E-Shock Wave in Physical Therapy

Mohammed TA Omar PhD PT
Rehabilitation Health Science

Objectives

Following completion of this lecture the student will be able to:

- Describe the mechanical characteristics of ESW.
- Identify musculoskeletal pathology that may benefit from ESWT.
- Discuss the biological effects of ESW on soft tissue and bone

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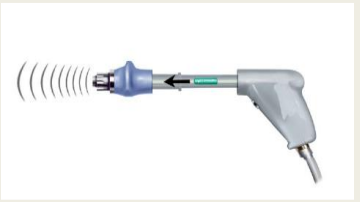
Outline

- Essential and History
- Principle of Production
- Characteristics of ESW &Energy production
- Physiological Effects &Mechanism of Action
- Clinical Applications
- Adverse effects of ESW
- Evidence-Base of ESWT

ESWT: Essential and History

- Therapeutic shockwave was first introduced into medicine over 30years ago for kidney stones .
- Recently, ESW was used for musculoskeletal disorders in the early 1980's.
- By the early 1990s, reports to start to appear in the journals and conference about use of ESW for soft-tissue problems.
- Although becoming much more popular (especially in Europe and to some extent in the UK), it is still a relatively new technology for musculoskeletal/tissue repair intervention.

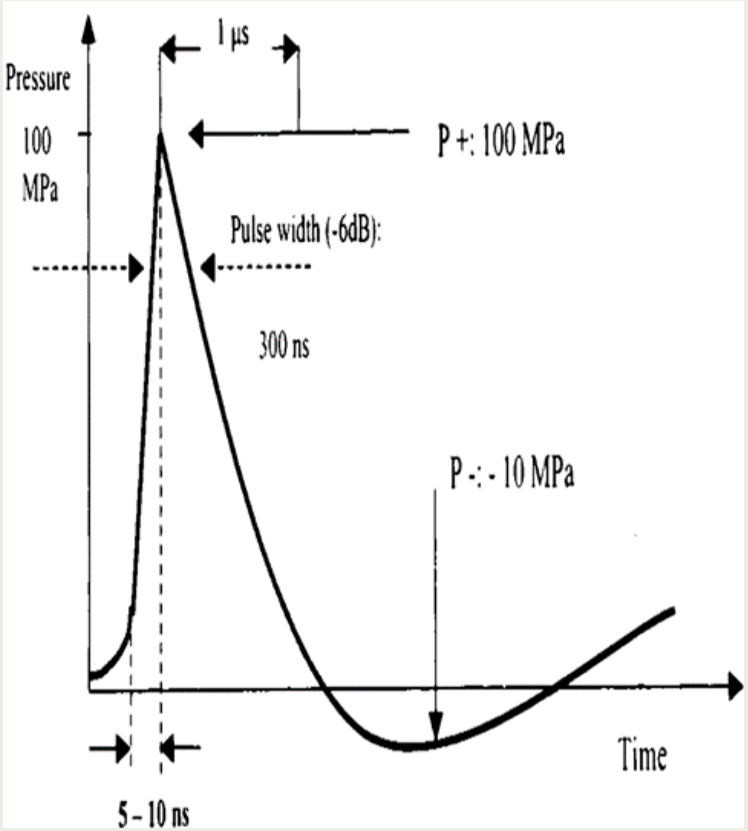
ESWT: Definition



- **Shock-wave** is an acoustic large-amplitude compression wave, with high pressure peak, adjustable in a limited frequency range with one the wave side, the positive pressure increases in a short time follows at negative pressure.

The characteristics of a shock wave are:

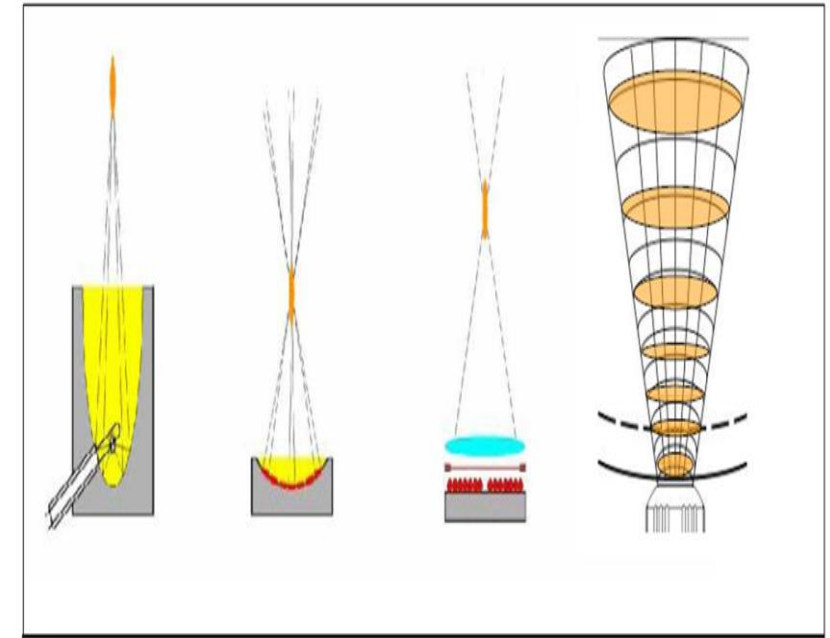
- **HIGH** Peak pressure typically ≈100MPa
  - *50-80MPa*
  - *35 - 120MPa*
- Fast pressure rise duration <10 ns
- Short life duration ≤10 µsec
- Narrow effective beam (2-8mm diameter)
- Frequency range 16HZ-20MHz
- Pause of negative pressure

