

- Modalities in Rehab
  - Faizan zaffar kashoo
- **most commonly used**
- **cryotherapy**
- **thermotherapy**
- **electrical stimulation**
- **iontophoresis**
- **traction**
- **ultrasound**
- Modalities in Rehab
- **modalities are adjuncts to treatments not sole treatments.**
- **most have limited evidence to support its use.**
  - **lots of anecdotal evidence**

- **parameters in the literature are very variable resulting in wide ranges**
  
- **Cryotherapy**
- **Indications**
  - **Acute or chronic pain, or muscle spasm**
  - **Acute inflammation**
  - **Post surgical pain or edema**
  - **Facilitate mobilization**
  
- **Cryotherapy**
- **Heat Abstraction**
- **Depth of 5cm can be cooled**
- **Change in Temperature depends on:**

- **Type of Agent**
- **Temp. difference between agent and tissue**
- **Amount of insulation**
- **Thermal Conductivity**
- **Limb circumference**
- **Duration of application**
- **Cryotherapy**
- **Leads to vasoconstriction**
- **Decreases tissue metabolism**
- **Decreases tissue permeability**
- **Decreases capillary permeability**
- **Decreases pain**
- **Decreases spasms**

- **Analgesic relief of pain**
- **Types of Cryotherapy Applications**
- **Ice Massage**
- **Ice Packs**
- **Cryocuffs**
- **Ice Immersion (Whirlpool)**
- **Commercial Gel and Chemical Packs**
- **Controlled Cold-Compression Units**
- **Vapocoolant sprays**
  
- **Thermotherapy**
- **Increases circulation**

- Increases cellular metabolism
- Produces analgesic or sedative effect
- Helps resolve pain and muscle spasm
- Vasodilatation:
  - Promotes Healing
  - Increases Oxygen concentration
  - Removes debris and waste products
- **Thermotherapy**
- **Types of Applications**
  - **Moist heat packs**
  - **Ultrasound**
  
  - **Paraffin baths- hands (OT)**

- **Diathermy heat –not used clinically anymore**
- **Whirlpools - training rooms**
- **Hot tubs – training rooms**
  
- **Electro Therapy**
  
- **TENS**
- **Conventional**
- **Low Rate**
- **Conventional / High Rate TENS**

***Indications:***

- **Any painful condition**
  - **Chronic typically**
- **If Muscle contraction:**
  - **increases pain**

- contraindicated
- **Post-op management of pain**

*Contraindications:*

- **Known myocardial problems, pacemakers**
- **Stimulation over anterior neck**
- **Thrombophlebitis**
- **Superficial skin lesions**
  
- **Conventional / High Rate TENS**
- **Low Rate TENS**
- **Mechanism of action equated with acupuncture**
- **More vigorous than high-rate**

- **Used to treat sub-acute, chronic pain and trigger points**
- **Pain modulation:**
  - **neurochemical inhibitory mechanisms**
  - **motor level pain modulation**
- **Beta-endorphins!**
- **Low Rate TENS**
- ***Indications:***
  - **pain, now tolerates muscle contraction**
  - **trigger points**
  - **muscle guarding**
- ***Contraindications:***
  - **same as for conventional TENS**

# ■ **Therapeutic Electrically Induced Muscle Contraction**

- **Therapeutic gains:**
  - **muscle reeducation**
  - **muscle pump contractions**
  - **muscle strengthening**
- **Muscle Reeducation**
- **Primary indication:  
inhibition after injury or  
surgery**

- **Theory for inhibition related to sensorimotor dysfunction**
- **ES induces involuntary muscle contraction which increases sensory input from that muscle**
- **A modified NM Elect Stim protocol for quad strength training following ACL reconstruction**
- **Muscle Strengthening**
- **Effectiveness with ES for weakness (post-surg).**

- **More rapid recovery and greater gains than exercise alone** (Snyder-Mackler 1995, Delitto 1988, Eriksson 1979, Godfrey 1979)
- **Mechanism:**
  - **Specificity: preferential recruitment of type II muscle fibers**
  - **Overload principle:**
    - **e-stim with ex – NO improved strength than either one alone (Alon 1987)**
- **Kots (1977) reported significant strength gains in healthy individuals using ES**
- **Russian Current**
- **Russian Current**
- **1977 Yakov Kots**
  - **report during Canadian-Soviet exchange symposium on electrostimulation of skeletal muscle**
  - **3 revolutionary claims**

