Shortwave Diathermy

Definitions: Form of deep localized heating for tissue
An oscillatory electric current of high frequency

Specifications:
- Frequency: 27.12 MHz
- Wavelength: 11 meters
- Penetration: up to 2 inches (at muscle layer)
- Temp: 109.4 – 113 F (43-45 C)
- Propagation of heat: conversion
- Treatment time: 20-30 minutes

Experimentation:
Kirchoff’s law

2 types of short wave diathermy (SWD)

**Electrostatic SWD** (2 electrodes)
- A.k.a. condenser SWD
- Best for deep cavity heating
- Fat does not tend to decrease the absorbance

An electrical field
- Patient is part of the circuit
- Electrode Spacing
- Electrodes: air-spaced (space plate)
- Condenser pads / cuffs (condenser cuffs) / sinus mask /
- Butterfly electrode / internal electrode

**Electromagnetic SWD** (1 electrode)
- Best for vascular heating
- Not affected by adipose tissue

A magnetic field
- Patient is not part of the circuit
- Electrodes: Induction coil / pancake coil / drum (Monoplude or Diploide)

For Both:
- Application: *Must always use for SWD*
- 1 inch of toweling
- 1-2 inch apart avoids edge effect
Pulsed Units:
- Penetration without concentration
- Equal on and off time

<table>
<thead>
<tr>
<th></th>
<th><strong>Acute</strong></th>
<th><strong>Chronic</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>up to 48 hours</td>
<td>48+ hours</td>
</tr>
<tr>
<td>Pain</td>
<td>constant / intense</td>
<td>intermittent sub-intense</td>
</tr>
<tr>
<td>Pain on Activity</td>
<td>greatly increased with pain</td>
<td>maybe some pain w/ activity</td>
</tr>
<tr>
<td>Area of Pain</td>
<td>diffuse / all over</td>
<td>localized</td>
</tr>
<tr>
<td>Examination</td>
<td>red/hot/swollen/tender</td>
<td>not rubar, calor/tumor/dolor</td>
</tr>
<tr>
<td>At rest</td>
<td>pain</td>
<td>no pain</td>
</tr>
<tr>
<td>Sleep</td>
<td>disturbed due to pain</td>
<td>no sleep disturbances</td>
</tr>
</tbody>
</table>

Contraindications:
- Pg. 193
- 4 foot rule
- IVD’s
- Contact lenses
Microwave Diathermy

Definitions:
- Superficial localized heat
- Magnetic Field
- More concentrated than SWD
- Less penetration than SWD
- 1/3 as effective overall of SWD

Specifications
- Frequency 915 MHZ & 2456 MHZ
- Wavelength: 12.2 cm
- Conversion
- Temperature: 106’ F
- Law of Grothus-Draper
- Power: to 100 W (% of power)
- Treatment time: 19-20 min.

Basics for Office
1. Cryotherapy
2. Heat therapy
3. Nerve / Muscle Stimulators
4. Ultrasound

Ultrasound Diathermy

Mechanism
- Reverse piezoelectric
- Expansion and Contraction

Specifications
- Frequency: 1.1 MHZ and 3.3 MHZ
- Wavelength: 0.15 cm
- Voltage: 100 -> 2000 volts
- Penetration: up to 2 inches

Interfaces:
- Change: Conversion

Power: W or W cm squared
- Time: up to 5 min. or up to 15 min
Equipment:
   Transducer head
   Piezoelectric crystal (s)
   Couplant medium
   Waterproof
   Wear
   Cleaning
Piezoelectric crystals:
   1. Barium titanate
      Most commonly used
      100V gets 3W
   2. PZT (Lead, Zirconium, Titanate)
      Quartz sulfate
      Most stable
      2000V gets 3W
      Lithium Sulfate
      500V gets 3W

Physiologic effects of ultrasound
1. Chemical effect
2. Mechanical effect
   Phonophoresis
      1-2 mm
3. Neural effect
4. Thermal effect
   Volume heating – 3500 m/s
   Structure heating – 1500 m/s
   Ultrasound through air 300 m/s

Application of Ultrasound
Shearing Effect
Direct
Sub-aqueous
Cooler mediums
Coupled modalities
Coupling Cushion Technique

