<table>
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<th>Modality</th>
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<th>Physiol effects</th>
<th>Penetration</th>
<th>Modalities</th>
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<tr>
<td>High Frequency</td>
<td>&gt; 100,000 Hz</td>
<td>Deep heat</td>
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<td>Diathermy</td>
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<td>Conver’sn heat</td>
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<td></td>
<td>includes VAN,</td>
<td>Shortwave</td>
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<td>Molecular friction rub makes</td>
<td></td>
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<td>joints, bone,</td>
<td>Microwave</td>
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<tr>
<td>heat</td>
<td></td>
<td></td>
<td>cartilage &amp; ligaments</td>
<td>Ultrasound</td>
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<tr>
<td>Middle Freq</td>
<td>1,000 – 100,000 Hz</td>
<td>EMNS mostly</td>
<td>1 – 2 “ medium</td>
<td>Interferential</td>
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<td>Conduction heater</td>
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<td>penetration</td>
<td>current stim</td>
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<td>Hot =&gt; cold</td>
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<td>Fires nerves</td>
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<td>Russian stim</td>
</tr>
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<td>Low Frequency</td>
<td>00 – 1000 Hz</td>
<td>EMNS mostly</td>
<td>0 - 1” usually</td>
<td>Muscle stim</td>
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<tr>
<td>Conduction heater</td>
<td></td>
<td>Very little heat</td>
<td>only 1 - 2 mm</td>
<td>DC-LV &amp; HV</td>
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<td></td>
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<td></td>
<td>AC Sine wave</td>
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<td>Square wave</td>
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<td>Faradic wave</td>
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<td>TENS</td>
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<td></td>
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<td>MENS</td>
</tr>
</tbody>
</table>

**Physical Tx** … restoring proper function & prevent disability after Dz or injury
- Heat … ms stim or hot pack
- Ice … cold pack
- Electricity …. EMNS
- Water … hydroTx
- Force … Flexion & Distraction
- Sound … U/S

**Start - Inflammation** … prevents further injury by decreasing joint mobility
- Vasoconstriction ..... T. media of arteries & veins
- Vasodilation …… Influx of nutrients & inflam mediators from arteries, veins & Lymphatics like Histamine*, serotonin*, bradykinin, Prostaglandins & lactate.
- HIS, SER from mast cells, platelets, Connective & parenchymal tissues.
- Coagulation of RBC’s …. accum. in injured tissues
- WBC migration & activation to injury site … phagocytosis
- Exudate … fluids, inflammatory mediators, necrotic debris from phage etc
- Stasis … platelet plug formation to prevent further fluid loss "walled off"

**Acute injury** … 0 – 48 hours, constant, diffuse pain w/ passive & active mvmts
- Red, hot, tender, swollen possibly still bleeding & sore
- Nerve is still irritated … even @ sleep => interrupted & poor

**Chronic injury** … 48+ hours, intermittent, localized pain in active ROM only
- Tissue may still be tender but pax assymptomatic
- Not really mindful of pain … no pain @ rest, little upon mvmts
- No significant impact on sleep cycle

**Muscle or ligament tear** … 1’ …. 25% fibres torn / evulsed from bone => pain
- 2’ …. 50% …………………………. => severe pain
Heat Therapy .... conduction ... contact b/t hot & cold objects transfers heat
Convection ... exchange of heat through a medium ie. Air / water
Ie. Sauna uses steam to Tx heat
Radiation ... photon transfer through medium that does not absorb the energy ie. X-rays flying through air
conversion .... Deep heating via molecular vibrational energy by creating ms. Stimulation to excite movement

Physiological effects .... How the body responds to the applied modality
Van Hoff's law ..... bodily metabolism increases 2-3x for each 10°C increase
be careful how you stimulate w/ heat => inflamm'n & cancer growth or other Dz conditions
heart rate increases 10 bpm for every 1°F increase
be careful how you treat b/c pax may have cardiomyopathies
Joule's law ..... heat production depends on current, treatment time & tissue resistance
water is a conductor but b/c skin has high resistance, more heat produced
Johnson's law .... For every 'F rise in temperature => 10 bpm increase in heart rate
Wave train ..... modulated treatment plan to vary intensity, frequency, wavelength or pulselwidth to prevent nerve or muscle accommodation
Ohm's law ... current is proportional to voltage & inversely proportional to resistance
low resistance ..... nerves
high resistance ..... fibrous tissues, adhesions & skin

<table>
<thead>
<tr>
<th>Material</th>
<th>% Conductivity</th>
<th>% Absorbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>Muscle</td>
<td>72 - 75</td>
<td>25</td>
</tr>
<tr>
<td>Brain or Neural</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>Fat</td>
<td>14 - 15</td>
<td>85</td>
</tr>
<tr>
<td>Skin or Bone</td>
<td>5 - 16</td>
<td>95</td>
</tr>
</tbody>
</table>

Absolute refractory period ... nerve & muscle cannot fire b/c they are still repolarizing
Relative refractory period ... nerve & muscle can fire but it requires a greater than normal stimulus ... HVDV can do this b/c it is greater than the normal electrochemical stimulus

Modulation of frequency .... pax will adapt or accommodate to stim so you change the stim or modulate it
1000 - 100,000 Hz ... not enough to cause muscle contrax'n b/c it is a subthreshold stimulation

Wedensky inhibition ... after a normal Action Potential, the muscle or nerve cannot fire b/c of a absolute refractory period during which no response can be generated regardless of the size of the stimulus

Reymond Dubois Law ... nerve or muscle can be re-stimulated to fire even if the stimulus is sub-threshold as long as the stimulus is rapid

long time of Tx ... pax will accommodate or adapt to it and develop patterns
Depolarization ... All or none
Threshold ... minimum stimulus to fire the nerve or muscle
**Subthreshold stimulus** ... insufficient to cause an action

**Low Frequency generators** ... stimulate spastic/atrophied muscle, diinnervation to change physiology and function

**EMNS** ... stimulate healing, skeletal & smooth ms, neuralgia (LOWER FREQ. BETTER STIMULATION)
- If there is overstimulation ...... skeletal ms contrax'n would slow down skeletal ms contrax'n b/c "ratchety" pain during & after stimulation

**Medium Frequency generators** 1000 - 100,000 Hz => no muscle stim b/c Wedensky inhibition which prevents reaching threshold

**Indications** .... Dx signs that there is something I can do to help

**Precautions** ... an indication to be careful while doing something to help pax

**Contraindication** ... Dx sign not to do something b/c it may exacerbate the conditions

- **Vascular deficiency** .... AS, DM
- **Anesthetized areas** ... pax has no feeling in this area ... you may overstim CNS degenerates by age 72 y/o

- **Malignant neoplasms** .... You may spread it in circulation
- **Radiation Therapy** ... will depress an already depressed immune system
- **Hemorrhage** ... add’nl anticoagulant Tx would not be wise
- **TB** ... incr’d pulmonary stim will spread to other parts of the lung
- **Fever** ... vasodilation may spread the infection from local to systemic
- **Deep acute lesions** ... spread by heat, don’t apply if pax is pregnant
- **Rashes / gangrenous** ... electrodes don’t stick & incr’d circ’n spreads Dz
- **Infants(<1 y/o) / elderly** ... exercise extreme caution
- **Organic visceral Dz** ... AAA, pheochromocytoma, renal carcinoma, AS, TAO, Reynaud’s Dz, RA, Burger’s Dz, varicose veins lymphoma, AV fistulae, Arteritis, peripheral vascular Dz,
- **Gonadal Dz** ... thrombophlebitis, phlebothrombosis
- **Menthol rub** ... A-535, Flexall 454 ... Can be chemically by heat
- **Fair skin** ... precaution b/c sensitive skin
- **Metal clips, cardiac pacer** ... may be demagnetized
- **Eyes / contacts** ... may react to heat therapy

Definitions about electricity

**Volts (V)** ... ElectroMotiveForce ... determines speed of moving electrons

**Amperes (A or mA)** ... intensity, strength or amount of electric current

**Ohm** ... resistance

**Watt (W)** ... power = A x V ....... LVDC is like low force boring into something HVDC is like meric recoil ... low force high velocity
- In X-ray physics ... kVp x mAs combination

**Low Voltage DC** ..... aka LVDC or Galvanic current ... < 150 Volts
- Ideal for hydro & iontophoretic therapy b/c of polarity
- LVDC .... Low force that bores into pax
- HVDC ... low force but high speed that is very fast
Monophasic/monopolar pulse ..... one pole ... either +/- ... polarity based upon effects
    One phase .... On/off
    Or
    One direction
    One second in duration as a minimum

Polarity and physiological effects

    Anelectrotonus ... diminished irritability of nerve/muscle near ANODE
    Catelectrotonus ... increased excitability of nerve/muscle near CATHODE

Electrode selection ..... Based upon desired physiological effects

    Positive (Anode) +:'ve acidophilic       Negative (Cathode) −:'ve ... basophilic
    Vasoconstriction .. like ice             vasodilation ... like heat
    Analgesia ..decr nerve irritation        pain or nerve irritability
    Ischemia                                  hyperemia ... enhances bleeding
    Coagulation                               anticoagulation
    Germicidal ... repels alkaloids           increases perfusion & O2 to tissues
    Corrosive to metals                       hydrates and softens fibrous tissues
    Dehydrates & hardens tissues             attracts alkaloids & repels acids
    Attracts O2 & oxidizes metals             attracts H+ but no corrosion of metal

Active electrode ...........aka. treating electrode .... concentrates current on a small area
    Place directly upon the Tx site .. small pad to concentrate effects
    Current density = 0.5 – 1.0 mA/sq.in
    If pad is 2” x 2” ...... Min current is 4 sq.in x 0.5 mA = 2 mA
                           Max current is 4 sq.in x 1.0 mA = 4 mA

Inactive electrode .... Aka dispersive / non-treating electrode .... Completes the circuit
    Must be w/in 18 inches of the active electrode to be effective
    Must be larger to disperse the current from Tx healthy areas
    If pad is 3” x 3” ...... min current is 9 sq.in x 0.5 mA = 4.5 mA
                           Max current is 9sq.in x 1.0 mA = 9 mA

Pflueger’s law ... CCC > ACC > AOC > COC
    CCC or ACC ... apply one electrode & close circuit by applying other electrode
    COC or AOC ... open the circuit by removing one electrode before the other
    Depending on your choice, electricity will be removed or applied to the pax

Flow of electricity .... Always from the negative (cathode) to the positive (Anode)
Threshold ... how much should we apply .... Just enough to cause a ms contrax’n

    Inactive electrode       active electrode @ motor point
    complete circuit         stim an atrophied area
    Positive electrode       Negative electrode
    4 – 8 mA                 2 – 4 mA

Water bubble test .... Performed to verify current flow through the leads by confirming
    the production of Hydrogen gas bubbles @ -'ve end

Litmus paper test .... Verifies proper function of the machine
    Blue litmus paper => pink when exposed to +’ve (anode)
Pink litmus paper => blue when exposed to −ve (cathode)

**Phenolpthalein** test … verifies proper function and polarity of LVDC
  
  Red colour should appear @ -ve (cathode)
  
  Colour will disappear around +ve (anode)

**Physiochemical/physiological effects**

**LVDC settings**

- **Pulse width** … Duration must be a minimum of 1.0 sec
- **Depth of penetration** … 1 – 2 mm
- **Intensity** … Volts or mA (max of 30 mA)
- **Frequency** … lowest possible is 1 b/c < 1 is Zero
- **Ion allergy** … Iontophoresis drives ions into the body through the skin
  
  Ie. Drive MgSO4 into the body … Mg2+ for vasodilation even though the +ve pole is vasoconstrictive

**Treatment time** … 15 – 20 min

**Treatment range of current** … @ least 5 mA

**Pad placement** … Monopolar … small & large … Either single or bifurcated

**Interpad distance** … 18 inches max … they can be immediately adjacent

**Joules law** … heat produced is dependent on current, time and resistance of tissues

**Benefits of LVDC** …

- **Polarity** … +/- depending on desired physiological effects
  
  - **Frequency** … Different physiological effects too .. < 1000 Hz
  
  - **Combination Tx** … use polarity and Frequency together

**Frequencies and their physiological effects**

- **1 – 10 Hz** … vasoconstriction by stimulating T. media of arteries & veins
- **20 – 40 Hz** … vasodilation by relaxing T. media of arteries & veins
- **40 – 80 Hz** … muscle stim … skeletal muscle contrax’n
- **80+ Hz** … analgesia … slows down nerve conduction velocity (axoplasmic flow)
  
  - Machine maxim frequency is 300 Hz … body can’t detect

**LVDC output scheme** …

**Continuous** (0 Hz) … hydrophoresis (+) anophoresis and (-) catophoresis

**hydrophoresis** … water is the medium for electrophoresis

**cataphoresis** … drive −ve ions into a body … Anion and the Cathode

**electrophoresis** … moving charged ions/colloid across a membrane through a medium … requires minimum of 5 mA

- 15 – 20 min treatment
- penetrate 2 mm
- Iontophoresis (+) or (-)

**Iontophoresis** … therapeutic mvmt of ions w/ physiologic effects via LVDC

- Polarity does the work when frequency = 0 Hz
- cannot add effects of variable frequency

**Pulsed** (variable frequency) … 4 basic frequency groups can be used synergistically w/ polarity

- when frequency is other than 0 Hz

**Anion** (-)

- **Acetate** … vinegar, sclerolytic effect b/c hardened tissues … scars & calcified tissues
- **Chloride** … lugol’s solution, sclerolytic, analgesic & antibacterial
- **Iodine** … can be allergenic
- **Niacin** … vasodilatory …. Inhibited by Etoh and triglyceride
Salicylates … Sodium & methylated ions are OK

Cations (+)

Copper … Copper Sulfate is antiseptic & antifungal

Zinc … ZnO2 … stabilizes threshold, vasodilation, sclerolytic & b/d calcifications

Sunscren … baby powder, prevents diaper rash & repels water

Calcium … increases irritability threshold

Magnesium … analgesic, vasodilatory, makes you go to the bathroom

Nasal sprays … antipyretic & analgesic

DMSO … allows Rx to soak & be carried ion across membranes… ie. Pesticides

Types of waves

Monophasic … monophasic pulses all either +’ve or –‘ve

Biphasic …… pulses include +’ve and –‘ve

Polyphasic …. Pulses alternate inclusive of +’ve and –‘ve

Interpulse interval (IPI) … the time between individual pulses

Duty cycle … off time aka interpulse interval

Pulse … the ON time when the current is on

Pulse duration ….. time from ON to OFF measured in us or ms

Phase … current from the beginning of the pulse (zero) til it returns to zero

Phase width … time for ON to OFF of pulse

Current density … how much electricity runs through an electrode

Russian stim …. Many little biphasic pulses in rapid succession (b/c small IPI) as one big “burst” in which case interburst interval > burst width

High Voltage DC (HVDC) … voltage > 150 Volts …

Twin peaks, monophasic pulse …. either +’ve or -’ve

Treatment time …. 20 - 30 minutes

Intensity …. changes Voltage only

Intensity/Current … 1 – 1.5 mA “fixed” … low amperage is more comfortable

Voltage … > 150 volts up to 600 Volts but usually 300 or 500

Variable voltage to drive a narrow stream of electrons @ very high velocity

Use HVDC to treat w/ velocity of electrons

Pulse width … about 100 us (microsecond)

