Infrared Modalities

Fall in the infrared portion of the electromagnetic spectrum.
Associated with thermal changes within the body.
Can include both superficial heating and cooling modalities.

Electromagnetic Spectrum

<table>
<thead>
<tr>
<th>Therapeutic Modalities</th>
<th>Wavelength</th>
<th>Frequency</th>
<th>Depth of penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical stimulating currents</td>
<td>longest</td>
<td>highest</td>
<td>5 - 1 cm</td>
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<tr>
<td>Shortwave diathermy</td>
<td></td>
<td></td>
<td>1-2 cm</td>
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<tr>
<td>Microwave diathermy</td>
<td></td>
<td></td>
<td>10-15 mm</td>
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<tr>
<td>Infrared</td>
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<td></td>
<td>2 mm</td>
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<td>Cold packs</td>
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<tr>
<td>Cold whirlpool</td>
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<tr>
<td>Hot whirlpool</td>
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<tr>
<td>Paraffin</td>
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<tr>
<td>Hydrocollator</td>
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<td>Red (visible light – laser)</td>
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<tr>
<td>Ultraviolet</td>
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</tbody>
</table>
Types of heat transfer

- Conduction:
  - Heat exchange through direct contact
  - Transfer of heat moves from the area of higher heat to lower heat to try and balance temperatures.
  - Clinical examples:
    - Ice bag
    - Heat pack
    - Ice massage
    - Paraffin Bath

- Convection:
  - Heat exchange through particles (air, water) moving around an object
  - Clinical examples:
    - Whirlpool
    - Fluidotherapy
Types of heat transfer

- Radiation:
  - Heat exchange without the use of a medium.
  - Clinical examples:
    - Infrared lamps
    - Laser
    - Ultraviolet light

Types of heat transfer

- Conversion:
  - Changing from one energy form to another
  - Clinical examples:
    - Ultrasound
    - Diathermy

Cold Modalities

- What is cold?
  - A state that allows for decreases in molecular motion

- Cryotherapy
  - Modalities that range in temperature from 32° to 65°F
  - Allows for metabolic and vascular changes
Physiological Effects

- **Decrease in Tissue Temperature**
  - ↓ in blood flow
  - ↓ in metabolic rate
  - Allows for survival of hypoxia
  - Limits further injury to tissue
  - Tissue temp. must be decreased to 57°F for this to occur.

- **Local Vasoconstriction**
  - Occurs due to stimulation of local nerve receptors which triggers the Sympathetic N.S.
  - Assists in ↓ hemorrhaging and edema formation.

Hunting Response

- Study performed by Lewis in 1930’s discovered intermittent periods of vasoconstriction and vasodilation during ice immersion to the fingers.
- Recent research has debated the hypothesis.

Cold-induced Vasodilation

- Knight investigates further...
- **Hypothesis:** Immediate vasoconstriction after ice application. Followed by vasodilation; which leaves the diameter of the vessels larger than before treatment.
- **Findings:** Immediate vasoconstriction after ice application. Followed by vasodilation; which leaves the diameter of the vessels smaller than before treatment.
**Effects on Inflammation**

- Reduces the release of inflammatory mediators
- Decreases prostaglandin synthesis
- Decreases cellular permeability
- Limits secondary hypoxic injury

**Effects on Inflammation**

- **Secondary Hypoxic Injury**
  - Initial cell death occurs which results in ischemia and suffocation of cells
  - Rupture of capillaries occurs due to fluid in interstitial space which allows ischemia and suffocation of those structures which perpetuates the cycle.
  - Can be reduced by decreasing the rate of cellular metabolism, need for oxygen, and fluid in the interstitial space
  - Achieved through Ice, Elevation, and Compression.

**Effects on Muscle Spasm and Function**

- **Muscle Spasm**
  - Decreases pain
  - Decreases sensitivity of muscle spindles
  - Drop tissue temp. 9°
  - Allows inhibition of stretch reflex mechanism

- **Muscle Function**
  - Decrease ability to perform rapid muscle movements
  - Decreases strength, power, and endurance for 30 min. after Tx.
Pain Control

- Interruption of pain transmission
- Reduction of Muscle Spasm
- Decrease in nerve conduction velocity
- Limiting Edema formation

Pain Control

- Acts as a counterirritant
- Stimulates A-beta fibers

Pain Control

- Reduction of Muscle Spasm
  - Alleviates mechanical stimulation placed on nerve receptors in that area of spasm

Pain Control

- Decrease in Nerve Conduction velocity
  - Reduction in excitability of free-nerve endings.
    - Small-diameter myelinated nerves react first
  - Slows communication at synaptic levels
  - Greatest immediately after ice application
  - Can drop to a level where impulses cannot be transmitted
    - Cold-induced nerve palsy
Pain Control
- Limit of Edema Formation
  - Lessens mechanical pressure on nerve endings

Sensations of Cold Modalities
- Cold
- Burning
- Aching
- Numbness
- Analgesia
  - Most apparent during ice-immersion
  - Everyone is effected differently by ice.