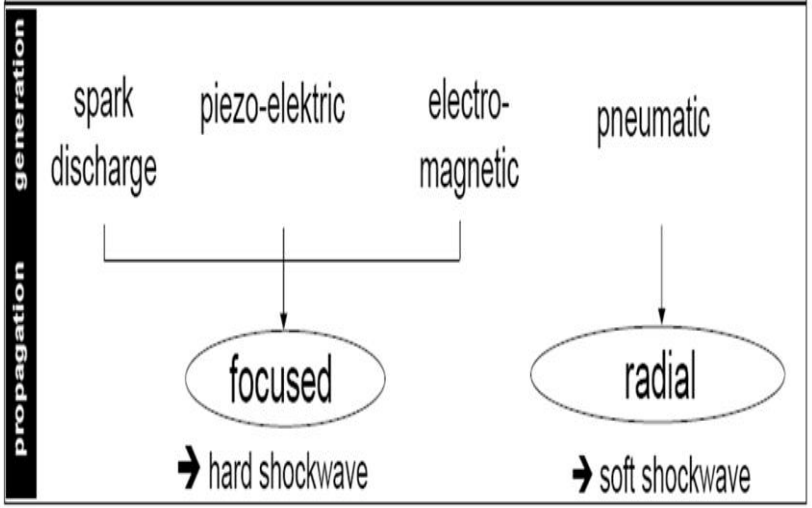


ESWT-Principles of Production

Types

- Electrohydraulic
- Electromagnetic
- Piezoelectric
- Radial or Electro-pneumatic





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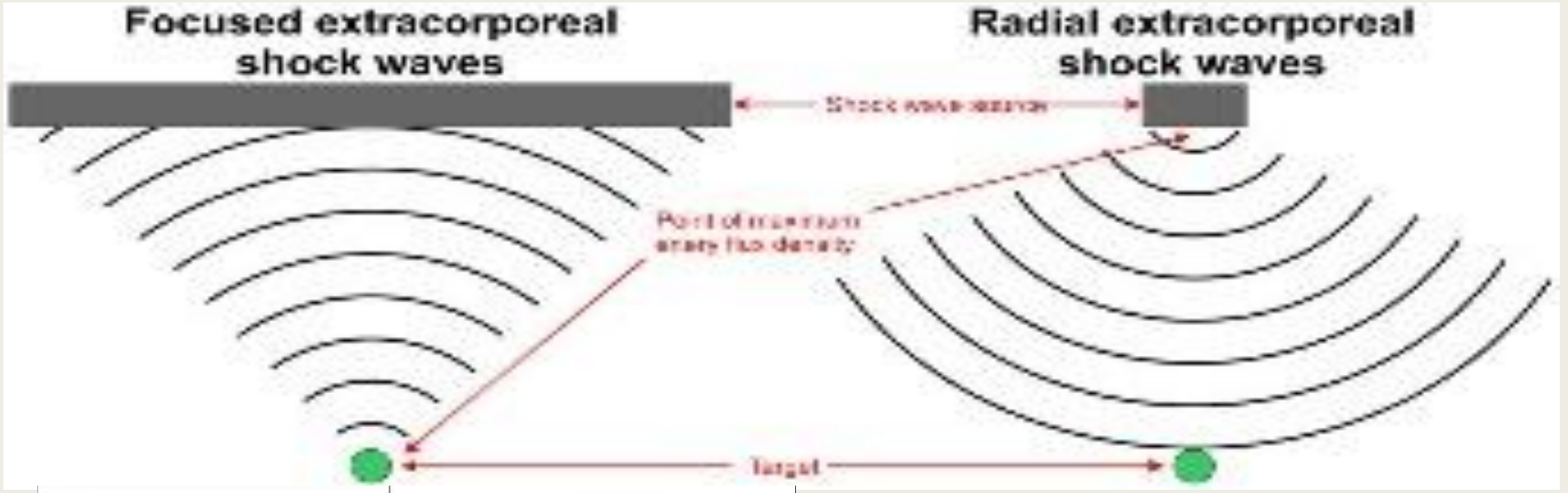
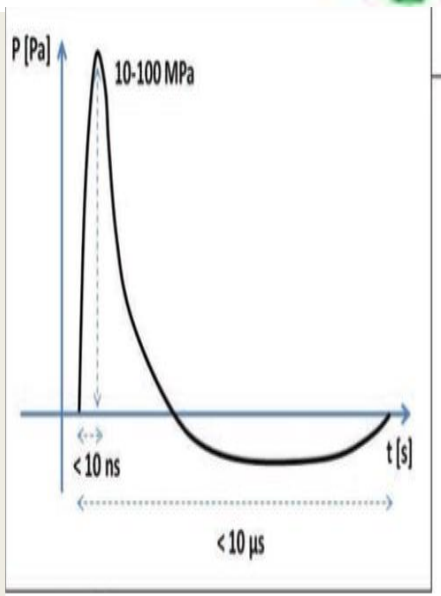
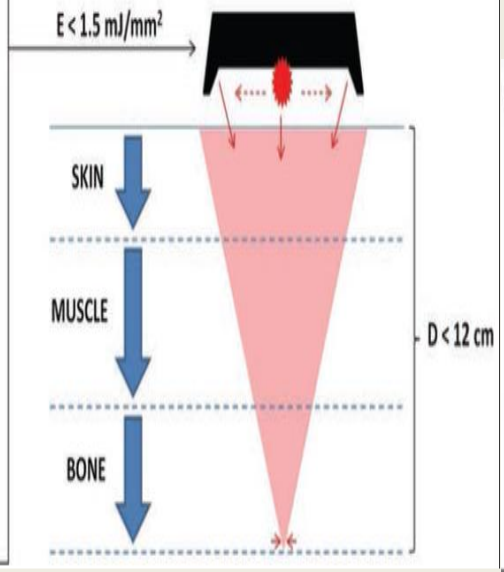
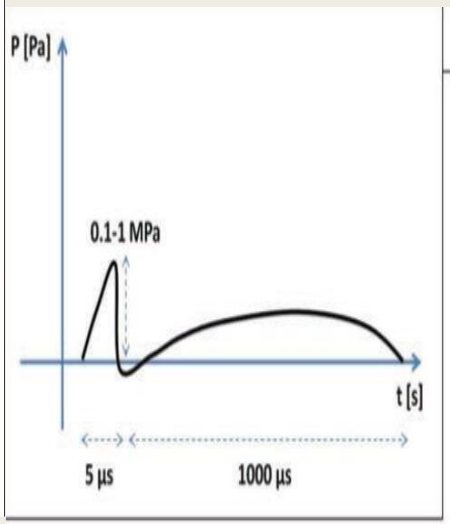
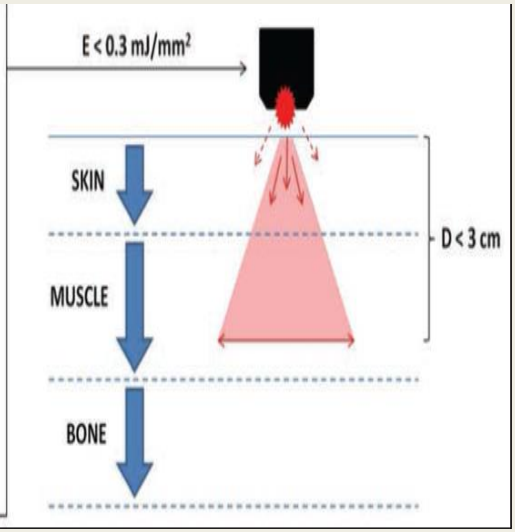