Diasonic USD (Static USD)
Infrared Radiation

Mechanism
Heliotherapy
Heating elements
Photothermal effect

Specifications:
Long wave vs. Short wave

<table>
<thead>
<tr>
<th>Long wave IR</th>
<th>Short wave IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Far wave IR</td>
<td>Near wave IR</td>
</tr>
<tr>
<td>15,000-120,000 Angstrom A</td>
<td>7500-1400 A</td>
</tr>
<tr>
<td>Penetration: 0.1-3.0 mm</td>
<td>Penetration: 5-10 mm</td>
</tr>
<tr>
<td>Surface temp: 113.9 F</td>
<td>Surface temp: 110.8 F</td>
</tr>
<tr>
<td>Subsurface temp: 107 F Non-luminous</td>
<td>Subsurface temp: 117.8 F Luminous</td>
</tr>
<tr>
<td></td>
<td>a.k.a. candescent incandescent</td>
</tr>
</tbody>
</table>

Examples: dull red bathroom heater light bulb

Physiologic effects
General heat modalities
Immediate erythema
Erythema ab igne (Redness without fire)

Applications:
Direct or toweling
Toweling – wet or dry
Protect eyes
Cosine (Lambert’s cosine) Law
Inverse square law

Treatment distance: 18-24 inches (24 inches)
Treatment time: 20-30 min.
Rest period: 10-15 min. (textbook range)
3-5 min. field range

Other conjunctive treatments
Indications
Contraindications
ULTRAVIOLET RADIATION

Heliotherapy 40%
Actinic = photochemical effects
Mercury vapor arc

Long Wave UV (near UV):  (156)
  Wavelength:  2000-4000 Angstroms
  Penetration:  0.1-0.3 mm

Short Wave UV (far UV)
  Wavelength:  1800-2000 Angstroms
  Penetration:  0.1-0.3 mm

UV-A
  Near band range
  3400-3600 Angstroms
  Photosensitive agents
  Tanning parlors

UV-B
  Near band range
  2900-3100 Angstroms
  Hot Quarts Radiator
  High vapor pressure
  High heat (8000 degrees C / 14,432 degrees F within the tube)
  High Amperage (5-20 A)
  Mercury & Argon
  Treatment distance:  30 inches
  Vitamin D synthesis

UV-C
  Far band range
  2000-2900 Angstroms
  2537 A = 90% bactericidal
  Cold quartz radiator
  Low vapor pressure
  Low Amperage (2 Amps)
  Step-up transformer (2500 V)
  Mercury & Neon
  Treatment distance:  1 inch from skin
  Bactericidal
Specialty Lamps / Lights

Wood’s Light
- Black light
- Enhances Keratin
- Pre cancerous
- Cancerous
- Secondary syphilitic eruptions
- Fungal infections on skin
- Wavelength: 2500-4000 Angstroms

Kromeyer Light
- Water cooled
- Wavelength: 2537 Angstroms
- Highly bactericidal

General Therapeutic UV Lamps
- MED at 24 inches ≤ 15 minutes

General Sun Lamp’s UV Lamps
- MED at 24 inches, 15-60 minutes

Physiologic effects of UV (pg. 156)
- Protein shock (sun poisoning)

163 Indications
- Contraindications
- Cosine (Lambert’s Law)
- Inverse square law applies

Pigmentation
- Melanin granules
- Skin layers
  - Stratum corneum = best protection from UV
  - Stratum lucidum
  - Stratum granulosum (melanin) pigment deposited
  - Stratum Sinosum (melanin)
  - Stratum basale (melanin)
Erythema doses (of UV)

*Goal is to inflame the tissue

Reddening of the tissue
True inflammation
2400-3200 Angstroms
3300 Anstrums+ does not treat the patient

waves longer than 3300 don’t cause Erythema (Woods lamp doesn’t)

1st degree Erythema
AKA MED / Tonic dose
Slight redness

2nd degree Erythema
Strength: 2.5 times the MED
Mild sunburn

3rd degree Erythema – Don’t allow
AKA counter-irritant dose
Increased redness
Slight edema
Peeling
Intense pigmentation formed
Strength: 5 times MED