Frequency …. 4 BFG’s ……. Vasoconstriction … 1 – 10 Hz

Vasodilation ……. 20 – 40 Hz

Muscle stim ……. 40 – 80 Hz

Analgesia ……… 80 + Hz

0 Hz is of no clinical significance in HVDC

Polarity … only 30 % effective but use whatever you can get out of it

+’ve … like ice for vasoconstriction

-‘ve …. Like heat for vasodilation

Benefits of HVDC … Frequency ….. 4 BFG’s b/c polarity …….. 30 % effective
Physiological effects … general EMS effects
High penetration …. More speed & less resistance approx. ½” – 1” below the skin
short wavelength, high penetration, low heat => decreases vasodilation
dinervation (1 ms “rule”) ……. LVDC can stim ms & nerve in pax w/ dinervation can help
throughout the full range of nerve damage
HVDC can only help when there is minimal damage
Any damage to nerves => dinervation & peripheral neuropathy w/I 10 – 14 days
Progressive sensory defect/tingling as the deep tendon reflexes
decrease => ms atrophy
dying nerves require a PW of >1 ms to stimulate

Bipolar pad placement …2 pads of equal size are used
Active pad … place @ motor point
Inactive pad … place @ insertion of the muscle distal to motor point < 18”

Pad switching rate … for active electrodes …
0.0 sec … continuous for rehabilitation from initial Tx until fully recovered
2.5 sec … no physiological effects … don’t use this
5.0 sec … 1’ for acute conditions … low voltage w/ ice for vasoconstriction
10.0 sec …. chronic & need stimulation … be careful not to overdo
scarring, fibrous tissues need more stim so high voltage & long time

MicroInterval Space (MIS) aka microspace interval … fine tunes the intensity
Small MIS … more irritating b/c 2 peaks narrowly space summate => more stim
Moderate MIS … comfortably spaced out for stim balanced for each pax
Large MIS … less irritating b/c peaks spread out to minimize discomfort in acute injury
or the hypersensitive pax
MIS cannot exceed the PW …. Illegal operand

Small MIS Moderate MIS Large MIS
Maximum stim comfortable stim mild stim
Chronic/rehab routine stim acute injury

Fuses …. Thin wires that detect surges in electricity & will break to protect the electronics of the
machine … rated in mA or Amperes

Sine Wave Current (SWC) … net polarity is 0 … can’t use this modality to drive ions
LVDC Alternating polarity, biphasic, symmetrical current
HVDC IPI > pulse width
Ideal for a near degenerated nerve b/c it requires a
minimum of 1 ms and HVDC is measured in us
(microseconds) but LVDC is OK
Can even stimulate a cadaver to contract b/c SWC closely
mimics the physiological stimulation of nerves &
muscles => ideal for dinervated ms.
PW ... 1 ms ... “fixed” .... ideal time for muscle stim of dinervated muscles

**Polarity** ..... 0 .... b/c it has alternating polarity, the net polarity is Zero

**Voltage** .... 110 Volts ... household voltage therefore it has no step-up transformer

**Frequency** ... choose from the 4 BFG’s

**Intensity** ..... 1 – 60 mA

**Treatment time** .... 20 – 30 min

**Pulsed Mode SWC** ...... uniform amplitude ... pulse heights identical b/t pulses
Can be used for anyone w/ any complaint
Add BFG frequency group ... vasoconstriction, dilation etc.

**Surged Mode SWC** .... variable amplitude ... builds to a crescendo-decrescendo
Usually 10 –15 % difference b/t pulse heights
PW, IPI & Frequency the same
Amplitude builds to a crescendo & decrescendo .. =>
Ideal for rehabilitation .... 40 – 80 Hz .. rehab current for ms stim
to bring an atrophied ms back to normal strength
stim’n resembles the complete, natural & normal ms contrax’n
Use of variable amplitude “modulation” prevents adaptation.

**Rectifier/AC adaptor** ... converts AC into DC voltage

**Concentric** contrax’n ... ms shortens ... tension varies through the range of motion
**Eccentric** contrax’n ... ms lengthens when contracted
**Electrodes** ... doesn’t matter if +/- b/c there is no polarity in SWC => bipolar placem't

**One electrode** ..... place on motor point of the muscle
**Other electrode** . Place @ TendonousMuscularJunction or ms insertion

**Physiological effects** ... same as general EMNS ... ideal for dinervated muscle
**HVDC** can only help innervate a minimally damage nerve
**LVDC** can help the full range of muscular dinervation except the very low levels
**SWC** can help even the most dinervated muscles b/c it closely simulates natural physiological
stim & can help a broad range of injuries
SWC can even stimulate a cadaver to contract !

**Isotonic contrax’ns** ...... Concentric ... +’ve tension => increase ROM
Eccentric ... –’ve tension => increase ROM

**Isokinetics** ..... full ROM against resistance to strengthen muscles
**Isometrics** ..... muscle tension w/o joint movements just to increase the ms strength
**SWC pads** ...... Bipolar arrangement .... Both pads identical b/c no polarity
Pads exactly the same size
Active pad on the Tx site and the inactive pad dispersing on the ms insert
Transformer converts AC to DC. .. pulsed AC => transformed DC
   Edison supplies 20,000 V-AC running along the streets
   Step-down transformer converts the 20,000 => 120 V-AC
   X-ray machines require 220 V-AC so you need a step-up transformer

Square Wave AC … SQWC ….. available on ME-200 and ME-206
   Assymmetric, biphasic pulse (don’t have to be equal above & below 0)
   Usually more comfortable to patients
   PW is measured in us
   Instantaneous peak w/o a ramp or rise time … instant treatment time.

Polarity .... None so use bipolar pad placement

PW … us (microseconds) … Any PW > 600 irritates or exacerbates tissues

Frequency …. 4 BFG’s … universal regardless of AC or DC modalities

Voltage … 150 V maximum … so you can use household voltage

Intensity …. 20 – 30 mA …. Much like LVDC and SWC

Treatment time …. 20 – 30 min

Pad placement …. Bipolar … both are active so it doesn’t matter where they are except in the case of muscle stim …. Motor point and the TMJ

Application …. Anyone …. There is no specific pax type & can be used like SWC

3 variations of SQWC …. Pulsed SQWC
   Narrow … for acute conditions, smaller muscles, ms groups or neuralgia
      If the injury is acute or involves large ms groups, treat w/ narrow pulse
      The Dz condition supercedes the size of the problem … quality must be the primary focus not the quantity of ms to be treated.
      +’ve phase is 4X higher but 4X shorter
      -’ve phase is 4X longer but 4X smaller

Wide …. For chronic conditions, larger muscles, dense connective tissues or fibrosis b/c you need a longer stimulation to break through

      +’ve phase is 4X higher but 4X shorter
      -’ve phase is 4X smaller but 4X longer

AC (Equal) ….. even & equal above & below the zero line
   For rehab of muscles or groups of any size

      +’ve phase is = -’ve phase in amplitude and duration

25% rule of SQWC …… time & polarity will balance out to keep the net overall polarity at zero.
      +’ve phase amplitude is 4X taller but lasts 4X shorter
Prioritizing treatment for an Acute vs Large muscle injury

- Acute injury: Requires narrow pulse
- Large muscle: Requires a wide pulse

We prioritize the condition instead of the size of the injury so treat as an acute condition.

Surged SQWC usually fixes the frequency @ 60 Hz which makes it ideal for muscle stimulation in the 4 BFG’s.

Nerve damage can be graded on scale .......... stage I => sensory deficit
- Stage II => hypo-reflexia
- Stage III => muscular atrophy

Faradic Wave Current … FWC … aka Tetanic current or induced current

Application …… induce spasms or seizure of the muscles to burn out ATP and then the muscle will finally be able to relax.

- Biphasic, asymmetrical pulse of low frequencies AC w/ bidirections
  - +’ve phase is high in amplitude but short in duration
  - -’ve phase is low in amplitude but long in duration

The +’ve phase is negated by the –’ve phase so that net polarity = 0

Great modality for treatment and for ElectroDiagnosis
Useful in producing ms contrax’ns in innervated by atrophied ms.

FWC is to be applied to the motor point or along the nerve but b/c the IPS is very short, the muscle never relaxes b/w contractions => continuous sustained contrax’ns.

Remember, muscular contrax’ns occur when frequency is b/w 40 – 80 Hz and these machines are fixed @ 60 Hz => no smooth contrax’ns.

Pad placement … bipolar b/c there is no polarity

Polarity ….. 0 …. All electrodes are active

Frequency …. 1 – 60 Hz (variable) but ME-200 will give 4 BFG’s but many manufacturers fix the frequency output @ 60 Hz for muscle stimulation.

Wavelength … 1 ms … just like SWC

Voltage … fixed @ 110V therefore no transformer needed to use household voltage

Intensity …. 20 – 30 mA ……. Or ranges from 1 – 60 mA

Treatment time ….. 20 – 30 minutes

Types of FWC …… regular (tetanic) => homogenous pulses

- Surged => eccentric & concentric pulses
**ElectroDiagnosis (ED)**. Procedure to test or determine the state of the myoneural system when you suspect degeneration of a nerve or a muscle fibre by testing the efferent pathway. Once you know the ED, you can determine RD

**ElectroMyeloGraph (EMG)**. Machine that graphs the electroconductivity or rheobase or threshold of the efferent pathway that can elicit a motor response. EMG measures how much stimulation or electricity it takes to cause a contrax’n and that is the threshold or rheobase.

**Performing an EMG**. Requires 2 machines to test. FWC and LVDC

Note: this is w/in the DC’s scope of practice & if pax does not improve w/in 2 weeks, you better refer the pax OUT … continue treating if pax referred back to you

**Apply a pulsed LVDC @ 60 Hz** into the muscle & feel for a ms contrax’n to determine the rheobase or threshold of stimulation for the affected side & the unaffected side.

- Lt = 5 mA
- Rt = 10 mA

Now use the FWC and repeat the exercise to determine the threshold stimulation

- Lt = 7 mA
- Rt = 14 mA

**Data analysis**. Comparison b/w patient’s Rt & Lt (affected and unaffected muscle)

Refer to charts of age groups and relative thresholds

**Conclusions**. The Lt side is the good side b/c it is a strong ms & requires less stim’n

The Rt side is bad b/c it takes a greater stimulation to contract

**Treatment plan**. Ironically, we use FWC & LVDC to test and treat the condition

**Degeneration (RD)**. Test results of an ED. A partial degeneration may take 3 weeks to 1 year to return to normal function. A complete RD will probably take at least a year to rehabilitate. RD occurs when the conduction of impulses through the peripheral nerve is impaired b/c of some Dz, trauma to nerve trunk or anterior roots, or a lesion to the lower spinal cord which produces an electrical reaction of the muscle innervated. RD may be seen w/in 10 - 14 days after the injury.

If RD has occurred => treat w/ SWC, FWC or LVDC

**Chronaxie**. Minimum time for a current w/ 2X the intensity of the rheobase current in proportion to the sensitivity index of a nerve to electrical stimulation.

Minimum time to cause stimulation of a nerve or muscle

Rem: We do not use SWC to perform ED b/c it can even make the cadaver contract

SQWC and HVDC cannot be used either b/c of the PW

**ED is the test you perform**

FWC checks for partial & full RD => no response / brief impulses affected by subluxation & IVF contents

LVDC checks for full & complete RD => sluggish response

**RD is the result of the tests**. b/c you establish the muscle threshold

RD affects innervated tissues only

RD means damage to Anterior horn & nerve root or Peripheral nerve (IVF) or the presence of fibrosed muscles.

**Partial Degeneration**. Muscle is partially dinervated and requires greater stimulation

S/S. Decr’d response of affected muscles to LVDC & FWC

Affected muscle is the one that requires more stimulation to get contrax’n

Diminished tetanic excitability, slow / sluggish response

**Px**. 3 – 52 weeks to return to normal
**Absolute Degeneration / Full** … complete dinervation of the muscle
  
  $S/S$ … no response to normal FWC or LVDC
  
  Sluggish response to very high LVDC
  
  $Px$ … Rehab will require approx. 3 – 52 weeks

**Complete Degeneration** …
  
  $S/S$ … absolutely no response to any form of current or stimulation
  
  $Px$ … beyond any hope … theoretically no chance of any recovery

We cannot evaluate nerve twitch b/c it is too fast and the electrical potential too small
We can evaluate the muscle twitch b/c we can see it & feel it
Normally, we use 60 Hz => muscle contrax’n
Use of FWC => ms. contrax’n => tetany

**Transcutaneous Electrical Nerve Stimulation (TENS)** For nerves only not muscles
  
  Application ….. Remove or mask over pain
  
  There is no healing / regeneration of tissues
  
  Assist in child labour pains

Once the machine is turned ON => instant neuralgia ….. quick “fix”
As soon as the machine is turned OFF => pain @ same intensity as before treatment

**Gate Theory of pain** …. Transmission of pain signals b/w sensor & Thalamus

*Peripheral nerve fibre* (C-fibre) Slow & non-myelinated transmits pain to spinal cord
  
  Carries pain information from sensor into lamina II (SG) of the dorsal horn

*A-Delta fibre* ….. fast & myelinated transmits info from periphery => dorsal horn => Thalamus integration centre.
  
  Carries proprioceptive information to Thalamus

**TENS strategy** ….. place electrodes over the area of pain to stimulate A-delta fibres

  A-delta fibres >>> C-fibres

Artificially boost A-delta signal to “*shut the gate*” of the Spinal Thalamic Tract to any further information … C-fibre pain signal cannot get into the SpTh Tr before the gate is closed => no pain signal transmission beyond the dorsal horn.
  
  Application ….. place electrodes over the area of pain / site of injury
  
  A-delta fibres are very fast and effectively occupies the ascending pathway to “*close the gate*” to the slow C-fibre signals.
  
  Very similar to acupuncture electrical stimulation of nerves to shut off all pain sensations

$S/S$ ….. Effective block of pain signals carried by C-fibres from reaching the Thalamus => neuralgia … no more pain sensations
  
  A-delta fibre signals are felt as “buzz” or “tingling”

**Bias or Pattern Theory** …. Aka synaptic inhibition to mask over the pain
  
  Pain is transmitted to the Thalamus along the C-fibres
  
  Inhibition of C-fibre pathway will block any sensation of pain
Stimulate A-delta fibre w/ TENS so that the “buzz” exceeds pain signals
TENS produces counternetal or distraction to divert focus away from pain
The “bias” essentially masks over the pain signals @ the Thalamus
Similar to paresthesia …. Buzz when your foot falls asleep & you are numb

Note: Both theories … Gate & Bias … may operate simultaneously
**TENS machine setup** … very simple like a portable radio
**Power supply**….. 9 V battery
**Frequency** …. 1 – 600 Hz
**Current** …. mA
**Voltage** …. Fixed …. But can reach 80 V …. Usually b/w 50 – 80 V
**PW** …. as much as 150 us …. Can use polarity but not efficient for iontophoresis b/c
  PW is not over 1 second
**Treatment time** ….. highly variable
**Pulse** ….. biphasic like SQWC but can be changed to monophasic +/-
**Biphasic wave** … commonly symmetrical but sometimes asymmetrical “Squar-adic”

**Monophasic wave** ….. either +/-

  or

**Polarity** …… usually zero … cannot drive ions unless you use monophasic pulse
**Contraindication to use** …. “Demand” type pacemakers or a pregnant uterus
Why? “fixed” pacers emits constant signals into the heart regardless of what the heart is
  doing so when the heart has a signal, the pacer signal is ignored. If the heart does
  not have a signal, pacer signal triggers the heart to beat.
“demand” pacers receive input from Purkinje fibres like a feedback loop so when
  there is no signal detected in the Purkinje fibres, the pacer emits a signal to
  trigger a heartbeat. A TENS unit may interfere w/ the signal from the Purkinje
  fibres causing the pacer to emit an impulse at the wrong time and disrupt the
  normal cardiac rhythm.