- generates 30% more force than max vol contraction
  - painless current
  - lasting gains up to 40% strength increase in normals
- **Commercial reaction**
  - production of “Russian” current stimulators
- **Indications for “Russian” current**
- **Post knee lig surgery**  
(Curwin et al, Can Ath J, 1980)
- **Post arthroscopic knee surgery** (Williams et al, JOSPT, 1986)
- **ACL sprain (increase quad force during immobilization)** (Nitz, PT, 1987)
- **“PRIME” indication: strengthen the muscular**

# **apparatus of HEALTHY population**

- **Muscle Pump Contractions**
- **Edema Reduction**
- **ES to induce muscle contractions (pumping action)**
- **Duplicates normal muscle pumping contractions**
- **Stimulates circulation thru venous and lymphatic channels**
- **Induce circulatory changes while protecting limb**
- **Edema Reduction**
- **Sensory level stimulation may be used for edema control**
  - **increase ionic movement**

- reported to decrease edema *in vitro*
- effectiveness not found in humans *in vivo*

# ■ Interferential Current

- Interferential  
Biophysical  
Characteristics

## Methods of delivery

quadripolar: 4 electrodes,  
each pair to separate  
channel

Interference at level of  
TREATMENT AREA

“4 leaf clover” shaped field

- **Interferential  
Biophysical  
Characteristics**

## **Methods of delivery (cont)**

quadripolar

Target

sweep: **enlarge field**

Vector scan

- **Electrical  
Stimulation for  
Denervated  
Muscle**

- **ES for Denervated Muscle**
- **Utilized in PT for decades**

- **Purpose: minimize atrophy during regeneration**
- **Parameters depend on generator:**
  - **Can be DC or AC**
- **ES for Denervated Muscle**
- **Controversy over efficacy produced several *in vitro* studies in mid 80's (Girlanda 1982 Exp Neurol; Pachter Arch Phys Med Rehabil, 1982)**
- **Does Not effect improvement in rate of regeneration**
- **Difficult to reach a consensus whether to use ES to treat denervated muscle b/c:**
  - **animal vs. human studies**
  - **variety of methods used**

- animals: no treatment has lasted more than 2 months
  - **ES for Denervated Muscle**
- More controversy: (*in vitro* studies)**
- **Rats. Estim may retard motor nerve sprouting and reinnervation (Schimrigk 1977)**
  - **Delay of functional return from interference with reinnervation**
    - **ES induced contraction disrupts regenerating NMJ**
    - **this retards reinnervation**
  - **Trauma to regenerating cell body ??**
  - **Definitely more research needed!**

# ■ **Iontophoresis**

■

- **Introduction**
- **Transcutaneous drug delivery has been used for centuries**
  - **herbal plasters, medicated baths, etc.**
- **Iontophoresis -- the use of an electrical current for the transcutaneous delivery of ions into the body**
- **Introduction**

- **Fairly widespread use of iontophoresis past 20-30 years**
- **Very commonly used now in PT clinics**
- **Iontophoresis offers a safe and painless way of “injecting” drugs through the skin into underlying target tissues**
- **Alternative to oral or injection methods of drug delivery**
- **Basic Principles of Application**
- **Electrostatic repulsion of like charges is the driving force for iontophoresis**

- Knowledge of a drug's or ion's polarity is critical – dictates the polarity of the electrode needed to drive the drug to underlying Rx area
- IontoPatch™
- “Patch” is both a current generator and electrodes
- Applied in the clinic and the patient wears the patch home
- Delivers a very low amplitude of current (0.1 mA) that is worn for 12-24 hours

- **Manufacturer states that the low intensity current reduces the risk of skin irritation and burns**
- **Common Medications Used in Iontophoresis**
- **Does it Work ??**
- **Experimental evidence does exist to show that iontophoresis does enhance the transcutaneous delivery of ions into tissues**
- **Limited depth of penetration (1 cm  $\approx$  1/2 in)**
- **Lack of high-quality clinical evidence to support its use, but**
- **Sufficient evidence from case studies and commentaries that suggest clinicians should**

**consider iontophoresis for the treatment of superficial inflammatory conditions**

## ■ **Traction**

### ■ **Indications**

- **Herniated disc**
- **Spinal nerve impingement**
- **Spinal nerve inflammation**
- **Joint hypo-mobility**
- **Narrowing of intervertebral foramen**
- **Degenerative joint disease**
- **Joint pain**

