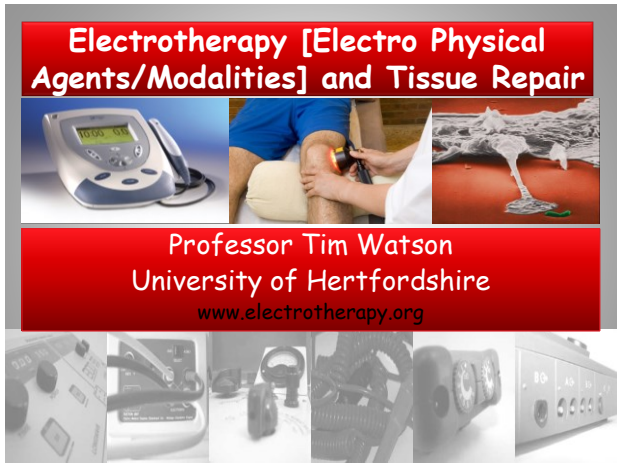
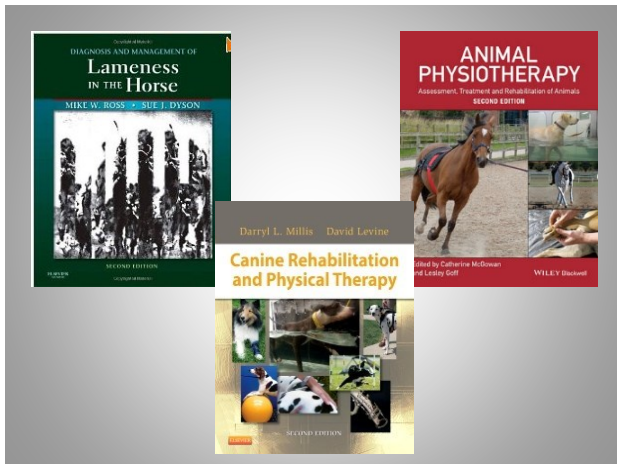

Electrotherapy [Electro Physical Agents/Modalities] and Tissue Repair
Professor Tim Watson
University of Hertfordshire
www.electrotherapy.org

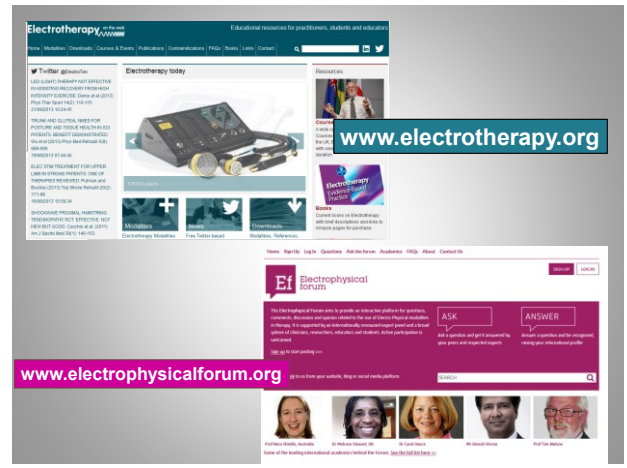
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Electrotherapy Evidence-Based Practice
Electro Physical Modalities
Evidence Based Practice
Tim Watson
Ethne Nussbaum
Evolve
ELETROTERAPIA
PRÁTICA BASEADA EM EVIDÊNCIA
Electroterapia
Práctica basada en la evidencia

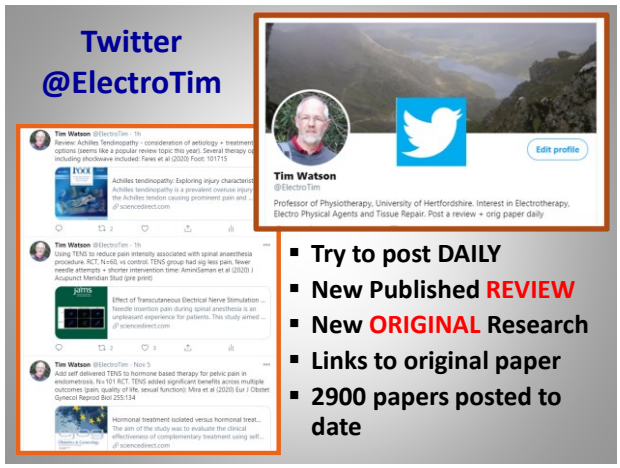
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DIAGNOSIS AND MANAGEMENT OF
Lameness IN THE Horse
MIKE W. ROSS • SUE J. DYSON
ANIMAL PHYSIOTHERAPY
Assessment, Treatment and Rehabilitation of Animals
SECOND EDITION
Darryl L. Millis David Levine
Canine Rehabilitation and Physical Therapy
WILEY Blackwell

3


www.electrotherapy.org
www.electrophysicalforum.org
Electrophysical forum
ASK
ANSWER

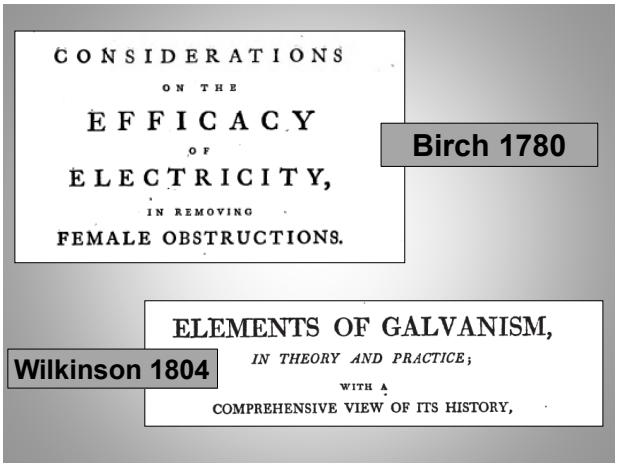
4


Twitter
@ElectroTim
Tim Watson
@ElectroTim
Professor of Physiotherapy, University of Hertfordshire. Interest in Electrotherapy, Electro Physical Agents and Tissue Repair. Post a review + orig paper daily
Edit profile
Try to post DAILY
New Published REVIEW
New ORIGINAL Research
Links to original paper
2900 papers posted to date

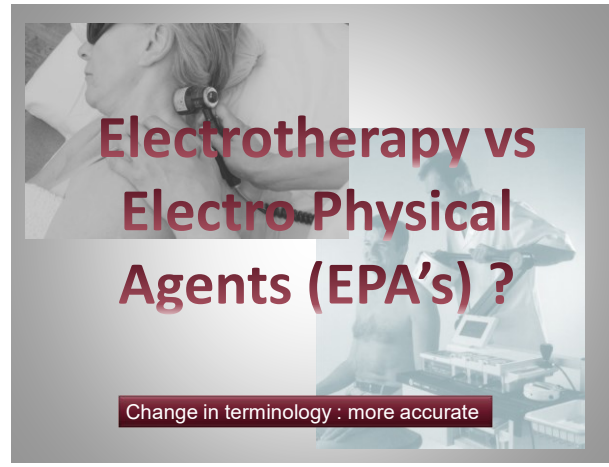
5


Blast of electricity can stop an asthma attack
2012
Electric pulses strengthen bones better than exercise
2015
Singing fatbuster
2009
ELECTROTHERAPY IS NOT NEW!
How ultrasound helps wounds heal 3 times faster
2015

