

Modality	Frequency	Physiol effects	Penetration	Modalities
High Frequency Convers'n heat Molecular friction rub makes heat	> 100,000 Hz	Deep heat	2" below skin includes VAN, joints, bone, cartilage & ligaments	Diathermy Shortwave Microwave Ultrasound
Middle Freq Conduction heater Hot => cold	1,000 – 100,000 Hz	EMNS mostly Very little heat Fires nerves Fires muscles	1 – 2 " medium penetration	Interferential current Russian stim
Low Frequency Conduction heater	00 – 1000 Hz	EMNS mostly Very little heat	0 - 1" usually only 1 - 2 mm	Muscle stim DC-LV & HV AC Sine wave Square wave Faradic wave TENS MENS

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 asymptomatic

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

3' 75% => pain

4' 100%=> no pain at all

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 pulsewidth 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

Material	% Conductivity	% Absorbance
Water	100	0
Muscle	72 - 75	25
Brain or Neural	68	32
Fat	14 - 15	85
Skin or Bone	5 - 16	95

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, denervation 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 merric 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 pulseone 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 electrodeaka. 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

complete circuit

Positive electrode

4 – 8 mA

active electrode @ motor point

stim an atrophied area

Negative electrode

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)

Phenolphthalein 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

either +'ve or -'ve

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

catophoresis 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

Sunscreen ... 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

Maximum stim

Chronic/rehab

Moderate MIS

comfortable stim

routine stim

Large MIS

mild 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

HVDC

SWC

Alternating polarity, biphasic, symmetrical current

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.

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

-‘ve phase is 4X lower in amplitude but last 4X longer

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.

Ie. 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 denervation 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 countersignal 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 / enkephalin 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 / enkephalin 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 patients 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

Frequency A	A	B	Frequency B
4000 – 4100 Hz ... variable			4000 Hz .. fixed
modulated like a wavetrain			SWC .. equal +/-
SWC ... equal +/-			
			“Heterodyne” 3-D wave
crossed currents mutually			electrostatic field @ 90°
destructive “Interferential” B		A	

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 of electricity into the tissues.

metallic hollow

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 Same as EMNS b/c you can choose the 4 BFG'sp193

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

Location of
Wave pattern

Mousepad that can
steer the location of
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

How does this work ? 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

..... 2 Do not let the centre of the propeller fall on the spine but shift it slightly lateral of the spine ie. Treat the paravertebrals

p353 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

p354 machine has the ability w/ premodulation to create IFC’s within the machine so that the output is 0 – 100 Hz so that the creation of an IFC is w/in the machine itself.

The resultant is great penetration into the patient b/c it uses a carrier frequency of 4000 Hz to drive the IFC 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

p373 & 350 LSI produces IFC

p355 IFC

p356

p359 fig.93c scanning

p360 fig 94 if electrodes are farther apart, the depth of penetration increases

p366-7 you can shift IFC by changing the electrode size or intensity

p368 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

Ultrasound USD

all will penetrate > 2” to deep heat local tissues

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 "monoplude"

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

monoplode

pancake coil

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 diplode 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 pads

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 coccydynia
 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 piezoelectric 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 piezoelectric 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

coaxial cable

transducer head ... contains piezoelectric 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 desirable 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

Patient’s condition	Tissue type	Recommended dose	Underwater dose
Acute	Thin	0.5 – 1.0	1.0 – 1.5
Acute	Thick	1.0 – 1.5	1.5 – 2.0
Chronic	Thin	1.0 – 1.5	1.5 – 2.0
Chronic	Thick	1.5 – 2.0	2.0 – 2.5

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 USD EMNS electrode ... +/-

Into the USD machine

1

Channel A

Channel B

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 ...

Maximum force
@ 90°

Glancing % of treatment
when @ an angle other than
90°.

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. Goadng, 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.

Long Wave UV aka Near UV	Short Wave UV aka Far UV
Wavelength = 2000 – 4000 A	Wavelength = 1800- 2000 A
Penetration = 0.3 – 0.5 mm	Penetration = 0.1 – 0.3 mm
Fairly deep penetration for photochemical	Very poor penetration

reaction subcutaneously to treat the vascular system.	The further away from the visible spectrum, the less potent the effects
---	---

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 coloured 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 °C or 14,432 °F

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

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

Exposure times for different UV's

UV-C 1 2 3 4 5

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 SubErythema 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

Tube use	% of original intensity
New	100 %
> 100 hours use	80 %
> 1000 hours use	50 – 60 %
Old	60 – 70 %

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

Description	Temperature range in 'F
Very Hot	104 - 115
Hot	98 - 104
Warm	96 - 98
Neutral	92 - 96
Tepid	80 - 92
Cool	65 - 80
Cold	55 - 65
Very cold	34 - 55

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 Sclerolytic effects break up:

Hyperemic b/c of the water temperature 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

Double heating coil
To melt the wax

Direction of immersion through the tank
along the long axis of the tank

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
menstrual cramps & 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

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

Evaporation ... 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
ice

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 desirable 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 H₂O 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 H₂O + ½ ICE used w/ EMNS or USD *Treatment protocol* subaqueous 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 preparationslabs 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

rubber top seals the nozzle contents

rubber coated bottle keeps glass

shards together in case of breakage

Contents under pressure so that

when inverted, the pressure will help push the contents out.

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 evaporation & 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 evaporation 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

SPRAY flames or sparks b/c of the noxious paint & glue odors
 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 ... **L**ight **A**mplication of **S**timulated **E**missions of **R**adiation

This is w/in the DC scope of practice but not in California

Types & Fx'sOptic Maser ... 1st generation invention based on microwave tech.

Low power lasers ... commonly used today

Green => remove tatoos & birthmarks .. can cauterize wounds

Ruby => surgical incision that heal quickly

Gallium => 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

Semiconductors ... Ga / Ar used in Gamma-Knife

Liquids / dyes clothing

Chemicals Military uses Stream of "excited" electrons

Absolute light

Light reflector

w/o any

absorbance

Focused beam

dense & focussed

"collimated"

"concentrated"

Ruby crystal/Lasing medium

Provides a source of electrons

Usually a stone chip

Laser housing

Battery to excite

electrons into the

next orbital shell

Semipermeable

membrane mirror

collimates the

electron beam

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 pulposus back into the IVD
 helps isolate L4-L5 and L5-S1 segments using the harness

Continuous traction indications for use:

joint fixations	spinal curvature deformities ie. scoliosis
occipital neuralgia	OA, adhesions, contractures & fixations
subluxations (chronic)	activate mechanoreceptors

Intermittent tractions indications for use:

IVD hydration	spinal curvature deformities
occipital neuralgia	OA, adhesions, contractures & fixations
subluxations (chronic)	activate mechanoreceptor

Stroking ... aka. Effleurage (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
 Tortipelvis, 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 scoliosis & 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' => harrington 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 rotate 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 liftsno 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 asymmetry 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 Pressurelinear 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.