Shocking results? Evidence for the use of ESWT in soft tissue conditions

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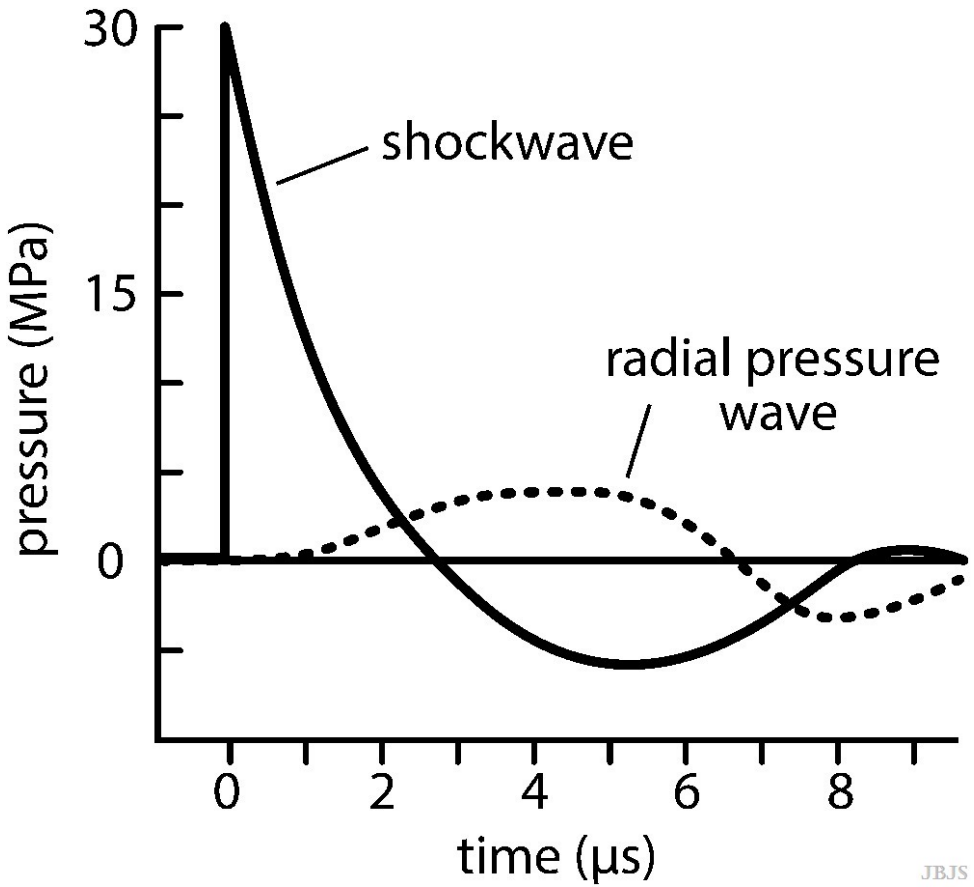
Shockwave Therapy Demonstration - https://www.youtube.com/watch?v=P5dibaAu7pQ

What is Extracorporeal Shockwave Therapy?

Mechanics

- Non-linear pressure waves / sound waves
- Short rise time, a shockwave = ~ 10 µs
- Positive & Negative phases
- Parameter – Energy Flux Density (EFD)
  - mJ/mm^2



