Extracorporeal Shock Wave Therapy (ESWT)

Jenna Veens, MPT 2015
Western University

Family Physiotherapy Centre Of London
What is it?

- Extracorporeal = outside body
- Shockwave = intense, short energy wave travelling faster than speed of sound
- Well-controlled mechanical insult to tissue
- ESWT was established based on the principles of lithotripsy
  - Technology that uses acoustic sound waves to break up kidney stones
How Does It Work?

- Mechanical pressure increases cell membrane permeability\(^1\)
- Acoustic waves cause small capillaries in tissue to rupture, which increases growth factors to the area\(^3\)
How Does It Work?

- Neovascularization or new blood supply\textsuperscript{1,3}
  - More blood = more oxygen = better healing
- Stimulates fibroblasts for connective tissue healing\textsuperscript{1,3}
  - Tendon, ligament, fascia
How Does It Work?

- Stimulates osteoblasts for healing and new bone production\(^1\)
- Destroys calcifications\(^3,4\)
How Does It Work?

- Decreases pain
  - Hyperstimulation anesthesia\textsuperscript{1,4,5,6}
  - Reduces effects of Substance P neurotransmitter\textsuperscript{3}
  - Gate-control theory\textsuperscript{1,5,6}
Gate Control Theory

- Activation of A-Beta fibers inhibit transmission of pain signals to brain\(^5,6\)

\[ \text{SG} = \text{Substantia Gelatinosa} \]
Types

- Electrohydraulic
- Electromagnetic
- Piezoelectric
- Radial or Electro-pneumatic
  - Requires no imaging or additional treatments such as ultrasound or local anesthetic⁵

(Graph from DJO Global, 2012)
Mechanics

- Radial wave pulses are produced by compressed air in the cylinder of the hand piece
- A projectile in the hand piece generates kinetic energy
- This kinetic energy is transferred into acoustic energy which is sent into nearby tissues
- Depth of energy penetration is approximately 0-6 cm
Terminology

- **Energy Flux Density**: Degree of energy transmitted to the tissues
  - Low (<0.08 mJ/mm²)
  - Medium (0.08 to 0.28 mJ/mm²)
  - High (0.28 to 0.60 mJ/mm²)

- **Pulses Per Dose**: Ranges from 1000 to 3000
  - Several doses may be given over course of a treatment
Conditions Treated with ESWT

- Plantar Fasciitis
- Achilles Tendinopathy
- Epicondylitis
- Calcific Tendinopathy of the Shoulder
- Patellar Tendinopathy
- Post-Traumatic Myositis Ossificans
- Non-Union Fractures
- Trigger Points
- Frozen Shoulder
- Dupuytren’s Contracture
- DeQuervain Syndrome
- And more...
Evidence: Calcific Tendinopathy

- High-Energy Extracorporeal Shock-Wave Therapy for Treating Chronic Calcific Tendinitis of the Shoulder
  - Systematic review
  - Results: high energy ESWT was effective for treating calcific tendinitis
    - Reduced pain, improved function, resorption of calcifications
  - Low energy ESWT is less effective
  - Regardless of energy level, ESWT is not effective in treating non-calcific tendinitis

(Bannuru et al., 2014)
Evidence: Plantar Fasciitis

- Extracorporeal shockwave therapy versus placebo for treatment of chronic proximal plantar fasciitis: results of a randomized, placebo-controlled, double-blinded, multicenter intervention trial
  - Single treatment of EWST (n=115) vs. placebo (n=57) with 3 month to 1 year follow-up
  - All patients had previously failed at least 2 pharmacologic treatments AND at least 2 non-pharmacologic treatments
  - No use of corticosteroid injections, NSAIDs, or physical therapy during study

(Malay et al., 2006)
Evidence: Plantar Fasciitis

- **Outcome Measures**
  - Blind assessor’s objective assessment of heel pain
  - Participant’s subjective assessment of heel pain (VAS)