Focus		Radial
Electromagnetic, electrohydraulic,	Generator	Pneumatic
100-1000Bar	Pressure	1-10bar
≈0.2μsec	Pulse duration	0.2-0.5msec
0.01-1.50mJ/mm2 (high)	Energy flux density	0.01-0.05mJ/mm2 (slow)
Focus	Pressure field	Radial
Large>12cm Deep	Penetration depth	Small <3cm Superficial
Cell	Effect	Tissue
1-3	Treatment sessions	3-5
Higher	Adverse effect	Lower

Shock Wave : Principles of Production

Energy Flux Density (mJ/mm^2)

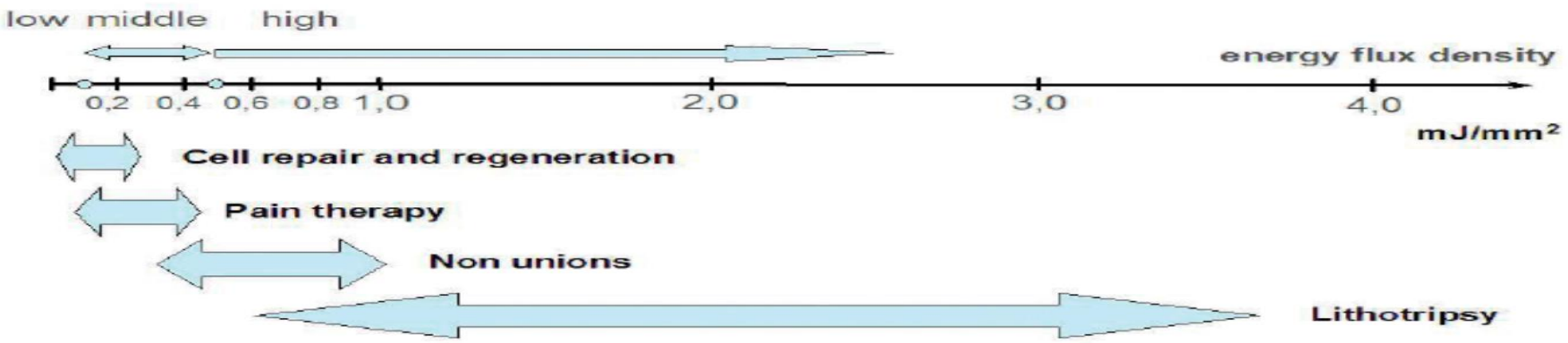
Degree of energy transmitted to the tissues