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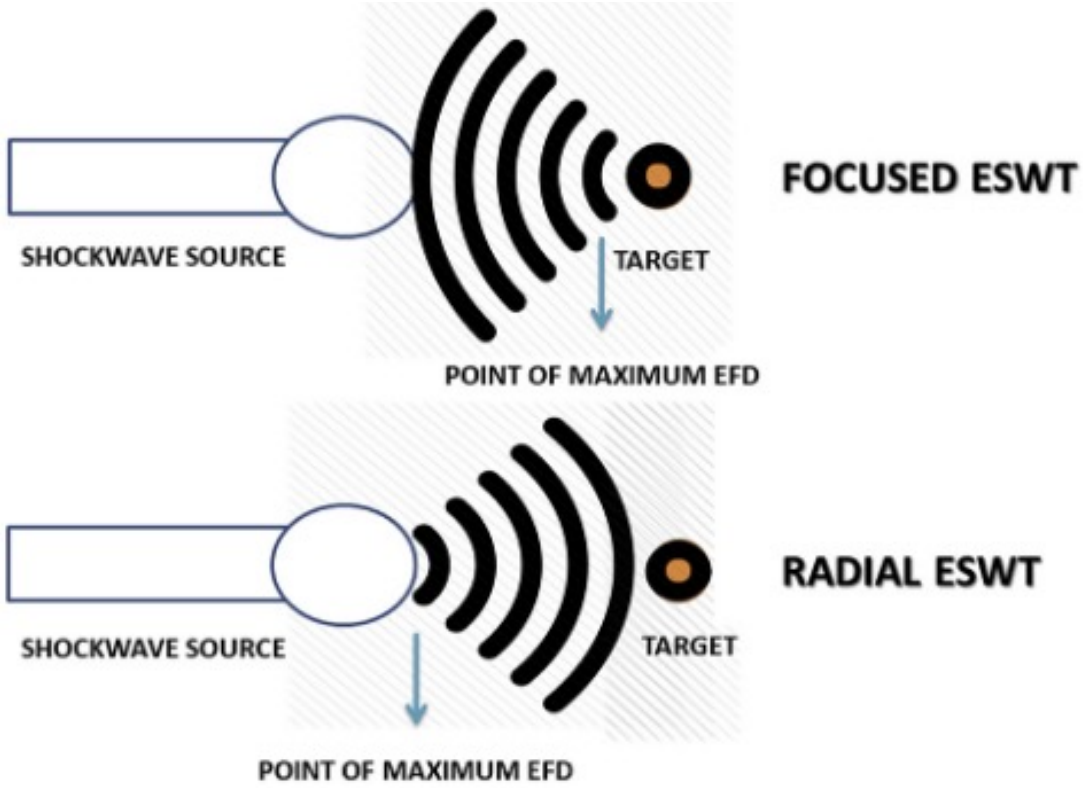
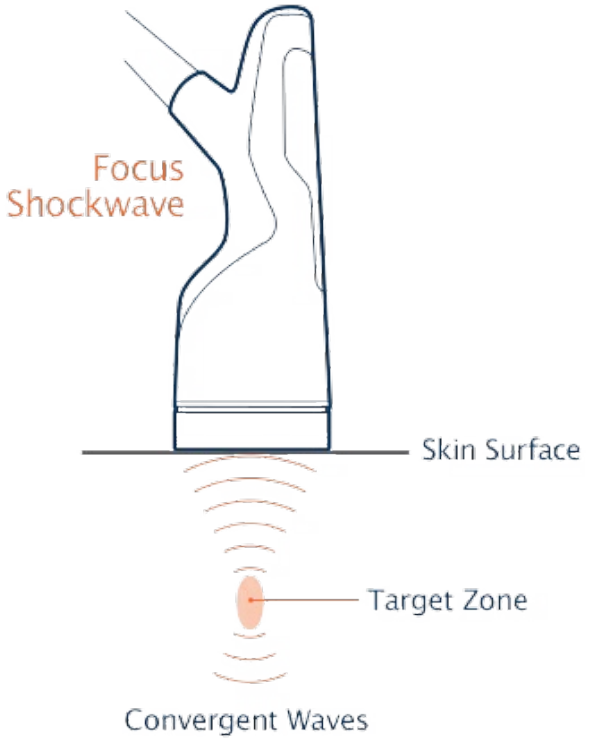
Moya et al. (2018)

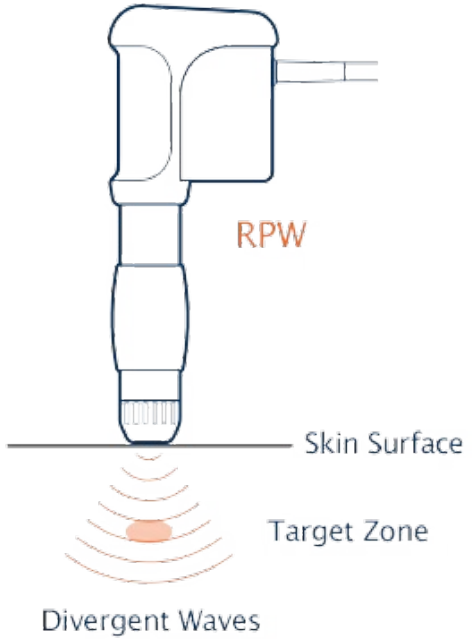
Simplicio et al. (2020), Moya et al. (2018)

What is Extracorporeal Shockwave Therapy?