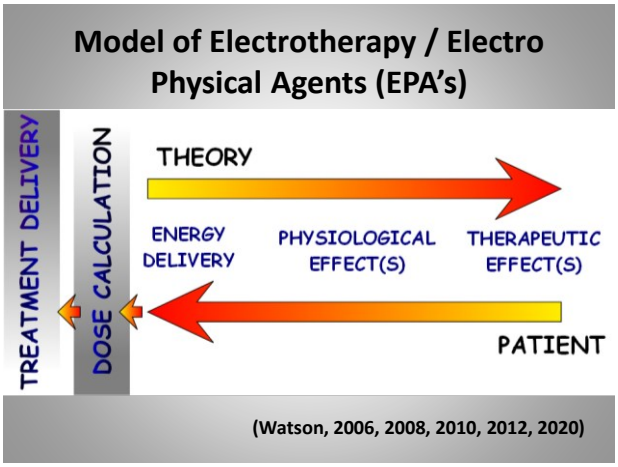
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CONSIDERATIONS
ON THE
EFFICACY
OF
ELECTRICITY,
IN REMOVING
FEMALE OBSTRUCTIONS.
Birch 1780
ELEMENTS OF GALVANISM,
IN THEORY AND PRACTICE;
WITH A
COMPREHENSIVE VIEW OF ITS HISTORY,
Wilkinson 1804

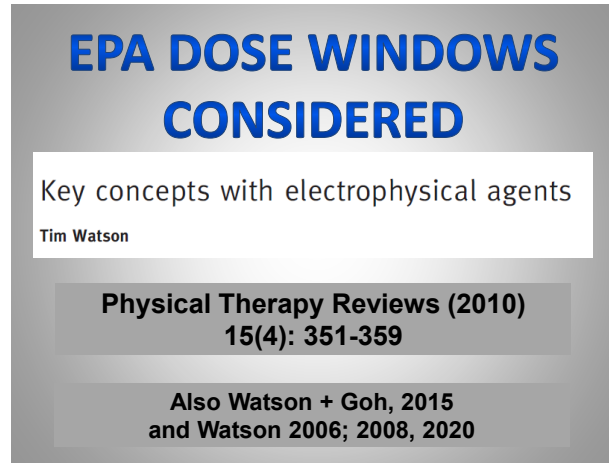
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Electrotherapy vs Electro Physical Agents (EPA's) ?
Change in terminology : more accurate

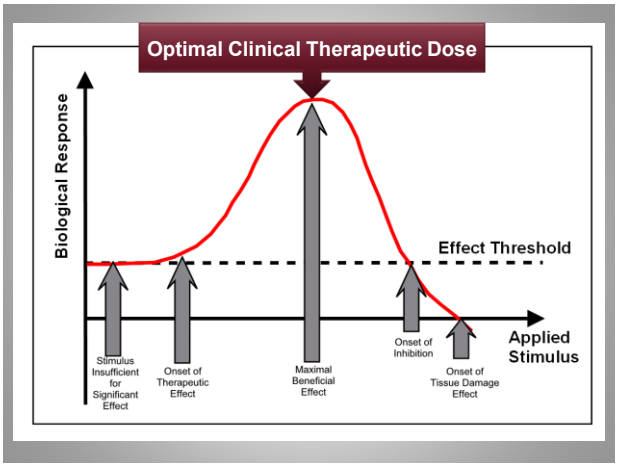
8


Model of Electrotherapy / Electro Physical Agents (EPA's)
TREATMENT DELIVERY
DOSE CALCULATION
THEORY
ENERGY DELIVERY
PHYSIOLOGICAL EFFECT(S)
THERAPEUTIC EFFECT(S)
PATIENT
(Watson, 2006, 2008, 2010, 2012, 2020)

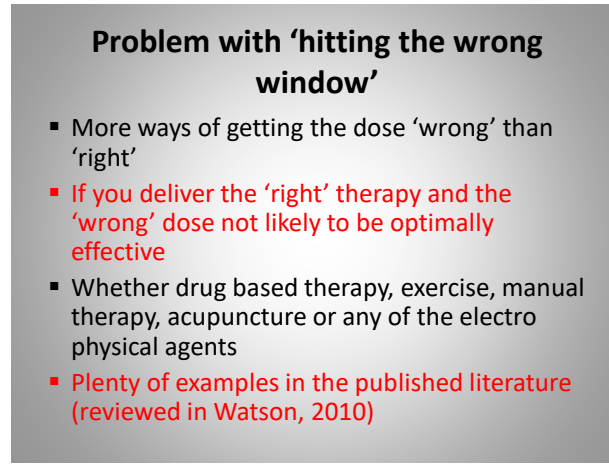
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EPA DOSE WINDOWS CONSIDERED
Key concepts with electrophysical agents
Tim Watson
Physical Therapy Reviews (2010) 15(4): 351-359
Also Watson + Goh, 2015 and Watson 2006; 2008, 2020

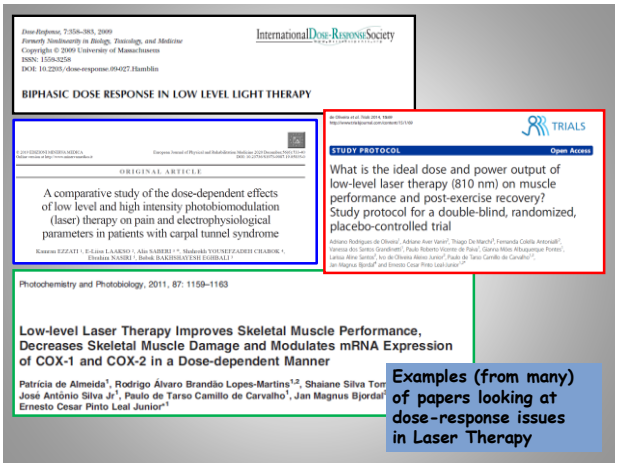
10


Optimal Clinical Therapeutic Dose
Biological Response
Effect Threshold
Applied Stimulus
Stimulus Insufficient for Significant Effect
Onset of Therapeutic Effect
Maximal Beneficial Effect
Onset of Inhibition
Onset of Tissue Damage Effect

11


Problem with 'hitting the wrong window'
More ways of getting the dose 'wrong' than 'right'
If you deliver the 'right' therapy and the 'wrong' dose not likely to be optimally effective
Whether drug based therapy, exercise, manual therapy, acupuncture or any of the electro physical agents
Plenty of examples in the published literature (reviewed in Watson, 2010)

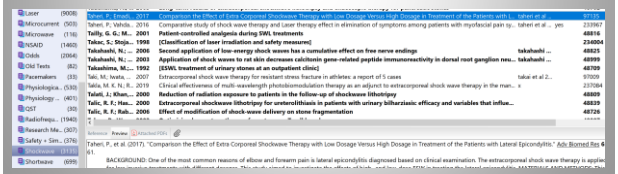
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13

The EVIDENCE

- There is a BIG volume of EPA evidence
- Database ≅ 240,000 references
- This is a BIG body of evidence
- Not all good, but we DO have evidence
- Potential Evidence – Practice MISMATCH



14

You have got to get it right to make it worthwhile - the evidence says so -

That means – at the very least

- Select the most appropriate **MODALITY**
- Select the optimal **DOSE**
- Deliver it **OFTEN ENOUGH**
- **INTEGRATE** with a best evidenced treatment package

BUT that is NO DIFFERENT from any other intervention Manual Therapy – Acupuncture – Exercise . . . .