### ■ **Contraindications**

- **Unstable vertebrae**
- **Gross emphysema**
- **Temporomandibular joint dysfunction**
- **Patient discomfort**

## ■ **Ultrasound**

**COL Josef H. Moore, PhD, PT, SCS, ATC**

### ■ **Introduction**

### ■ **Ultrasound uses:**

- Diagnostic (low intensity)
- Surgical (high intensity)
- Therapeutic
- **Therapeutic US widely used for deep heat**
- **Introduction**
- **Primary clinical use:**
  - Soft tissue repair
  - Pain relief (analgesia)
  
- **Effective Radiating Area (ERA)**
- **Total area on surface of transducer producing soundwave**
- **Ideally ERA should match size of transducer**

- **Treatment area should not exceed 2-3 times ERA**
- **Frequency of Ultrasound**
- **Determined by number of times crystal deformed/sec.**
- **2 most common utilized in U.S.**
  - **1.0 MHz**
  - **3.0 MHz**
- **Determines depth of penetration, unlike ES**
- **Frequency of Ultrasound**
- **Inverse relationship between frequency and depth of penetration**
- **Penetrating depths:**

- **1.0 MHz: 2-5 cm**
- **3.0 MHz: 1-2 cm**
- **Absorption rate increases with higher frequency**
- **Pulsed vs Continuous**
- **Most new generators produce both**
- **Both produce thermal & nonthermal effects**
- **Pulsed vs Continuous**
- **Continuous:**
  - **Sound intensity remains the same**
  - **Commonly used for thermal effects**
- **Pulsed vs Continuous**
- **Pulsed:**

- Intensity periodically interrupted
- Average intensity reduced over time
- **Physiological Effects of Ultrasound**
- Thermal effects
- Non-thermal effects
  - Cavitation
  - Acoustic microstreaming
- Thermal Effects
- Clinical effects:
  - Increased extensibility of collagen fibers
    - tendons
    - joint capsule
  - Decreased joint stiffness
- Thermal Effects

- **Clinical effects:**
  - Reduction in muscle spasm
  - Pain modulation
  - Increased blood flow
  - Increased nerve conduction
- **Thermal Effects**
- **Primary advantage of US**
  - Selective heating of tissues high in collagen
  - Non-thermal effects are occurring
- **Non-thermal (Mechanical) Effects**
- **Primary physiological effects are cavitation and acoustic microstreaming**
- **Cavitation:**

- **Formation of gas-filled bubbles in tissue fluids**
- **Expansion/compression of bubbles either stable or unstable**
  
- **Non-thermal (Mechanical) Effects**
- **Acoustic microstreaming:**
  - **Unidirectional movement of fluids along cell membrane boundaries**
  - **Produces high viscous stresses**
  - **Alters membrane structure & function**
  - **Increased permeability to ionic influx**
  
- **Non-thermal (Mechanical) Effects**

- **Potential therapeutic effects from cavitation & microstreaming**
  - **Stim. of fibroblast activity increases protein synthesis & tissue repair**
  - **Increased blood flow**
  - **bone healing & repair of non-union fractures**
- **Ultrasound**
- **Indications**
  - **Increase deep tissue heat**
  - **Decrease inflammation**
  - **Decrease muscle spasms**
  - **Decrease pain**
  - **Increase extensibility of collagen tissue**
  - **Decrease pain of neuromas**
  - **Decrease joint adhesions**

- **Treat myositis ossificans**
- **Contraindications**
  - **Hemorrhage**
  - **Infection**
  - **Thrombophlebitis**
  - **Suspected malignancy**
  - **Impaired circulation or sensation**
  - **Stress fracture sites**
  - **Epiphyseal growth plates**
  - **Over the Eyes, Heart, Spine, or genitals**
- **Phonophoresis**
- **Ultrasound with drugs, used to increase absorption and penetration of drugs**
- **Anti-inflammatory's**

- **Cortisol**
- **Dexamethasone**
- **Salicylates**
- **Analgesics**
  - **Lidocaine**
- **Phonophoresis**
- **in theory phonophoresis increases the permeability of the stratum corneum allowing better penetration of drug**
- **Summary**
- **modalities are best utilized as adjuncts not primary treatment**
- **limited evidence**
  - **plenty of anecdotal proof**

- variable parameters
- most utilized are ionto, traction heat/cold, and estim

▪ **Questions??**  
**??**