Measure of the energy flux /square area (mm^2)

- Low (<0.08 mJ/mm^2)
- Medium (0.08 to 0.28 mJ/mm^2)
- High (0.28 to 0.60mJ/mm^2)

Pulses Per Dose7

Ranges from 1000 to 3000



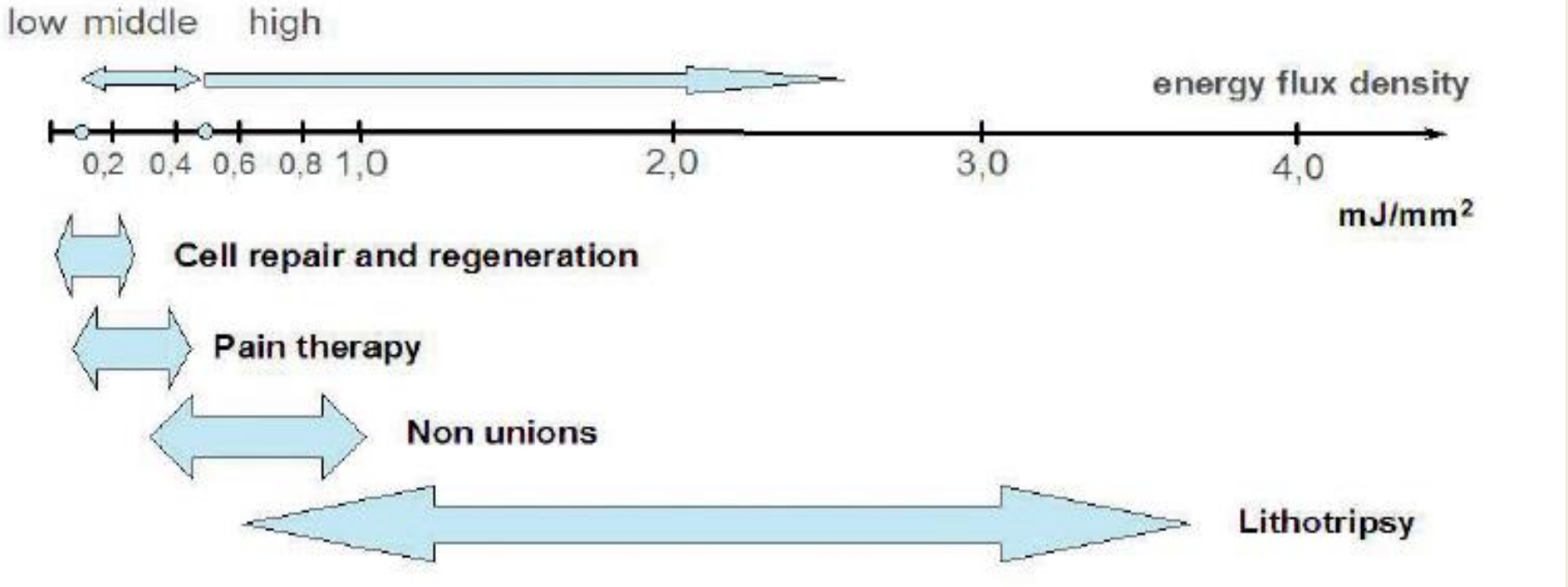
Energy Flux Density

LOW: Up to 0.08mJ/mm^2

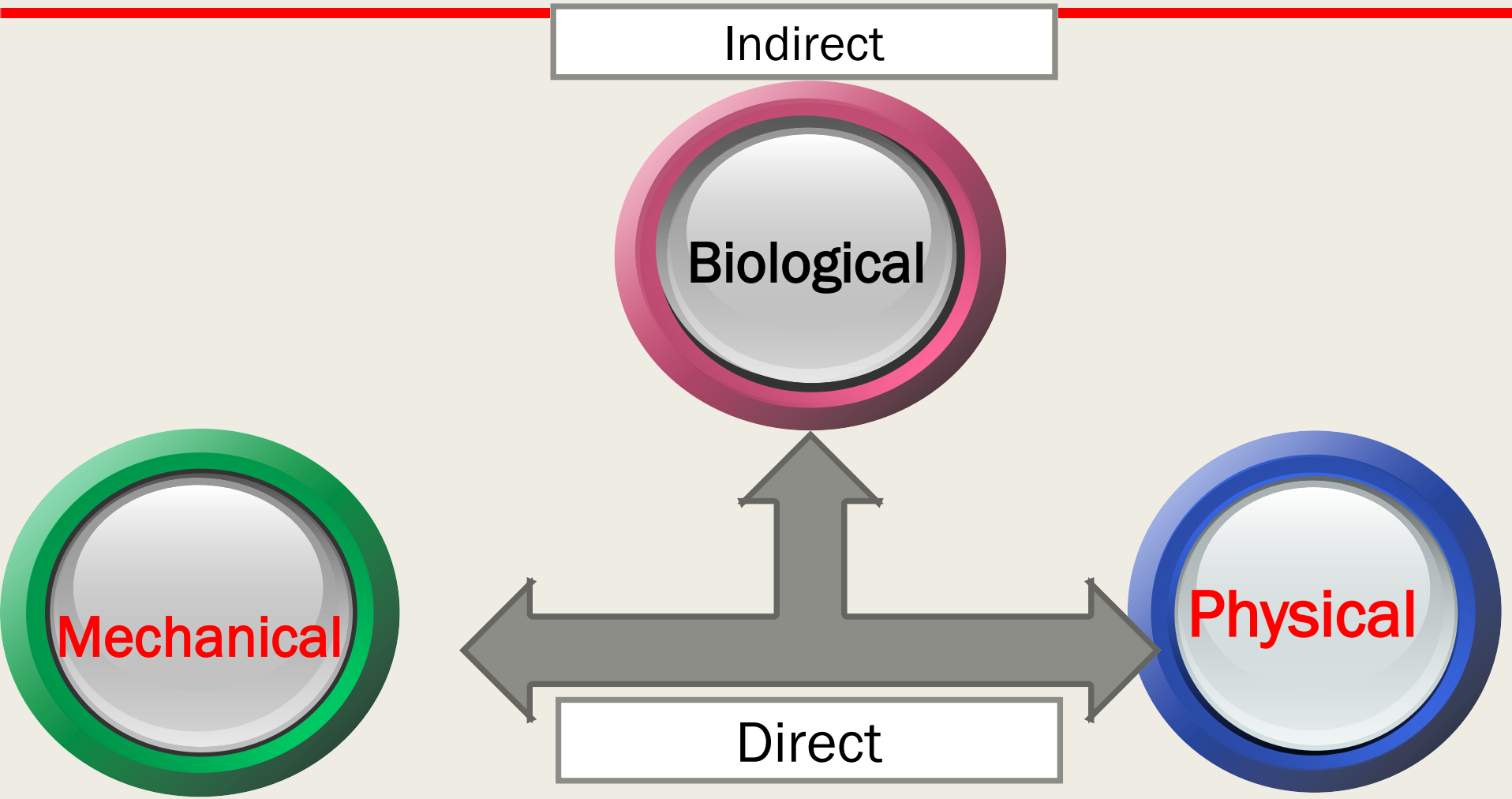
MEDIUM :Up to 0.28mJ/mm^2

HIGH : > 0.28mJ/mm^2

Rompe et al,1998