4th degree Erythema
AKA destructive dose
Severe dermatitis
Blistering, Peeling, Exudation
Intense Redness
Strength: 10 times MED

5th degree Erythema (Sub-Erythema dose)
Below 1st degree (pt can’t feel the dose given)

Precautions:
Collumnate (with white towels to reduce exposure)
No erythema on an erythema
Protect eyes (doctor needs eye protection)
Bare, clean, dry skin (like microwave)
Sensitive structures / situation (albino, alcoholic, red head, women more sensitive then men, un-tanned areas, face)
Treatment Schedule:

Patch Test (pg. 159)

AKA: Sleeve Test
Don’t use the same area for treatment and testing
In 8-24 hours you want to see the results
Which area turned red & which did not
Each additional treatment will increase by ½ the MED.
Treatment continues until
  The patient is cured
  You hit 10 x the MED (10xMED = STOP)
During continuous treatment don’t tx pt until redness goes away
If pt misses apt by 1 week or less – start w/ the previous tx
If the pt misses apt by 2 weeks – start from the beginning

Tube Wear – *do patch test every time tube is changed*
New UV tube is used *so re-do patch test*
First time treatment *of a new condition*
Time Lag *pt goes a month or more w/out tx – do a patch test*
Every 6 months *do a new patch test*
After 100 hours = 80%: 100hrs of tube usage=80% Wattage of most
*UV tubes*
After 1,000 hours = 50-60%

HYDROTHERAPIES

Temperature scale *(pg. 408 on final)*

Hydrocollator:
  Hot packs, moist steam packs
  Silica gel (1 SiO2 : 17 H20)
  Temp: 150-170 degrees F (165-174 degrees C)
  Time: 20-30 minutes
  1: toweling
  Indications (pg. 140,193)
  Contraindications (pg. 142)
  Check patient every 3-5 minutes
  4 pack unit: 45-60 minutes
  12 pack unit time: 12 hours *for this tank to go from room-treatment temp.*
  Maximum heat: 10-20min. *(then stop checking on patient)*
  Re-charge: 30-40 minutes
Clean machine monthly
Check skin for Oils, gels, lotions, creams

Whirlpool: AKA Jacuzzi
   Effects: massage, sclerolytic, hyperemia
408 Other use: open wound
      Temp: 102 – 104 degrees F
      Time: 20-30 minutes
193 Indications
140 Contraindications

Hubbard Tank: pg. 417
   Large whirlpool
      Litter = chair used to lower pt in & out of tank
      Temp: 102-104 degrees F
   Indications:
   Contraindications
PT Lab

Infrared
Long wave (non luminous)  Short wave (candescent, luminous)
1. Alloid disc  1. Light bulb (250-1200 Watts)
2. reflectors  2. Reflectors
3. Light bulb with internal reflector
Takes time to warm up  Get immediate heat when turned on
Reflector will get hot  Reflector does not get hot b/c lt refl.

Procedure:
1. Tell pt that you are using IR
2. You will feel a warm soothing feeling
3. Tell them what it is going to do for them
4. Use one layer of Terry cloth towel
5. Set machine 2 feet away from patient
6. Check on patient every 5-10 minutes
8. Wait 3-5 min. before you begin working on the patient (adjustment etc.)

UV RADIATION
1. Goal = produce MED
2. Do a patch test in to determine where to start your tx
3. Structures
   a. UV pack can generate 5-20 amps
   b. Mercury tube
      1. Mercury in the tube interacts w/ the neon to produce UV
      2. Initially when tube 1st turned on – bottom of tube is brighter than top
      3. When doing a patch test you need:
         a. glasses for patient
         b. tongue depressors
         c. UV tube with power pack
         d. Slieve with 7 squares
         e. Patients response card (should go on their chart)
            Name
            Date
            Where patch test don (R or L)
            Legend (P=Pink, R=Red)
         f. ink pen or felt tip marker
         g. tape
         h. Piece of paper towel (wrap it around the tube, to collimate the tube)
            • note: Test an area on the body that is more sensitive than the area being treated
            • note: Make sure you hold the tube 1 inch away from the area being treated
• note: The MED is where your going to start the treatment (This is where the First P=Pink appears)

