“ESWT” use in Foot and Ankle: 13+ year experience

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High-Energy/Low-Energy

- OLD Terminology!!!
- **Current Terminology** (since 2006): *Focused* aka “ESWT” (true shockwaves) and *radial* (RSW, SWT, rESWT) “sound/pressure” waves

- Most “shockwave” devices current in US market are radial devices ($16-26K)
- ESWT (focused) devices are $55+K (but have more indications beyond musculoskeletal, ie *wounds*, neuro, GU)
How does it work?

- Causes pain, release & depletion of Substance P
- Creates micro-trauma, releases growth factors, neovascularization, re-introduces a healing response
- Can induce stem cell release in bony & fatty areas
Contraindications

- Coagulopathies
- NSAIDS, Gluco-Corticoid tx (wait 6 wks)
- Anti-coagulation therapy (coumadin, Xalerto)?
- Tumors
- Pregnancy?
- Open growth plates
- Neurogenic seizure
- Neuropathy/Radiculopathy/Tarsal Tunnel? My have increased pain
Note:

- Some devices require gel &/or mineral oil between application area & device
- Local anesthetic decreases effectiveness
- Much more indications beyond US borders
Note:

- Changing a degenerative state to regenerate
- Creating acute inflammation
- Some data to show treatment of trigger points can be more helpful
Note:

- Patients’ response to pain can be variable but most have some temporary relief after each treatment.
- Variable # of pulses/shocks, may need to space out more treatment sessions if not achieving therapeutic range.
- Having more pain after treatment is not correlated with a better or worse response.
- Can take 10-12 wks to see improvement after completion of treatment!
TIP:

- It’s like re-painting a wall...the colors take a while to match!
- Like painting, may need “touch-up” treatment @ 6 & 12 wks.
- Some athletes have used RSW during sports competition (half-time), daily, & “annually”
Working principle of focused and radial extracorporeal shock wave technology.

In case of focused shock waves, single acoustic pulses are generated either with a spark-gap (electrohydraulic principle), a technology similar to a loudspeaker (electromagnetic principle) or piezocrystals (piezoelectric principle).

By means of reflectors of certain shape, the acoustic pulses are converted into a focused acoustic pressure wave/shock wave with a point of highest pressure at the desired target within pathological tissue.

In case of radial shock waves, a projectile is fired within a guiding tube that strikes a metal applicator placed on the skin. The projectile generates stress waves in the applicator that transmit pressure waves into tissue.
Devices

- ESWT aka “focused”, ultrasonic
- RSW: radial, acoustic sound wave, “Extracorporeal Pulsed Activation Treatment” aka “EPAT”
- “V-actor”-vibration therapy used for muscle spasm/trigger point therapy
- Different applicator “tips” change depth penetration
Duolith (ESWT)
Orthopulse: RSW aka “EPAT”
EnPuls: Radial SW
# Energy setting based on device

<table>
<thead>
<tr>
<th>Bar</th>
<th>Duolith (mJ/mm²)</th>
<th>EnPuls (mJ)</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.7</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.12</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>0.15</td>
<td>110</td>
<td>Achilles, medial tibial stress syndrome &amp; other superficial areas (tennis elbow, patellar tendon, hip &amp; elbow bursitis)</td>
</tr>
<tr>
<td>3</td>
<td>0.2</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.25</td>
<td>150</td>
<td>Plantar fascia, hamstring, muscle strains, rotator cuff</td>
</tr>
<tr>
<td>5</td>
<td>0.3</td>
<td>185</td>
<td></td>
</tr>
<tr>
<td>0.3-.55</td>
<td></td>
<td></td>
<td>Non-union, AVN, stress fractures (may need local anesthesia proximal to area)</td>
</tr>
</tbody>
</table>

Note: contraindication is coagulopathy, nsaisds

Note: tx settings are typical but can be a range, usual session is 2500 pulses, larger areas can adjust up to 5000 pulses

Note: with Duolith apply mineral oil between head every 3 tx

Note: with Duolith, D Actor & Orthopulse, use ultrasound gel between applicator tip & patient’s skin

Note: with EnPuls, may need blue cap for superficial areas (eg Achilles) & mineral oil (not US gel) between tip & skin

Note: radial devices can be used daily, but focused ESWT (Duolith) should be used 2-14 days apart for musculoskeletal & 4-6 wks for bone
Benefits

- Ideally, NO “downtime” for most conditions, no immobilization, (No Boot! -but some protection, ankle brace, orthosis), great for athletic & active patients
- Better not to use NSAIDS concurrently
- Few relative contra-indications (coagulopathies)
Note on study Levels