15

MAKE THE MODALITY CHOICE BASED ON TISSUE TYPE TO BE MOST CONSISTENT WITH THE EVIDENCE

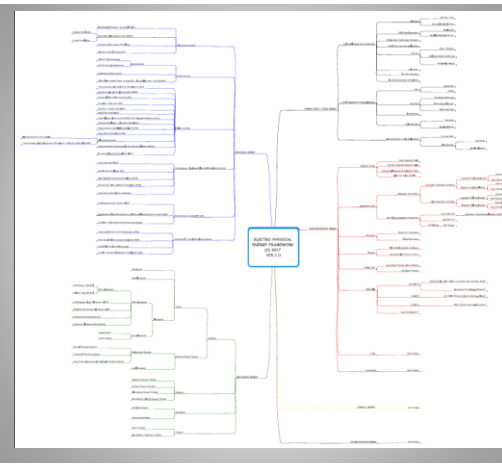
ENSURE THE OPTIMAL DOSE IS DELIVERED FOR BEST EFFECTS BASED ON TRIAL EVIDENCE

MODALITIES ARE NOT A MAGIC SOLUTION TO CLINICAL ISSUES :: THEY ARE AN EVIDENCED ADJUNCT AS PART OF A TREATMENT PACKAGE ::

16

Electrical Stimulation Agents / Modalities	Thermal Agents / Modalities	Non Thermal Agents / Modalities
Transcutaneous Electrical Nerve Stimulation (TENS)	Infra Red Irradiation (IRR)	[Pulsed] Ultrasound
Interferential Therapy (IFT)	Shortwave Diathermy (SWD)	Low Intensity Pulsed Ultrasound (LIPUS)
Neuromuscular Electrical Stimulation (NMES)	Microwave Diathermy (MWD)	[Pulsed] Shortwave Therapy (PSWT)
Functional Electrical Stimulation (FES)	Other RF Therapies [Indiba; TECAR]	[Pulsed] Laser Therapy (LLLT / HILT)
Faradic Stimulation	Hydrocollator Packs	[Pulsed] Microwave Therapy
Iontophoresis	Wax Therapy	Low Intensity RF Applications [Indiba; TECAR]
High Voltage Pulsed Galvanic Stimulation (HVPGS)	Balneotherapy (inc spa/whirlpool)	Pulsed Electromagnetic Fields (PEMF's)
Low Intensity Direct Current (LIDC) and Pulsed LIDC	Fluidotherapy	MAGNETIC THERAPIES
Twin Peak Monophasic Stimulation	Therapeutic Ultrasound	Pulsed Magnetic Therapy
Diadynamic Therapy	Laser Therapy [LLLT + HILT]	Static Magnetic Therapy
H Wave Therapy ; Action Potential System (APS); Scrambler Therapy		Shockwave Therapy [Radial / Focused]
Russian Stimulation : Aussie Stim Medium Frequency Stimulation	Cryotherapy / Cold Therapy / Ice / Immersion Therapy	Vibration (Local / Whole Body}
Rebox Therapy; Scenar Therapy, NRN (InterX) based therapy		
Microcurrent Therapy (MCT)		Microcurrent Therapy (MCT)

17



18

Electrical Stimulation Agents / Modalities	Thermal Agents / Modalities	Non Thermal Agents / Modalities
Transcutaneous Electrical Nerve Stimulation (TENS)	Infra Red Irradiation (IRR)	[Pulsed] Ultrasound
Interferential Therapy (IFT)	Shortwave Diathermy (SWD)	Low Intensity Pulsed Ultrasound (LIPUS)
Neuromuscular Electrical Stimulation (NMES)	Microwave Diathermy (MWD)	[Pulsed] Shortwave Therapy (PSWT)
Functional Electrical Stimulation (FES)	Other RF Therapies [Indiba; TECAR]	[Pulsed] Laser Therapy / Photobiomodulation (LLLT / HILT)
Faradic Stimulation	Hydrocollator Packs	[Pulsed] Microwave Therapy
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High Voltage Pulsed Galvanic Stimulation (HVPGS)	Balneotherapy (inc spa/whirlpool)	Pulsed Electromagnetic Fields (PEMF's)
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Russian Stimulation : Aussie Stim Medium Frequency Stimulation	Cryotherapy / Cold Therapy / Ice / Immersion Therapy	Vibration (Local / Whole Body)
Rebox Therapy; Scenar Therapy, NRN (InterX) based therapy		Microcurrent Therapies (MCT)
Microcurrent Therapy (MCT)		

19

Evidenced EPA's that can (directly) influence Tissue Repair

ESTABLISHED (THE 'CLASSICS')

Ultrasound Therapy
Pulsed Shortwave Therapy
Laser Therapy

EMERGING (EVIDENCED BUT LESS 'POPULAR' IN PRACTICE)

LIPUS (Low Intensity Pulsed Ultrasound)
Radio Frequency (not shortwave) e.g. Indiba; TECAR
Microcurrent Therapy
Shockwave Therapy

ALSO

Magnetic Therapy [incomplete clinical evidence]
Pulsed Microwave [evidenced but not used]

INDIRECTLY

IFT, TENS, NMES, Russian, Twin Peak Monophasic . . .

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Modalities to Consider in This Session

Ultrasound
Laser
Pulsed Shortwave
Shockwave

This does not devalue 'others' on the evidenced list – it is just a reflection of time / volume contraints

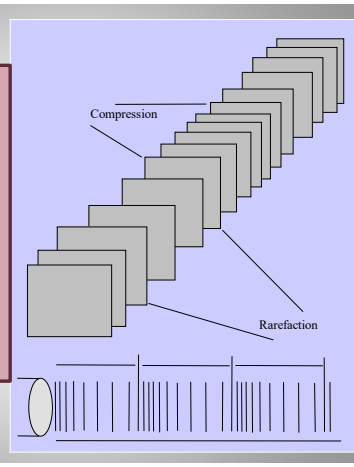
21



22

Hearing range 16Hz - 20,000 Hz

Therapeutic Ultrasound frequencies usually between 1 and 3 MHz (millions of cycles per second)



23

Absorption Characteristics of Ultrasound Energy

Blood Fat Nerve Muscle Skin Tendon [Cartilage Bone]

Increasing Protein Content gives Increasing Absorption

Best absorption in TENDON, LIGAMENT, FASCIA JOINT CAPSULE and SCAR TISSUE

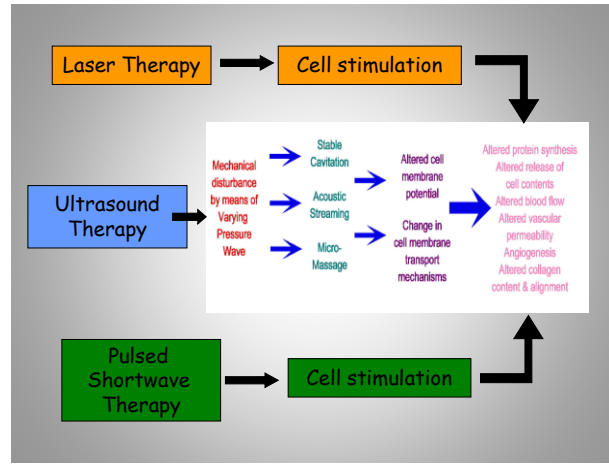
24

Tissues Absorption Characteristics

ULTRASOUND	PULSED SHORTWAVE	LASER
Dense collagen based tissues	Wet, ionic, low impedance tissues	Superficial Vascular Tissues
Ligament	Muscle	Open wounds
Tendon	Nerve	Muscle
Fascia	Areas of oedema, haematomas and effusion	Nerve
Joint capsule		Tendon sheath . .
Scar tissue		

EFFECTS on the repair process are the SAME :: the [TARGET] TISSUE is DIFFERENT ::

25

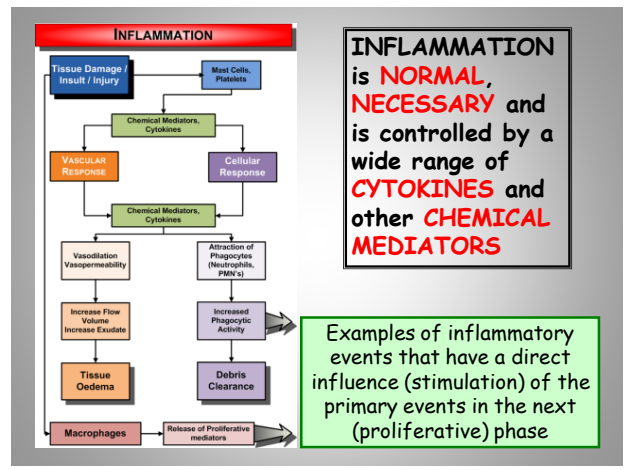


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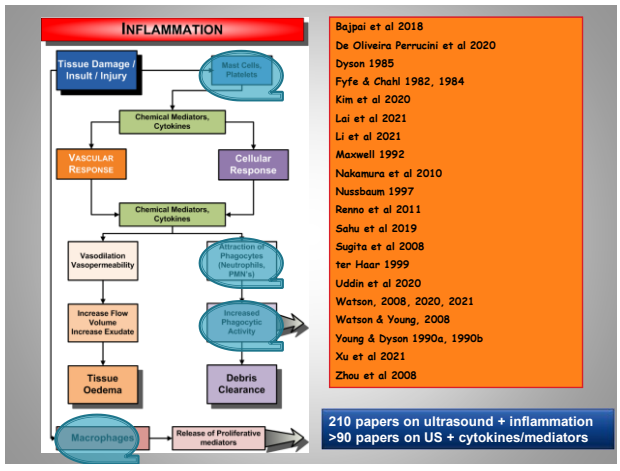
Physiological Effects of US

