

## 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: convection

Treatment time: 20-30 minutes

Experimentation's:

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 (Monopole or Dipole)

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

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

## 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

	<u>Long wave IR</u>	<u>Short wave IR</u>
	Far wave IR	Near wave IR
	15,000-120,000 Angstrom A	7500-1400 A
Penetration:	0.1-3.0 mm	5-10 mm
Surface temp:	113.9 F	110.8 F
Subsurface temp:	107 F	117.8 F
	Non-luminous	Luminous
		a.k.a. candescent incandescent light bulb
Examples:	dull red bathroom heater	

### 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

(148)

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  $\leq$  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 Angstroms+ does not treat the patient

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

1<sup>st</sup> degree Erythema

AKA MED / Tonic dose

Slight redness

2<sup>nd</sup> degree Erythema

Strength: 2.5 times the MED

Mild sunburn

3<sup>rd</sup> degree Erythema – Don't allow

AKA counter-irritant dose

Increased redness

Slight edema

Peeling

Intense pigmentation formed

Strength: 5 times MED

4<sup>th</sup> degree Erythema

AKA destructive dose

Severe dermatitis

Blistering, Peeling, Exudation

Intense Redness

Strength: 10 times MED

5<sup>th</sup> degree Erythema (Sub-Erythema dose)

Below 1<sup>st</sup> 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 than 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 SiO<sub>2</sub> : 17 H<sub>2</sub>O)  
 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

Litler = chair used to lower pt in & out of tank

Temp: 102-104 degrees F

Indications:

Contraindications

*PT Lab**Infrared**Long wave (non luminous)*

1. *Alloid disc*
2. *reflectors*

*Takes time to warm up*  
*Reflector will get hot*

*Short wave (candescent, luminous)*

1. *Light bulb (250-1200 Watts)*
  2. *Reflectors*
  3. *Light bulb with internal reflector*
- Get immediate heat when turned on*  
*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*
7. *Time Range: 20-30 min.*
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 1<sup>st</sup> 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 1/4 -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*



### 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

2<sup>nd</sup> & 3<sup>rd</sup> – during illnesses

Rehabilitation:

Ultimate restoration

To maximum capacity

Physical, emotional, vocational

Start as early as possible

In early 2<sup>nd</sup> phase through 3<sup>rd</sup> 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 1: 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 =  $220 - \text{age}$  (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

Co<sub>2</sub>: 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  
 Indications

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 &amp; L5/S1

Can be used with heat, cold, massage &amp; adjusting

12.3 figure

426 pages

443,5,6,7

## 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 &amp; extension moderately

Soft for Mild -&gt; Moderate sprain / strain

Firm for Moderate -&gt; Severe sprain / strain

Post &amp; Posters for Vertebral fractures

Halo for C1,C2, or C3 fracture (6-8 surgical screws into pt. Skull)

## Pg. 462 Lumbar Supports

Two pull support – (Home Depot support) = coordinate &amp; limit flexion &amp; extens.

Taylor Brace- controls Kyphosis &amp; Lordosis of lumbar &amp; thoracic spine

\* good for vertebral compression fracture, facet syndrome, spondylolisthesis

Rami body cast – thermoplastic devices (can be heated &amp; rinsed in cold water &amp; 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