

통증조절을 위한 물리치료



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Physical Therapy in Pain

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Physical Therapy

- 여러 가지 물리적 요소(physical agents) – 열, 광선, 전기, 초음파, 운동 등 – 를 이용하여 재활 의학적 치료를 하는 것



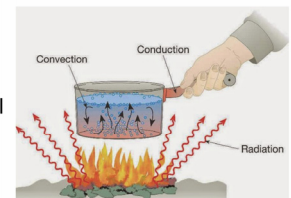
Types of Physical Therapy

- 온열치료 (Therapeutic heat)
- 한냉치료 (Therapeutic cold)
- 전기치료 (Electrical therapy)
- 역학치료 (Mechanotherapy)
- 운동치료 (Therapeutic exercise)

Therapeutic Heat

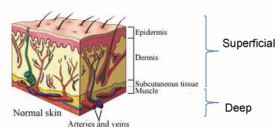
Form of Heat Transfer

- Conduction (전도)
 - Hot pack/Paraffin bath
- Convection (대류)
 - Fluidotherapy/Whirlpool
- Radiation (복사)
 - Infrared
- Conversion (전환)
 - Ultrasound/Shortwave/Microwave



Depth of Penetration

- Superficial heat (표재열)
 - Skin, subcutaneous tissues (~2 cm)
 - Hot pack/Paraffin bath
 - Fluidotherapy/Whirlpool
 - Infrared
- Deep heat (심부열)
 - Muscle, tendon, ligament, bone (3~7 cm)
 - Ultrasound/Shortwave/Microwave



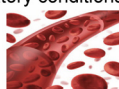
Therapeutic Range

- Target tissue temperature
 - 40~45 °C
- Applying duration
 - 20~30 min for most modalities
 - US; 5~10 min per site
- Frequency
 - Based on severity of the condition being treated & on clinical judgement



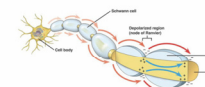
Physiologic Effects

- Hemodynamic
 - Blood flow ↑, Vasodilatation
 - Ingress of nutrients, leukocytes & antibodies ↑
 - Egress of metabolic byproducts & tissue debris ↑
 - Facilitate resolution of chronic inflammatory conditions
 - Bleeding ↑
 - Edema formation ↑
 - Exacerbate acute inflammatory conditions



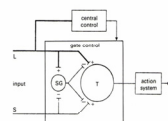
Physiologic Effects

- Neuromuscular
 - Nerve conduction velocity ↑
 - Up to 7.5 m/sec following hydrotherapy at 44~45 °C
- Joint & connective tissue
 - Tendon extensibility ↑
 - Collagen activity ↑
 - Joint stiffness ↓



Physiologic Effects

- Miscellaneous
 - Pain ↓
 - Cutaneous counterirritant effect
 - Vasodilatation
 - Ischemic pain ↓, Washout of pain mediators ↑
 - Endorphin-mediated response
 - Alteration of nerve conduction / cell membrane permeability
 - General relaxation



Indication

- Musculoskeletal conditions
 - Tenosynovitis, tendinitis, bursitis, capsulitis...
- Pain
 - Neck, lower back, myofascial...
- Arthritis
- Contracture
- Muscle relaxation
- Chronic inflammation



Contraindication

- Acute trauma/inflammation
- Impaired circulation
- Bleeding diatheses
- Edema
- Large scars
- Impaired sensation
- Malignancy
- Cognitive impairment



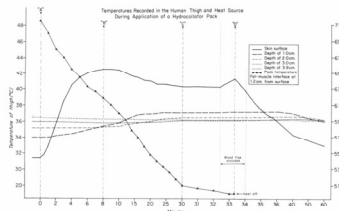
Hot Pack

- Hydrocollator pack
- Silicone dioxide + Canvas pack
- 70~80°C
- 20~30 min
- Precautions
 - Should not lie on the pack!
 - (Increasing the risk of burns)



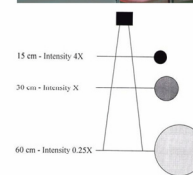
Hot Pack

- 1 cm depth : 3.3°C elevation
- 2 cm depth : 1.3°C elevation
- Intra-articular : 1.2°C elevation