1. **Conventional TENS** …. Paresthesia (Sub Motoric Threshold)
   Adjust the intensity to a level where you barely see the muscle contract and then
   bring it down just a little bit
   **Frequency** …. > 80 Hz into the range of analgesia (max out @ 200 Hz)
   **PW** …. 20 – 60 us
   **Treatment time** ….. 23 hours … give pax 1 hour off for personal hygiene
   **Application** …. Temporary mask over pain for a painful procedure
     Ie. Hot segment that you need to adjust or childbirth

2. **Acupuncture-like TENS** …. Motoric Threshold
   Triggers an endorphin / encephalin release to prolong the masking of pain
Frequency .... 1 – 4 Hz  
PW .... 150 – 250 us  
**Treatment time** .... 20 – 30 minutes  
**Pads** .... Bipolar placement immediately adjacent to the lesion  
Do not place the pads on the motor point  
**Application** .... Irritate the body to release endorphins  

3. Brief Intense TENS ..... SMT  
**Frequency** .... 70 – 110 Hz (80 Hz) for analgesia by stimulating A-delta fibres  
70 Hz is too close to muscle stimulation  
**PW** .... 150 – 250 us  
**Treatment time** .... 20 – 30 minutes  
**Application** .... Will not have an endorphin / encephalin release  

4. Burst TENS ..... SMT  
**Frequency** .... 2 frequencies on a piggyback ie. 1 – 4 Hz => endorphin release  
80 Hz => carrier  
**PW** .... 150 – 250 us  
**Treatment time** .... 20 – 30 minutes  

5. Modulated TENS ..... SMT  
**Frequency** ..... variable  
**PW** ..... Variable  
**Treatment time** ..... 20 – 30 minutes  
**Application** ..... variable PW and Frequency to modulate the signal and prevent the possibility of accommodation => achieve analgesia at all times.  

**Use of TENS is something like this** ......  
3 => good first choice as an opener even for the worst patient  
4 => 75 – 85% of all pax --- even the tough ones  
5 => if you really need something strong  
2 => you the DC are desperate for something to mask over the pain  
1 => your last resort b/c of time so pax must buy / rent the TENS from DC  
100% price mark-up b/c you are expected to train the pax as to the care and operation of the unit to limit your liability.  

**Risks of using TENS** ...... none ...... you can do no wrong w/ TENS  
**Using a TENS** ...... place pads proximal to site of pain along the path of radiation  
If pax is using steroids, wait 30 days after discontinued use b/c the body can respond by fibroid formation subcutaneous.  

Paresthesia .... Masking over the pain  
Anaesthesia .... Removing pain w/ an intrathecal injex’n b/w L2-L3  
**TENS vs. Epidural** during childbirth ... very popular in Europe or alternative birth centres.  
Ideal drug-free alternative to the standard epidural shot  
Whoever runs the TENS is the coach which only has 2 electrodes/unit so you need to simultaneously use 3 separate TENS units ... pain will decrease strength of contrax’n so you can mask over it.  

**Advantages** .... Immediate / temporary relief of pain  
Mask over most of the pain but just enough to maintain control of ms  
Buzzing effect of TENS but mother still maintains motor control
Application ….. TENS masks pain but pax may over extend themselves & thinking they are recovered and will hurt themselves even more.
If there is complete masking of pain or inability control motor functions, there is too much TENS
T8 => mask spinal nerves
L1 => highest level of pelvis
S2 => lowest level of uterine tissue
When non-contractile … T8 & L1 units are ON … low setting b/c there is less pain
During contrax’ns …. L1 and S2 units should be ON … high setting b/c higher pain
When contractions are close together => leave T8 & L1 units ON

T 8
L 1
S 2

Microcurrent Electrical Nerve Stimulation (MENS) p381-383, 386-393
Assoc. w/ LVDC and promotes ATP prod’n
Microcurrents flow normally in healthy tissues and irritates/stresses the tissues
Probably not very effective b/c patient can’t feel anything …. uA
Damage/Diseased tissues interrupt the flow of current which can be measured in uA
Intensity … uA which is still subthreshold
PW ….. < 500 ms
Frequency …. 0.3 – 0.5 Hz …. < 1 Hz p.393 technically 0 Hz but there is a regular pattern so you can still write 0.5 Hz
Treatment time …. 20 – 30 min
Application …. Non-union bone fractures and skin wound lesions
Theory … necrotic or atrophied tissues stop the flow of current or “opens” the circuit
Stimulate w/ enough MENS to jump the open gap to close the circuit
This allows the body to remodel and effect repairs to the injured tissues
Natural “aura” of energy flows around all tissues of the body which can be interrupted by ligament or tissue injury ….. in uA units
We add MENS to bridge the gap to enhance healing to restore flow
How ? replace tissue current by using a DC & carrier frequency to travel the entire span of the gap b/w electrodes
MENS promotes the formation of ATP but does not trigger action potentials b/c the current is uA levels & is subthreshold
Procedure ….. Use calibrated modalities ….. send an impulse from –‘ve to +’ve sides
Machine knows output signal and reads return input from patient
Ie. 500 uA output and 500 uA return => no nerve damage
500 uA output and 250 uA return => problem b/c tissue abs to repair damage
machine compares patient readings to programmed “normal” but there are errors b/c no patient fits the mold of the generic norm
machine output is 100 % so leave the MENS on until the return signal from the patient is also 100 % => tissue effectively repaired

In your office, you need to have muscle / nerve stimulation modalities
You also need something for moist heat generation … hydroculator
You also need cryotreatment like ice or instant ice in your access
You need something to treat acute or superficial injuries …. Ultrasound
It would be really great to have a machine to treat superficial & deep muscles

**Interferential Current (IFC)** is the superimposition of 2 middle frequencies of SWC (exogenous) that cross and intersects at target tissues forming a new 3rd frequency wave form (endogenous) of a low frequency SWC.
IFC is created by using 2 middle frequencies (1000 – 100,000 Hz) approximately 4000 Hz that are crossed over such that they combine inside the patient and become the new 3rd current which can have different depths of penetration.
P355, 359 & 360 …. the new 3rd current is a Low Frequency wave ……

<table>
<thead>
<tr>
<th>Frequency A</th>
<th>A</th>
<th>B</th>
<th>Frequency B</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 – 4100 Hz … variable</td>
<td>modulated like a wavetrain</td>
<td>4000 Hz .. fixed</td>
<td></td>
</tr>
<tr>
<td>SWC … equal +/-</td>
<td>“Heterodyne” 3-D wave electrostatic field @ 90’</td>
<td></td>
<td></td>
</tr>
<tr>
<td>crossed currents mutually destructive “Interferential” B</td>
<td>A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Frequency C** is the 3rd new frequency which is the endogenous Low Frequency wave
Called the “heterodyne” wave form
When Freq A = 4000 Hz variable range up to 4100 Hz
Freq B = 4000 Hz remains fixed @ 4000 Hz
Freq C = 0 Hz 100 Hz

The variable range allows selection of any of the 4 BFG’s to select treatment plan
Heterodyne wave falls in the low frequency range

**So what’s so special about IFC?** This modality allows you to select the depth of treatment either superficial or deep muscles so that you can rehab atrophied muscles wherever they may be. The wave modulation will prevent accommodation.

**IFC** is superior for muscle rehab
**FWC** is superior for muscle tetany or fatigue

Frequency A and Frequency B are opposing frequencies which are out of phase by their resonance signatures so that they travel from electrode to electrode to complete the circuit instead of being improperly crossed over.
IFC aka Quad Polar IFC
Voltage .... 120 V up to a max of 150 V
Frequency ... 4 BFG’s
Intensity ... up to a maximum of 90 mA but usually set at 20 – 30 mA
PW ..... milliseconds
Treatment time .... 20 – 30 min
Polarity .... 0

Electrodes .... bipolar placement ..... pin-type, banana, pads or vacuum type
  Vacuum electrodes .... Will leave temporary superficial “marks” on the patient
  Have advantages .... Improves vascularity b/c vasodilation brings blood
  and water into the tissue which improves conduction
  metallic hollow of electricity into the tissues.
  Tube for vacuum More comfortable for the patient b/c the vacuum
  brings the skin into contact w/ the electrode for
  uniform contact.
  Patient can be treated in any position b/c the vacuum
  holds the electrodes regardless of supine or standing

Application .... Sames as EMNS b/c you can choose the 4 BFG’s ....p193
  You must have crossed currents that are mutually destructive

Why is the resultant heterodyne low frequency ? The 2 exogenous waves are destructive to each
other and cancel out but not completely to the
point of annihilation

Quad Polar probe .... Fixed construction by the manufacturer
  Produces a small heterodyne pattern for TMJ, SIJ, CTS or trigger points
  general application for small areas b/c the unit is very small itself
  This unit has a fixed electrical setup and will always form a heterodyne

Target mode on Dynatrons
  Mousepad that can
  Location of steer the location of
  Wave pattern the wave.

This function allows us to distort the heterodyne
upon a specified target ... maintained distortion

Target Sweep Mode ... whatever pattern is emitted, the wave will be focussed
  This serves as wave modulation to concentrate all of the effects
  upon a desired treatment area which can be changed w/o moving
  the electrodes simply by using the mouse pad

Static mode .... Electrodes don’t move and the pattern does not change and the
  treatment area remains exactly the same so the concentrated wave
  remains exactly over the same area of tissue.
**Scan mode** … p.359 … vectoring the heterodyne will rotate and thus changes the treatment area moving just a ¼ turn but that is enough when it oscillates to both the Right and Left to make a “daisy”. The oscillations will encompass a complete circle even though the electrodes don’t move at all but the pattern changes by changing the current on each electrode like a distributor in a car to distort the field.

**Advantages** .. covers an amorphous area
- Widens the treatment area in a uniform fashion
- Vectoring is achieved by varying the current output to the 4 electrodes so that 3 electrodes have a higher current than the 4th one => distorts the heterodyne

**Bad** wave placement …. Directly over the spine

**Good** wave placement … heterodynes do not remain over the spine

**Basic rules of IFC** …… 1 …. Never put the heterodyne directly on the spine b/c this could damage the spinal cord
- Do not let the centre of the propeller fall on the spine but shift it slightly lateral of the spine ie. Treat the paravertebrals

**Premodulated vs Quadpolar** …. Mixes all ingredients inside the patient like a normal IFC
- **Endogenous IFC** is created inside the patient
- **Exogenous IFC** is created by the machine and transmitted into the patient

**Advantages** …… Still capable of the 4 BFG’s and …. 
- Operator can control the depth of penetration b/c of carrier wave

**Premodulated machine** only requires DC to place 2 electrodes on the patient in a bipolar pad placement strategy

**LSI produces IFC**

**fig.93c** scanning

**fig 94** if electrodes are farther apart, the depth of penetration increases

**you can shift IFC by changing the electrode size or intensity**

**suction type of electrodes for treating the knee**

**Russian Stimulation** … p.367 …. Similar to IFC b/c …. Middle frequency wave Modified SWC
- Middle frequency generator …. For muscle stimulation only
- Not for acute or chronic conditions b/c pax are beyond these stages
- Used exclusively for rehabilitation and strengthening muscles to regain normalcy
- 1970’s developed in Russia for the Olympic team … modified polywave current
**Frequency** = 2500 Hz => that means there are 2500 “bursts” per second

**Burst** .. approximately 50 pulses (polyphasic) join together to form a single burst

How do we produce a burst ? we decrease the IPS b/w pulses so that they all summate together to form a great big “burst”

**PW** .... us (microseconds)

**Intensity** .. mA .. up to a maximum of 90 but usually no more than 30 mA
Set the intensity to achieve a working viable muscle contraction

**Electrodes** .. Bipolar .. same size for AC just like all the other modalities
Motor point
TMJ

**Treatment time** .. 10 – 15 minutes for standard Russian Stimulation

**10-50 cycle** .. 10 seconds of ON => muscle stimulation & tetany b/c the muscle is prevented from entering the refractory period and remains depolarized.
Muscle is in absolute refractory period like the Wedensky inhibition or complete tetany => build up of lactic acid => cramps
50 seconds of OFF => duty cycle b/c the machine is on but no treatment wave is produced.
This is the time period during which the muscle can completely repolarize and replenish ATP supplies or else the muscle will complete fatigue.

10/50 cycle tantalizes the muscle just into relaxing before another burst hits again by playing w/ the muscles threshold so that the ON time remains in absolute refractory period.

Other cycles are also possible .. 10/20 cycle, 10/30 cycle or even 10/40 cycle

**Application** .. rehabilitate muscles or re-educate muscles for strengthening

**If you want to fatigue a muscle to treat spasms** .. use 10/10 cycle
10 seconds ON => tetanize the muscle
10 seconds OFF => insufficient time to fully repolarize and replenish ATP so muscle fatigues very quickly

**What currents will result in muscle fatigue to treat spasms ?**
Russian Stim (RSC)
Faradic wave current (FWC)
Vasodilation

**What is the best modality to cause fatigue in a spastic muscle ?**  RSC

**Deep Heaters** .. Aka High Frequency generators
Microwave .. MWD
Shortwave .. SWD all will penetrate > 2” to deep heat local tissues
Ultrasound .. USD ie. Otitis externa, prostatitis or vaginitis
Heat is generated by conversion modality b/c of molecular friction since frequencies are approximately > 100,000 Hz
Oscillations vibrate the atoms together & friction produces heat by thermal heating
p.193 indications for use …… Upper & Lower respiratory conditions
   Treat the lungs from the posterior to avoid the heart
   Sinusitis … Charle’s law of PV=nRT of gas expansion
   Thick mucous is bad b/c it paralyzes cilia so
   use heat to b/d the plug and allow the cilia to beat once again.

Short Wave Diathermy (SWD) … high frequency oscillating electrical current
Frequency … 27.12 MHz
Wavelength … 11.06 m
Temperature … 109.4 – 113 ‘F (43 – 45°C)
During WWII, diathermy was used to superheat soldiers to induce an artificial fever to drive out illness so the idea was to heat the body just slightly above normal core temp.
Applications ….. Continuous SWD for chronic injuries
   Pulsed SWD for acute injuries … small trickle of blood / vasodilation
      to bring in blood and nutrients & phages is better for recovery than straight vasoconstriction
SWD can be pulsed ON/OFF @ 1 second intervals to achieve penetration w/o conc’n.
Usage of SWD ….. 1” of towelling b/w pax and electrode to absorb perspiration / sweat
   b/c SWD will heat the fluid and burn the pax
   paper towelling will absorb the fluid away from the pax
   1-2” b/w the treatment apparatus and the pax avoid the “edge effect”
      whereby there is summation of high frequencies => sparks & burns
      at the edges of the condenser pads.

Kirchoff’s law of tissue density .. the density of the tissue is directly proportional to the amount of heat generated when connected to a generator source.