- **THERMAL** effects are considered to be of less significance, though present if sufficient energy is delivered to the tissues in sufficient concentration
- **NON THERMAL** effects are considered to be the more important and are based on established mechanisms (**STABLE CAVITATION** and **ACOUSTIC STREAMING**) – as a result, **CELL EXCITEMENT** increases

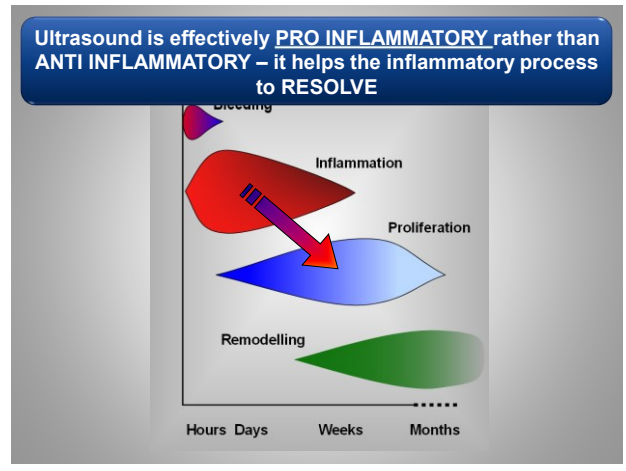
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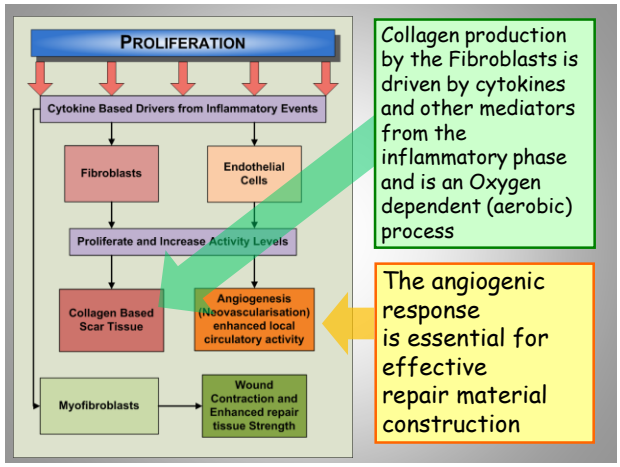
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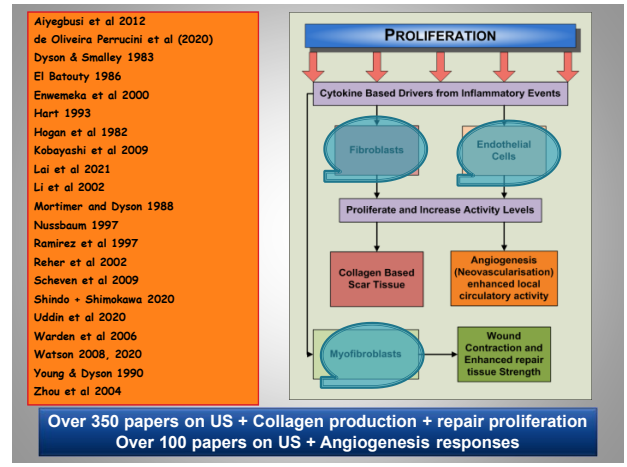
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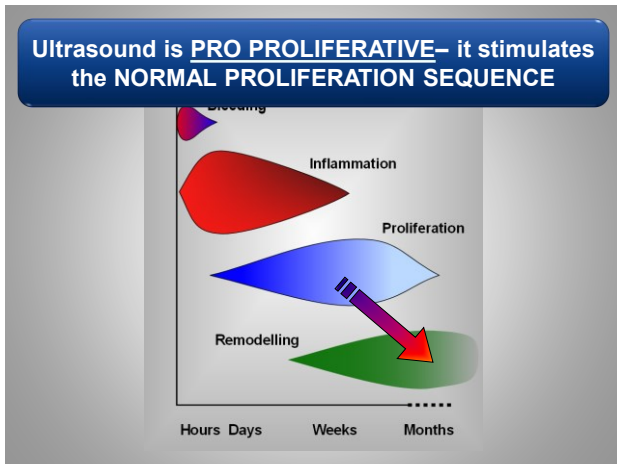
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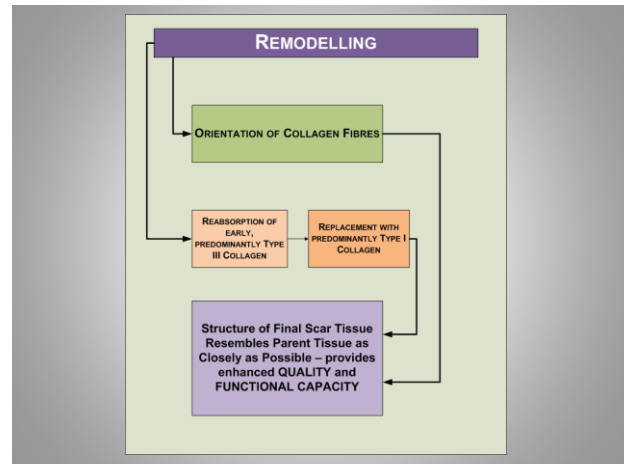
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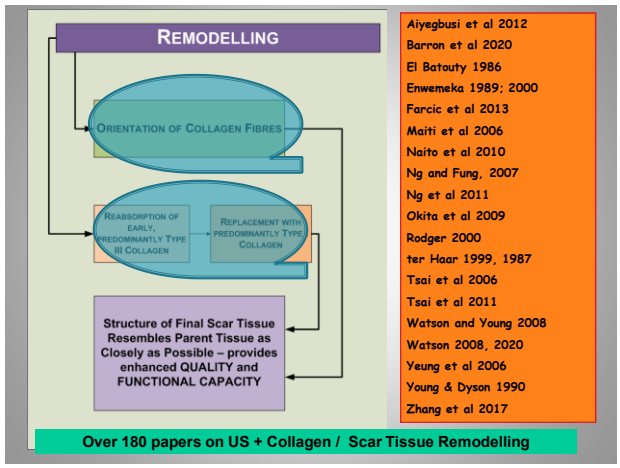
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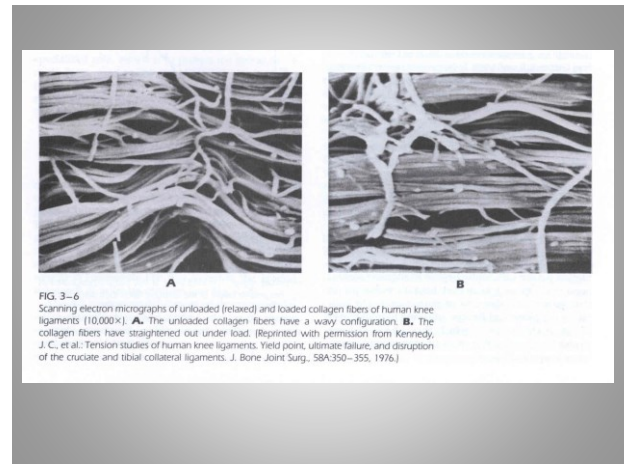
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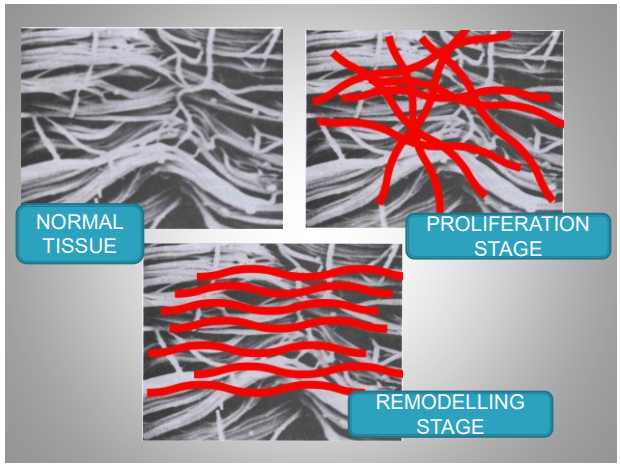
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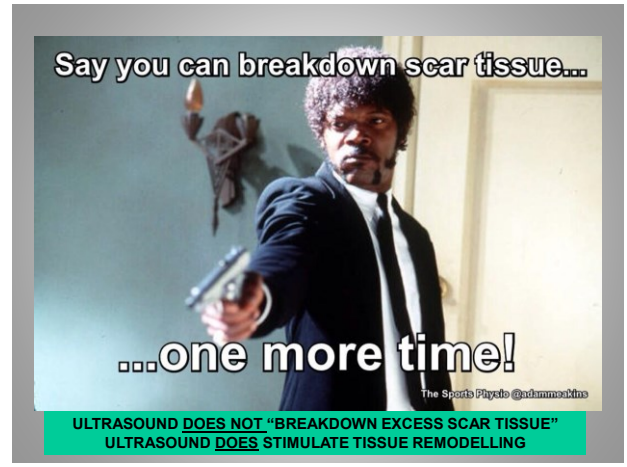
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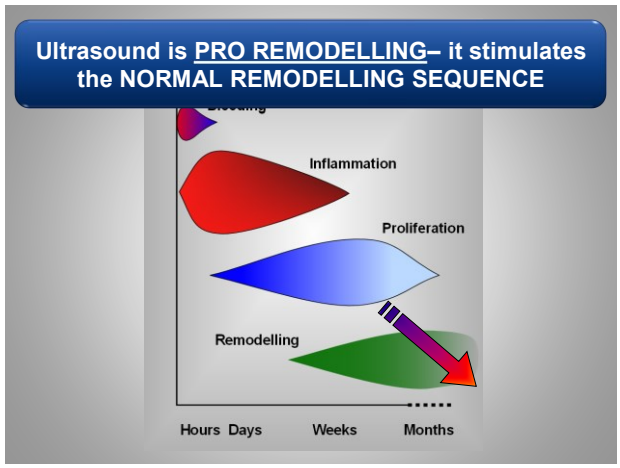
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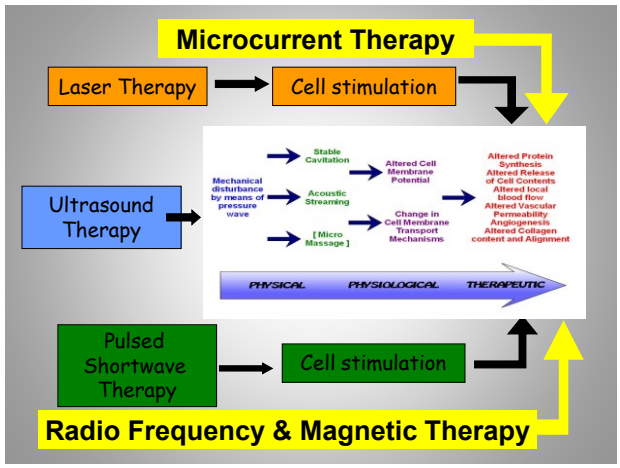