Infrared Radiation

- Precautions
 - General heat precautions
 - Light sensitivity
 - Skin drying
 - Dermal photoaging
- Intensity of radiation
 - Inversely with the square of the distance from the source



Paraffin Bath

- Paraffin wax : Mineral oil = 7 : 1
- 52.2°C~54.4°C
- Method
 - Dipping
 - 7 to 12 dips followed by wrapping in towels
 - Subcutaneous tissue : 3°C↑, muscle : 1°C↑
 - Immersion
 - Several dips to form a thin glove, followed by immersion for 30 min
 - Subcutaneous tissue : 5°C↑, muscle : 3°C↑



Fluidotherapy

- Hot air & solid particle (solid-gas mixture)
 - Superficial, dry heating modality
- Heat therapy + massage action
- Freedom to perform ROM exercise
- 46.1°C~48.9°C



Hydrotherapy

- External application of hot or cold water, in any form, for the treatment of disease
- Whirlpool bath, Hubbard tank, Shower cart, Contrast bath
- Primary uses are in arthritis & variety of MSK conditions
Cleansing & debridement of burns & other dermal injury



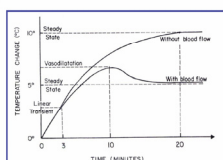
Whirlpool Bath / Hubbard Tank

- Control water temperature & agitate it by aeration
- Whirlpool bath
 - For limb or localized lesion (43~46℃)
- Hubbard tank
 - For whole-body immersion (33~36℃)
- Treatment
 - Degenerative arthritis (OA, RA)
 - Acute MSK injury
 - Burn / skin ulceration
 - Sodium chloride (antibacterial solution)

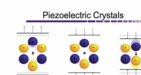


Deep Heating

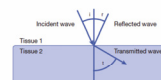
- Diathermy
 - Dia (“through”) + therme (“heat”)
- Target tissue
 - Muscle, tendon, ligament, bone
 - Not skin, subcutaneous fat
- Therapeutic target temperature
 - 40~45℃



Ultrasound

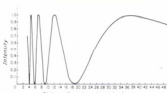


- High frequency acoustic energy to produce thermal & non-thermal effects
 - Reverse piezoelectric effect; Electrical current → vibration
- Attenuation; travel through tissue, lose their energy
 - Absorption (major cause); energy is converted into heat
 - Beam divergence
 - Deflection
 - Reflection / Refraction / Scattering
 - High frequency; more focused & more superficial



Ultrasound

- Non-thermal effect
 - Cavitation; gas bubble in a sound field
 - High temperature & pressures
 - Platelet aggregation
 - Local tissue damage & cell death
 → High frequency, low intensity
 - Media motion (acoustic streaming)
 - Unidirectional movement in pressure field
 - Cell membrane damage
 - Accelerate metabolic processes
 - Standing wave
 - Resonant superposition
 → Stroking method



Ultrasound

- Application
 - Stroking method
 - Slow (1~2cm/sec)
 - 100 cm²/5~10min
- Intensity
 - 0.25~2.0 W/cm²
- Frequency
 - 0.8~1.1 MHz



Ultrasound

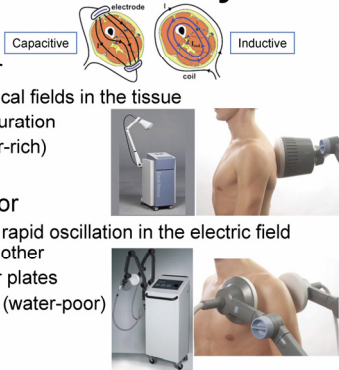
- Precautions
 - General heat precautions
 - Near brain, eyes, reproductive organs
 - Gravid or menstruating uterus
 - Near pacemaker
 - Near spine, laminectomy sites
 - Malignancy
 - Skeletal immaturity
- ★ 금속성 내고정물을 갖고 있어도 안전하고 효과적으로 치료할 수 있는 거의 유일한 심부열 치료