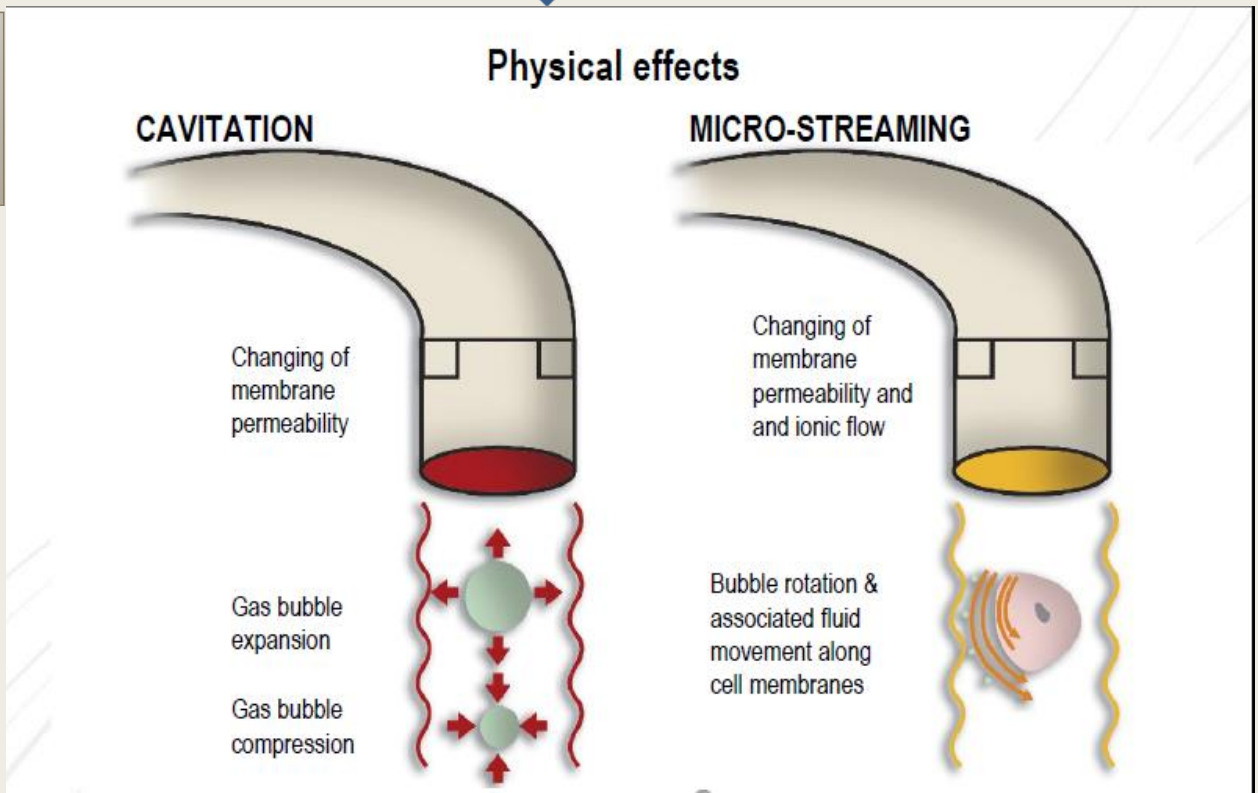


ESWT-Mechanism of Action

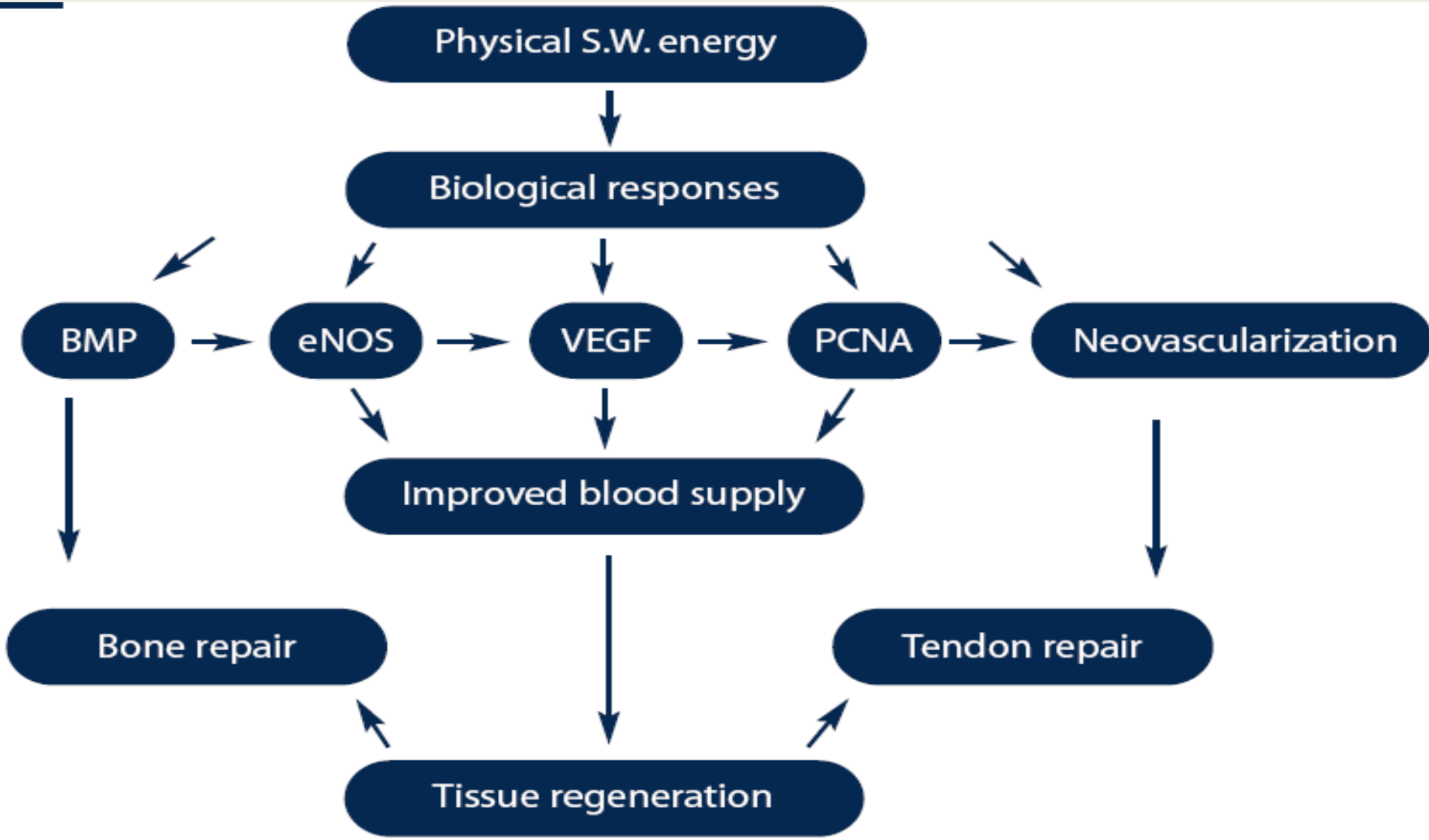


ESWT-Physical &mechanical of Action

Molecular ionization
Increase cell membrane permeability.



