Physical Agent Modalities (PAM)

Interventions (technologies) that produce a response in soft tissue through the use of 1) Light 2) Water 3) Temperature 4) Sound 5) Electricity

Superficial Thermal Agents

	Define	Indications	Contraindications
Conduction: Transfer of heat from agent to tissues **through direct contact**			
Hot Packs: effective up to a depth of 1-2 cm and can elevate subcutaneous soft tissue nearly 39 degrees **Hydrocollator temp:** 158-168 °F Hot pack requires 30 mins to reheat	☐ Temperature of 104-113°F to get a physiological effect ➢ Coupling media: **at least 6 layers** ■ **Hot pack layer=2 layers** ➢ Body application: Over flat and large body surfaces V. over the body extremities ➢ Time: most effect 20 mins	☐ pain management ☐ joint stiffness ☐ Muscle spasm	☐ impaired skin sensation ☐ Acute musculoskeletal conditions ☐ Impaired circulation ☐ Open wounds or skin conditions
Paraffin **Paraffin Temp** 122-125°F	➢ Decrease stiffness and improve ROM. ➢ 10 to 12 dips ➢ Time: 20 mins		
Convection: Heat transfer by <u>fluid motion around tissues</u>			
Hydrotherapy/ Whirlpool	➢ Uses forced air to agitate water to provide mild, mod, or vigorous doses of heat or cold.	➢ Wound care ➢ Edema control ➢ ROM	**NO Contraindication mention** **Disadvantages:** 1) dependent position of extremities 2) risk of cross-contamination 3) time consuming 4) requires large amounts of H20
Fluidotherapy	➢ Forced Convection ➢ Used as a mild, mod, or vigorous doses of dry heat	➢ Desensitization - #1 indication for use ➢ Decreasing edema through movement ➢ Reduces stiffness	➢ Open wounds
Cryotherapy cold transfer by 1) Convenction (cold whirlpool) 2) Coduction (ice packs) 3) Evaporation (cold sprays)			
Cryotherapy Muscle and nerve tissue changes begin to occur when the temperature drops below **80.6 °F** • **Reversing nerve conduction velocity (takes approx. 30 mins)**	(**Freezing air**, Another way of saying "cold pack", ice chips, ice machine, ice chambers)	➢ Edema ➢ Pain ➢ Inflammation ➢ Muscle spasms ➢ Spasticity	➢ Hypersensitivity to cold ➢ Impaired circulation ➢ Directly over open wounds ➢ Sensory deficits ➢ Infections

Deep Thermal Agents

Conversion:

- Heat is generated internally by sound waves moving molecules
- The energy of sound waves is converted to heat energy that can penetrate to a depth of 5 cm
- Two Types: 1) Ultrasound 2) Phonophoresis
  - **Ultrasound** Purposes: 1. elevating tissue temperature 2. providing nonthermal secondary cellular effects
    - Transfer of heat to deep tissue via sound waves produced by an eletric voltage across a crystal
    - The rate at which the wave travels depends on the density of tissue (Adipose absorbs more heat than tendon)
    - Does not heat up skin superficially.
    - 1 MHz = pentrates 5 cm 3 MHz = pentrates 1-2 cm

<table>
<tr><th></th><th>Effects of Ultrasound</th><th>Indications</th><th>Contraindications</th></tr>
<tr><td>Thermal

Non-thermal

0.2 W/cm2 20% duty cycle
3MHz</td><td>Heating: Thermal effect
• Usually with higher intensity and <u>continuous</u> mode
• increased metabolic rate, blow flow
• increased viscoelasticity of connective tissue
• decreased viscosity of fluid elements in the tissue
• elevated pain threshold
• increased enzymatic reactivity to stimulate the immune system

Healing: Non-thermal effect
• Lower intensity and <u>pulse</u> mode (On/off, on/off, on/off)
• Helps the healing process of the target tissue.
• Helps decrease inflammation.
• Pulls blood and nutrients to the affected area.</td><td>Thermal
Soft Tissue Contracture: Pre-Heating Tissue Prior to Stretch

Non-thermal
Promotes Tissue Healing
Also heals Dermal Ulcers (decubitus ulcers)
• Tendon Injuries
• Fracture Healing
• Pain control for Acute, Sub-Acute, or Chronic.</td><td rowspan="3">◆ Cancer (Tumors or Cancerous Areas)
◆ Pregnancy
◆ Central nervous system tissue
◆ Plastic components
◆ Pacemakers
◆ Thrombophlebitis
◆ Eyes
◆ Reproductive organs
◆ Not be applied over cemented
◆ prosthesis or plastic components since such materials can heat quickly
◆ Growth plates in children
◆ Heart
◆ carotid sinus
◆ cervical ganglion
◆ spinal ganglion
◆ DVT, hemorrhage
◆ Tumors
◆ Osteoporosis
◆ Infection

WARNING: Can cause INTERNAL BURN</td></tr>
<tr><td>General Considerations for Ultrasound</td><td colspan="2">➢ How big is the Sound Head Size determines where we will use this modality.
➢ Size of the Treatment Area
➢ Speed of the Sound Head
➢ Mode: continuous (heated) or pulsed (healing)
➢ Longitudinal vs. Circular Application Technique
➢ Contact Pressure: Firm
➢ Must keep moving the sound head and have direct contact with the skin
➢ Can overheat w/in 30 seconds</td></tr>
<tr><td>Phonophoresis</td><td>◆ Use of ultrasound to enhance the delivery of topically applied drugs (i.e. corticosteroids) into tissue</td><td>◆ Not really used anymore, iontophoresis is used more</td></tr>
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	research ➢ How much is actually transmitted?		