Frostbite
- Occurs when skin temperature drops below 32° F.
- Skin should not look pale or cyanotic as an indication of lack of circulation
- Mainly occurs while using reusable cold packs that are stored at temperatures below freezing.
**Indications**
- Acute/Subacute Inflammation
- Acute and Chronic Pain
- Muscle Spasm
- Sprain
- Strain
- Contusion
- Bursitis
- Tendinitis
- DOMS
- Post-surgically
- Small, superficial burns
- In conjunction with Rehabilitation Exercises

**Contraindications**
- Open wounds or skin conditions (whirlpools)
- Anesthetic Skin
- Circulatory Insufficiency
- Advanced Diabetes
- Hypersensitivity or Allergy
- Raynaud’s Phenomenon: vascular reaction to cold or stress that results in white, red, or blue discoloration of extremities. Fingers and toes are first affected.
- Infection

**Types of Cold Modalities**
- Commercial Ice Pack
- Ice Pack
- Ice Massage
- Ice Immersion
- Cryocuff
- Cold Whirlpool
- Cryokinetics
- Cryostretch/Cold Sprays
Commercial Cold Packs

- Contained in a cold hydrocollator kept at 15°F
- Each pack contains petroleum distillate gel
- Used any time a cold pack is indicated

Tx Application:
- Place wet or dry towel on the skin of the tx area
- Apply toweling to protect patient’s modesty
- Apply cold pack over toweling
- Apply dry towel over cold pack

Commercial Cold Packs

- Application (Con’t)
  - Secure cold pack to the injured area with wrap
  - Elevate as needed
  - Time for 20 minutes
  - Check for frostbite and general comfort every 4-5 minutes.

Ice Packs

- Materials needed:
  - Ice machine
  - Plastic bags
  - Towels
  - Compression wrap (optional)

Application
- Fill plastic bag with desired amount of ice
- Remove air from bag
- Tie knot close to top of bag
- Apply to injured area being sure to mold it to the part being treated.
Ice Packs

Application
- Be aware of patients' modesty and use toweling to protect them
- Use compression wrap to secure bag to the area
- Leave pack on 7-30 minutes depending on treatment area

Ice Massage

Materials Needed:
- Paper Cups or commercial Ice massage cups
- Water
- Freezer
- Towels

Application:
- Fill cups ¾ with water
- Freeze overnight
- Drape treatment area with towels to prevent mess and preserve modesty of patient

Ice Massage

Application
- Tear away a portion of the paper cup
- Check for any jagged edges on the ice cup
- Pin-point treatment area
- Apply ice cup to injured area using circular or longitudinal strokes
- Be sure to apply some pressure to get a massaging effect
- Treat area for 7-15 minutes depending on target tissues.
- Wipe up excess water
Ice Immersion

Materials Needed:
- Basin or bucket
- Water
- Ice
- Toe caps
- Toweling

Application
- Fill bucket or basin ¾ full of ice
- Fill with water
- Temperature should range between 50-60° F
- Make sure toweling is on hand to clean up any spillage

Ice Immersion

Application
- Allow patient to use toe caps for highly sensitive areas
- Instruct patient to submerge the injured area into the bucket
- Treatment time should range from 10-20 minutes
- Use toweling to dry off area after treatment
- If treating acute injury be sure to compress and elevate after treatment
- If doing cryokinetics be sure the bucket is large enough.

Cryo-cuff

Materials Needed:
- Cryo-cuff
- Water
- Ice

Application
- Fill cooler with ice to specified line
- Fill cooler with water
- Attach bladder to the injured area
- Attach hose to cooler
- Open spout and lift cooler above injured area
**Cryo-cuff**

- **Application**
  - Once bladder is filled to desired level, close spout and lower cooler
  - When water warms, repeat above process

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**Cold Whirlpool**

- **Materials Needed:**
  - Whirlpool
  - Water
  - Ice
  - Towels

- **Application:**
  - Choose appropriate sized whirlpool
  - Fill with water and flaked ice
  - Temperature should range between 50-60° F
  - Turn on turbine before athlete gets into whirlpool

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**Cold Whirlpool**

- **Application:**
  - Allow athlete to position themselves appropriately
  - Treatment time is between 5 and 30 minutes
  - Turn off turbine after athlete has exited the whirlpool
  - Drain and clean whirlpool
  - Take precautions about electrocution and be sure to have GFI switch.
Cold Whirlpool

**Pros**
- Treatment of large areas
- Decrease likelihood of thermopane
- Decrease Tx Time
- Aids in Cryokinetics
- Helps weed out fakers

**Cons**
- Initially Expensive!!!
  - Start-up costs: $1500-4000
- Difficult to always target specific area of injury
- Gravity Dependant Position

Cryokinetics

**Materials Needed:**
- Some form of cold therapy: Ice bag, cup, immersion, whirlpool, etc
- Rehab plan or specific exercises
- Toweling as needed

**Application**
- Apply cold therapy for 12-20 minutes until initial "numbness" is achieved
- Remove from ice and have them perform a series of exercises for 3-5 minutes
- Repeat ice application for 3-5 minutes
- Repeat exercises for 3-5 minutes
- Repeat up to five times
- Always finish with ice for 12-20 minutes

- Be sure that exercises increase in difficulty and work only in a pain free range
- Results should target flexibility and strength gains
Cryokinetics

- Pros
- Cons

Cryo-stretch/Cold Sprays

- Materials Needed
  - Fluorochloro or ethyl-chloride spray
  - Stretches

- Application:
  - Place patient in comfortable position
  - Avoid spraying patients eyes, nose, or mouth
  - Hold the bottle upside down about 12-18 inches away from the skin

Cryo-stretch/Cold Sprays

- Applications
  - Spray the entire length of the muscle allowing the spray to contact the skin at an acute angle of 30° to 45°
  - Spray only in one direction in a sweeping manner
  - The tissue should be covered but not frosted in appearance
  - The static stretch should begin as you are applying the spray
  - Spray and stretch until you reach the maximal length of the muscle
  - This could take between 2-4 sprays
  - Allow tissue to re-warm and repeat stretching and spraying sequence.
  - Can be used many times in one day without causing harm
**Cold-spray precautions**

- Can cause frost-bite if used improperly
- Can cause skin irritations
- If ethyl-chloride is used:
  - Extremely flammable
  - Can cause a general anesthetic effect if fumes are inhaled

**Questions**