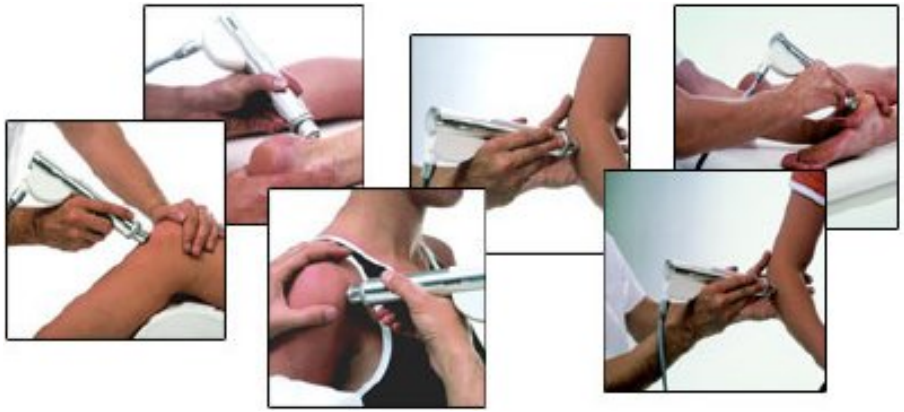
Extracorporeal Shock Wave Therapy (ESWT)



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What is it?

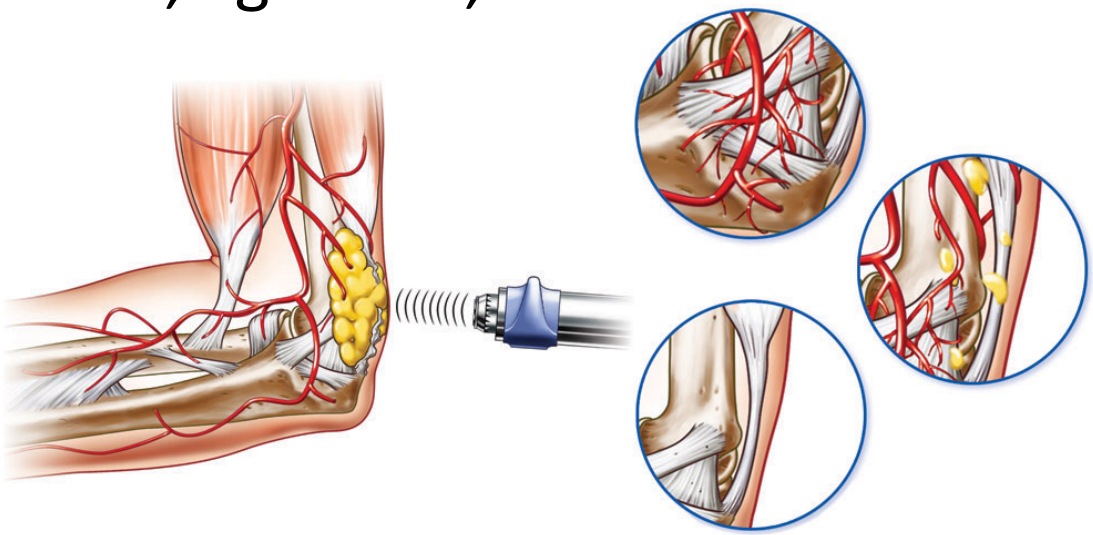
- Extracorporeal = outside body[1]
- Shockwave = intense, short energy wave travelling faster than speed of sound[1]
- Well-controlled mechanical insult to tissue[2]
- ESWT was established based on the principles of lithotripsy[1]
  - Technology that uses acoustic sound waves to break up kidney stones

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[1,3]
  - More blood = more oxygen = better healing
- Stimulates fibroblasts for connective tissue healing[1,3]
  - Tendon, ligament, fascia



How Does It Work?

