Shockwave Therapy

Technological Differences in Energy Wave & Focal Zone Characteristics between Modalities
First Use in Medicine

• Kidney stone lithotripsy – Mid 70’s

• Advent of minimally invasive medical technology.

• 10yr follow-up on patients found changes in:
  – MSK & Bone density.
  – Considered for use in orthopaedic application

(Herr, 2008)
Type of Devices

- spark discharge
- piezo-electric
- electromagnetic
- pneumatic

Medical Shockwaves

Radial Pulse
Technology Used in Lithotripsy

• Electro-Hydraulic
  – MediSpec
  – Dornier

• Electro-Magnetic
  – Siemens
  – Storz

NOTE:
Radial pulse is not used in lithotripsy
Piezo-electric poor efficacy – Not used
Shockwave Characteristics

A Shock Wave = A high-pressure amplitude with the following typical characteristics:

- Sharp impulse with pulse width of 1us (equivalent to 1 MHz)
- Rise time of approximately 40 nano seconds
- Peak pressure higher than 50 Bars

(Gerdesmeyer et al, 2004)
Only **True shockwave** system generates cavitation, penetrating deeper to the treated area, yielding higher efficacy and better clinical results. (Weschel, 2004)

Cavitation bubbles occur directly after the pressure/tension alternating load of the shockwaves has passed in a water medium. Shock wave therapy causes fragmentation of calcium deposits into “crumb” and circulation slowly clears the site. (Gerdesmeyer, 2005, Craig & Miller 2011)

**Note:** Radial & piezoelectric devices CANNOT produce cavitation as it does not have a liquid medium.
Mechanism of Action: ESWT

ESWT onto Injury Site

Increased Cellular Permeability & Neuronal Signalling. Release of eNOS

Anti-inflammatory Response, Improved Micro-circulation, modulation of neurotransmitters & immune response

Cellular Expression of Growth Factors PCNA, VEGF. Collagen Type 1, Progenitor cells Generation.

New Vascularisation & Injury Resolution

Schaden, 2001; Ogden, 2002; Weil et al, 2002; Ogden et al., 2004; Furia, 2006; Amelio & Manganotti, 2010; Angehrn, 2008; Cacchio, et al, 2009; Furia, 2008; Mariotto, 2005; Mariotto, 2009 Nortanicola et al., 2010
# Shockwave vs Radial Pulse

<table>
<thead>
<tr>
<th>Therapy</th>
<th>ESWT</th>
<th>RWT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Penetration Depth</td>
<td>0-140 mm</td>
<td>0-35 mm</td>
</tr>
<tr>
<td>Pressure of Wave</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative To Time</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Diagram of Pressure Wave Within Tissue**

The Radial device (RWT) ie. dolorclast is a cheap alternative and is NOT a shockwave device.
Important Factors for Shockwave Generation

• Size of focal / therapy zone. Effects:
  – Number of shocks required per Tx.
  – Region / area covered during each Tx.
  – Impacts of Tx outcomes

• Electrode spacing gap (optimum gap 0.3mm)
  – Provides a uniform wave
  – Bio-physiological impact on tissue
  – Impacts Tx outcomes
The Device(S) We Use

- OrthoSpec – OR 3

- OrthoSpec – OR5

All devices are manufactured by MediSpec Ltd.
OrthoSpec vs Other Devices

Typical *ESWT System
Small Focus Zone

- Typical size at -6dB:
  Diameter 3mm
  Height 30mm
  ED = 0.4 mj / mm^2

- Typical size at 5MPa:
  Diameter 7mm
  Height 35mm

- Imaging (X-Ray or ultrasound) and anesthesia are recommended

Orthospec™
Large “Therapy Zone™”

- ED = 0.32 mj / mm^2
- Size at -6 dB:
  Diameter 26mm
  Height 96 mm
  ED = 0.29 mj / mm^2

- Size at 5 MPa Therapy Zone:
  Diameter 46mm
  Height 134 mm
  ED = 0.20 mj / mm^2

- Energy level up to 0.32/mm^2
- Relatively even energy distribution throughout the Therapy Zone
- Does not require imaging (X-Ray or ultrasound) or anesthesia

* Data provided to ISMST by various companies
OrthoSpec Special Patents: 1

Allows for large focal therapeutic region due to unique reflector design combining and elliptical and ellipsoidal reflector
The Orthospec patented reflector uses both focused and unfocussed wave, resulting in better clinical efficiency.
Penetration Depth: OrthoSpec vs Radial

CT Scan of gluteus mimimus region: penetration of focused ESWT (125mm) vs radial (dolorclast 30mm)
• This is why we chose the OrthoSpec Electro-hydraulic device after 18 months of testing all other devices.

• Better long term clinical outcomes and versatility.
ESWT in New Zealand

In 2000 Mr. Bruce Twaddle & I commenced investigation of shockwave devices. Devices tested:

- Reflectron (electro-magnetic) – HMT
- Dolorclast (pneumatic-radial) – EMS
- OrthoSpec OR3 (electro-hydraulic) – MediSpec

In 2002 Mr. Joe Brownlee investigated ESWT using

- Piezosone 100 (piezo-electric) - Wolf
Conclusion

- November 2002 the OrthoSpec was selected because of its superior Tx outcomes compared to the other devices. This is constant with international findings.

- Expertise and leadership of the manufacturer MediSpec in medical shockwave technology.

- Mr. Brownlee’s concluded that the piezo-electric device was ineffective, and did not proceed with it. This is constant with international findings.
Expansion of the Use of ESWT in Medicine

- Urinary Stones
- Orthopedics
- Cardiology
- Wound Healing
- Plastic Surgery
- Neurology

- Urinary Stones
- Orthopedic Pathologies
- Angina Pectoris

- Neural Regeneration
- Burns Healing
- Diabetic Ulcers
Advances in Shockwave Medicine

- **Cardiology**  (Vasyuk et al., 2010)

- **Complex Ulcers**  (Schaden et al., 2007; Sagginni et al, 2008; Moretti et al., 2009; Mittermyer et al, 2011)

- **Erectile dysfunction**  (Yardi et al., 2010; Yardi et al., 2012; Gruenwald et al, 2012)

- **Dystonia**  (Trompetto et al, 2009; Amelio et al., 2010)

- **Neuropathy**  (Craig K & Walker M, 2012; Craig et al, 2011)

- **Complex Pain**  (Nortanicola et al., 2009; Craig, 2011; D’Agostino et al, 2011; Craig K, D’agostino, & Perez R., 2012)

Note: Radial & piezoelectric devices are NOT used in these areas.
Electrohydraulic Devices Across Disciplines

**UROLOGY**

- E3000 & EM1000
- Extracorporeal Shock wave lithotripters

**CARDIOLOGY**

- Cardiospec
- SWT for cardiac ischemic diseases

**ORTHOPEDICS**

- Orthospec
- Orthopedic Shock wave system

**VASCULAR**

- ED1000
- SWT for erectile dysfunction
Reference


THANK YOU