- **Results**
  - Significantly greater reduction of objective heel pain in treatment group (mean ↓ of 2.51) vs. placebo group (mean ↓ of 1.57) (P<0.001)
  - Significantly greater reduction of subjective heel pain in treatment group (mean ↓ of 3.39) vs. placebo group (mean ↓ of 1.78) (P<0.001)

- **Conclusion**
  - Effective for heel pain reduction in patients with recalcitrant plantar fasciitis

(Malay et al., 2006)
Evidence: Plantar Fasciitis

- Extracorporeal shock wave for chronic proximal plantar fasciitis: 225 patients with results and outcome predictors⁹
  - Retrospective study
  - All subjects had plantar fasciitis > 6 months with failure to respond to at least 5 conservative modalities
  - Multivariate analysis performed to determine outcome predictors

(Chuckpaiwong, Berkson & Theodore, 2009)
Evidence: Plantar Fasciitis

- **Outcome Measures**
  - Health questionnaire, Roles and Maudsley scores, American Orthopaedic Foot and Ankle Society scores

- **Results**
  - Success rates of 70.7% at 3 months and 77.2% at 12 months
  - Previous cortisone injections, BMI, duration of symptoms, bilateral symptoms, and plantar fascia thickness did NOT influence outcomes
  - Diabetes, psychological issues, and older age NEGATIVELY influenced outcomes

(Chuckpaiwong, Berkson & Theodore, 2009)
Evidence: Achilles Tendinopathy

- The effectiveness of extracorporeal shock wave therapy in lower limb tendinopathy: a systematic review\(^\text{10}\)
  - 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)
  - One study demonstrated that eccentric loading with ESWT is superior to eccentric loading alone
    - Greater improvements in pain and function

(Mani-Babu et al., 2014)
Evidence: Patellar Tendinopathy

• The effectiveness of extracorporeal shock wave therapy in lower limb tendinopathy: a systematic review\textsuperscript{10}
  ◦ 7 studies reviewed, mixed results
  ◦ One study showed no difference between ESWT and placebo
  ◦ Two long-term studies showed ESWT to be comparable with patellar tenotomy surgery and better than non-operative treatments (NSAIDs, physical therapy, exercise, knee strap, and modification of activity)
    • Greater improvements in pain and function

(Mani-Babu et al., 2014)
Evidence: Epicondylitis

- Systematic review of the efficacy and safety of shock wave therapy for lateral elbow pain

  - 9 placebo-controlled trials + 1 ESWT vs. steroid injection
  - Conflicting results
    - Three trials in favour of ESWT, four trials reported no benefit
    - Steroid injection more effective than ESWT
  - “ESWT provides little or no benefits in terms of pain and function in lateral elbow pain”

(Buchbinder et al., 2006)
Parameters

- No consensus in literature
- See Chattanooga Guidelines\textsuperscript{5}
Is It Safe?[^5]

- Mild side effects reported in studies
- Side effects usually come and go within 3 to 5 days
  - Redness
  - Swelling
  - Pain
  - Hematoma
  - Petechiae (red spots)
Contraindications

- Bleeding conditions
- Pacemakers
- Medications that prolong blood clotting
- Open growth plates (children)
- Pregnancy
- Acute injuries
Conclusions

- EWST is often a last resort treatment once other less expensive treatments have failed (ie. manual therapy, U/S)
- Best results when used in conjunction with exercise
  - Not a stand-alone modality!
- Positive findings for plantar fasciitis, patellar tendinopathy, and Achilles tendinopathy
- Mixed results for calcific tendinopathy of the shoulder and lateral epicondylitis
References


References


Images


2. Treatment Sites (slide 1): http://www.flamanphysiotherapy.com/services/radial-shockwave-therapy


4. Resolution of Calcifications (slide 5): http://www.kopi.ca/publisher/articleview/?PHXSESSID=8234bec68e07c0a23aef53421b6b0e67&/1/frmArticleID/227/

5. Gate Control Theory (slide 7): Adapted from lecture given by Dave Humphries in Introduction to Athletic Injuries (Kin 2236 @ Western University, 2013)