Example: W W W P P R R
MED = 4

OTITS MEDIA
1. Place tube into ear about ¼ -1 inch
2. Treat about 15 seconds
3. Twist the tube, don’t just keep it stationary

Hot Packs (Hydroculator)

Hubbard Tank (pg. 413)
Large Whirlpool
Litter = chair for disabled – lowers into water
DC can be in tank w/ patient or close to the patient from the outside
Temp: 102-104 degrees F
Indications / Contraindications (pg. 193,140)

Additional Heat Therapies

Paraffin Wax Bath:
3:1 (Paraffin: Mineral Oil)
Lowers wax’s melting point
Temp: 125-130 degrees F
Time: 20-30 minutes
Procedure: See lab notes
Alternate methods of application (pg 165-167)
Indications (164-167)
Contraindications
Physiological effects

Procedure:
1. Use 2 lbs wax to fill the bath (it takes 5-6 hours to completely melt)
   a. use parachips, they melt faster
   b. the wax comes mixed with mineral oil
2. Remove the film at the top of the melted wax
3. Inspect the patients body part for open wounds, etc., make sure area is clean
4. Tell the patient what you are going to do
5. Fingers should be spread apart, not touching
6. Place hands in wax; wiggle fingers
7. Pull hand straight out, wait for shiny appearance to disappear
8. Check for blebs (air pockets) – big ones need to be patched
9. **2\(^{nd}\) Dip**
   - Dip hand, stop 1 or ½ inch distal to the previous dip
   - Pull hand straight out

10. **3\(^{rd}\) Dip**
    - Dip hand, stop 1 or ½ an inch distal to previous dip

11. **Treatment**: 3-7 dips

12. **Wrap dipped area w/ plastic wrap or wax paper**

13. **Then wrap a towel around the plastic wrap**

14. **Treatment Time**: 20-30 min

*Note: Dry heat good for smooth muscle (good for menstrual cramps)  
Wet heat good for skeletal muscle*

**Contrast Bath:**
- Intense vascular reaction
- Peripheral circulation (*need 2 tanks*)
- Temp: 105 – 110 degrees F & 60-65 degrees F
  - Very hot  
  - Cold cool range
- 10 minute
- 1 minute
- Time (total): 30 min
- Procedure 10:1, 5:1, 1:1, 1
- Contemporary method

**Tepid Sponge Bath:**
- Relaxed, analgesia, antipyretic
- Temp: 80 degrees F
- Procedure
  - Water
  - 25% alcohol 105 degrees F

**Cryotherapy (worst modality for patients)**  
*pg. 244, study 6.1 & 6.2*
- Cycle of effects (sensory)
- Cold-burning-aching – anesthesia (4-5 min. process)
- Physiological Effects
- Indications (pg. 259)
- Contraindications (pg. 261)
- Test to check for the patients reactiveness to cold
  - Barlich Test
  - Wrapped Forearm Test
Cold Packs
Made with Sugar Gel (250-251)
Should be stored at _____
Treatment time: 20-30 min (equal on & off time)
Tell the patient to thaw – not to warm in any other area
Duration of pack: 30 min
Re-freeze time: 45-60 min.
Application Method
Wrap cold packs in a warm, wet paper towel
Lay a towel on top of the cold pack for insulation (to keep the cold in)

Chemical Cold Packs
Not as cold or effective
These are silica gel packs

Slush Pack
Use ½ water and ½ alcohol -> freeze it in a zip lock bag
This is what a patient can use at home if they can’t get to a doctor

ICE 247-348
Store it between 10-32 degrees F
Application Method
Paper cup / stick
Ice massage is appropriate for shin splints
If you don’t have ice, you can use frozen veggies

Cold Water Bath / Whirlpool (to tx irregular areas)
Use ½ water and ½ ice
Temp range: 50-60 degrees F
Can be used with EMG / USD
Treatment Time: 10-20

EXERCISE REHABILITATION

Purpose / Goals
Improve function
Maintain well being
Increase strength, stretch, coordination
Prevent / correct deformities
To do no harm
Accurate diagnosis & prognosis
Treating causes not effects  
Address the pain  
Adherence to laws of nature  
  Don’t rush  
  Don’t delay  
  Allow time to heal  
Be realistic, Be practical in treatments  
  Common sense  
  Follow through & compliance  
Treatment is elective, not an emergency  
Treat for the patient – not just to the patient