Electromagnetic SWD …. Aka …. Induction SWD
   Very good vascular heater for vasodilation to Tx DM & thrombophlebitis
   Heat is generated by electromagnetism and depends on the EM field strength
   Very good for superficial vascular Dz but can still Tx deep tissues
   Machine has 1 application electrode … induction coil or cable … wrapped around
      a body part to generate a 360’ EM field
   The patient is not part of the circuit but is Tx’d by being within the EM field
Coil / cable length approximately 4 – 5 ft long and ½ to ¾ inch wide
   The cable is plugged into the machine & wrapped around the body part b/c there is an EM field generated all along the entire length of the coil
   The induction coil/cable is very large and thick
   Towelling b/w patient & cable …. @ least 1 inch to avoid skin burns
      Moisture absorbs the heat and burns the skin
Types of induction cables …. Based on shape
   coiled pancake may be open or enclosed within a drum called the “monoplode”
   the coils must be kept apart from each other by spacers to avoid edge effects
   Coils must be kept @ least 1 inch apart using spacers to avoid the edge effects
   Even though there is a built-in air space, still use 1 layer of towels to absorb water
monopole

drum is mounted inside a metal casing
so that it has only one treatment surface
still flexible and moldable to
bend around body parts ie. Leg

Rheostat … set the intensity of treatment …. 0 – 100 Watts
Timer … Up to 30 minutes of treatment ON or OFF

Treatment strategy …. Patient may be supine, standing or sitting
Treatment time … 20 – 30 minutes … so get comfortable

Electrodes ….. Place in close proximity for firm contact to maximize treatment
Put the electrode right on the patient

4 foot rule … applies for electronic items ie. Watches, beepers, phones & jewellery
a diplole drum is also possible and has the ability to wrap completely around the
body part and treat > 1 surface
bendable configuration
with multiple surfaces
to contact the patient
can wrap around pax
use 1 layer of towelling b/c there is a built-in air gap

hinges
electrode is enclosed w/in a housing … make sure there is no twisting to avoid edge effects
of the cables entering and exiting the U/S machine

Treatment procedure ….. Place the electrodes on the patient and the part to be treated
Set the treatment time ON or OFF … machine warm-up 3 min
Crank the rheostat to max … remember the intensity depends on
patient tissue & density which
determines the amount of heat generated
Rem .. you need firm contact w/ the patient b/c tissue
resistance governs the amount of heating
have the patient tell you when it gets too hot & read metre
adjust the machine down to where the metre reads ½ intensity
have the patient tell you if it becomes too cold

Place the electrode the same distance from the patient each time b/c this procedure of adjusting the
machine for maximum patient comfort level allows the DC to set the machine w/o calibrating for
future treatments
What about combination treatment of heating and muscle stimulation ?
Apply heat first b/c fluid & blood can help electrical stimulation and conduction of heating into
tissues.

Electrostatic SWD ….ES-SWD… static field of electricity w/ patients in between
Aka condenser field SWD
Especially good for treating deep cavities of the body superior penetration
abilities still can treat superficial parts.
Always has 2 electrodes connected to the patient — coplanar, transverse or longitudinally. 
Fat can interfere w/ the effectiveness of Treatment b/c water content conducts electricity and absorbs …. Remember the patient is not part of the circuit.

**Condenser pads** … rubber pads 8 x 10” electrodes wrapped in rubber or neoprene 2 pads are required to treat the patient

**Condenser cuff** … coiled form of condenser pads to wrap around the patient

**Air spaced electrodes** … space plate … electrode is covered w/ a layer of air to separate the treatment area from the patient. Keep 1 inch space gap away from patient and use 1 layer of towelling.

**Sinus mask** … mask w/ 4 electrodes embedded in neoprene or rubber to decongest the maxillary and frontal sinuses … use 1 layer of towelling or carpet pads.

- 2 electrodes for the Frontal sinuses
- 2 electrodes to treat Maxillary sinuses

**Internal electrode** …. Condenser that is inserted into the vagina or anus to treat vaginitis, hemorrhoids or prostatitis … urethritis or coccycodynia just lubricate and insert the electrode. Mucus membrane is sufficient protection for this modality.

**Microwave Diathermy (MWD)** … superficial localized heat … conversion heater
This microwave is the same as that of a microwave oven except power / strength
**Penetration** … > 2” makes it ideal to reach the fascia … fat and muscle layers
Less penetration than SWD

*Intensity* is measured in Watts = Amperage X Voltage or a % of power where the maximum power is 100% …. This is an old expression but it is still used today.

Magnetic fields are more concentrated than SWD

**Efficiency** …. only 1/3 as effective as SWD

*Application* ……… comfortable, seated, supine and prone etc.

Indications for treatment
Patient preparation …….. **Bare skin** b/c clothing can burn unless cotton
**Clean skin** …. No oils may burn
**Dry skin** … may burn or scald the patient

**Contraindications** …….. pacemakers are very sensitive
4 ft rule applies

**Magnetron** …. A huge C-shaped magnet that converts electricity into MWD and is the guts of the machine.
Directors are used in MWD ….. typically labelled A – E depending on size & shape
Director is composed of 2 components …. Reflector and antenna
Reflector behaves like a collimator to direct the beam of treatment
Antenna is the metal connected to the coaxial cable and actually emits the MWD
   A … small and round
   B … large and round
   C … small and rectangular
   D … medium and rectangular
   E … large and rectangular

Rules for director selection ….. Smaller director for small treatment areas
   Smaller director must be closer to the patient
   Smaller director is proportionately lower in power

Non-Contact type of MWD
Frequency … 2456 MHz
Wavelength … 12.2 cm
Temperature ….. 106 ‘F designed to cook and kill viruses and denature proteins
   Other methods of denaturing proteins is acids & neutral salts
Treatment time … 10 – 20 min
Penetration …. > 2” reflector coaxial
Scatter …. 20 – 50% antenna
Application ….. Director is built into the unit with a reflector to direct the beam
   Coaxial cable connects the machine to the director
   The antenna is connected to the coaxial and emits the EM
   High scatter losses as much as 50% so use high frequency

Uniquenesses ….. distance b/w the patient and the director
   Director is open and exposed in design
   If the patient sweats, it is easy to wipe off the sweat & continue

Contact type of MWD
Frequency … 915 MHz
Wavelength …. 12.2 cm
Temperature …. 106 ‘F cook and kill viruses
Treatment time …. 10 – 20 min
Penetration …. > 2”
Scatter …. 0%
Application ….. Directly on the skin w/o a barrier b/w the patient and the electrode
   Uses a lower frequency b/c less is lost b/c of scatter
   Employs a rotating antenna to create a uniform pattern by spinning a fan
   to avoid “hot spots” of treatment
   perspiration on the patients can scald the skin so all contact machines
   have a built blower to evaporate the perspiration
   make sure the skin is clean and dry

Uniqueness ….. Low scatter loss almost 0 % so use a lower frequency
   Director is placed directly placed upon the patient
   Director is enclosed w/in a housing
   Director contains a rotating antenna for more even distribution
   Air blower to keep the skin dry
Ultrasound Diathermy (USD) ..... small diameter coaxial cable
Microwave Diathermy (MWS) ..... Large diameter coaxial cable

Contraindications .......... 4 ft rule when you have a SWD or MWD
You must keep all machines w/ transistors in the circuit ie. Cell phones, pagers, pacers, hearing aids and radios b/c EM can melt the circuitry on anything magnetic ie. IUD or contact lens

p183 SWD
p184 High frequency generators .... SWD, MWD and USD
p185 physics experiments

The Light Bulb Experiment .... Hold a cylindrical electrode in each hand and attach the end to a light bulb which should light when the machine is turned ON and demonstrates a high frequency current flowing to create an electrothermic effect on the body w/o triggering a NMS contraction.

The Wrist Experiment ... patient grasps a SWD cable or a cylindrical electrode and extends the wrists while the machine is turned ON to see if heat is felt in the wrists, hands or forearms indicating that a high frequency current is creating heat where tissue resistance is greatest.

The Water Experiment ... conducting coils from SWD are placed 2 cm apart in a container and look at the meter to verify current flow and look to make sure that NO bubbles form @ any electrode w/ or w/o salt electrolyte to prove that SWD has no electrolytic or electrochemical properties.

p186 EM and static
p190 TMJ treatment ... otitis media/externa ... there is a lot of other structures & tissues so this is not optimal

p193 good treatment
p195 poor treatment b/c they forgot to towel the patient
p198 good treatment
p200 transverse electrode one on each side of the body
longitudinal application down the core of the body
p202 two electrodes on same side is coplanar
p204 good treatment b/c it can go over spine
p205 always have towels when using SWD

Ultrasound Diathermy (USD) ..... a high frequency generator > 100,000 Hz
Creates heat by conversion heating or friction rub
Penetrates up to 2” into tissues ... commonly used
Very effective & has significant physiological effects

USD treats ..... bone, joints, bursa, tendons & ligaments as well as muscles
p.573 piezoelectric treatment w/ electricity to create a vibrational, inaudible wave

piezoelectric effect .... Convert mechanical energy into electrical energy
ie. A watch uses a battery to vibrate a quartz crystal
Lithium & quartz crystals expand & contract in regular rhythm
A spinning turbine w/ Copper windings will generate electricity

Reverse piezoelectric effect ... converts electrical energy into mechanical energy
p.217-219 U/S vibrations produced by crystals located b/w 2 electrodes of High Volts
Piezoelectric crystals ..... contained inside the transducer attached to electricity
Undergoes rapid expansion & contraction => produce U/S
USD Specifications ..... there are only 2 frequencies used in U/S
Velocity of U/S ..... 300 m/s
Frequency .... 1.1 MHz 3.3 MHz
Wavelength ... 0.15 cm slightly longer
B/c of the small wavelength, USD is small enough to penetrate into tissues
Voltage .... 100 – 2000 Volts (you may need a step-up transformer depending upon the
peizioelectric crystal element)

Depth in pax ... very deep ( 2 inches ) shallow & superficial
Treatment tissue bone, muscle, fascia & fat muscles, fascia & tendon
Articular cartilage & ligament articular cartilage sometimes
Heating & mobilization Joint capsule & periosteum

Heating .... Conversion heater conversion heater
Initially feels cool but generates heat slightly delayed effect

Power ... W or W/sq.cm W or W/sq.cm
Watts/sq.cm .... therapeutic output – intensity used to treat the patient
Watts ... modality output b/c it comes right out of the machine
Quantity ...... 5 W < 10 W
Quality ...... W/sq.cm b/c it has relative meaning accounting for surface area

Low velocity High velocity
Velocities and pressures are different but the volume remains the same
Treatment time ..... any treatment < 5 min is physiologically useless
Any treatment > 15 min will hurt a lot
Acute condition Chronic condition
5 min 15 min

p.217-223 Equipment ...... transducer assembly
Transducer ...... contains the piezioelectric crystals to convert electricity to vibrations
Waterproof ..... completely immersible in water except where power cord
enters the back of the transducer assembly
Wear ..... lasts the lifetime of the machine ... check for damage on face
Nicks, scratches, dents, rough edges => signs of abuse
Normal wear ... concentric rings on the transducer face
Cleaning ....... wipe the gel off the transducer face w/ Etoh, UV or bleach
Heavy cleaning may require soaking for 20 min in bleach
There are “0” reported cases of Dz transfer b/w patients

transducer handle

transducer face ..... in contact w/ pax
check for wear.
Stainless steel
c coaxial cable transducer head ... contains piezioelectric crystal
small coaxial cable either forward or reverse
transducer head
transducer face … crystals are glued to the face and are
connected by electrodes to a coaxial cable.

Large single crystal                  multi-crystal array

Piezoelectric crystals … generates the U/S and are made of many different materials
Barium Titanate …. Very cheap & easy to make …. Most commonly used
                        3 Watts @ 100 Volts ..... uses household current
Lead Zirconium Titanate (PZT) …. Synthetically manufactured
Quartz Sulfate …. Mined & very stable & maintains a regular rhythm
                      Most expensive material in any U/S
                        3 Watts @ 2000 Volts …. Requires a step-up transformer
Lithium Sulfate …… synthetically manufactured … not commonly used
                      3 Watts @ 500 Volts …. Also needs a step-up transformer

Couplant medium …. Some gel used b/w transducer and the patient to transmit the U/S
Water is the best couplant for U/S .. especially for MHz range
Air is the worst couplant especially U/S
Gels may be based on water, glycerine and mineral oil
Alternatively use ….. analgesic creams ie. Ben-Gay, Icy Hot etc. & creams of
menthol, camphor or eucalyptus for vasodilatory effects.
Aquasonic gel = water + gelatine suspension of water so it doesn’t run off the patient
during the treatment.

Physiological Effects of USD ( 5 Basics ) page 225 - 227
Chemical ….. changes cellular metabolism @ the molecular level
Thermal …… U/S travels @ 300 m/s in air
            Volume heating ….. creates heat in tissue & travels faster ie. 3500 m/s
                        (1.1 MHz) Since heating is proportional to tissue density, U/S
                        travels fast in bone, ligament, tendon & periosteum.
Structural heating … U/S travels @ 300 m/s in air but in the body, it
                        (3.3 MHz) averages around 1500 m/s.
            Sound transmission is faster solid > liquid > gas
Mechanical …..
Neural …….. can stop or slow peripheral nerve conduction as in pseudoanalgesia
            Using the 3.3 MHz transducer
Phonophoresis ….. Sound waves that cross a membrane barrier and involves
            Chemical and Mechanical components w/o ionic dissociation.
            Remember Hydro & Iontophoresis which drive ions across the
            membrane in a water or ionic medium after the ions dissociate.
            USD can drive chemicals into adipose, connective, deep & vascular tissues as deep as 2 mm.

Conduction velocity of USD …….. 300 m/s in air
            When U/S travels in something less dense & structured
the U/S beam slows down & creates less heat.
Ie. Soft tissues, muscles & fascia.

**U/S Shearing** … Similar to edge effect so it is very important to keep the transducer moving.
Move the transducer continuously, circularly approximately 1” per sec b/c USD can burn the pax’s periosteum. Treat by moving over it but don’t park over it.

**Sub-Aquaeous application (underwater)**…. Use water as the coupling medium so that the entire treatment area is surrounded.
Caution … Make sure there are no air bubbles on the pax’s skin and keep the transducer head 1” away from the skin surface.
This permits sound wave scatter over the skin but keep the transducer in continuous motion during the treatment.

Patient comfort … usually the sensation of water & the U/S ripples will be felt

**USD Treatment strategy** …. flat surfaces => use a flat transducer … no air bubbles
Irregular surfaces => consider subaquaeous method
Cooler medium …. Better b/c you can incorporate simultaneous cryotherapy
Warmer medium …. Not desireable b/c it absorbs the U/S & decreases efficiency

**USD machine maintenance** … do not leave the machine ON => burns the PZT crystals

**USD dosage** ….. acute to chronic … requires an increase of 0.5 W/sq.cm
    Thin to thick ….. requires an increase of 0.5 W/sq.cm
    Direct to subaquaeous ….. requires an increase of 0.5 W/sq.cm

B/c the U/S is not as concentrated

<table>
<thead>
<tr>
<th>Patient’s condition</th>
<th>Tissue type</th>
<th>Recommended dose</th>
<th>Underwater dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>Thin</td>
<td>0.5 – 1.0</td>
<td>1.0 – 1.5</td>
</tr>
<tr>
<td>Acute</td>
<td>Thick</td>
<td>1.0 – 1.5</td>
<td>1.5 – 2.0</td>
</tr>
<tr>
<td>Chronic</td>
<td>Thin</td>
<td>1.0 – 1.5</td>
<td>1.5 – 2.0</td>
</tr>
<tr>
<td>Chronic</td>
<td>Thick</td>
<td>1.5 – 2.0</td>
<td>2.0 – 2.5</td>
</tr>
</tbody>
</table>

**Thin** …. Head & Neck, Arm & Forearm, Sacrum, Coccyx, SIJ, leg distal to the knee
**Thick** …. The rest of the body
Thin & Thick tissues depends on body type ….. ecto, meso & endomorph

You cannot rely on Maximum Patient Comfort Level or tolerance to set the intensity b/c in USD, the *patient cannot feel the treatment* but they will feel the effects.
Some manufacturers leak out some electricity from the coaxial cable to the transducer face so that the patient will feel something.