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Evidenced Effect of Ultrasound on Tissue Repair

- It DOES NOT change the normal sequence of events
- It effectively serves to STIMULATE; ENHANCE; SUPPORT; FACILITATE the normal sequence of events
- If the process is DELAYED or STALLED it will help to PROMOTE / RESTORE the sequence
- Will have more effect in a slow or delayed circumstance than when progressing normally

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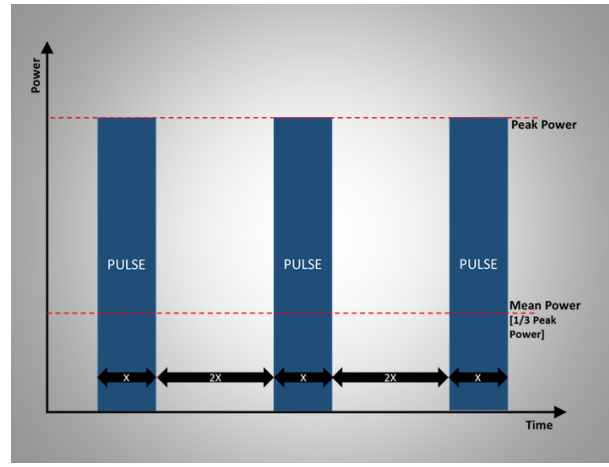


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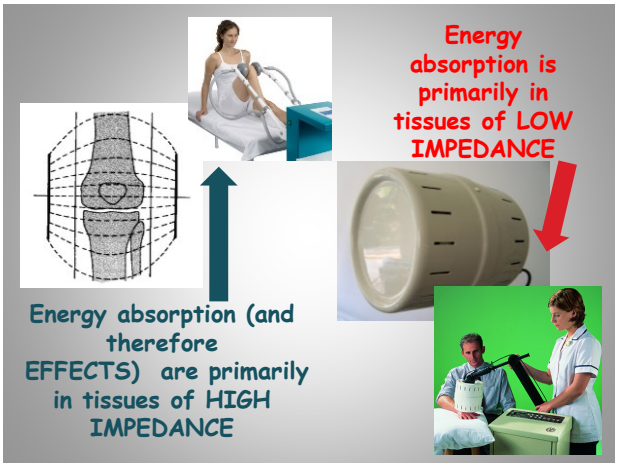
What is Pulsed Shortwave?

- Not accurate to call it PEME
- Broad umbrella term for many therapies
- Should not refer by machine name
- It ***IS*** literally Pulsed Shortwave
- when the machine is 'ON' it delivers normal shortwave
- BUT the machine is 'OFF' for a greater proportion of the time

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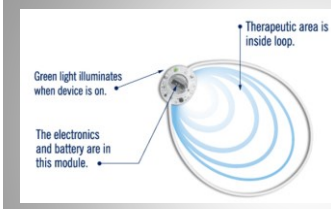


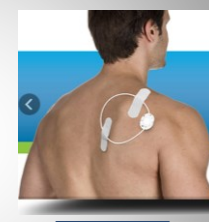
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45

Smaller, portable, low powered devices are available





720 hours use from a single unit = 90 days @ 8hrs (?overnight)

< £25

If deliver @ 73μW/cm2 over 720 hours (battery life) brings into same power range as PSWT treatment from clinic device

46

Pulsed Shortwave Therapy - Tissue Absorption

- Pulsed shortwave energy is primarily absorbed in tissues of LOW IMPEDANCE - the **WET** tissues
- Most effective therefore in **NERVE**, **MUSCLE**, **VASCULAR tissues** and tissue which is **OEDEMATOUS** or where there is a **HAEMATOMA**

47

Tissues Absorption Characteristics

ULTRASOUND	PULSED SHORTWAVE	LASER
Dense collagen based tissues	Wet, ionic, low impedance tissues	Superficial Vascular Tissues
Ligament	Muscle	Open wounds
Tendon	Nerve	Muscle
Fascia	Areas of oedema, haematomas and effusion	Nerve
Joint capsule		Tendon sheath . .
Scar tissue		

EFFECTS on the repair process are the SAME
:: the TISSUE is DIFFERENT ::

48

Pulsed Shortwave in Therapy

- Thermal and Non Thermal Effects
- Both have potential value
- Need to be aware of thermal threshold
- Non Thermal effects useful for acute situations and where heating not appropriate
- Almost identical effects to US and Laser
- BUT energy absorption in different tissues

49



50

Principles of Laser Therapy

- LASER is (in a simple sense) a form of **ENHANCED LIGHT** or **CONCENTRATED LIGHT**
- LASER light has some specific characteristics which appear to be important
- LASER light has bioeffects that are different to non-laser light
- Substantial research but controversy remains

51

LASER light is different because . . . .