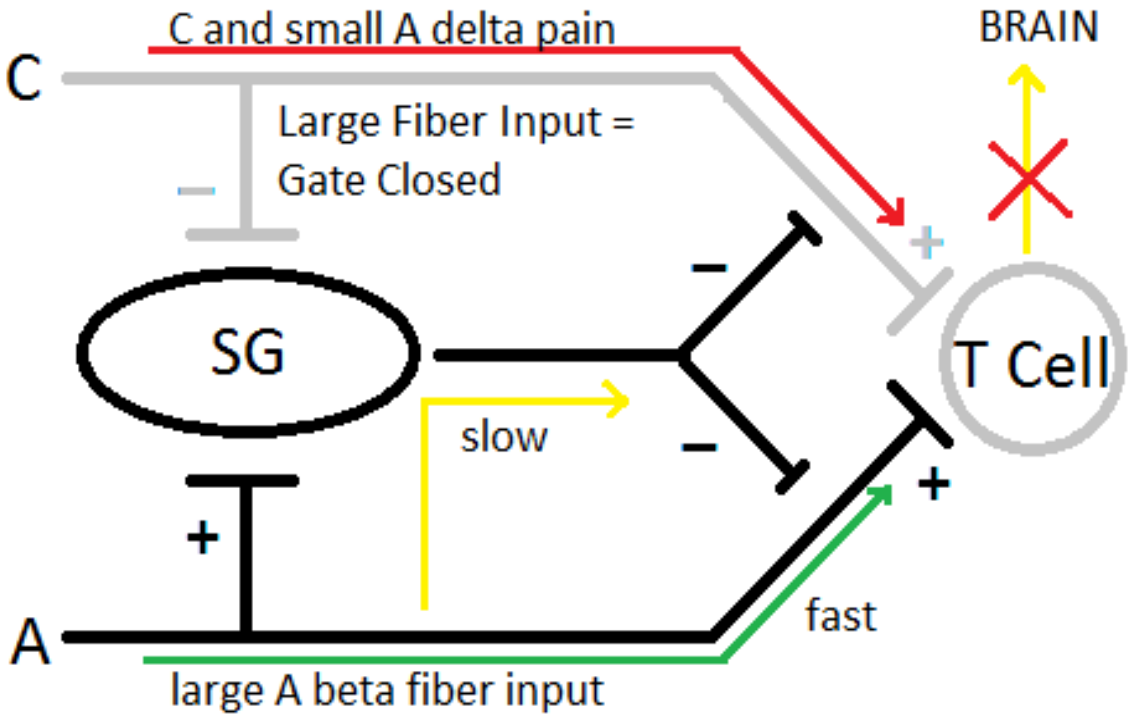
- Stimulates osteoblasts for healing and new bone production[1]
- Destroys calcifications[3,4]

How Does It Work?

- Decreases pain
  - Hyperstimulation anesthesia[1,4,5,6]
  - Reduces effects of Substance P neurotransmitter[3]
  - Gate-control theory[1,5,6]

Gate Control Theory

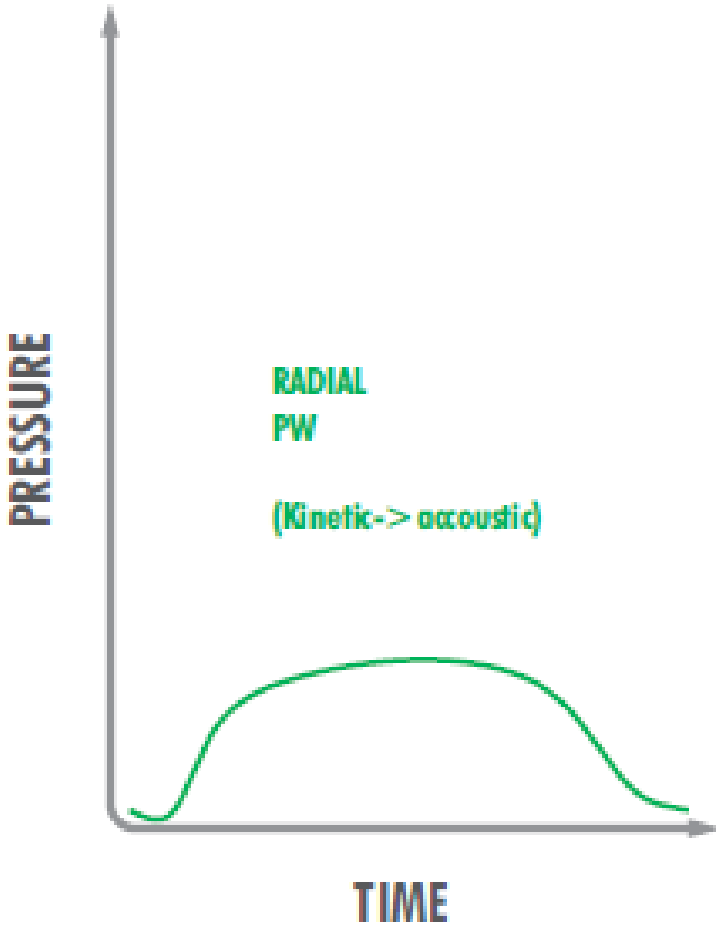
- Activation of A-Beta fibers inhibit transmission of pain signals to brain[5,6]



SG = Substantia Gelatinosa

Types[2]

- Electrohydraulic
- Electromagnetic
- Piezoelectric
- **Radial or Electro-pneumatic**
  - Requires no imaging or additional treatments such as ultrasound or local anesthetic[5]



(Graph from DJO Global, 2012)

Mechanics[5]

- 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[7]
  - Degree of energy transmitted to the tissues
    - 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 Dose[7]
  - 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[7]**
  - 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[8]**
  - 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 predictors[9]**
  - 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[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[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)