**Coupled modalities** …. Link different treatment modalities together … USD + HVDC
U/S & electrical stimulation simultaneously *saves time*
SWC, IFC, RSC etc. but not TENS & MENS
Initially causes local vasodilation to perfuse the tissues b/c more fluid improves electrical conduction .. saturate & stimulate

**Transducer** one EMNS port plugs electrode … +/-

Into the USD machine

<table>
<thead>
<tr>
<th>Channel A</th>
<th>Channel B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
28

electrode  
2 electrodes  
2 electrodes

Transducer can be used as an electrode +/-
treatment / dispersive electrode depending on desired effects

**Total possible electrodes** .... Coupled modalities may have up to 5 active electrodes

AM-316  
Set the timer for treatment

Check the fuses

Interrupted U/S .... Pulsed U/S .... Alternates b/w 1 sec ON and 1 sec OFF

Why ? Penetration without concentration … ideal for acute condition

Trickled heat to treat …… edema, inflammation & soreness

Gentle vasoconstriction/heat

Positive galvanism

Regulated U/S …. Continuous U/S …. Ideal for treating chronic conditions

U/S stimulator …… Up …. For simultaneous U/S and HVDC

Down … for HVDC only

Rheostat for U/S to adjust the intensity

Meter to read the intensity

Transducer w/ attached coaxial cable  (MWD also has a coax cable)

Transducer face may have some rings … it is a sign of age

p.223-229  
**analog intensity metre**

p.234  
digital readouts will automatically default to Watts but you need to change scales in order to read the therapeutic output

<table>
<thead>
<tr>
<th>Average</th>
<th>Watt ................. Continuous U/S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>Watt / sq. cm ........ Pulsed U/S</td>
</tr>
</tbody>
</table>

Machine output = **Watts**

Therapeutic output = **Watts/sq.cm**

To accurately determine the intensity of the U/S, you must read the scale corresponding to the operational mode (continuous or pulsed U/S) and the transducer

If using another transducer, you need to calibrate and compensate

The U/S machine is calibrated to used the original transducer & output so changing the transducer requires recalibration.

**How do you know that the U/S is working or a transducer is working ?**  
Tape test

Wrap a loop of tape around the transducer face so that it is like a bowl

Fill the bowl with water and turn on the machine and verify that the water is rippling and bubbling evenly all over the transducer face.

**Procedure for USD ....** Prepare the U/S, gel and towels

Place the patient in a comfortable position

Make sure DC is also comfortable b/c you must be there to operate the transducer

Acute (5 minutes) and Chronic (15 minutes) continuously moving the transducer in a circular pattern

apply plenty of gel to the patient and warn them that it is quite cool on the skin collimate the area so that the gel doesn’t get all over the pax & clothing

camphor & menthol may liquify and run down the skin so clean the skin well
apply the gel and spread it evenly over the treatment area
move the transducer continuously … 1 inch/sec … and do not press down b/c it
would squeeze out the gel and decrease the treatment efficiency
if you forget to move the transducer, the patient will burn w/in 1 second

**Treating a patient along the back …. SIJ**
Place the patient prone on the treatment bench
Use towels to drape the patient if there are any exposed areas
Tuck paper towels under panties or brassiere to protect the clothes
Drape around the treatment area as if you were performing surgery

**Treating a patient along the anterior …. Abdomen**
Place the patient supine and have them roll up the gown just under the brassiere
Use a towel to cover the groin area and tuck in the towel to protect the panties
Now the belly is exposed for treatment

**Sonicator 710**

fg How do you calculate the transducer surface area?
Turn the machine ON and turn the intensity to 1 W/sq.cm
Switch the meter to Watts and read the corresponding #

Frequency …. 1 MHz
Transducer ..... 4 sq. cm
Power …. Always defaults to Watts when any USD is turned ON
Timer ..... set for condition
USD mode ..... CW or Pulsed
Go

**Sonicator 716** … features a magnetic cradle b/c this unit can be mounted to a wall

Frequency …. 1 MHz
Transducer … 10 sq.cm
Timer keypad
USD mode ..... CW or Pulsed … … …. Intensity set

**LSI 410** …. ability to set the variable pulsed mode

Frequency …. 1 MHz
Transducer ..... 10 sq. cm
Timer …. ON / OFF …. up to 30 min
Needle meter …. Watt or Watt / sq.cm
Rheostat or intensity switch

**Duty cycle ..... machine ON .......... 100% ON = CW**

10 % ON = 90 % OFF variable pulsation
20 % ON = 80 % OFF

**Me-900** … dual HVDC and USD

Frequency …. 1 MHz
Transducer ..... 7.2 sq. cm

**Me-720** … has multiple Frequency transducer capability … 1.1 MHz and 3.3 MHz
And a computer interface b/w transducer and machine autodetects the
transducer and automatically recalibrates the intensity output.

10 sq.cm transducer …. 1 MHz and 3 MHz
5 sq. cm transducer …. 1 MHz and 3 MHz
1 sq. cm transducer …… 3 MHz … for small parts ie. TMJ
ie. Sinuses Frontal or Maxillary, Carpals or SIJ

Timer …. ON and OFF
Go / Hold
Power …. Watt or Watt/sq.cm
Intensity / rheostat
USD mode …. CW or Pulsed

**Diasonic USD** …. Aka Static USD
Transducer head is kept static …. Do not move the transducer head
Large transducer face (50 sq.cm) but you are still limited to a small treatment area
**Treatment dose** …. 0.01 – 0.3 W/sq.cm … very low output level
**Treatment time** …. Maximum of 15 min b/c it is a small treatment area
**Advantages** ..... DC does not need to be present during the treatment
Sensitive trigger points may be treated
**Disadvantages** … you can only treat one area at a time

**Pulsed USD** …. Aka interrupted mode
“Penetration without concentration” …. Ideal for acute condition w/o exacerbation

**Radiation Modalities** ….. Infrared 60 % (IR) or Ultraviolet 40 % (UV)
Heating was always thought to be beneficial to health …. **Heliotherapy** from the sun
Sunlight … Infrared (IR) 60 % … heat, warmth of sun on skin, light bulb
Photothermal … IR produces heat as light
Ultraviolet (UV) 40 % .. produces sunburn when there is overexposure
Photochemical effects …. UV produces chemical reactions
**Heating elements** … metals like Ni, Cd, C smelted as an alloy packed in a vacuum tube
Ie. Light bulb is an enclosed, gas-filled chambré w/ a Copper filament
Electricity heats up the filament and heats up the gas => light production
The glowing wire heats up the gas and produces photons of light

**Visible Spectrum** ……. light that is visible to the human eye … 4000 – 7000 A

<table>
<thead>
<tr>
<th>Wavelength (in micrometres (um) or nanometres (nm))</th>
<th>UV (short wavelength)</th>
<th>Visible Spectrum</th>
<th>IR (long wavelength)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000</td>
<td></td>
<td>7000 A</td>
<td></td>
</tr>
<tr>
<td><strong>Violet</strong></td>
<td><strong>Blue</strong></td>
<td><strong>Green</strong></td>
<td><strong>Yellow</strong></td>
</tr>
</tbody>
</table>

**Infrared Radiation (IR)** …. Easily identified by the visible spectrum …. P.148
Choose type of IR depending on desired effects & location

<table>
<thead>
<tr>
<th><strong>Short Wave IR</strong> aka Near Wave IR</th>
<th><strong>Long Wave IR</strong> aka Far Wave IR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most common … close to visible range</td>
<td>Uncommon … far from visible range</td>
</tr>
<tr>
<td>Wavelength = 7500 – 14,000 A</td>
<td>Wavelength = 15,000 – 120,000 A</td>
</tr>
<tr>
<td>Deep heater …. Deep into dermis</td>
<td>Superficial heater …. Superficial dermis</td>
</tr>
<tr>
<td>Penetrates 5 – 10 mm</td>
<td>Penetrates 0.1 – 3.0 mm (dermis = 2mm)</td>
</tr>
<tr>
<td>Surface temperature 111˚F</td>
<td>Surface temperature 114˚F</td>
</tr>
<tr>
<td>Subcutaneous temp 118˚F</td>
<td>Subcutaneous temp 107˚F</td>
</tr>
</tbody>
</table>
Penetrates tissues w/o reflection  Most of this heat is reflected off patient
Luminous … glows, incandescent Non-luminous … dull, red heaters

Applications of IR therapy … Heat is applied from outside into the patient
- Direct treatment b/c towelling is optional, not a requirement … use a single layer ie. Gown, shirt or blouse to protect the patient from getting burned or if the bulb breaks
- Heating by towel method b/c the towel gets hot => transfers heat into the patient
- make sure that the treatment area is clean of oil or creams … may heat up & burn
- towels can be applied wet / dry …. wet is optimal in carrying water into the patient and avoiding dehydration of skin surface b/c IR tends to dehydrate rapidly & cause cramping.
- IR causes local heating so protect the patient’s eyes w/ goggles when treating

Cosine law … aka Lambert’s Cosine Law
 … the greatest amount of radiation is received when the energy is applied at a right angle (90’) to the treatment area …

<table>
<thead>
<tr>
<th>Maximum force</th>
<th>Glancing % of treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>@ 90’</td>
<td>when @ an angle other than 90’.</td>
</tr>
</tbody>
</table>

Inverse Square Law … The intensity of radiation from any light source varies inversely with the square of the distance from the source of the radiation.

Treatment distance in IR ..18 – 24” from the patient for maximum physiological effect
- If you double the distance, the treatment decreases 4X
- If you decrease the distance by ½ , treatment increases 4X
- So, if you are too close => you might burn the patient
- Conversely, if you are too far away => IR would be useless

Treatment time …. 20 – 30 minutes

IR treatment strategy … . Trickle in the heat so you must exercise your clinical judgement in setting Intensity & Distance.

Rest period …. Permit the skin to cool off after the IR treatment b/c the skin is very erythremic b/c of the vasodilation.
- Superficial skin needs to cool off b/c the skin is sensitive b/f starting further treatments on the patient ie. Goading, massage or adjusting.
- 10 – 15 minutes according to the textbook but this would cool off the patient and you lose the effects of IR treatment.
- 5 minutes … clinically realistic to achieve of heat therapy prior to adjusting

IR machines …. Remember Long & Short wavelength modalities
- Long wave IR …. Does not glow but takes 5 minutes to warm
  So remember to add 5’ to your treatment
  Alloy disk inside the external reflector
  This external reflector gets very hot
- Treatment distance … 18 – 24” according to inverse square law
Treatment angle ... Perpendicular to skin surface according to cosine law

Power output ... 600 Watts

Treatment time ... 20 – 30 minutes

Short wave IR ... Incandescent light bulb w/ glow Coating of Aluminum foil inside the bulb
Large external reflector w/ an internal coating
Chromo Tx Clear, red (heat) or green (healing)

Power ... 1200 Watts is standard

Towelling ... not required but 1 layer is recommended to protect the pax
The light bulb may burst so make sure there is no bare skin

Treatment intensity ... Depends on the bulb ... either ON or OFF

Treatment time ... 20 – 30 minutes ... so let the patient get comfortable

Treatment distance ... 18 – 24” ... According to inverse square law

Treatment angle ... Perpendicular to the patient’s skin surface ... cosine

Reflector ... Only the light bulb heats up & but the reflector doesn’t get hot

UltraViolet Radiation (UV) ... Only 3% of all DC’s use this routinely

Heliotherapy (sun) ... 60% IR + 40% UV

Actinic ... radiant energy w/ photochemical effects on the body b/c UV is therapeutic

Actinotherapy ... Tx Dz using UV, chemical light or X-rays via a Hg vapour arc

Mercury Vapour Arc ... you only need a few drops of Hg like an oral thermometre
Glass tube of quartz-glass w/o impurities to avoid attenuating the UV rays
Several drops of Hg inside the glass tube
Some inert gas ie. Argon or Neon is sealed inside the glass tube
Electricity is passed through the tube to vapourize the Hg droplets
Excited Hg gas mixes w/ Argon / Neon gas => emit UV light through tube
Escaping UV reacts w/ atmospheric Oxygen to form Ozone .... O3

Quartz glass tube

Argon / Neon

-- + Hg droplet

When buying a UV tube? if you cannot smell ozone when tube is ON, it doesn’t work.

Why no ozone prod’n? The impurities of Pb in the glass will prevent escape of UV and act as a good shield of UV protection like photographic UV filters.

<table>
<thead>
<tr>
<th>Long Wave UV aka Near UV</th>
<th>Short Wave UV aka Far UV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength = 2000 – 4000 A</td>
<td>Wavelength = 1800- 2000 A</td>
</tr>
<tr>
<td>Penetration = 0.3 – 0.5 mm</td>
<td>Penetration = 0.1 – 0.3 mm</td>
</tr>
<tr>
<td>Fairly deep penetration for photochemical</td>
<td>Very poor penetration</td>
</tr>
</tbody>
</table>
Mechanism of UV therapy ... causes chemical changes w/in the patient and is capable of killing viruses and bacteria

UV Index ...... Numerical value b/c it denotes the amount of time that you can safely stay in the sun exposed to UV before the skin begins to burn.

   Measured in _____ minutes.

UV-A ... 3400 – 3600 A ...aka Near Band Range ...... ideal for tanning
   Photosensitive agents ....... Certain drugs have actions altered by UV rays
   Keep Rx out of light by using colored bottles

   Tanning salons ... commonly used and commercially available but damages the dermis

UV-B ... 2900 – 3100 A ... aka Near Band range

   Hot Quartz Radiators b/c this is a very good heater
   Not commonly used but emits a powerful vapour arc under high gas pressure
   Extremely high heat produced ... 8000 ºC or 14,432 ºF

   Current requirements ...... 5 – 20 Amperes (Electric chair operates @ 5 A)

   Treatment distance ..... 30 inches

   Application .... vitamin-D synthesis by the skin to enhance Ca2+ absorption

   Good for patients @ risk for Ca2+ deficiency or osteoporosis

   Any human Dz condition or infex’ns

   Treat any non-union fractures

UV-C ... 2000 – 2900 A ... aka Far Band Range

   Cold Quartz Radiators using Neon gas b/c it has a low pressure & boiling pt
   Most commonly used by DC b/c it is safe to use ...low amperage requirements

   Low vapour pressure of gas w/ Hg and Neon b/c it is easy to heat up

   Step up transformer needed to convert 110 Volts => 2500 Volts

   Current requirements .... 2 amps

   Treatment distance .... 1 inch directly over the skin area / infected site

   Applicat’n ... 2537 A wavelengths destroy bacteria, fungi, viruses & parasites

   Unfortunately, pathogens & healthy tissues are both destroyed
   Hopefully, the pathogens are permanently killed but dermis will regenerate in time.

   Basically, this can be used to treat any form of Dz

   Direct the UV ray @ affected site vs an internal oral antibiotic

UV lamps available

   Wood’s light aka Wood’s lamp ... long wavelength for Dx not for Tx

   Wavelength .... 3500 – 4000 A (UV-A)

   Not for therapy, this is used only to Dx ... ie. Detect phosphorescence

   Keratin in substances will fluoresce under UV

   Keratinized tissues are precancerous, cancerous lesions & 2’ Syphilis sores

   Tinea infex’ns .... Roundworms can be treated

   Kromeyer light .....  

   Wavelength .... 2537 A => ideal as a bacteriocidal modality

   Contains a water cooled bulb => cold quartz radiator
Applications of UV lamps

General Therapeutic UV lamps .... Minimal Erythemal Dose (MED) 24 inches < 15 minutes

General Sun UV lamps ...... sold as tanning lights to the general public MED @ 24 inches b/w 15 – 60 minutes

p.162-163 Indications & contraindications for UV ...... Primary indications

*Dermatologic Dz .... psoriasis, acne, abscesses, boils, tinea
* Antibacterial actions * Herpes Zoster / Shingles * Oropharyngitis
* Osteomalacia * Lupus vulgaris * Diabetic ulcers
* Open sores * Sinusitis

Other considerations for treatment w/ UV

* Acne * Alopecia * Asthma & Bronchitis
* Bone / joint TB * Mild skin burns * Dermatitis herpetiforms
* Staph impetigo * Erysipelas

Contraindications against the use of UV

* DM * SLE * Malignant cancer
* Eyes, genitalia, buttocks & breasts
* Photosensitive Rx ie. Sulfonamides, tetracyclines, quinine or green soap
* HC-thiazide, Haldol, Thorazine, Griesiofulvates – dyflucan, fulvicin
* BCP’s can be inactivated by UV

Treatment schedule for UV ..... your goal is to create an MED every time you treat
1. Patch test ..... used to determine the MED to begin treatment
2. Routine treatment method ...... 1st treatment ..... start @ MED
   2nd treatment .... 1st Tx setting + (½ MED)
   3rd treatment .... 2nd Tx setting + (½ MED)
   4th treatment ..... Maximum treatment .... 10X MED

Why increase duration by ½ MED ? This compensates for the increasing tanning of skin
Maximum treatment time is 10X MED .... If you have to go beyond this, something has
   changed w/in the patient or else you are using the wrong modality to treat.