Phases of treatment  
  Clinical medicine & preventative medicine  
  Preventative medicine  
  Primary- Pre- pathogenesis or optimum health  
  2nd & 3rd – during illnesses  
Rehabilitation:  
  Ultimate restoration  
  To maximum capacity  
  Physical, emotional, vocational  
  Start as early as possible  
    In early 2nd phase through 3rd phase  
  Exercise is vital to rehab  
  Full restoration may not be attainable – ortho devices

Methods of treatment:  
  Rest  
    Too much:  
      Disuse atrophy  
      Muscle soreness  
      Osteoporosis  
      Increase in calcium excretion  
      DVT (with or w/out embolism)  
      Decubitus ulcer (bed sore)  
      Adhesion formation  
      Increase edema formation  
  Proper rest:  
    Effective w/ early ambulation (Mvt)  
    Decreases inflammation & pain
Increases speed of healing
Relative
Decrease in weight bearing load
Decrease usual daily stress loads
Long term = 1-2 months

Physiological Effects of exercise
Type I: red, slow twitch muscle fiber
Better endurance activity
Increased myoglobin
Increased mitochondria
Decreased ATP-ase
Aerobic activity
Type II: White, fast twitch muscle fiber
Better brief; intense, sprinting
Anaerobic activity

Blood flow
Rest:  15-20% to muscles
      80-85% to viscera
Work: Reversed
Cutaneous: Increase for heat release
Cutaneous: Decrease for shunting
Core temp will increase

Heart rate
Increases progressively with workout
 Increases linear with work load
Average person = 220- age (target heart rate when working out)

Stroke volume
Linear with work load
SV @ rest is 60 ml / beat
SV @ max is 120 ml / beat

Cerebral Flow remains constant

Co2: Carbon Dioxide
Linear with work load
@ rest 5 l/min
@ max 20 liters / min
Driving force for respiration

Blood Pressure
Linear to work load
Max @ 190-220 mm/HG
Relatively stable systolic
Pulse Pressure linear to Work load

Muscle Spindle Reflex: < 6 seconds
Golgi tendon organ
AKA: reflex relaxation, autogenic inhibition

If you are going to stretch pt – stretch for more than 6 seconds.
This stimulates a G to which overrides MSR

Traction
Types:
  Mechanical
  Manual Traction

  Intersegmental traction
  Inversion traction
421 Door devices
422-4 Bed devices

434 Physiological effects
442 Contraindications

Cervical traction specifics
1. 10-30 lbs -> 40-50 lbs (max)
2. 5% of total body weight
   Increase in 2 lb. Increments
   C3-C7 (30 degrees)
   O-C2 (0 degrees)
Lumbar traction specifics
25-50%
150 lbs. Max
5 lb. Increments
Most benefit: L4/L5 & L5/S1
Can be used with heat, cold, massage & adjusting

Orthopedic Devices
451 Physiological effects
To immobilize
454 Indications
----------------------------------------------------
the rest was not on an overhead

Orthotics
General Physiological effects
451 Fluid compression
Decrease 30% of disc pressure
Indications
Contraindications

Cervical Supports (456)
Soft Cervical – weak immob. Of C-spine, doesn’t limit ROM =
   Proprioceptive reminder
Firm Cervical – Limits flexion & extension moderately
Soft for Mild -> Moderate sprain / strain
Firm for Moderate -> Severe sprain / strain
Post & Posters for Vertebral fractures
Halo for C1,C2, or C3 fracture (6-8 surgical screws into pt. Scull)

Pg. 462 Lumbar Supports
Two pull support – (Home Depot support) = coordinate & limit flexion & extens.
Taylor Brace- controls Kyphosis & Lordosis of lumbar & thoracic spine
   * good for vertebral compression fracture, facet syndrome, spondylolisthesis
Rami body cast – thermoplastic devices (can be heated & rinsed in cold water &
   changed many times.
Milwaki Brace – treats scoliosis (structural). Can wear brace 8-23 hrs/day
   * Must write fitted on insurance device for them to pay.
Read 451, 3, 5, 6, pictures, 459, 466 (shoe supports & shoe lifts)