What is heat?
- Increase in molecular vibration and cellular metabolic rate
- Normally utilized during subacute inflammatory phases
- Need to increase skin temperature to 104° to 113° Farenheit
- Transmission occurs via conduction or convection

Classified into three categories
- Chemical action associated with cellular metabolism
  - Superficial heating modalities
- Electrical or magnetic currents
  - Diathermy
- Mechanical action
  - Ultrasound
Electromagnetic Spectrum

- Electrical stimulating currents
- Shortwave diathermy
- Microwave diathermy
- Infrared
  - Cold packs
  - Cold whirlpool
  - Hot whirlpool
  - Paraffin
  - Hydrocollator
- Red (visible light – laser)
- Ultraviolet

<table>
<thead>
<tr>
<th>Wavelength</th>
<th>Frequency</th>
<th>Depth of penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>shortest</td>
<td>short</td>
<td>1-2 cm</td>
</tr>
<tr>
<td></td>
<td>shortest</td>
<td>10-15 mm</td>
</tr>
<tr>
<td></td>
<td>shortest</td>
<td>2 mm</td>
</tr>
<tr>
<td></td>
<td>longest</td>
<td>2 - 5 cm</td>
</tr>
</tbody>
</table>

Cellular Response

- Reciprocal Relationship:
  - ↑ in tissue temp. = ↑ in metabolism
  - ↑ in metabolism = ↑ in tissue temp.
- ↑ need for O² and nutrients
- ↑ in waste
- Higher metabolic rate allows arteriole dilation and ↑ in capillary flow.

Fluid Dynamics

- Vasodilation
  - Greater in superficial vessels
  - Allows local hyperemia
- Increase in Edema
- Increase in capillary pressure and permeability
Effects on Inflammation

- Accelerates inflammatory process
  - Increase in blood flow
    - Brings Oxygen
    - Brings Nutrients
    - Inflammatory metabolites
  - Allows removal of debris
    - Encourages phagocytosis

Effects on Muscle Spasm

- Allows for muscular relaxation
- Decreases primary and secondary muscle spindles sensitivity
- Reduction of local metabolites
- Increase in blood flow

Pain Control

- Mechanical damage
  - Occurs during the acute phase through swelling and spasm
  - Decreased by:
    - Reduction of pressure on nerve endings
    - Encouragement of venous and lymphatic return

- Chemical irritation
  - Occurs during the subacute/chronic phase through ischemia and irritation
  - Decreased by:
    - Increase in circulation
      - Movement of pain-causing chemicals
      - Delivery of Oxygen and nutrients to suffocating cells
**Pain Control**

- Increase in Tissue Temperature
  - Allows analgesia and sedation in injured area
  - Acts as counterirritant
    - Stimulates A-beta fibers
  - Effects lasts only as long as treatment

**What happens during heat application?**

- Rapid rise in skin temperature
- 10-15 minutes into Tx temperature gradient evens out
  - When athlete complains that modality has cooled down
- Rebound vasoconstriction occurs 20 minutes into Tx

**Rebound Vasoconstriction**

- When maximal dilation has occurred to the vessels and the intensity of Tx stays constant, vasoconstriction will occur
- Body’s defense mechanism to sacrifice superficial layer of tissue to save underlying tissues
- If treatment is continued, burning can occur
- Most common in modalities where the intensity of treatment stays consistent.
Mottling

- WARNING!!!!
- Tissue temperatures are getting to dangerously high levels!!!!
- Skin will appear to have beet-red splotches and ghost-white areas.
- Discontinue immediately

Effects of Heat

- Increase local temperature
- Increase metabolism
- Vasodilation
- Increased blood flow
- Increase in leukocytes and phagocytosis
- Increase in capillary permeability
- Increase lymphatic and venous drainage
- Increase metabolic wastes
- Increase in elasticity
- Increase formation of edema
- Decreased muscle tone
- Decrease muscle spasm

Indications

- Subacute/chronic conditions
- Subacute/chronic pain
- Subacute edema removal
- Decreased ROM
- Muscle guarding
- Muscle spasm
- Myofasical trigger points
- Sprains
- Strains
- Subacute contusions
Contraindications

- Acute conditions
- Impaired circulation
- Skin anesthesia
- Poor thermal regulation
- Open wounds or skin conditions
- Neoplasms—Abnormal tissue that grows at the expense of healthy tissue (ex. Tumor)

Heat vs. Cold

- Answer the following questions...
  - Does the area feel warm to the touch?
  - In the area sensitive to light or moderate touch?
  - Does swelling continue to increase over time?
  - Does swelling increase during activity?
  - Does pain limit joint range of motion?
  - Is the acute inflammatory process still active?

