, Arch Phys Med Rehab, 2004
- Pain and decreased function with neck pain:
  - Improved pain at rest with continuous ultrasound vs., pulsed ultrasound vs.. Sham

  Ilter et al, 2015



Myofascial Trigger Points

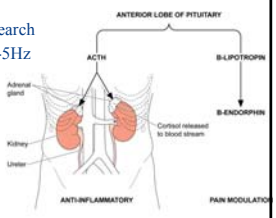
Electrical Stimulation Electrode Placement



A common electrode placement approach is over the segmental inputs for pain based on the dermatome where in the pain lies

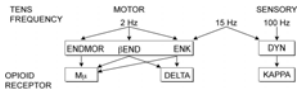
Electrical Stimulation Physiology To Treatment: Motor Frequency

- Also referred to as "acupuncture-like or low rate TENS"
- Discovered: 1976 – Acupuncture research
- Activates: Adelta fiber typically at 2-5Hz
- Opioid released: Endorphin, Endomorphin, Enkephalin
- Receptor: Mu, Delta
- Pain modulation:
  - Segmental and systemic
- Anti-inflammatory:
  - Cortisol Systemic



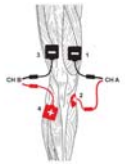
Electrical Stimulation Physiology To Treatment: Sequential Frequency

- Discovered: 1982 Han and Chen
- Activates: Abeta (sensory TENS) and Adelta (motor TENS) fibers
- opioids released: B-endorphin, Enkephalin, Dynorphin, Endomorphin
- Receptor: Mu, Kappa, Delta



- **Pain modulation:**
  - Motor followed by sensory:
    - Starts with 15 Hz shifts to 2 Hz then to 100 Hz
    - Set for motor twitch
  - Sensory followed by motor
    - Starts with sensory 100 Hz followed by motor 2 Hz
    - Set for sensory level
    - Used on patients with low tolerance to motor stim

Knee Osteoarthritis Pain
Motor TENS/ IFC



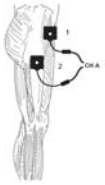
TENS-LVPC or PREMOD

IFC

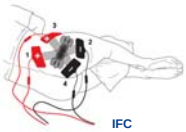
- Evidence-based practice guidelines recommend the use of TENS for Knee OA

  Bjordal , BMC Musculoskeletal Disorders, 2007

Hip Pain
Motor TENS/IFC



TENS-LVPC OR PREMOD

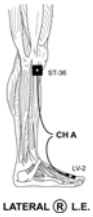


IFC

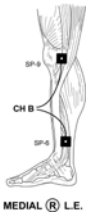
- Transcutaneous electrical nerve stimulation on acupoints reduces fentanyl requirement for postoperative pain relief after total hip arthroplasty in elderly patients.

  Lan , Minerva Anestesiol , 2012

Diabetic Peripheral Neuropathy Pain
Motor TENS



LATERAL Ⓡ L.E.



MEDIAL Ⓡ L.E.

EA applied 3x wk/3wks significantly reduced L.E. diabetic neuropathic pain while improving physical activity and quality of sleep

Hamza MA, White PF, Craig WF, Ghoname ES, et al, 2000

Chronic Neck Pain
Motor TENS

Cervical Osteoarthritis

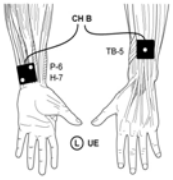
Cervical Spondylosis
With C6 Radiculopathy

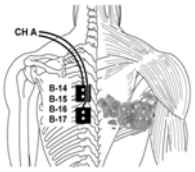
Acupuncture showed improvement in neck pain and disability over routine care alone in chronic neck patients.

Witt (Pain 2006)

Postherpetic Neuralgia Pain
Motor TENS

Acupuncture points (segmentally and distally) can be used to reduce pain with P-6 and H-7 assisting in reduction of insomnia



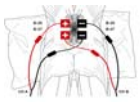


Chronic Low Back Pain
Motor TENS

RCTs suggest that EA can be an important supplement to conservative orthopedic management of chronic low back pain

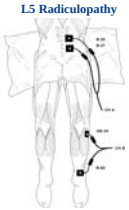
MOTOR TENS was significantly more effective than placebo in the treatment of lumbar pain and stiffness caused by ankylosing spondylitis

Weiner, Rudy, et al, 2003



Motor IFC

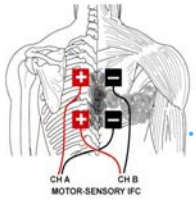
L5 Radiculopathy

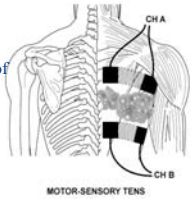


Motor LVPC

Herpes Zoster Pain
Frequency Sequential TENS

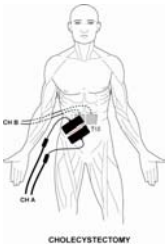
- After 2 weeks of TENS a statistically significant improvement in VAS pain scores, physical activity, and quality of sleep was found in a RCT on 50 patients
- Pain reduction continued on long term follow up, thus reducing the risk of development of





Post-op Pain
Frequency Sequential TENS

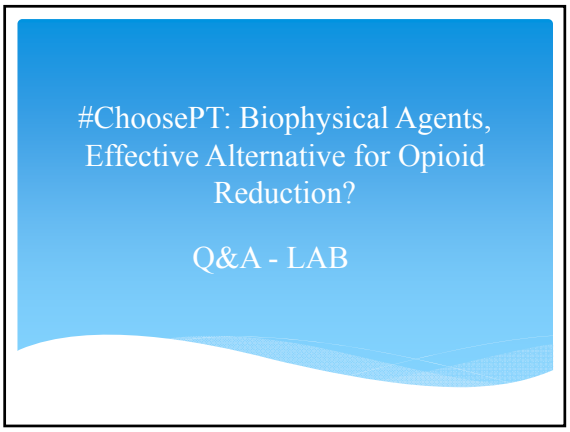
- Decrease pain
- Reduce opioid & NSAID requirements
- Improve pulmonary function
- Enhance mobility
- Accelerate activity progression



- Bjordal JM, Johnson MI, Ljunggreen AE, 2003

Key Takeaways

- Adjunctive, **non-pharmacological** options
- Employ biophysical agents' **physiological effect.**
- **Correct application and dosage** of biophysical agents impact outcomes
- **Biophysical agents are another effective interventions** to adjunct comprehensive pain management rehab. .


#ChoosePT: Biophysical Agents, Effective Alternative for Opioid Reduction?
Q&A - LAB