Shortwave Diathermy

- 초단파; 27.12 MHz (most commonly used)
- Mean temperature increases (3 cm depth GCM m.)
 - 1.36 °C at 5 min / 3.78 °C at 15 min
- Precautions
 - General heat precautions
 - Metal (jewelry, pacemakers, IUDs, surgical implants)
 - Contact lenses
 - Gravid or menstruating uterus
 - Skeletal immaturity

Shortwave Diathermy

- Inductive applicator
 - Induce circular electrical fields in the tissue
 - Cable or drum configuration
 - Muscle, vessel (water-rich)
- Capacitive applicator
 - Heat is generated by rapid oscillation in the electric field from one plate to the other
 - Two metal condenser plates
 - Subcutaneous tissue (water-poor)



Microwave Diathermy

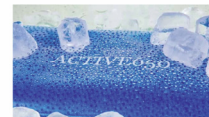
- 극초단파; 915 MHz (most commonly used)
- Average temperature of approximately 41 °C at a depth of 1~3 cm
- Precautions; same as shortwave diathermy



Therapeutic Cold

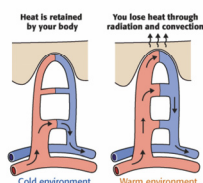
Form of Cold Transfer

- All forms of cryotherapy are superficial agents
- Conduction (전도)
 - Cold pack/Ice massage/Cold water immersion
 - Cryotherapy-compression units
- Convection (대류)
 - Whirlpool bath
- Evaporation (기화)
 - Vapocoolant spray



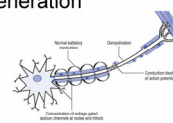
Physiologic Effects

- Hemodynamic
 - Immediate cutaneous vasoconstriction
 - Bleeding ↓
 - Edema formation ↓
 - Chemical action of cell ↓
 - Acute inflammatory conditions ↓



Physiologic Effects

- Neuromuscular
 - Nerve conduction velocity ↓
 - Prolonged exposure ; Conduction block & axonal degeneration
 - Muscle fatigue ↓
- Joint & connective tissue
 - Tendon extensibility ↓
 - Collagenase activity ↓
 - Joint stiffness ↑



Physiologic Effects

- Miscellaneous
 - Pain ↓
 - Reflex muscle relaxation
 - Cutaneous counterirritant effect
 - Alteration of nerve conduction
 - General relaxation

Indication

- Musculoskeletal conditions
 - Sprain, tenosynovitis, tendinitis, bursitis, capsulitis...
- Myofascial pain
- After certain orthopedic surgeries
- Component of spasticity management
- Emergency treatment of minor burns



Contraindication

- Cold intolerance / hypersensitivity
- Cryotherapy-induced neurapraxia or axonotmesis
- Arterial insufficiency
- Impaired sensation
- Cognitive impairment
- Cryoglobulinemia / Cryopathies
- Paroxysmal cold hemoglobinuria
- Raynaud disease or phenomenon



Therapeutic Cold

- Acute condition; first 48~72 hrs (PRICE)
- Transition from cold to heat
 - No signs of increase inflammation
 - Decreased swelling
 - No increase in tissue temperature
 - When effect from ice applications plateaus
 - Decreased range from stiffness



Cold Pack

- Hydrocollator pack
 - Cooled in a freezer to -12°C
- Chemical gel pack
 - Ammonium nitrate + water \rightarrow heat absorbing reaction
- Ice pack
- 20~30 min
- Cooling time
 - Subcutaneous tissues; within min
 - Muscle at a depth of 2 cm; approximately 5°C after 20 min



Ice Massage

- Ice + stroking motion
 - Cooling with the mechanical effects
- 5~10 min per site
- Initial perception of coolness
 - \rightarrow Burning or aching
 - \rightarrow Hypoesthesia & analgesia



Cold Water Immersion

- Suited for circumferential cooling of the limbs
- Usually at temperatures of $5\sim 13^{\circ}\text{C}$
- Localized burns



Cryotherapy-Compression Unit

- Cryotherapy + pneumatic compression
- Acute musculoskeletal injury with soft tissue swelling
- After surgical procedures
- Temperature; 7.2°C / Pressure up to 60 mmHg