ESWT-Biological effects



ESWT-Physiological Effects

1-Mechanical stimulation

2-Increased local blood flow and Neovascularization

3-Increase in cellular activity release of

(BMP, eNO, VEGF, & inflammatory cytokines)

4-Reduction of concentration of Substance P

(decrease pain/edema)

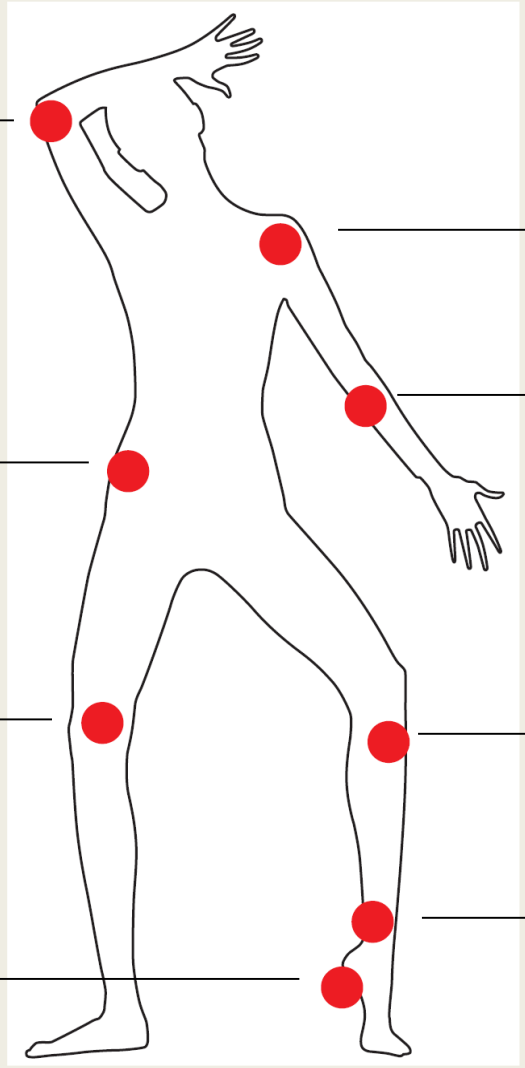
5-Transient analgesic effect on afferent nerves

6-Break down calcific deposits

(primarily, but not exclusively in tendon)

7-increase of collagen production

ESWT-Indictions



Tennis elbow (Epicondilitis humeri radialis)

Subacromial pain syndrome

Golfer‘s elbow (epicondylitis humeri ulnaris)