Patch test .. aka Sleeve test .... systematic method of determining the MED
MED ... Minimum Erythematic Dose = amount of UV to cause the skin to turn red
   The colour will appear & fade w/in 8 – 24 hours
   Neon gas
   UV tube Pen applicator (UV-C)
   Mercury droplets use 1” away from skin

Hot UV .... UV-B ... treat for 5 seconds ... stay 30 inches away from skin
Cold UV ... UV-C ... treat for 1 second .... Stay 1 inch away from the skin
1.Tape template to patient’s forearm & draw a dot in the middles of each window
   try to stay away from areas with hair & pigmentation
2.Use collimation to drape around the template area
3.Patient & DC need to wear goggles
4. Expose on flap at a time and use UV over the exposed window approx 1 inch away
   UV-B  5  10  15  20  25
   UV-C  1  2  3  4  5

Exposure times for different UV’s

5. Patient carries a card w/ …… Name, Date, test area, official office stamp & phone #
   patient must observe every hour for colour change and identify Red, Pink or No Rx’n

6. Identify the 1st window that shows a “PINK” change in colour as the MED

7. Enter the MED value into the chart as SOAP notes.
   TQ …. How do you set up a patch test? See above synopsis
   TQ …. How does a new tube differ from an old tube? Exposure times
   TQ …. If the patient is darker, how do you compensate? Increase the exposures

Erythema Doses  wavelength 2400 – 3200 A b/c no UV > 3600 A will cause tanning
   Essentially a form of inflammation b/c skin becomes red & inflamed

1st Degree …. Aka Tonic dose …. This is the ideal goal of UV treatment
   tonic = treatment …. Slightly red or pink

2nd Degree …. Mild sunburn => may peel but may not tan …. 2.5 X MED

3rd Degree …. Aka counter irritant dose … very red appearance w/ slight edema
   peeling, no tan, like freckles … intense pigmentation .. 5 X MED

4th Degree … aka destructive dose … severe redness, dermatitis, blistering,
   peeling & exudation … burnt / incinerated flesh b/c 10X MED

5th Degree … aka SubErythemal Dose … no visible results but anymore UV will push it
   over the limit => erythema

Setbacks during the treatment process …. Do not put an erythema on top of an erythema

Missed appointments ….. 1-2 days => continue on schedule
   1 week => resume treatment but start 1 level back
   2 Weeks => resume treatment but start 2 levels back
   2 weeks => begin treatment from the beginning

Tube wear … tube degrades & loses its intensity b/c of the UV the more it is used
   Tube will normally wear but the treatment only lasts for a few seconds

<table>
<thead>
<tr>
<th>Tube use</th>
<th>% of original intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>100 %</td>
</tr>
<tr>
<td>&gt; 100 hours use</td>
<td>80 %</td>
</tr>
<tr>
<td>&gt; 1000 hours use</td>
<td>50 – 60 %</td>
</tr>
<tr>
<td>Old</td>
<td>60 – 70 %</td>
</tr>
</tbody>
</table>

When must you determine the MED ….. when you purchase a new machine starting a new Tx

Essentials when using UV ….. Perform patch test on the 1st visit
   Compensate for any missed appointments
   Repeat patch test every 6 months to compensate for tube

Precautions when using UV …. Protect the patient & the DC
   Collimation ….. done right on the patient w/ towels or paper towels to reflect the
   XS UV rays to limit the treatment area … like drapes for Sx

Erythema ….. Do not put an erythema on top of an erythema …. Too much UV-rays can become a suberythema or a full erythema
   Protect the eyes ….. goggles or UV coated glasses to attenuate scatter UV-rays
   Remember to seal completely around the edges
**Treatment area** ... Clean, dry & bare ... Clean off all oils, creams, lotions & UV blockers by using rubbing alcohol

**Patient sensitivity** ..... Females burn easier than Males
Albinos > redheads > blondes > brunettes
Areas normally covered by clothes are more sensitive
Alcoholics are more sensitive b/c peripheral vasodilation
Dz’s that increase sensitivity ... RA, psoriasis & Sjogren’s

**Protein shock** ...... Aka Sun poisoning .... XS suntanning => ill feeling
XS sunlight can actually fracture the body’s proteins ie. Albumin
Fractured proteins are filtered by the kidneys & liver which must now work overtime to excrete the fragments.

*Treatment* .... Hydration to help flush out the kidneys

**Protection from UV** ..... pigmentation by melanocytes & melanin pigments
Stratum corneum .... #1 UV protection layer
Stratum lucidum ..... #2 UV protection layer
Stratum granulosum 3 layers contain melanin
Stratum spinosum
Stratum basale

**Sister Kenny** movie highlights ..... 
*Location* .. Queensland, Australia => bush-nurse
*Disease* ... infant paralysis aka poliomyelitis
*Etiol* ... viral attack of the ventral horns
Antagonistic muscles are functioning normally but the agonistic muscles are Spasmed not that certain muscles are weak.
*S/S* .... **Acute stage** ...... muscular spasms of lower extremities especially the calf muscles
Cervical rigidity of posterior neck muscles
Contracted hamstrings & relaxed quadriceps
PlantarFlexion muscles contracted ... antagonists impaired
Headaches, respiratory distress, fever & decr’d motor to UE & LE

**Middle stage** ... muscular flaccidity of all muscles

**Late stage** ... hyporeflexia
*Treatment* ..... hot strips to wrap the contracted / spasmed muscles
Use moist heat to treat the symptoms, not the Disease
*Prognosis* ... flaccid paralysis / destruction of the ventral horns
*Rehab* ... PNF ... Proprioceptive Neuro Facilitation to retrain the neural pathways

**Hydrotherapy** ... WATER is the most important part of this modality
p.141-143 moist heat / steam packs ... use the 4 towel / 3 towel wrap method and remember erythema ab igne principle
sizes .... 8” x 10” is ideal for lumbar skin ... bare, clean & dry
p.144
p.145 applications of hydrotherapy
p.147 Occlusive heat is when the patient may be lying on the hotpack and the heat may be trapped
w/o a vent => may scald the patient
p.403 definitions
p.405 types of hydrotherapy ------colonic therapy & whirlpool therapy

<table>
<thead>
<tr>
<th>Description</th>
<th>Temperature range in 'F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Hot</td>
<td>104 - 115</td>
</tr>
<tr>
<td>Hot</td>
<td>98 - 104</td>
</tr>
<tr>
<td>Warm</td>
<td>96 - 98</td>
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<tr>
<td>Neutral</td>
<td>92 - 96</td>
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<tr>
<td>Tepid</td>
<td>80 - 92</td>
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<td>Cool</td>
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<tr>
<td>Cold</td>
<td>55 - 65</td>
</tr>
<tr>
<td>Very cold</td>
<td>34 - 55</td>
</tr>
</tbody>
</table>

**Hydroculator** …… uses hot packs that emit moist heat and are placed on the patient
Commonly used in P/T and very cheap w/ a variety of applications

**Tank** …. **Upper part** … racks for holding hot packs that must remain completely submerged in the water solution
**Lower part** … thermostat to regulate temperature

**Warming up the tank** … Takes approx. 45 – 60 min b/f the hot packs are useful so heat up the tank 60 min b/f treatment time if the tank accommodates more hot-packs, the warm-up time is longer

**Broken thermostat** ……. tank is cold or the tank is boiling the water

**Cleaning the tank** … once monthly … drain & clean w/ soap & water then refill tank

**Water level** … fill daily w/ water to maintain full level to compensate for evaporation

**Hot packs** …. SiO2 … hydrophilic silica gel that absorbs water & retains heat covered by canvas each molecule can attract 17 molecules of water

**Hot pack recharge time** .. usually 30 – 40 min to return to 150 – 170 ´F after treatment

**Temperature** ….. 150 – 170 ´F .. usually preset by the factory @ 165°F

110 – 120 ´F is the effective heat to patient through towelling

**Treatment time** ….. 20 – 30 min …. effective heating will last approximately 12 – 15 min

**Towelling** … 1” minimum so that the pack is warm not hot and the towel should be moist not damp or wet …. So towels must be washed after each use

never place the hot pack directly on the patient’s skin
never use hot packs in an occlusive manner --- do not place under patient

** Four towel wrap** …. use 4 Turkish towels folded in ½ along the length so that there are 8 effective towel layers b/w hot pack & the skin

**Three towel wrap** use 3 Turkish towel folded in ½ along the length so that there are 6 effective towel layers

**Patient prep’n** … clean, bare & dry skin w/o any oils etc b/c they may burn the skin

**Application** ….. Once removed from the tank, allow to drip dry then wrap in towels

Apply to patient for moist heat and check every 3 – 5 min for comfort

**Whirlpools** … p.404 … hot or cold and small to large full body immersion (Hubbard)

**Physiological effects** … sclerolytic & hyperemic effects

**Massage** b/c of the blasts from the air jets

**Hyperemic** b/c of the water temperature

Sclerolytic effects break up:

scar tissues, joint contractures & adhesions
treat skin Dz, clean open wounds (ulcers), skin grafts, infex’ns, cellulitis, soothe muscle spasms and nerves

Betadyne solution … added to water to slough off necrotic tissues

Treatment time …. 20 – 30 min

Therapeutic temperature …. 102 – 104 ‘F …. anything > 115’F is dangerous

90’F is for recreational hot tubs

Danger …. Patient may pass out (syncope) & drown

Whirlpool maintenance …. Tank must be drained & cleaned after each use

Indications for use … p.193

Contraindications ……. Acute colon Dz (ulcers, diverticular Dz, cancer or infex’n)

Hemorrhoids, acute abdominal Dz, cancer of SI or LI or Etoh

p.404 Hubbard tank …. Amoeboid shape w/ sunken trough in the middle so that the patient can exercise while immersed in the tank

Application … full immersion therapy much larger than a whirlpool

Therapist can be inside tank w/ patient to supervise & assist w/ passive exercise

Walking exercises w/in the tank

External hoist w/ litter for paralyzed patients

External hoist w/ litter … allows weak, paralyzed & severely handicapped patients

MS patients require neutral buoyancy to exercise

Treatment temperature …. 102 – 104 ‘F

Treatment time …. 20 – 30 min

Hot Sitz Bath …. Partial immersion of the body as the patient “sits” in the bath

Application …. Treat the pelvis, rectal, perianal & genital regions up to the umbilicus

Treatment temperature … 98 – 104 ‘F water jet nozzle

Treatment time …. 15 – 20 min

Treatment methodology … water jets directed @ the pelvis region

Indications for treatment … post-Sx prostatitis to reduce swelling

Buttock seat

AV-fistulae, hemorrhoids, coccygodynia, episiotomy (99%)

Episiotomy …. if the baby’s head is too big for the vaginal canal, they cut from the vagina toward the anus to open the birth canal but the open wound is susceptible for infex’ns

Contrast Bath …. Ideal for treating moderate & chronic conditions

Application …. Promote intense vascular reaction on an ischaemic patient*

Increase vascular permeation using alternating hot & cold treatments

Especially in extremities, below the knee or distal to the elbow

Reduce edema or chronic swelling in extremities

Physiological effects …. Increase vascular circulation in the periphery

Tank #1 …. 105 – 110 ‘F Alternating immersion tanks for hot & cold

Tank #2 …. 60 – 65 ‘F

Treatment time … 30 min …. Always begin & end w/ heat

Treatment procedure 10 min “hot” & 1 min “cold” => vasodilat’n >> vasoconstrict’n

5 min “hot” & 1 min “cold” => vasodilat’n > vasoconstrict’n

1 min “hot” & 1 min “cold” => alternating for 13 min
Contemporary method … use hot & cold packs instead of using immersion tanks
  Hot packs … 165°F attenuated w/ 6 layers of towelling => 135 °F
  Remember that it takes 5 min for the heat to penetrate towels
  Cold packs … Instant ice chemicals

Tepid Sponge Bath … gently and gradually lowers the body temperature
Applications … promote relaxation, analgesia & anti-pyretic effects to lower the body temperature
Treatment temperature … 80 °F … slightly heat the water
Treatment solution … 25 % rubbing Etoh @ 105 °F heated in a water bath
Treatment procedure … patient is unclothed & covered w/ a layer of linen
  Apply solution in quadrants … arms, legs then trunk
  Keep untreated areas covered up until ready to treat
  Wipe treatment area w/ water first and then use Etoh sol’n
  Continue this cycle several times until body temp decreases

Tepid Splash Bath … contemporary alternative to the “sponge bath”
Applications … pediatric patients that require cooling down b/c fever or sunburn
  gentle reduction in body temperature w/o using any Etoh
Treatment procedure … disrobe patient & place in a bathtub filled to 1” of water
  drain should be partially blocked to maintain constant water level
  adjust faucet so water temperature is comfortable @ approx. 80°F
  patient lies down in the tub and splash water over the entire body
Physiol effects … Circulate new tepid water over the entire body
  Evaporation of water from the body surface helps cool the body
  Splash & scoop method is effective in recirculating water & cooling

Hot Fomentation Compress generally used as a home therapy b/c this is a poor man’s
hydroculator using flannel, cotton & wool towels b/c they retain
  heat & provide insulation as well
Application … fester superficial skin blisters that are purulent ie. boils so that they can be lanced
  or “popped”. Make it worse so the wound can be drained
Treatment procedure … Heat up the compress using IR or HCP
  Alternatively use Terry cloth towel w/ hot water from the faucet
  Dip compress in hot water & wrap the body part to be treated
  Cover the compress w/ a dry towel
Treatment time … 20 – 30 min
Physiol effects … each compress provides 5 – 10 min of moist heat so repeat the process @ least 4
  or 6 times during the treatment.

