

INTRODUCION TO SPORTS THERAPY

Practical – Cryo Thermo Modalities SHSS4065

By the end of this session students should be able to:-

- Utilise cryotherapy and ice massage
- Apply superficial heat
- Apply ice in conjunction with compression
- Clinically reason the use of heat, cold and contrast therapy

Cryotherapy/Cryokinetics

- Application of cold for therapeutic purposes
- Therapeutic combination of cold and exercise

Cryotherapy

- Greater cooling achieved with crushed ice (maintain 0°C)
 - Knight (1995)
- Cold pack from freezer (much colder)
 - Not on direct skin. Insulating layer
- Cryocuff: cold water circulating units
 - Less effective tissue cooling
- Ice Massage
- Cold water immersion/ cold whirlpools (thermopane)
 - Water is typically 4-10°C
- Vapocoolant sprays
 - Superficial, rapid cooling via evaporation
 - No temperature change below the epidermis



Cryotherapy

Temperature decreases and physiological responses

- After few minutes of ice application, temperature decreases, level off few degrees above temp of ice
- Greater decreases in skin temp observed with wetted ice
- Skin temp can remain low up to 1 hour after a 30 minute application of ice (rest)

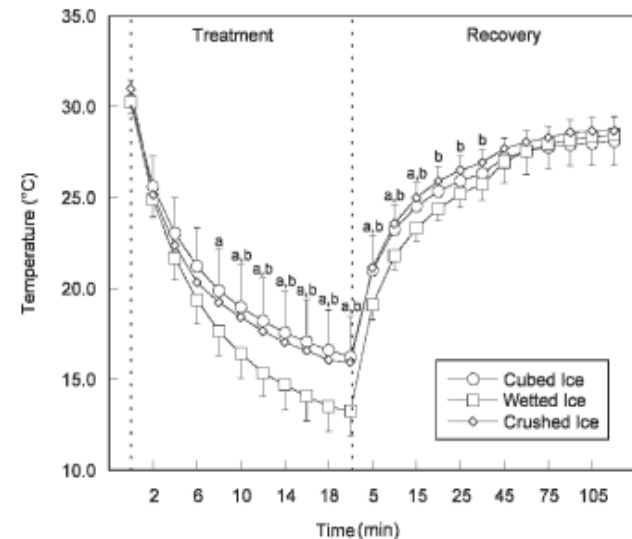


Figure 1. Change over time for mean surface temperature. Values are displayed in °C. ^a Indicates difference between wetted ice and cubed ice. ^b Indicates difference between wetted ice and crushed ice.

Cryotherapy

Cooling and Re-warming Deeper Tissues

- Deeper tissues cool more slowly and to lesser extent than the skin
 - 2.3cm below surface of calf, gastroc only cooled to 28°C after 22mins of ice pack (Hartviksen, 1962)
- Knight (1995)
 - Reapplication during the re-warming period results in cooler tissue temps
 - 30min application
 - 1 hour off
 - 30min application
 - Re-warm period should be twice the cooling period

Cryotherapy

Impact on Blood Flow

- Localised cooling
 - Decreased metabolic activity
 - Decreased oxygen demand of cells
 - Vasoconstriction and reduced blood flow
 - Reflex mechanism (Superficial)
 - Decreased metabolic activity (Deep)

Cryotherapy

Impact on nervous system

- Nervous system sensations
 - Intense cold
 - Aching pain
 - Pins and needles or warmth
 - Numbness
- Initially stimulates pain and cold receptors
- Cooling of nerve fibres slows conduction of nerve impulses: after several minutes impulses cannot be transmitted from periphery to sensory cortex
- Analgesia

Cryotherapy

Impact on Muscle Spasm and Function

- By relieving pain, ice breaks the pain-spasm cycle
- Also reduces muscle spasm by affecting muscle spindles
 - Sense the stretch of the muscle
- Reflex
 - Reflex to cold prior to cooling effect
- Decreased sensitivity of spindles
 - Muscle relaxes
- Reduction in force production
 - Maximum isometric & isotonic strength & rate of force development reduced when tissue cooled below 15-18°C (20mins)

Cryotherapy

Impact on Proprioception & Sensation

- Temporarily observe reduction in postural stability and balance (lower leg immersion)
- Ice pack does not produce same effect
- Jumping and agility may also be affected by tissue cooling
- Conflicting results on cutaneous sensations (Forearm and hand v foot)
- RELEVANCE??

Cryotherapy Implications

- **Cryotherapy and Acute Inflammation**
- Ice pack should be used and combined with compression, elevation and protection (rest)
- Control pain, limit swelling, prevent further injury
- Early application
- 20-30mins application every 2hours
- Pain reduced due to slowed nerve conduction velocity
- Reduced secondary cell death (hypoxic cell death)
- Elevation lowers capillary hydrostatic pressure (reduced swelling)
- Compression holds fluid in the capillary system and reduces swelling (elastic wraps v felt pads and tape)

Cryotherapy and Therapeutic Exercise: Cryokinetics

- **Cold and Motion (Knight, 1995)**
 - Cold application (water immersion, whirlpool, ice massage) for 10-15min (Analgesia)
 - Careful progression of exercises
 - Several repetitions required
- **Speeds functional recovery**
 - Breaks pain, spasm cycle
 - Resets central bias (Pappard 1977, relating to increased sensitivity of injured tissue)

Contraindications to Cryotherapy

- **Raynaud's Phenomenon**
- Constriction of arteries and arterioles in an extremity