Greater trochanteric pain syndrome

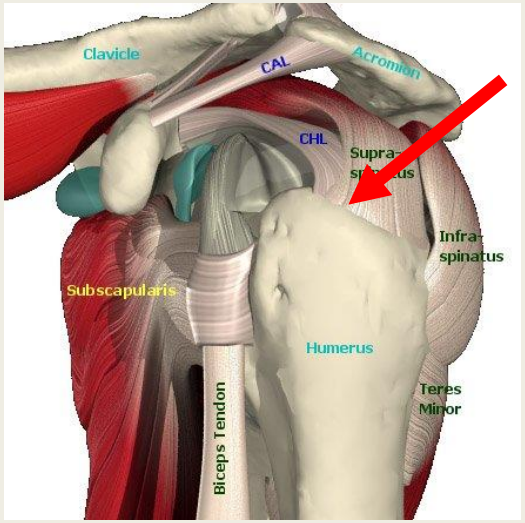
Patellar tip syndrome

Medial tibial stress syndrome

Achilles tendinopathy

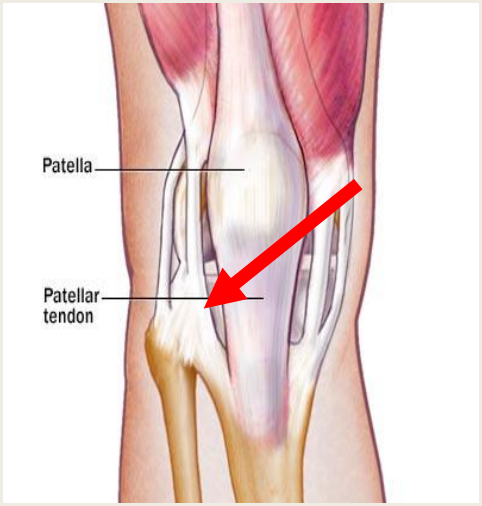
Plantar fasciopathy

ESWT-Indictions



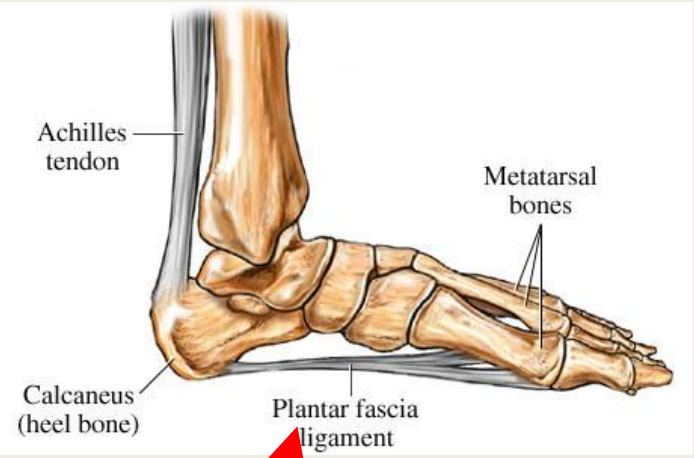
Supraspinatus tendon

Common extensor tendon



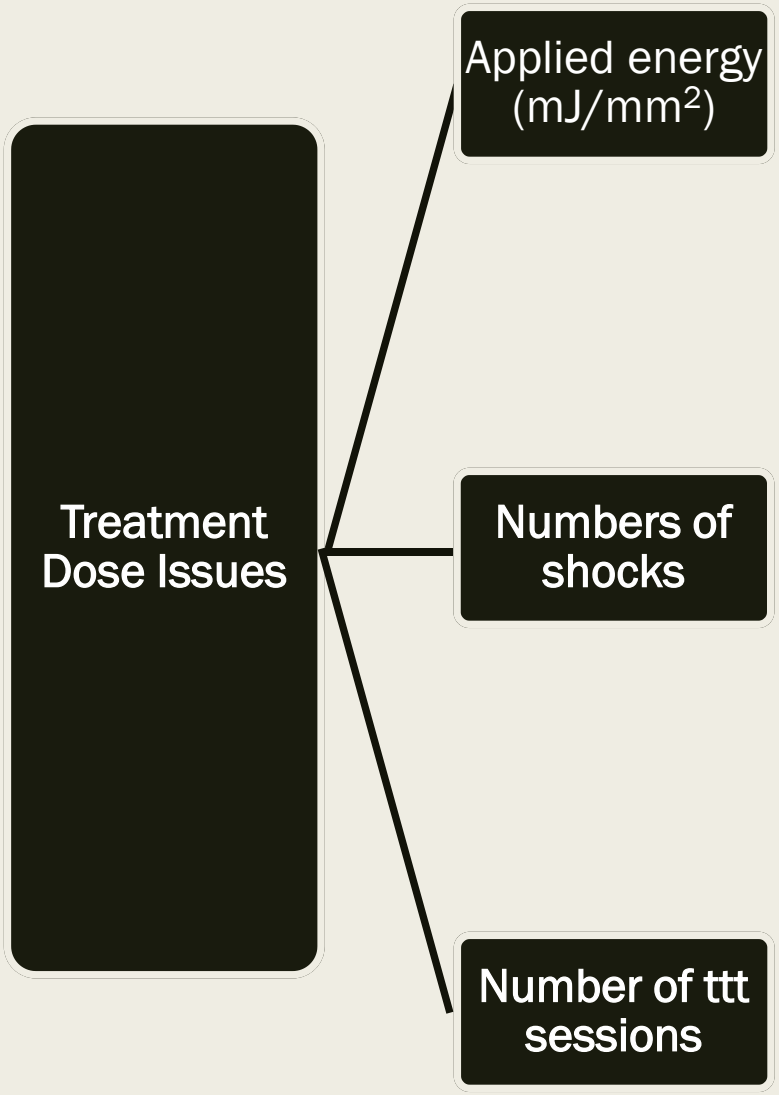
Patella tendon

Achilles tendon



Plantar fascia

ESWT-Clinical Application



- LOW (up to 0.08mJ/mm²)
- MEDIUM (up to 0.28mJ/mm²)
- HIGH (> 0.28mJ/mm²)

Shock number between 1000 - 2000,

- Some research has tried as few as 100-500
- 500 more effective than 100
- 1000-2000 shocks/session is most commonly applied range

A single session BUT only for High level treatment – using local anesthesia – not physiotherapy.

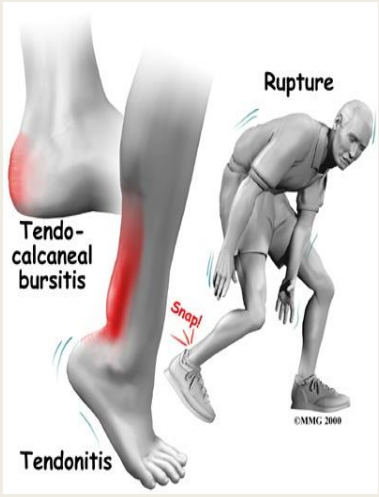
3–5 sessions at low energy levels, for the majority of patients.

No RCT trials yet to determine the maximally effective therapy session number and interval (3days-3weeks).

ESWT-Achilles Tendinopathy

- Insertional: within 2 cm of its insertion.
- Mid-substance:2-6 cm proximal to its insertion

S/S: Pain, swelling, and impaired performance



11 studies reviewed

ESWT produces greater short-term and long-term improvements in pain function compared to other non-operative treatments
(rest, footwear modification, NSAIDs, stretching, or strengthening)

Therapy parameters
pressure: 2–3 bars
frequency: 5–10 Hz
Patient position lying on back supported with knee
Frequency of treatments 5–10 days
Number of treatments 3–5 sessions

ESWT-Contraindications

- Lung tissue appears to be damaged and should be avoided
- The epiphysis it would make sense to avoid
- Patients who are haemophiliac/ on anticoagulant therapy.
- Malignancy
- Metal implants
- Infection in the local area should be treated with strong caution
- Joint replacements - come up with a mixed result

ESW-Adverse Events

Adverse events are equivalent to those of conventional ESWT –

- *Transient pain*
- *Subcutaneous hematoma (up to 4%)*

Local symptoms are much more common in RSWT due to lower penetration energy area.

- *Local irritation does not appear to be of lasting clinical significance.*

Side effects usually come and go within 3 to 5 days