Fluidotherapy … p 169 – 178 aka Dry whirlpool … not the most effective modality
Application … simulate the effects of regular, water-filled whirlpool
Physiol effects … LWIR heating element produces dry heat @ high temperatures which is blown
  & circulated w/in a closed chambre heat conduction & convection into the body
  part
  LWIR = Long Wave Infra Red
Treatment procedure … the body part being treated is placed in the heating chambre
Treatment temperature … 120 – 125 °F
Treatment time .... 15 – 20 min
Whirlpool maintenance run for 15 min b/w each patient to avoid cross-contamination

Paraffin Wax Bath ... p 163 .... requires a mixture of 3:1 to 7:1 for the wax to melt
Direction of immersion through the tank
Double heating coil along the long axis of the tank
To melt the wax

Paraffin tank lid ... insulates the heat inside and acts like a dipstick of wax level
Tank grate ... ½” waffle pattern to prevent the patient from hitting the bottom
Debris & impurities will settle to the bottom of the tank
Wax level .... Maintain levels by adding paraffin chips & mineral oil b/c wax should be on the tank lid each time or else the level is too low
Treatment is for .... Hands, elbows, knees and feet
Treatment procedure use mineral oil to lower the melting point of wax from 300°F to 125 -130°F
Surface will solidify b/c atmospheric air is cooler so scrape it off before patient’s body part is immersed inside the tank
Explain the procedure & the temperature of this treatment
Patient must wash the treatment area w/ soap prior to treatment
Use your finger to move the solidifying surface film
Patient keeps fingers open & don’t touch the sides or bottom of the tank
Dip the patient’s hand into the tank proximal by 2 – 3” and hold there
Have the patient wiggle the fingers slightly to get an even glove formation
As you remove the patient’s hand, instruct him to keep the fingers straight
Let the wax drip off and fall back into the tank
Once the glove solidifies, inspect the glove for blebs or air pockets
DC patches any holes b/c future dippings may enter the glove and get trapped b/w the original glove which insulates and traps the heat => scald the skin
Wrap the glove in plastic / wax paper and then use terry cloths to cover the wrap
Definitely do not use paper towels or foil to wrap the wax glove b/c it will stick to the wax or crack it
2nd dip will be ½ to 1” distal to the 1st dip
3rd dip will be ½ to 1” distal to the 2nd dip
3 dips is a minimum up to a maximum of 7 dips
Treatment time ...... 20 –30 min for a wax glove
If the glove cools down too much, use IR, SWD or towelled hot pack
Do not use MWD or UV b/c it will melt the fibres of the terry cloth and the patient may sweat
Clean-up ..... un-wrap the towelling and the plastic wrap
Remove the glove and then return the wax to the tank
Any wax that falls to the floor is thrown away
Any wax in the tank for 1 hour will be sterile
Physiol effects ..... paraffin wax is used as a conduit of heat into the patient
Insulation of the heat for superficial & deep heating
stiffness is treated by a wax glove to remove spasms, scar & strictures
Treatment follow-up ….. use massage after treating w/ a wax glove
Remove the mineral oil w/ a solvent

Indications for treatment chronic, non-exacerbated Rheumatoid/Osteoarthritis of the hands & feet

Contraindications to treatment … open cuts, abrasions, sores and lesions

Heating Pad … generally inferior b/c this uses dry heat => dehydrates the tissues
dry heat => cramps & dessicates tissues … ideal for treating smooth muscles during menses & phlebitis

moist heat => vasodilates & hydrates tissues … skeletal muscles are susceptible

Contraindication to use menthol ointments => chemical or thermal burn => necrosis
absolutely NO menthol ointments like Ben Gay etc.

Occlusive heat … trapping the heat w/in a closed space is dangerous so always make sure there is ventilation

Aqua-Soothe Table … aka Dry Water Hydrotherapy … very $$$ for the deluxe

Treatment procedure … patient lies supine upon the tarp covering the water-filled tank

Physiol effects … moving water jet nozzles spray streams against the patient’s skin water temperature can be varied for the treatment
water jet nozzle movement can be fixed or varied for each patient
axial traction, skin friction & enhanced vascular circulation

Colon Therapy … lavage of the colon, colonics, intestinal hydrotherapy / irrigation

Types of colonics …. Low Bowel Enema … water introduction up to sigmoid colon ie.Fleet enema
High Bowel Enema … water introduction up to ileocaecal valve

Physiol effects …. water forced into anus to colon as far as the ileocaecal valve
clean the colon & add acidophilus & lactobacillus to water to replenish normal flora.
loosen up impacted faeces to clean up the colon & improve feeling

Window to watch the contents going OUT

IN

Tank … 2 gallon capacity w/ filters & UV radiation to sterilize & sanitize the water

Contraindications … aneurysm, AS, GI ulcers, Diverticular Dz & Internal hemorrhoids

Precautions … disposable equipment to keep sanitary conditions replace normal flora of the colon

Cryotherapy … p.243 6-1 … very cold & not well-tolerated by patients
p.245 6-1
p.247

Cryotherapy units … cold therapy refrigerators that maintain constant cold temperatures

Very $$$ b/c freon gas generates refrigeration
Temperature range … 20 – 80 °F … can be adjusted as desired
Treatment time … 20 – 30 min

Advantages … temperature regulation & constancy

Physiol effects … stop the inflammatory process before it begins
cycles of cryotherapy cause changes in sensory perceptions
**Conduction** … therapeutic cooling to draw out heat from the patient

**Evapouration** … p.253 … highly volatile liquids are sprayed on the skin by Ethyl chloride or Fluoromethane

**Convection** … fluid medium is used

**Screening tests** … assess the patient for cryotherapy tolerance before treating w/ ice
- **Boruch test** …scrape an area where there is superficial skin on bone using a tongue blade to cause a red streak to appear.
  - Redness => normal b/c vasodilation & Histamine response
- **Wrapped forearm test** … rinse paper towel in cold water & wrap the forearm
  - Keep the cold compress on skin for 30 sec & remove
  - Redness => ‘ve / normal b/c vasodilation

**Hunting’s reflex** … reflexive vasodilation as the body sends fresh blood into the region

Body pumps blood into the area and patient experiences a dull, achy, throbbing feeling.

**Physiol effects of ice** … P.249
- **Stage I** … coolness … patient immediately feels cold => uncomfortable feeling
- **Stage II** …burning …nerve irritation after the initial coolness & lasts 3 minutes
- **Stage III** …aching & throbbing … body reflexively responds by vasodilation
- **Stage IV** … numbness … progressive analgesia that begins after 5 min of ice

**Precautions to ice therapy** … Hx of frostbite or hypersensitivity to cold

**Contraindications** … p.261 … use heat for chronic conditions very similar physiol
- Use ice for acute conditions effects in the body

**Local effects** … decr’d nerve conduction in motor & sensory neurons
- Analgesia b/c decr’d excitation in muscle afferents
- Decr’d metabolism, vasoconstriction, spasms, fluid exudation, capillary hydrostatic pressure & ms tonicity

**Reflexive effects** … visceral vasoconstriction, decr’d sympathetic atonic, analgesia of PNS & sedation of the CNS

**Systemic effects** … Decr’d ms fatigue, incr’d HR, respiration & leucocytosis

P.247 Hot & Cold comparison

**Ice Packs** … just the opposite of hot packs

**Storage** … 10 – 32 °F inside a refrigerator freezer @ least 30 min
  - If the pack is too rigid => temperature may be too cold

**Material** … Semi-Flexible Silica gel units …. Flexibility is desireable to be placed directly on the patient’s body part or be wrapped in a towel b/f application

**Ice Pack duration** … 30 min

**Ice Pack recharge time** … 45 – 60 min

**Treatment time** … 20 – 30 min or as long as necessary …. Remember equal ON & OFF time

**Types of cold packs** …
- Chemical cold packs … instant ice but is not as effective as the silica gelpacks
  - Catalyst surrounded by resin beads => instant cold pack
- Freezer ice packs … ¼” cotton stitched so that it can be held onto the treatment area by the other hand w/o freezing that hand
Jack Frost packs ..... can be used once as a chemical instapack but may be re-used as a freezer ice pack indefinitely
Frozen vegetables … works great and they are edible too
Slush pack … ½ \( H_2O \) and ½ Etoh mixture frozen in a bowl / plate in case of leakage. Permits the pack to get very cold but remains pliable
p.248 Paper cup w/ stick ... wax coated cup w/ water frozen inside
Livedo reticularis .... Skin cyanosis like frostbite b/c overexposure or over-ice

Treatment procedure .... P.260
* Wrap cold pack in a hot, wet paper towel (hottest possible from tap)
  Towel is an insulator & prevents sticking of pack to patient’s skin
* Patient experiences immediate heat that gradually becomes cold & icy

Cold Water Bath / Whirlpool ... p.248 .... ½ \( H_2O \) + ½ ICE used w/ EMNS or USD Treatment protocol ..... subaquaeous .... USD to reduce inflamm’n & penetrate area
EMNS to vasoconstrict & neuralgia
Contraindication .... Avoid using 20 – 40 Hz or 40 – 80 Hz in EMNS
Treatment temperature .... 50 – 60 °F
Treatment time ..... 10 – 20 min

Cold Clay Compress ... p.256 ... old-fashioned treatment b/c clay is quite messy
Treatment preparation ....slabs of clay placed on wax paper or terry cloth that is frozen
Treatment protocol .... Frozen clay is placed directly on the patient
Treatment temperature ... 40 – 50 °F
Treatment time .... 20 – 30 min
Spray should come out straight so open the nozzle all the way

Chemical Coolant Sprays ...
Trigger opened all the way during use and should be against the glass bottle
When releasing the trigger, be gentle or else it will slam the nozzle down into the bottle
Coolant operation ..... Grasp the bottle with the thumb & index fingers & operate the trigger
Nozzle sizes .... Fine, Medium & Large
Physiol effects ..... decr’d temperature b/c evapouration & heat conduction
  Analgesia b/c cold temperature that decreases nerve conduction speed
  Anti-inflammatory => incr’d ROM
Coolant liquids ... Fluoromethane (FM) ... very $$$ approx. $27 per bottle
  Application ... increase ROM & muscle stretch
  Protocol .... Spray & Stretch method directly on patient skin
Ethyl Chloride (EC) ... considerably cheaper @ $14 per bottle
  Application .. temporary topical analgesia => instant freeze b/c of the fast evapouration of 3 seconds
  Precaution ... very volatile & combustible

Spray & Stretch Technique ... used together w/ IR or a hotpack to generate heating
Application ... uses Fluoromethane to relieve muscle contraction, spasm, shortening and to break down adhesions & fibrosis of ligaments
**Physiol effects** … combination of cooling & heating lasts for a very short period

**Treatment protocol** … Use the coolant spray in an open & well ventilated area w/o flames or sparks b/c of the noxious paint & glue odors

**SPRAY**
Ensure patient comfort & have the patient face away from the treatment area in case of overspray
Hold the bottle 18 – 24” away from the patient
Spray perpendicular to the skin surface in one direction only
Sweep from Origin to Insertion in the direction of stretch
Number of spray passes depends on the size of the muscle
Each pass should be ¼” apart moving @ 4 inches per second
The skin should frost over when there is enough coolant.

**STRETCH**
Pull the muscle insertion away from the origin to stretch
ie Move the body part in the opposite direction of the muscle action
OR
Strip the muscle by starting @ origin & move toward the insertion
ie. Effleurage w/ thumbs / fingers to distract the muscle

**WARM**
heat the area that was just cooled down by using a hot pack / friction
15 seconds of heating w/ IR or hot pack is sufficient

How much Spray & stretch ??? Repeat Spray, heat & stretch cycle until the muscle cannot be stretched any longer

**LASER** … Light Amplitude of Stimulated Emissions of Radiation
This is w/in the DC scope of practice but not in California
Types & Fx’s ……Optic Maser … 1st generation invention based on microwave tech.
Low power lasers … commonly used today
**Green** => remove tatooes & birthmarks .. can cauterize wounds
**Ruby** => surgical incision that heal quickly
**Galium** => surgical incision

**Components of a laserbeam**
**Crystals**…. Source of electrons …. Commonly uses Ruby crystals
**Gas** …. He or Ne are commonly used in cauterization
Ar or CO2 have no medical applications
**Sempiconductors** … Ga / Ar ..... used in Gamma-Knife
**Liquids / dyes** ..... clothing
**Chemicals** …. Military uses Stream of "excited" electrons

Absolute light
Light reflector
w/o any absorbance

Ruby crystal/Lasing medium
Provides a source of electrons
Usually a stone chip

Focused beam dense & focussed "collimated" "concentrated"

Laser housing
Battery to excite electrons into the next orbital shell
Semipermeable membrane mirror collimates the electron beam
**Muscle testing** ... 5+ Full ROM against full resistance
   4+ Full ROM against partial resistance
   3+ Full ROM against gravity only
   2+ Full ROM against no gravity
   1+ Fasciculations only
   0+ Paralysis / atonia

**Reflex testing** .... 4+ Clonus / pathological reflex
   3+ Hyper-reflexia
   2+ Normal
   1+ Hypo-reflexia
   0+ A-reflexia

**Taxation stuff** .... if you have a contractor in your office working in any capacity
   If income < $800 / year => maintain contractor status
   > $800 / year => must be an employee & cannot keep 10-99 status

**Work categories** ...... mandated for State, Federal & Worker's Comp cases
   Categories defined using postal employees ... Males = Females
   Amount of lifting is such that will not cause any injury
   Does not account for maximum, frequency or duration of lifting
   *Sedentary* ... 10 lbs lift and 5 lb carry b/c most of the time is spent sitting
   *Light* ... 20 lbs lift and 10 lb carry b/c patient does significant walking & standing
   Alternatively, patient may be seated - doing pushing & pulling work
   *Medium* ... 50 lbs lift and 25 lbs carry w/ no restrictions
   *Heavy* ... 100 lbs lift and 50 lbs carry w/ no restrictions
   *Very heavy* ... No maximum for lift or carry capacity w/ no restrictions

**Worker's comp** ... workplace injury that covers the right to treatment & rehabilitation

**State disability** ... workplace injury or any other disability in full or part and covers treatment and rehabilitation.

**Traction** p.421 ... either mechanical or manual designed to draw or pull the body or its parts to mobilize the joints

**Types of traction** ...... Axial ... distraction in the long axis of the body
   Weights ... use of weights
   Elastic ... rubber bands, elastobands or elastic stockings
   Cervical or Lumbopelvic ... specific distraction to treat IVD's
   Extremities ... alignment of fracture post-reduction

**Continuous Mechanical Traction** ... use of a machine to perform distraction

**Physiol effects**
   stretch segments & spinal joint surfaces
   distract & glide joint facets
   relieve ms spasms to restore normal physiological ms relaxation
   reduce edema of body part
   reduce fibrosis & break up adhesions
   stimulate proprioceptive receptors
   immobilize parts that are splinted to promote healing

**Intermittent Mechanical / Alternating Traction** ... distraction w/ periods of relaxation
   Total treatment time 15 - 30 min

**Physiol effects**
   pumping action reduces edema of body part
   stretch fibrosis & adhesions
stimulate proprioceptive receptors
stimulate muscle tonicity
pumping action promotes hydration of the IVD's
increases segmental mobility in arthritic patients

**Intersegmental traction** ... pulls things apart ie. Segments of the spine

*Mechanical* ... hydrotherapy or anatomotor ...

  Adv ... Patient is supine on the bed & rollers push segments and separates in P-A
  Disadv ... spine is pushed into extension & puts stress on the facets

*Manual* .... SOT block pumping

**Inversion traction** ... Adv ... gravity is the force that distracts spinal segments

  Disadv ... non-specific distraction b/c it distracts all segments

Inversion boots ... worn on the feet but distracts everything w/ gravity

  Danger is that patients slipped out of the boots => discontinued

*Mechanical methods* ... Heidelberg table ..

- **Orthopod**  A-frame designed to apply tension to distract spinal segments but places a lot of stress on the lower extremities
- **Backswing**  … patient is supine & secured @ ankles & the table top will swing back to the inverted position

**Door Mounted devices** … very cheap approx. $15 => continuous traction

  fits over any door and uses a weight over a pulley system to create distraction.
  The harness is secured to the jaw @ mandible for axial Cervical spine.