- **Cold Urticaria**
- Allergic skin reaction: anaphylactic reaction
- **Cold Induced Haemoglobinuria**
- RBC breakdown exceeds Hb combining with proteins



Contraindications to Cryotherapy

- **Cryoglobulinemia**
 - abnormal clumping of plasma proteins stimulated by cold application
- **Cold Induced Nerve Palsy**
 - Require insulation: dry cloth, max 30min application

Superficial Heat

- ‘Superficial’ Fatty layer beneath dermis: insulates deeper tissues
- Little or no effect on temp of deeper tissues therefore metabolism or blood flow (exceptions)
- Despite this, often used to reduce pain and muscle spasm

Superficial Heat: Modes of Application

- Moist heat pack (Hydrocollator pack)
 - Hydrocollator tank heated to 170°F/76.6°C
- Warm water whirlpools
 - Also allow for active or passive motion
 - Temp should never exceed 115°F/ 46°C
- Paraffin Baths
 - 7 parts paraffin wax to 1 part mineral oil
 - Heated to 125-127°F/ 51.6-52.7°C
- Heat Lamps
 - Old school. Use a moist towel to increase temp of skin (Inverse square law)
- Fluidotherapy
 - Ground cellulose material heated to 120-125°F/ 48.8-51.6°C then blown around in air.



Superficial Heat and Physiological Responses

- Increase in skin temp
- Increase in inter-articular temperature of small joints
- Temperature of large muscle and deeper joints rises insignificantly
- Draper et al (1998)
 - 3.8°C rise at 1cm depth
 - 0.74°C rise at 3cm following 15min hot pack
- Ichikawa et al (2016)
 - Superficial response only compared to METs
- Superficial heat will not raise the temperature of tissues sufficiently to have therapeutic effect

Superficial Heat mechanism of effect

- **PAIN**

- Heat sensation carried by A-Delta and C-fibres
- Not understood WHY heat reduces pain.
- Heat sensation in to CNS may stimulate descending pain control mechanisms

- **ANTI SPASMODIC**

- Reduce pain, reduce spasm?
- Decreased sensitivity of muscle spindles (despite their temp not changing) Spinal Reflex Mechanism

- **Other**

- Superficially,
 - Increased metabolic activity, circulation, inflammation, tissue elasticity,
 - Decreased viscosity, sweating

Superficial Heating Implications

- Apply to relieve heat and spasm prior to therapeutic exercise
- Superficially
- Ultrasound and diathermy result in more vigorous heating and are preferred for tissue heating prior to mobilisation and stretching

Superficial Heating Implications

- Nadler et al (2002) continuous heat wrap application more effective in reducing pain than oral acetaminophen (paracetamol) or ibuprofen
- Nadler et al (2003a) low back pain reduced with heat more effectively than placebo medication or ibuprofen.
- Malanga et al (2014) showed that heat effect could be due to the increased oxygenation of the cells superficially leading to reduced pain, increased elasticity or neuromodulating effect of the pain.
- Akin et al (2001) Same for dysmenorrhoea

Superficial Heating

- **Research recommendations**

- Superficial heat applied for 20mins reduced sensitivity of active myofascial trigger points
- Long duration (8h) low level heat can be recommended in the management of acute low back pain,
- 20mins or more of superficial heat will reduce pain and thus likely stiffness in patients with musculoskeletal injuries and arthritic conditions

Heat and Cold: Contrast Therapy

- **Walsh (1996); Bell and Prentice (1998)**
 - Cold to hot ratio of 1:3mins or 1:4min
- **Effects;**
 - Vasodilation and vasoconstriction (pump action) to reduce swelling
 - Tissue temp not affected by contrast (Myer et al 1994, 1997)
 - Reduce oedema
 - Reduces pain (sharp sensory contrast) thus spasm
 - Combine reduced pain and spasm with increased active and passive ROM = increase lymphatic drainage and decrease swelling

Heat and Cold: Contrast Therapy

- **Conflicting data:**
- Cote et al (1988)
 - Increased ankle swelling after contrast treatment over 3 days after acute lateral ankle sprain
- Kuligowski et al (1998)
 - Contrast and cold were more effective than superficial heat on pain and ROM associated with DOMS

Conclusions

- **Pain and Muscle Spasm?**
 - Cryotherapy, Superficial Heat and Contrast
- **Contraindications?**
- **Acute injuries**
 - Cold: analgesic, antispasmodic, minimise secondary tissue injury
 - Combine with protection of healing tissue, compression and elevation
- **No Contraindications or Acute Injury**
 - Cold is better if pain and spasm are severe
 - Preference! (Placebo?)

Ice massage

- Polystyrene cup was filled with water and frozen to form an ice ball.
- Applied the ice ball directly to the skin by using circular and stroking motions for a period of 15 min
- The water not usually wiped away as the ice melted.



The Hunting Lewis Response

- The hunting reaction or hunting response is a process of alternating vasoconstriction and vasodilation in extremities exposed to cold
- Lewis (1930) was the first author to describe the hunting response that occurs during exposure of the fingers to the cold, the ascending part of which is commonly referred to as a cold induced vasodilation (CIVD)
- Thought initially to be protective mechanism, but now believed to do more damage



References

- Knight, K. L. (1995). Cryotherapy in Sports Management. Champaign Illinois, HK.
- Hubbard et al (2004). Does Cryotherapy improve treatment outcome? A systematic review. Journal of Athletic Training. (29). Pp. 88-94.
- Myrer et al (1997). Cold and hot pack contrast therapy. Journal of Athletic Training. (32). Pp. 238-241.