- The light is produced by a mechanism of stimulated emission
- Laser light is MONOCHROMATIC and COHERENT (but some disagreement here)
- It is 'BRILLIANT' - high power density

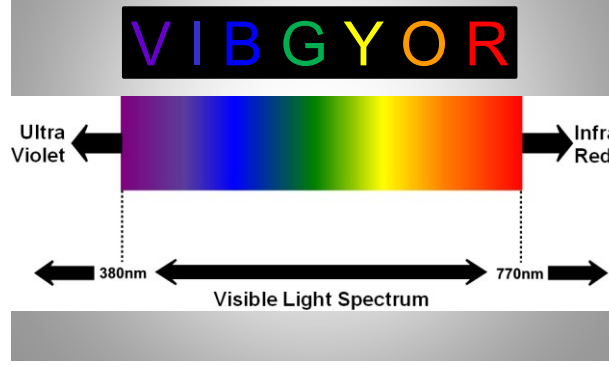
52

Laser Therapy / Photobiomodulation

- Lasers in therapy have been termed
- MID-LASER :: SOFT LASER
- LOW LEVEL LASER THERAPY (LLLT)
- LOW INTENSITY LASER THERAPY (LILT)
- **PHOTOBIOMODULATION (PBM)** is current preferred term
- **High Intensity (Class 4) Laser** is the new 'push' from manufacturers

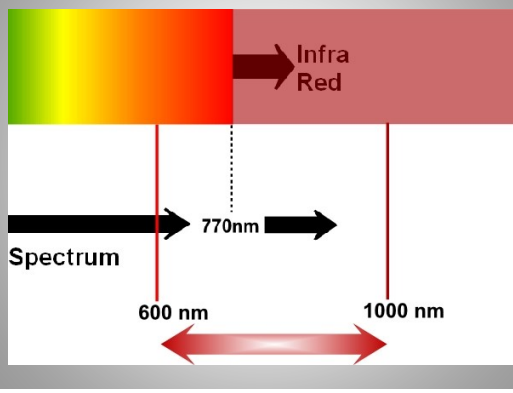
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Visible Light Spectrum



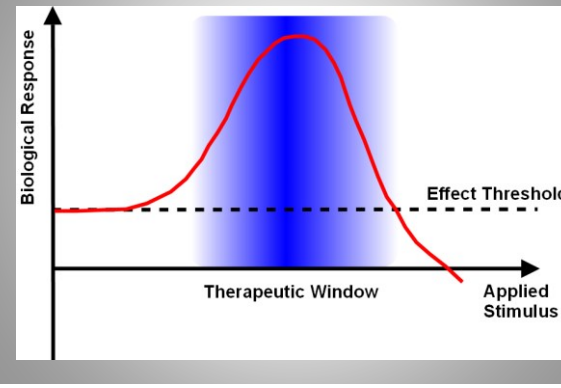
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Laser Use Spectrum : 600 – 1000nm



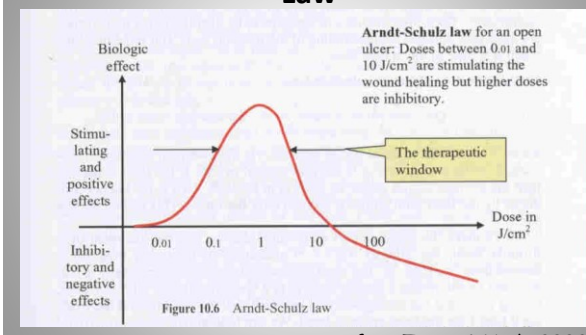
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AS Law Essential Components



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LASER light obeys the Arndt-Schultz Law



after Tuner & Hode 2002

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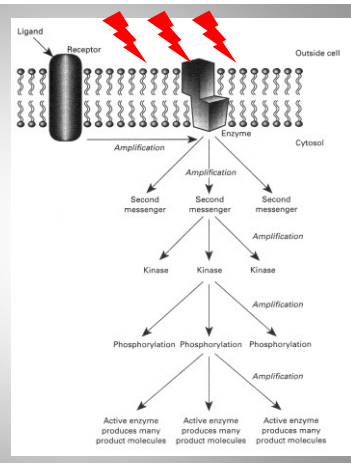
Tissues Absorption Characteristics

ULTRASOUND	PULSED SHORTWAVE	LASER
Dense collagen based tissues	Wet, ionic, low impedance tissues	Superficial Vascular Tissues
Ligament	Muscle	Open wounds
Tendon	Nerve	Muscle
Fascia	Areas of oedema, haematomas and effusion	Nerve
Joint capsule		Tendon sheath . .
Scar tissue		

EFFECTS on the repair process are the SAME :: the TISSUE is DIFFERENT ::

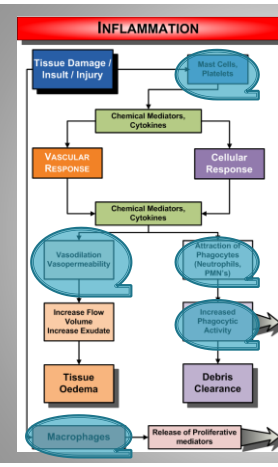
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Energy primary effect at MEMBRANE level → initiates second messenger cascade(s)



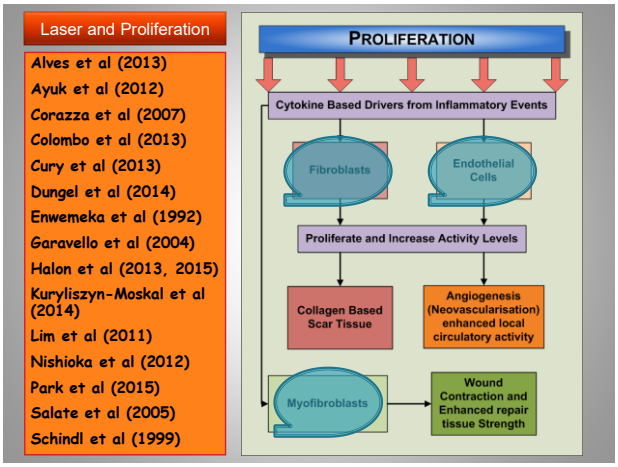
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Laser and Inflammation

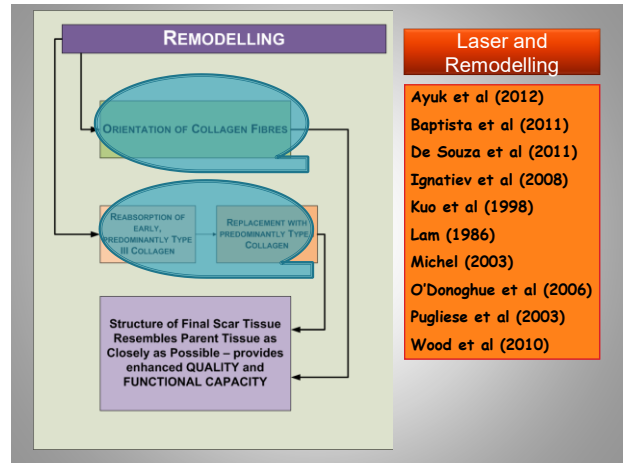


- Alves et al (2013, 2014)
- Aras et al (2015)
- Baxter + Nussbaum 2020
- Bjordal et al (2006)
- Dos Santos et al (2014)
- Hwang et al (2015)
- Marcos et al (2011)
- Mesquita Ferrari et al (2011)
- Moura Junior et al (2014)
- Pallotta et al (2012)
- Pires et al (2011)
- Safavi et al (2008)
- Saygun et al (2008)
- Silva et al (2015)
- Torres-Silva et al (2014)