**Cervical continuous traction** …. Start @ 10 lbs or 5 % of the total body weight

  Increments of 2 lbs up to the max of 40 – 50 lbs
  Traction of C3 – C7 @ angle of 30’
  Traction for Occiput, C1 & C2 @ 0’ angulation
  Patient is either supine or in the sitting position

**Intermittent Traction** … begin with 5 % of the patient’s body weight

**Lumbar traction** … p.425 … start @ 25 – 50 % of the patient’s body weight

  add 5 lbs increments up to max comfort level or 150 lbs
  safe way to suck the nucleus pulposis back into the IVD helps isolate L4-L5 and L5-S1 segments using the harness
**Continuous traction indications for use:**
- joint fixations
- occipital neuralgia
- subluxations (chronic)

**Spinal curvature deformities**
- ie. scoliosis
- OA, adhesions, contractures & fixations
- activate mechanoreceptors

**Intermittent tractions indications for use:**
- IVD hydration
- occipital neuralgia
- subluxations (chronic)

**Spinal curvature deformities**
- OA, adhesions, contractures & fixations
- activate mechanoreceptor

**Activate mechanoreceptors**
- Stroking … aka. Effleураge (Opening flower)

**Use massage lotion / oil**
- Broad surface stroking moving in one direction only
- Ie. Origin to insertion, Inferior to superior, Distal to proximal & Surface to deep

**Effects … acute/chronic …**
- displace swelling & edema in peripheral tissues
- “Uncorking” … chronic w/ edema … stroke in the opposite direction of edema to
  - break up any adhesions in the valves of veins & lymphatics.
- Immediately reverse directions to help facilitate normal flow

**Compression …**
- Petrissage, kneading, grasping, lifting, pressing, squeezing & wringing

**Use massage oil / lotion**
- Rhythmic motions to pick up, lift & mobilize the tissue like a wave
  - Effects … break down adhesions to put motion into the muscle
  - Mobilize tissue deposits ie. Mineral deposits, lactate, serotonin or PG’s

**Friction**, done in 90° perpendicular direction across the skin w/o oil so you do not slip off the
- skin … maintain constant contact with the patient’s skin
  - effects … break up fibrotic nodules, muscle spasms & trigger points works individual
  - muscles & nodules of a single muscle

**Percussion …**
- tapotement … transfer vibrational sensations from DC to patient

**Hacking** … closed finger chop using the hypothenar pad => deep Tx

**Beating** … pounding w/ a closed fist => deep Tx

**Whipping** … loose chop w/ fanned out fingers => superficial Tx

**Clapping** … slapping w/ a flat handed hack => superficial Tx

**Tapping** … use the fingertips to percuss the skin => superficial & light Tx

**Vibration** … use the open palm to rattle

**Cupping** ….. use a “cupped” hand to send deep, low force vibrations in the patient
  - to mobilize fluids or mucus plugs from the lungs #1 in children
  - ie. Cystic fibrosis, bronchitis, pneumonia, pleurisy & bronchiectasis
  - Patient lies prone w/ the head tilted down below the level of the body
  - while DC applies the treatment to the back.

**Hiring a Massage therapist …**
- have them massage you first as part of the interview to verify their
  - knowledge, training & licensure.

**Massage therapist …**
- do not Dx & do not perform Spinal Manipulative Therapy
- Requires approx. 600 hours training & malpractice insurance approx. $900 / year

**Application of massage …..**
- explain entire procedure before beginning
  - Uncover only what is necessary to preserve patient modesty
  - Half body or Full body massage
**Rules of massage** … keep body covered until you are massaging that area
   When patient is rolling over, use a towel to cover the groin
   Keep motions smooth, steady & in contact w/ patient always
   Optionally employ aromatherapy, music, lotion & oil
   Elevate any body part that may be edematous

**Vibration therapy** … p.443-445 … mechanical percussion to generate pulses
   *Parallel penetration* … place applicator parallel to the body surface to produce a
   “clapping” superficial oscillatory effect w/ a large flat applicator
   Horizontal entry of impulse into the patient’s skin

   *Perpendicular penetration* …. place applicator perpendicular to the body surface to
   “beating” produce a deep percussive effect w/ a sharper
   smaller applicator

   *combination* …. for uneven treatment surfaces or to achieve medium penetration with an
   applicator that is wide enough

**Miscellaneous info** … vibration is a form of percussion
   Superficial or deep penetration so do not concentrate too long
   DC may suffer vibrational effects too => CTS or dislocation
   Stop if patient experiences strong itchiness b/c Histamine
   Towelling is required even a shirt so that the applicator is
   restricted to the treatment area
   Clean the patient’s of oils b/c it will corrode the applicator tip

**Orthotics** … support device to relieve weight bearing or stress on joints & bones
   Also immobilizes during sustained weight bearing situations

**Billing issues** …. Must state “fitted” in order to get paid

**Physiol effects** … decr’d abdo ms activity, IVD pressure, LE venous return
   Incr’d abdo pressure, erector spinae tone & incr’d
   segmental motion above the immobilized area
   immobilize IVD, false sense of security, abnorm curvature &
   weight load distribution to other areas

**Fluid compression** … decr’d mobility of ms & decr’d axial compress’n of IVD by
   30% which can help suck the nucleus into the IVD.
   Decreases axial compression in disc hernia rehab
   Compresses abdominal contents against spine which
   tractions the spine axially.

**Indications** … acute IVD syndrome or sprain/strain, DJD, hyper-curvature
   Joint instability, ms spasms, scoliosis, spinal or VB Fx or
   assist in posture maintenance

**Contraindications** .. immobilization => atrophy of ms & weakness
   Immobilization => coagulation, adhesions & fibrosis
   Stasis, ischaemia, decr’d ROM or contracture changes

**Cervical supports** … varies in the degrees of immobilization
   **Soft Cervical collar** … foam collar of 2 sizes either 3” or 4” from chin to chest
   Does not restrict ROM but is a reminder not to move
   Proprioceptive Feedback Inhibition PFI to stop moving
   Tx …. Strain, sprain & whiplash
Hard Cervical collar … plastic, metal or fibreglass for rigid support
  Newport collar and Philadelphia collar
  Sandwich the neck b/w anterior & posterior plates
  Chin trough … limits ROM in flexion* & other motions
  Tx … C3 – C7 & cranium … sprain, strain & whiplash

Rigid supports … Has metal posts through the device for rigidity
  SOMI brace … Sternal Occipital Mandibular Immobilization
    Hard plastic plate under jaw & occiput w/ 2 metal posts
    Tx .. C4 – C7 vertebral fracture … limits Flex’n & Extens’n
  Peterson brace … similar to SOMI but has 4 posts through
    Hard plastic plate for occiput & chin trough
    Tx … limits all 6 movements of the C-sp
  Jewett brace … back, sternal & suprapubic pieces joined by rigid posts
    Controls A-P curvatures tensioning the pieces
    Tx … lumbar lordosis, fractures of T-sp & L-sp
  Dorsolumbar corset … obsolete canvas w/ straps to increase rigidity
    Disrupts breathing => lung infex’ns ie. Pneumonia
    Interferes w/ deep breathing, coughing & respirations
    Tx … T-sp, rib & compress’n fractures & ligament instability
  Knight brace … abdo piece anteriorly w/ posterior T & L-sp piece w/ strap
    Tx … increases tension to pull spine into desired lordosis
    Fractures of the T & L-sp
  Knight-Taylor brace … clavicle strap w/ sacral & abdo pieces like Jewett
    Pulls upper T-sp into extension w/ abdo support
    Controls T-sp & L-sp A-P curvatures
    More rigid than Jewett for paraspinal support
    Tx .. fractures in T-sp & L-sp .. isolates upper T-sp
  Chairback brace … anterior & posterior pieces wrap the SIJ & L-sp
    Tx … Fractures of L-sp, pars & laminae, paraspinal ms & spondy
    Tortapelvis, moderate strain/sprain & SIJ inflammation
    Most commonly prescribed for L-sp support
  Lumbosacral support … 2 pull support .. #1 used LBP support device
    Elastic w/ metal inserts embedded paraspinally
    1st pull .. large velcro belt wrapped snug
    2nd pull ….. pull “wings” snug for more support
      undo 2nd pull when seated for incr’d circ’n
    Tx … supports L1 – L3 down to SIJ if the belt is large enough
    Cleaning … must be air dried b/c of the elastic bands
  Milwaukee brace … #1 brace for scolios & is custom fit for curvatures
    Must be worn 23 hours/day for axial tension load
    Distracts the spine .. v. successful if < 18 y/o
    Lifts the occiput & pushes down on the pelvis
    If scoliosis is < 15’ => insignificant
    15 – 30’ => adjust & exercise
    30 – 60’ => herrington rods/brace
    > 60’ => pathological that cannot be treated & will
have problems ie. Heart tamponade, torsion & respiratory distress

**Ranee Body cast** … frontal abdo & posterior T-sp pieces of thermoplastic
  Heat form fitted to the patient & solidified w/ cold water
  Patient wears this until it needs refitting, remelting etc.
  **Tx** … IVD hernia, fractures & SIJ inflammation

**Yale brace** …. Similar to the Philadelphia collar for C & T-sp support
  **Tx** … limits flexion

**Halo brace** … most immobilizing brace b/c surgical screws are drilled into the skull for complete immobilization of C1, C2 & C3
  halo around head & T-sp & abdominal pieces

**Molded Minerva** …. same as Philadelphia brace w/ bigger pieces velcroed to encompass all C-sp & extends deep to the T-sp
  **Tx** … C-sp and T-sp support

**Heel lifts** .. helps level the pelvis to prevent subluxations of pelvis & sacrum
  Effects of the heel lift decrease as you ascend higher up on the body
  Body of L5 will rotates away from the side of lift
  If the difference in femoral head height is \( \leq 1/8 \) inch => it is insignificant
  Bilateral heel lifts … increases L-sp lordosis & the compensatory incr’d kyphosis to treat military back syndrome

**Sole lifts** … no effect on the femoral length …
  designed to stretch the posterior ankle, calf, thigh & pelvic extensors
  bilateral sole lifts … decrease L/S angle if pax has hyperlordosis or hyperkyphosis

**Full plantar lifts** … heel to toe to raise the femoral head w/o rotation to correct leg lengths

**Ischial lifts** …. Correct assymetry of ischiae that cause SIJ dysfunction or scoliosis

**Indications for Heel lifts** …… raise ipsilateral pelvis up & forward
  Raise & rotate pelvis & L-sp segment causing scoliosis
  Shift body weight for better weight distribution
  Mobilize hypomobile areas by shifting weight stress

**Contraindications to heel lifts** … lifting or rotating the Ilium or Femur is undesirable

**Biofeedback** …aka hypnosis …. Scientific self therapy to control physiology
  Everything is voluntary
  Hypnosis only works on people if people are willing to do it

**Major Biofeedback Techniques**
  Electromyograph (EMG) … electrodes monitor muscle activity
  ElectroEncephalograph (EEG) … Hans Berger … measure brain waves
    Alpha waves … awake but relaxed
    Beta waves … awake, conscious and alert
    Delta waves … deep relaxing sleep
    Theta waves … beginning to fall asleep

**Minor Biofeedback Techniques** …
  Galvanic Skin Response (GSR) … typical lie detector where electrodes @ skin pads detect perspiration that increases conductivity
  Blood Pressure Monitor … rest 2 minutes b/w measurements to see the change in
sympathetic tone
Gastric Acid Measurement .... Monitor changing pH of stomach
Rectal insufflator ... stress tension of anal sphincter to detect stress response

**Relaxation Techniques in BioFeedback** ... like hypnosis to control the body’s actions
Tense-Relax ... kinesthetic hypnosis ... soft soothing voice specifically naming
body parts to relax
Autogenic ... self talk ... “OK, let’s just take a deep breath & relax”
Visualization ... mental picture ... Metamorphosis into something soft
Self Directed Imaging ... imagine a relaxing place & place yourself there
Breathing ... Controlled respirations to expire tension & inspire relaxation

**General Adaptation Syndrome (GAS)** ... Neuropathophysiology ...
Seyle ... the father of biofeedback
Stage 1 ... **Alarm** ... fight & flight b/c sympathetic response
Stage 2 ... **Resistance** ... decr’d immune response, sleep or poor nutrit’n
Stage 3 ... **Exhaustion** ... dysfunction of systems

**Exercise & Rehabilitation** ... Not for the patient in the Acute phase of injury but for the Chronic
Begin ASAP to speed up recovery w/in the Pain-free ROM
Goal ... improve Function of the body part
Wellness ... restore health & maintain health
Increase strength, stretch and coordination
Prevent and correct deformities
Do no harm ... Do good
Accurate Dx & Px ... improve patient’s condition from disease to ease
Treat the cause of problem not the effects
Address the pain to relieve it
Stick to natural law --- don’t rush, delay enough to allow healing
Realignment of the skeleton takes a lot of time
Realistic & practical treatments ...... follow common sense
Determine patient compliance & biomechanics
Treatment is an elective not an emergency
Treatments are for the benefit of the patient not for the $$$

**Phases of treatment**
Clinical medicine to recover from Dz
**Preventative medicine** ... rehab, exercises & stretches
Primary prevention .. pathogenous or optimum health
If it is too heavy, don’t lift it
Secondary / Tertiary prevention ...... during illness ... already injured
Exercise is vital in recovery
Rehab ... ultimate restoration to maximum capacity
Physical, emotional & vocational
Start ASAP until the patient is 90 % back to normal ... physical limitations of matter may
limit a full recovery
Methods of Treatment

Rest ..... too much => disuse atrophy and muscle soreness
   Osteoporosis => incr’d Ca2+ excretion
   DVT may/may not have embolism
   Decubitus ulcers
   Adhesions
   Incr’d edema

Proper rest ... effective w/ early ambulation will decrease inflammation and improve healing

Relative rest .. decrease in weightbearing and daily stress load

Long term rest ... 1 – 2 months

Classifications of movements ...... Passive ROM ... DC moves the patient
   Active resisted ROM ... isotonic movements
   Active ROM .... Isokinetic or isotonic muscle contractions
   Active assisted ROM ... isokinetic controlled speed of mvmts

Physiological effects .... Type I muscles ... red, slow twitch, highly oxygenated, lots of mitochondria & myoglobin but little ATPase for endurance
   Type II muscles ... white, fast twitch, better for brief, intense sprint or burst contractions that are anaerobic
type I and II fibres are necessary for endurance

Blood flow @ rest ...... 15 – 20 % to muscles  don’t exercise after eating
   80 – 85 % to visceral
   @ work .... Exactly reversed ... 80 – 85 % to muscles
   15 – 20 % to viscera

   cutaneous .... Increased for heat dissipation from skin
decreased when blood is shunted to organs
   XS exercise => heat stroke & inability to regulate temperature
Core temperature will increase

Cerebral Blood Flow ..... should remain constant despite workload or else => CVA

Heart Rate .... Increases linearly & progressively w/ workload
   Maximum rate = 220 – patient’s age

Stroke volume ... increases linearly w/ workload ... SV = 60 mL @ rest
   Maximum = 120 mL/beat during maximum workload
   Cerebral blood perfusion should remain constant

Cardiac Output .... Linear increase w/ workload ... @ rest = 5 L/min to max = 20 L/min
[CO2] ........ the driving force for respiration not the need for Oxygen

Blood Pressure .. ...linear increase w/ workload up to max of 190 – 220 mmHg for systolic while the diastolic remains fairly constant
Pulse Pressure .. linear increase w/ workload ... represents the pressure upon the blood vessels

Muscle Spindle fibres .... Fires to tense the muscles
GTO’s.... fires to relax the muscles via autogenic inhibition

Concentric contractions ..... muscular contraction SHORTENS the length of the muscle

Eccentric contractions ... muscular contraction LENGTHENS the length of the muscle

Isometric ...... NO movement despite contraction of the muscle against a load
**Isokinetic** …. Muscle contraction against a load w/ change in speed & workload

**Isotonic** …. muscle contraction moving constantly in eccentric & concentric movements

**Codman’s Pendulum** …. treat frozen shoulders
  - Circles …. Patient bends @ waist w/ arms hanging straight down dependently
  - Start moving the arm in tiny circles progressing into bigger circles
  - As the patient improves, begin using small weights

**Finger walk** … patient stands next to a wall and elevate the arm as high as possible
  - encourage the patient to use the fingers like a spider to crawl up the wall even higher to improve abduction, flexion and extension ROM.

**Frenkle’s exercises** … treats sensory ataxia especially in the Lower Extremities
  - Weights are attached to the ankles and the patient performs contractions of the quadriceps and hamstring muscles.
  - Weights can be added in increments of 10 %, 20 %, 30 % etc.

**De Lorme's exercises** … Strengthening exercises for the Lower Extremities
  - Weights are progressively increased from 10 % until 100 % to improve strength and add muscle bulk.

**Oxford exercises** ….. primarily to increase the ROM and strength w/in the ROM
  - Instead of being fatigued, patient begins @ 100 % maximum and gradually reduced down to 10 % of the maximum.