- Does patient continue to progress with the use of cold modalities?
- If “no” is answered to all questions heat can be used safely.
- As the number of “yes” answers increase, so does the indication to use cold.
Types of Superficial Heating Modalities

- Contrast Bath
- Warm Whirlpool
- Hydrocollator
- Paraffin
- Fluidotherapy
- Heat Lamp

Contrast Bath

- **Equipment Needed:**
  - Two areas or containers to facilitate both heat and cold application
  - Toweling

- **Application:**
  - Fill whirlpools (50°-60° F for cold and 98°-110° F for hot) or make heat pack/ice bag
  - Check with athlete for contraindications for cold and heat
  - Apply cold modality for 1 minute

  - Apply heat modality for 3-4 minutes
  - Repeat cycle for 20 minutes
  - Can alter sequence to meet your needs
  - Make sure heating and cooling modalities stay at the appropriate temperatures

  - Generally end with cold when needing vasoconstriction and heat when needing vasodilation
Considerations for Contrast Bath

- Used in the Subacute phase
- Used to allow transition from cold modalities to warm modalities
- Not good for treatment of swelling
  - Does not cause pumping of capillaries
  - Length of treatment does not allow for deep penetration
  - Length of treatment allows rise in blood flow with increasing edema in the area

Warm Whirlpool

- Equipment Needed:
  - Whirlpool
  - Towels
  - Chair or bench
- Application:
  - Check whirlpool for cleanliness
  - Fill whirlpool to desired height and to 98°-110° F for UE, 98°-104° F for LE, 98-102° F for FB
  - Check contraindications
  - Position patient appropriately
- Considerations:
  - Turn whirlpool on before patient puts injured area in the whirlpool
  - Have athlete place injured area in the whirlpool
  - Tx time: 15-20 minutes
  - Remove injured area
  - Drain and clean whirlpool
  - Check GFI switch
  - Be aware of skin conditions
  - Can cause sedative effect

- Warm Whirlpool
**Hydrocollator Packs**

- **Equipment Needed:**
  - Heat packs: made of canvas pouches containing petroleum distillate
  - Hydrocollator
  - Towels or terry cloth covers

- **Application:**
  - Carefully remove pack from hydrocollator with tongs and place into terry cloth cover
  - Check for contraindications
  - Position patient comfortably

- Use toweling to preserve modesty
- Apply SIX layers or 1 inch of toweling to prevent burns
- Place heat pack over the injured area
- Do NOT allow the patient to lay on heat packs.

- **Tx time:** 15-20 minutes
- Remove and place heat pack into the hydrocollator
- Be sure to clean hydrocollator and covers regularly to avoid contamination

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**Paraffin**

- **Equipment Needed:**
  - 1 Paraffin Bath-kept at 126° F
  - Paraffin/Mineral Oil mixture: 1 gallon oil to 2 gallons wax
  - Plastic Bag or Paint Brush
  - Toweling

- **Application:**
  - Dipping
  - Immersion
  - Painting
Paraffin-Dipping Technique

- **Application**
  - Check area for contraindications
  - Remove all jewelry, watches, etc.
  - Wash extremity with soap and water
  - Dip extremity into paraffin and remove until shiny
  - Redip 6-10 times
  - Place extremity into the plastic bag
  - Tape to secure the bag
  - Apply toweling to hold heat in
  - Tx time: 10-30 minutes
  - Remove toweling, plastic bag, and wax being care to avoid contamination
  - Return wax to paraffin bath

Paraffin-Immersion Technique

- **Application**
  - Check for contraindications
  - Remove jewelry, watches, etc.
  - Wash extremity
  - Dip extremity until shiny
  - Redip 6-10 times
  - On 10th time place extremity back into paraffin bath for duration of treatment
  - Tx time 10-15 minutes
  - Remove from bath and return wax
  - Watch for burns as temperatures can reach 212° F

Paraffin-Painting Technique

- **Application**
  - Check for contraindications
  - Remove jewelry, etc from the area
  - Wash area
  - Using paint brush apply thin layer of wax
  - Let dry until shiny
  - Apply 6-10 layers of wax
  - Wrap in plastic
  - Wrap in toweling to keep heat in
  - Tx time: 10 minutes or until cool
  - Remove plastic and towel
  - Return wax to bath
Infrared Lamps

- Equipment Needed:
  - Infrared lamp
  - Dry toweling
  - Moist toweling
  - GFI switch

- Application
  - Check for contraindications
  - Apply moist toweling to treatment area and dry toweling to non-treatment area
  - Position patient comfortably and the lamp 20 inches from treatment area
  - Tx time: 15-20 minutes
  - Skin should be checked every few minutes for mottling

Considerations for Infrared Lamps

- Depth of Penetration: 1 mm
- Used when pressure from other heat modalities is contraindicated
- Burns due to “Dry” heat
- Need to re-wet toweling
**Fluidotherapy**

- Materials Needed:
  - Fluidotherapy unit
  - Toweling
  - Cellulose material

- Application:
  - Check for contraindications
  - Position patient comfortably
  - Place injured area into machine
  - Use toweling at the interface between machine and body segment
  - Set temperature range between 110°-125° F
  - Tx time: 15-20 minutes
  - Can do active exercises within machine

**Counterirritants**

- Created from peppermint, wintergreen, camphor, and capsaicin oils.
- Commercial names: Flex-all 454, Biofreeze, Icy Hot, Ben Gay, etc.
- Thought that thin a-delta and c-afferent fibers inhibit pain similar to acupuncture
- Thought to increase ROM
- No proof that tissue temp. increases
Counterirritants

- Rubbing application stimulates large myelinated mechanoreceptors
- Application includes: rubbing, massaging, use with ultrasound, use with padding
- Much research is still being done to prove efficacy

Questions