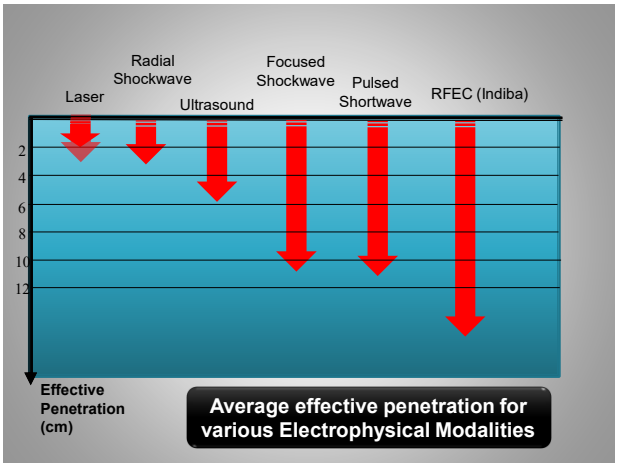
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Treatment Doses

- Almost all research for LASER therapy cites doses in terms of Energy Density (or more properly, Radiant Energy)
- Measured in J/cm^2
- Some difficulty with many machines in getting the output to match the research evidence

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Treatment Parameters

Power (W or mW)

Power Density (W/cm^2)

Energy (J)

Time (sec)

Energy Density (J/cm^2)

Range 1 - 30 J/cm^2

Typical 1 - 12 J/cm^2

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Low Intensity Laser Therapy - Indications (after Baxter 1995, 2002, 2007; 2020)

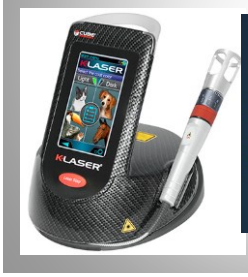
- Stimulation of **wound healing** in a variety of open wounds
- Treatment of various **inflammatory arthropathies**, mainly aimed at decreasing pain, reducing the intensity of the inflammatory response and thereby increasing function
- Treatment of **soft tissue injuries**
- **Pain relief (direct and indirect)** & laser acupuncture

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Class 4 Lasers – Cutting through the Manufacturers Blurb

Classification: all lasers are classified according to their output power. The classification is based on **average output power per source**. As a general rule following applies:

- Class 3B: 5 – 500 mW (1 milliWatt = 1/1000 of 1 Watt)
- Class 4: more than 500 mW (no upper limit, i.e. there is no Class 5)





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Dose and Wavelength are THE critical parameters

- From all the laser research over the last 40 years, the two most critical parameters to determine benefit (or not) are the **ENERGY** and the **WAVELENGTH**
- ✓ The Class 4 lasers deliver higher POWER so the ENERGY required is reached in a shorter time
- ✗ There is NO evidence that they 'penetrate deeper' in to the tissue (the early claims are being widely revised)
- ✓ IS true that at tissue depth X, a greater energy will be delivered – but that is not the same as 'deeper'

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Research

- Much (almost all) of the papers cited in the Class 4 laser manufacturers literature was actually conducted on Class 3b devices
- There is a VERY limited volume of literature specifically on Class 4 lasers
- None – as yet – directly compares the 2
- There is VERY LIMITED from VERY LIMITED published research on Class 4 lasers in Animal / Veterinary based therapy
- **[TW >9000 papers on Laser <25 of which are HILT/Class 4]**

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Electrical Stimulation Agents / Modalities	Thermal Agents / Modalities	Non Thermal Agents / Modalities
Transcutaneous Electrical Nerve Stimulation (TENS)	Infra Red Irradiation (IRR)	[Pulsed] Ultrasound
Interferential Therapy (IFT)	Shortwave Diathermy (SWD)	Low Intensity Pulsed Ultrasound (LIPUS)
Neuromuscular Electrical Stimulation (NMES)	Microwave Diathermy (MWD)	[Pulsed] Shortwave Therapy (PSWT)
Functional Electrical Stimulation (FES)	Other RF Therapies [Indiba; TECAR]	[Pulsed] Laser Therapy (LLLT / HILT)
Faradic Stimulation	Hydrocollator Packs	[Pulsed] Microwave Therapy
Iontophoresis	Wax Therapy	Low Intensity RF Applications [Indiba; TECAR]
High Voltage Pulsed Galvanic Stimulation (HVPGS)	Balneotherapy (inc spa/whirlpool)	Pulsed Electromagnetic Fields (PEMF's)
Low Intensity Direct Current (LIDC) and Pulsed LIDC	Fluidotherapy	MAGNETIC THERAPIES
Twin Peak Monophasic Stimulation	Therapeutic Ultrasound	Pulsed Magnetic Therapy
Diadynamic Therapy	Laser Therapy [LLLT + HILT]	Static Magnetic Therapy
H Wave Therapy ; Action Potential System (APS); Scrambler Therapy		Shockwave Therapy [Radial / Focused]
Russian Stimulation : Aussie Stim Medium Frequency Stimulation	Cryotherapy / Cold Therapy / Ice / Immersion Therapy	Vibration (Local / Whole Body)
Rebox Therapy; Scenar Therapy, NRN (InterX) based therapy		
Microcurrent Therapy (MCT)		Microcurrent Therapy (MCT)

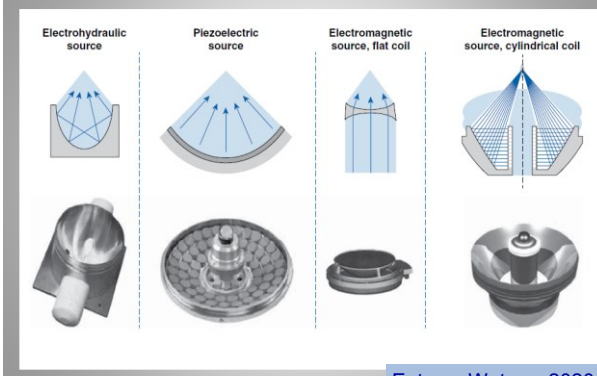
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Shockwave Production

- There are 4 basic ways to generate a shockwave (in the medical context)
  - Spark Discharge
  - Piezoelectric
  - Electromagnetic
  - Pneumatic (Ballistic)
- **Generally divided into HIGH (over 0.6mJ/mm²), MEDIUM (up to 0.28mJ/mm²) and LOW energy applications (up to 0.08mJ/mm²)**
- **No direct evidence that mechanism of generation changes the outcome – but the DOSE does**

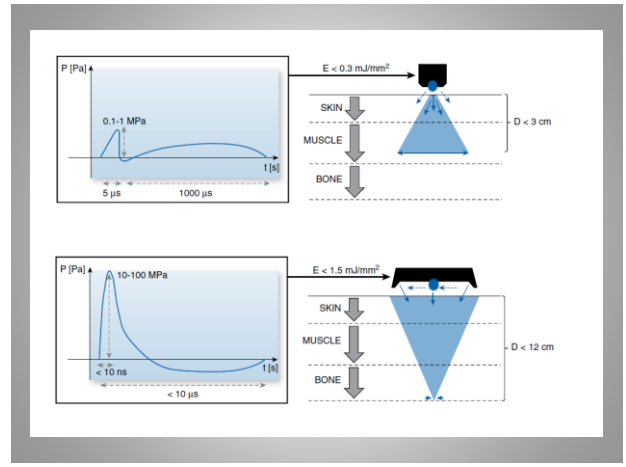
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Focused Shockwave Generation