Electrotherapy : Uses electricity and electromagentic spectrum to facilitate tissue healing, improve muscle strength and endruance, decrease edema, modulate pain, decrease the inflammatory process, and modify the healing process.

	Define	Indications	Percautions/ Contraindications
Neuromuscular Electrical Stimulation (NMES)	☐ For stimulation of innervated muscles ☐ activate specific muscles or muscle groups ☐ Stimulation of the nerve produces a motor response	➢ Prevent disuse atrophy during inactivity ➢ Maintain or improve ROM and strength ➢ Facilitate voluntary motor control ➢ Decrease spasticity and muscle spasm ➢ Pumping action (reduce edema)	❖ Pacemakers ❖ Over eyes ❖ Peripheral vascular disease or infection, decreased/absent sensation, undiagnosed pain ❖ Over carotid sinus or transcerebrally ❖ Pt with decreased sensation ❖ Pt with decreased cognitive ability or comatose patients ❖ Pt with cancer, TB, active hemorrhage, infection ❖ Obese pt with excessive adipose tissue (may cause skin irritation or burn) ❖ Near diathermy devices ❖ During pregnancy ❖ Over the low back or uterus during the first trimester of pregnancy ❖ Over a metastases ❖ With osteomyelitis ❖ With thrombosis ❖ With allergy or skin sensitivity to conductive interface under the electrodes ❖ Pt allergic to iontophoretically delivered medication ❖ Pt who are taking diuretics ❖ Precaution with superficial metal pins, plates, or hardware
Functional Electrical Stimulation (FES)	☐ Functional Electrical Stimulation ☐ Synchronizes with movement ☐ Promotes function ☐ Stimulation is often delivered in a "Timed" manner o Only works if in a consistent timed manner. ☐ Often difficult to achieve well coordinated movement	☐ Common applications o Hemiparetic shoulder o Drop foot o Wrist drop	
Electrical Muscle Stimulation (EMS)	➢ Used on PNS injuries to **prevent muscle atrophy** ➢ Direct stimulation of membrane of <u>denervated</u> muscle, I.e. from a nerve injury. ➢ Wide pulse duration ➢ High Intensity	➢ Slows down muscle atrophy ➢ Improve local blood flow	
Transcutaneous Electrical Nerve Stimulation (TENS)	➢ **Gate Control Theory:** Blocks relay of pain to high brain centers and can produce small quantities of opiates in the body ➢ Used for pain mgmt, no time restrictions, but they can become accustomed to it and continue to need higher input to gain effect	➢ **Pain management ("Electrical Tylenol")** ➢ mainly for chronic pain control ➢ Externally Applied ➢ Portable ➢ Low back pain, arthritis, inflammatory disorders of soft tissue, etc.	

Interferential Current (IFC)	➢ A deeper form of TENS ➢ Stimulatation is concentrated at the **point of interesction** bewteen electrodes ➢ Higher intensity do not get better results	**Same as TENS (pain management)** **Treatment frequencies and time** ☐ 80-120 Hz = acute pain (10-12 mins) ☐ 3-10 Hz = chronic pain (15-20 mins) ☐ 1-5 Hz = treating edema (?)	
Premodulated Current **(Premod)**	➢ **Similar to IFC**; main difference is how the current is delivered to the patient's muscle tissue. ➢ **Single channel** is used to mix the frequencies prior to delivery of the current through the electrode of the body ➢ (Using two electrodes rather than four)	**Same as TENS (pain management)** ➢ Beneficial when treating areas of the body that have less space available ➢ Use on smaller muscle groups and joints such as the 1) elbow 2) ankle 3) foot 4) hands.	
High voltage galvanic stimulation **(HiVolt)**	➢ Electrical Stimulation for **Tissue Repair** ➢ Uses polarity (positive or negative) ➢ Interrupted monophasic wave form which is greater than 100 volts. ➢ Reach deeper into the body tissue ➢ does not produce contraction in the denervated muscle	**Treatment of** 1) chronic or acute edema and pain 2) facilitate wound healing 3) decrease muscle spasm 4) delay atrophy **5)** increase blood flow.	
Iontophoresis	➢ Use of a small electrical current to deliver medication or ionized drugs through the skin ➢ Usually anti-inflammatory agent e.g. **Dexamethasone** ➢ Be concern of local dermal reaction to concentrated medication ➢ Be concern of burn area at the charge electrode, because the current is going through a very small area. ➢ Effectiveness dependent on the number of ions being delivered and dep	**Clinical Considerations** **Precautions**: 1) drug sensitivities 2) known allergies 3) abnormal localized reaction of skin **Contraindicaitons:** 1) known allergies or sensitiviy to medication or ions being applied 2) application over skin irritation, bruises, lacerations 3) impaired or absent sensation 4) all contraindications identified for eletrical stimulation	
References	Bracciano, Alfred. Physical Agent Modalities, theory and application for occupational therapist. 2nd ed Slack, 2008 Cameron, Michelle. *Physical Agents in Rehabilitation*, 2nd ed Elsevier, 2003 Belanger, Alain-Yvan. *Evidence based Guide to Physical Agents* Lippincott, 2003		