- Level I: **highest** (blinded, randomized, placebo-controlled)
- Level II: non-randomized, placebo controlled
- Level III: non-randomized, case-cohort, prospective
- Level IV: retrospective
- Level V: expert opinion
Acute Plantar Fasciitis (<6 wks)

- Rompe et al (2010) RCT. ESWT vs. Plantar fascia specific stretching for acute plantar fasciitis (<6wks) showed that stretching is superior\(^1\). Level I

- Mardani-Kivi et al (2015) RCT. ESWT vs. Corticosteroid for acute plantar fasciitis (<6wks). Corticosteroid injection showed more effectiveness for the acute condition\(^2\). Level II
Plantar Fasciitis tx “early” vs “traditional”) ie 6+mos

- Saxena et al (2016) Unpublished prospective analysis. Early implementation of RSWT on subacute plantar fasciitis (for symptoms <3 months) vs. Standardized implementation of RSWT on chronic (>6 months) plantar fasciitis was analyzed. **Better outcomes with early implementation with VAS and RM scores at 12 months, faster RTA & significantly more likely to continue sport/activity** 2017 J Foot Ankle Surg Level III
Chronic Plantar fasciitis (6+ mos)

- Gollwitzer et al (2015) Multicenter RCT. Focused ESWT vs. Placebo showed favorable VAS and RM outcome of ESWT\(^3\). **Level I**
- Saxena et al (2013) Case-controlled study on athletes. Comparing endoscopic plantar fasciotomy (EPF) vs. Focused ESWT. EPF with better outcome but ESWT preferable since they can remain active during treatment\(^4\). **Level II**
- Gerdesmeyer et al (2008) RCT. Radial ESWT vs. Placebo. Radial ESWT with superior VAS and RM results\(^5\). **Level I**
- Malay et al (2006) RCT. ESWT vs. Placebo with better VAS outcome of ESWT\(^6\). **Level I**
Achilles Tendinopathy

- **Saxena et al (2011)**. Prospective study. RSW for para, proximal, and insertional Achilles tendinopathy. Significant improvement in RM score for Achilles tendinopathy. 75% effective **Level III**

- **Rompe et al (2009)**. RCT. RSWT vs. Eccentric + ESWT with favorable outcome for the combined group. **Level I**


- **Rasmussen et al (2008)**. RCT. ESWT vs. Placebo ESWT. Better outcome with the ESWT. **Level I**

- **Furia (2008)**. Case control study. RSWT vs. Control (traditional conservative method). Better outcome with ESWT. **Level III**
Medial Tibial Stress Syndrome (Shin Splints)

- Rompe et al (2010) Retrospective cohort study. Radial ESWT + home training program vs. Home training program only. ESWT combined group out performed the other group.\textsuperscript{12} Level II

- Moen et al (2012) Prospective study comparing ESWT w a gradual RTRunning program. RTA sig faster (P=.008, 60 vs 92 days).\textsuperscript{15} Level II
Medial Tibial Stress Fracture: 17 Wks later, Olympic Gold
Non-Unions

- Furia et al (2010) Retrospective cohort. ESWT vs. Intramedullary screw for 5th metatarsal metaphyseal-diaphyseal fracture non-union treatment. ESWT showed comparable results\textsuperscript{13}. Level I

- Cacchio et al (2009) Prospective, randomized, multicenter trial. ESWT vs. surgical treatment for long-bone non-unions. Found comparable results\textsuperscript{14}. Level I
17 yo HS football player re-frx
Sept of Sr yr Tx 3x 0.30mJ/mm²
RTA Bootx2 wks, Practice in 6 wk, played 6 games inc state champs
17 yr old soccer player continues to play:
Pre- & 6wks Post-ESWT, 5000 pulses
0.30mJ/mm²
Sesamoiditis

- One series reported in the literature.
- Saxena et al (2016 epub) JFAS “prospective” analysis-pilot study. ESWT treatment for sesamoidopathy with failed other conservative treatments. 90% RTA. Stat sig improvements in both VAS and RM score. Mean return to activity $10.1 \pm 15.6$ weeks (biased by 1 pt who waited a year to RTA!- really only 5wks). **Level III**
PLATINUM LEVEL OF EVIDENCE

- With so many positive Level I-III studies, Cochrane Reviews has designated “Platinum Standard” beyond “Gold Standard”
- Nothing else this rigidly studied in musculoskeletal medicine
- At least 9 Level I, 4 Level II & 4 Level III studies...what are people waiting for?


References (continued)