Vapocoolant Spray

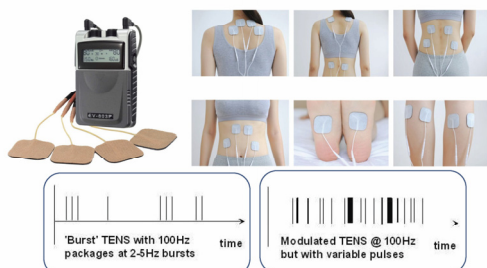
- Spray and stretch method
 - ; Unidirectional application
 - ; Begin in the "trigger area" \rightarrow "reference zone"
 - ; Passively stretching the muscle
 - ; Parallel to the muscle fiber
 - ; Rate of 4 inches/sec
- Counterirritant effect
- Myofascial pain syndrome
- Musculoskeletal pain



Electrical Therapy

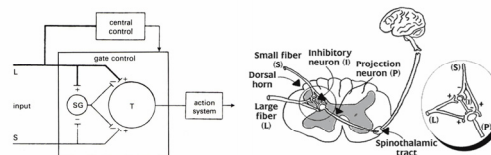
TENS

- = Transcutaneous electrical nerve stimulation
- Rate of 50~100 Hz



Physiologic Effects

- Stimulation of large myelinated fibers presumably block nociceptive transmission at the spinothalamic tract
- Gate control theory; act as a counterirritant

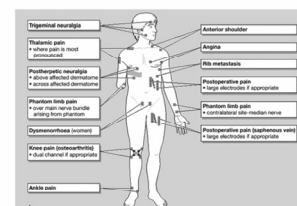


Physiologic Effects

- CNS endorphin ↑
 - β-endorphins, enkephalins, serotonin, dynorphin
- Peripheral effects
 - Nerve conduction velocity ↑
 - Pain threshold ↑
 - Local cutaneous blood flow ↑

Indication

- Musculoskeletal pain
 - RA/OA pain
 - Myofascial pain
 - Visceral pain
- Neurogenic pain
 - Deafferented pain syndrome (phantom limb)
 - Sympathetically mediated pain
 - Acute postoperative pain



Contraindication

- Impaired sensation
- Near pacemaker
- Cardiac conditions; arrhythmia
- Over carotid sinus, eyes
- Gravid uterus or fetus
- Psychological problems
- Malignancy

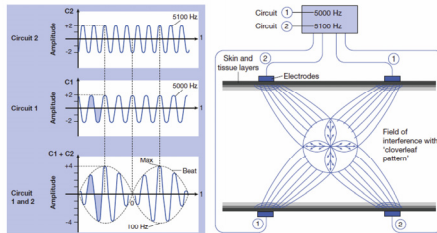
ICT

- = Interferential current therapy



ICT

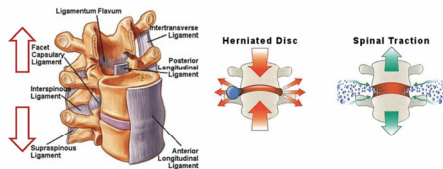
- Two alternating current signals of slightly different frequency



Mechanotherapy (Traction, Manipulation, Massage)

Spinal Traction

- Enlarged intervertebral space
- Separate facet (intervertebral) joint
- Production of PLL (posterior longitudinal ligament) tension to reduce herniated disc
- Stretching a tight muscle & ligament



Cervical Traction

- Sitting or supine position
- Neck flexion 20~30°
- Weight; 20~30 lbs
- Duration; 10~30 min



Lumbar Traction

- Supine position
- Hip flexion 70°, angle of pull of 18°
- Weight; 1/4 of body weight (up to 50~100 lbs)
- Duration; 10~30 min



Contraindication

- | | |
|---|---|
| <ul style="list-style-type: none"> General <ul style="list-style-type: none"> Osteomyelitis or discitis Bone tumor Unstable fracture Severe osteoporosis CVD Inadequate expertise | <ul style="list-style-type: none"> Cervical <ul style="list-style-type: none"> Central HIVD Hypermobility joint RA Carotid a. disease Lumbar <ul style="list-style-type: none"> Pregnancy Cauda equina syndrome |
|---|---|