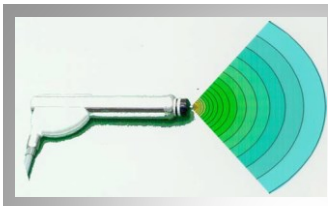


Eaton + Watson, 2020

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from Furlong 2001

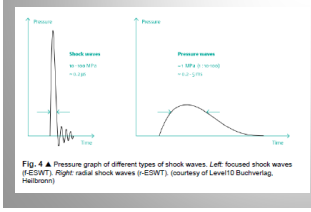


Fig. 4 ▲ Pressure graph of different types of shock waves. *Left*: focused shock waves (f-ESWT). *Right*: radial shock waves (r-ESWT). (courtesy of Level10 Buchverlag, Heilbronn)

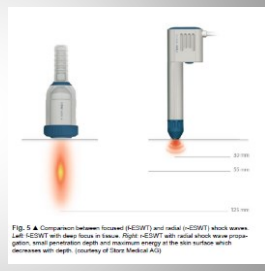


Fig. 5 ▲ Comparison between focused (f-ESWT) and radial (r-ESWT) shock waves. *Left*: f-ESWT with deep focus in tissue. *Right*: rESWT with radial shock wave propagation, small penetration depth and maximum energy at the skin surface which decreases with depth. (courtesy of Storz Medical AG)

from Storz Medical

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Mechanisms of Action

- Some of the effects relate to an **increase in local blood flow** – includes **angiogenic response**, not just transient shift (Calcagni et al 2011; Goertz et al 2014; Ha et al 2013; Notarnicola et al 2012; Mittermayr et al 2012)
- Partly also due to a **stimulation of an inflammatory response** – therefore enhancing tissue repair responses (de Girolamo et al 2014; Frairia et al 2012; Mariotto et al 2009 Mittermayr et al 2012)
- Stimulation of various **cells** associated with **tissue repair** (Chao et al 2009; Kuo et al 2009; Manganotti et al 2012; Mittermayr et al 2012)
- Almost certainly mediated, at least in part by **mediator and cytokine** mechanisms. VEGF, BMP-2, PGE2 and others (Watson, 2010, Eaton + Watson 2020) also evidence for ↑ hydroxyproline expression (Orhan et al (2001) and altered expression of MMP (matrix metalloproteinase) and interleukins (Notarnicola et al (2012) Nitric Oxide (NO) (Wang et al 2011; Hayashi et al 2012)

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Pro Inflammatory Model for Shockwave

European Cells and Materials Vol. 29 2015 (pages 268-280) ISSN 1473-2262

***IN VIVO* BIOLOGICAL RESPONSE TO EXTRACORPOREAL SHOCKWAVE THERAPY IN HUMAN TENDINOPATHY**

C.M. Waugh[1,2], D. Morrissey[1], E. Jones[3], G.P. Riley[3], H. Langberg[4] and H.R.C. Screen[2,*]

post-ESWT. Our findings provide novel evidence of the biological mechanisms underpinning ESWT in humans *in vivo*. They suggest that the mechanical stimulus provided by ESWT might aid tendon remodelling in tendinopathy by promoting the inflammatory and catabolic processes that are associated with removing damaged matrix constituents.

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Summary of Effects (Wang (2012), Westwood (2010)

Tissue from Chronic to Acute possibly primary mechanism

- Mechanical stimulation
- Increased blood flow (including angiogenic response)
- Increase in cellular activity – release of substance P, VEGF, BMP-2, PGE2 and other significant inflammatory mediators and cytokines
- Transient analgesic effect on afferent nerves
- Break down Calcific deposits (focused)

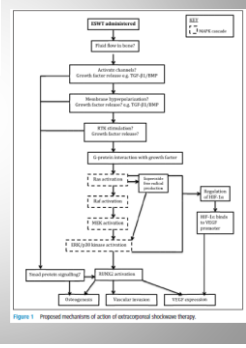
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Chamberlain and Colbourne (2016)
Vet Comp Orthop Traumatol
29(2): 99-107

Review Article

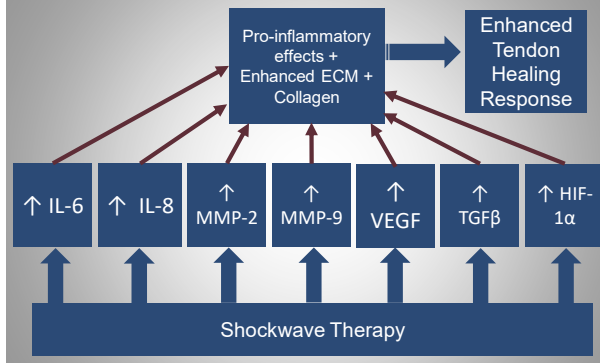
A review of the cellular and molecular effects of extracorporeal shockwave therapy

- Mechanotransduction
- Mitogen-activated protein kinase (MAPK), VEGF, TGF-β, BMP, FGF, PGE2 pathways



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Shockwave and Chronic Tendinopathy



e.g. Waugh et al 2015; Chamberlian & Colborne 2016

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Clinical Applications

- Strongest evidence is related to the use of Shockwave in the management of a range of **CHRONIC TENDINOPATHY** and related presentations including:
  - Plantar Fasciitis
  - Achilles Tendinopathy (insertional and mid portion)
  - Patellar Tendinopathy
  - Greater Trochanter Pain Syndrome
  - Lateral Epicondylalgia (Tennis Elbow)
  - Medial Epicondylalgia (Golfers Elbow)
  - Supraspinatus Tendinopathy (calcific and non calcific)
  - Other rotator cuff tendinopathies/lesions
  - Bicipital tendinitis/tendinopathy

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Additional / Emerging Clinical Application

- **Delayed and non union long bone fractures** (e.g. Alvarez et al (2011); Birubaum et al 2002; Cacchio et al 2009; Elster et al 2010; Furia et al (2010); Wang (2012) + **Stress Fractures** (Moretti et al 2009)
- **Avascular necrosis femoral head** (e.g. Furia et al 2010; Wang et al 2008)
- **Chronic venous ulcers (diabetic and non diabetic)** (e.g. Larking et al 2010; Saggini et al 2008; Wang et al 2011; Wolff et al 2011) and other **Chronic Wounds (**e.g. Antonic et al 2011; Mittermayr et al 2012)
- **Complex regional pain syndrome** (e.g. Notarnicola et al 2010)
- **OA Knee (**e.g. Frisbie et al 2004; Wang et al 2013, 2014; Zhao et al 2013)
- **Post spinal fusion** (e.g Lee et al 2008)
- **Spasticity in CP children** (e.g. El-Shamy et al 2014; Vidal et al 2011,)
- **Hypertonicity post stroke** (e.g. Manganotti et al 2005)
- **Post Carpal Tunnel pillar pain** (e.g. Romeo et al 2011) **+ Carpal Tunnel Syndrome** (Seok et al 2013)
- **Trigger point** application (e.g. Gleitz et al 2012)
- **Cellulite management** (e.g. Angehrn et al 2007; Schlaudraff et al 2014)
- **Tibial Stress Syndrome** (e.g. Moen et al 2012; Rompe et al 2010;)
- **Various DENTAL related applications** (e.g. Li et al 2010)
- **Chronic Low Back Pain** (e.g. Lee et al 2014)
- **Myositis Ossificans** (e.g. Buselli et al 2010; Reznik et al 2013)
- **Coccydynia** (Marwan et al 2014)
- **Myofascial Pain Syndrome** (Cho et al 2012)

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MAKE THE MODALITY CHOICE BASED ON TISSUE TYPE TO BE MOST CONSISTENT WITH THE EVIDENCE

ENSURE THE OPTIMAL DOSE IS DELIVERED FOR BEST EFFECTS BASED ON TRIAL EVIDENCE

MODALITIES ARE NOT A MAGIC SOLUTION TO CLINICAL ISSUES :: THEY ARE AN EVIDENCED ADJUNCT AS PART OF A TREATMENT PACKAGE ::

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Thank You



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