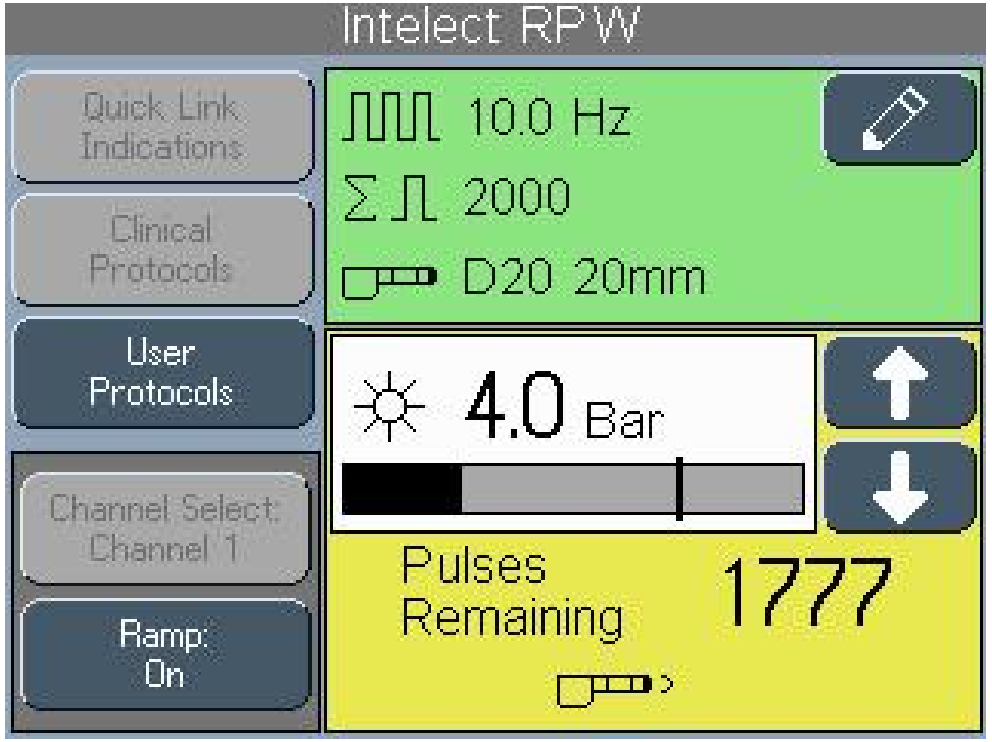
Evidence: Epicondylitis

- **Systematic review of the efficacy and safety of shock wave therapy for lateral elbow pain[11]**
  - 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[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[4]

- 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

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3. BTL. (2014). *Medical effects.* Retrieved from http://www.shockwavetherapy.eu/shockwave-therapy/menu-left/-/medical-effects/
4. Nolan, T.P. & Michlovitz, S.L. (2012). Alternative modalities for pain and tissue healing. *Modalities for therapeutic intervention, 5th ed* (389-402). Davis Company.
5. DJO Global. (2012). *Chattanooga RPW shockwave therapy clinical guide*. Retrieved from http://www.htherapy.co.za/user_images/shockwave/Intelect_RPW_Clinical_Guide_COMPLETE_LR.pdf

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7. Bannuru, R., Flavin, N., Vaysbrot, E., Harvey, E., McAlindon, T. (2014). High-energy extracorporeal shock-wave therapy for treating chronic calcific tendinitis of the shoulder. *Annals of Internal Medicine, 160*, 542-549.
8. Malay, D., Pressman, M., Assili, A., Kline, J., York, S., Buren, B., Heyman, E., Borowsky, P., LeMay, C. (2006). Extracorporeal shockwave therapy versus placebo for treatment of chronic proximal plantar fasciitis: results of a randomized, placebo-controlled, double-blinded, multicenter intervention trial. *Journal of Foot and Ankle Surgery, 45*(4), 196-210.
9. Chuckpaiwong, B., Berkson, E., Theodore, G. (2009). Extracorporeal shock wave for chronic proximal plantar fasciitis: 225 patients with results and outcome predictors. *Journal of Foot and Ankle Surgery, 48*(2), 148-155.

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10. Mani-Babu, S., Morrissey, D., Waugh, C., Screen, H., Barton, C. (2014). The effectiveness of extracorporeal shock wave therapy in lower limb tendinopathy: a systematic review. *American Journal of Sports Medicine.* DOI:10.1177/036354651453191 1
11. Buchbinder, R., Green, S., Youd, J., Assendelft, W., Barnsley, L., Smidt, N. (2006). Systematic review of the efficacy and safety of shock wave therapy for lateral elbow pain. *Journal of Rheumatology, 33*(7), 1351-1363.

Images

1. Chattanooga Shock Wave Machine (slide 1): http://www.physiosupplies.eu/media/catalog/product/cache/2/image/800x800/5e06319eda06f020e43594a9c230972d/2/_/2_4/intelect-rpw-shockwave-31.1386614068.jpg
2. Treatment Sites (slide 1): http://www.flamanphysiotherapy.com/services/radial-shockwave-therapy
3. Effects on Tissue (slide 4): http://www.shockwavetherapy.eu/shockwave-therapy/menu-left/-/medical-effects/
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)
6. Intelect RPW Screen (Slide 20): http://international.chattgroup.com/products/intelectr-rpw-shockwave