2 Main types of ESWT







https://enovisrehab.com.au/focused-rpw-shockwave-therapy

Simplicio et al. (2020), Moya et al. (2018)

What is Extracorporeal Shockwave Therapy?

Parameters

- Energy Flux Density (EFD)
  - Low – <0.08 mJ/mm^2
  - Medium – 0.08-0.28 mJ/mm^2
  - High – 0.29-0.6 mJ/mm^2

Extracorporeal shockwave therapy treatment parameters

Parameter/Variable	Description or unit
Depth of focus	Dependent on targeted pathology
Shockwave device	Multiple types on market
Time interval between treatments	Typically 1 week
Total number of treatments	Typically 3–5
Local anesthesia	Recommend none
Image guidance	Recommend clinical focusing
Type of shockwave therapy	Focused, radial, combined
Total number of impulses per treatment	Pulses
Impulse frequency	Number of shockwaves applied per second
Maximal positive pressure	Maximal positive pressure reached during treatment, measured in bar
Energy flux density (EFD)	Amount of energy/surface area, measured in mJ/mm^2
Total energy dose (TED)	EFD x total number of impulses = TED

Rompe et al. (1998), van der Worp et al. (2013), Schmitz et al. (2015)

Tenforde et al. (2022)

What is Extracorporeal Shockwave Therapy?

Proposed mechanisms

- Tissue regeneration through mechanotransduction
  - Angiogenesis & vascularisation
  - Cell proliferation & protein biosynthesis
- Pain modulation
- Calcific deposit disruption

Simplicio et al. (2020)

Safety considerations

Typically < 0.5 mJ/mm^2 (van der Worp et al., 2013)

Absolute Contraindications

- Pregnant / trying to conceive
- Under 18 years of age
- Steroid injection into the area to be treated within the last 12 weeks
- Haemophilia / Clotting disorder / Risk of haemorrhage
- Cardiac pacemaker or another cardiac device
- Unstable heart condition
- Cancer
- Tumour at site of treatment
- Infection at site of treatment
- Acute inflammation in the treatment area
- Current thrombosis
- Epilepsy
- Taking certain type of antibiotics called Fluoroquinolones eg. ciprofloxacin (Cipro), gemifloxacin (Factive), levofloxacin (Levaquin), moxifloxacin (Avelox), norfloxacin (Noroxin), and ofloxacin (Floxin).
- Osteogenesis Imperfecta (a group of rare disorders affecting the connective tissue and characterized by extremely fragile bones that break or fracture easily)
- Powered implant – e.g., nerve stimulator

Wrightington, Wigan and Leigh Teaching Hospitals NHS Foundation Trust. Shockwave therapy (2021).

Safety considerations

Typically < 0.5 mJ/mm^2 (van der Worp et al., 2013)

You may not be allowed to have this treatment if you have one of the following conditions:

- Taking Anticoagulant medication, e.g., Warfarin or Rivaroxaban
- Taking anti-platelet medication, e.g., Aspirin, Clopidogrel
- Fracture near the treatment area
- Underlying Prosthetic joint
- Inflammatory Diseases (not during an inflammatory phase or flare up)
- Previous Achilles Tendon rupture (not until solid repair confirmed)
- Acute tendon / plantar fascia tear
- Increased sensitivity over area to be treated
- Decreased sensation over area to be treated

Potential side effects

- Bruising
- Pain
- Local swelling
- Skin reddening
- Numbness or altered sensation
- Skin “break”
- Tendon / fascia rupture

Wrightington, Wigan and Leigh Teaching Hospitals NHS Foundation Trust. Shockwave therapy (2021).

Summary of evidence

The effectiveness of extracorporeal shockwave therapy in common lower limb conditions: a systematic review including quantification of patient-rated pain reduction

Vasileios Korakakis,[1,2,3] Rodney Whiteley,[1] Alexander Tzavara,[2] Nikolaos Malliaropoulos[4,5,6]

Front Med (Lausanne). 2024 Jul 30;11:1394268. doi: 10.3389/fmed.2024.1394268

Efficacy and safety of extracorporeal shock wave therapy for upper limb tendonitis: a systematic review and meta-analysis of randomized controlled trials

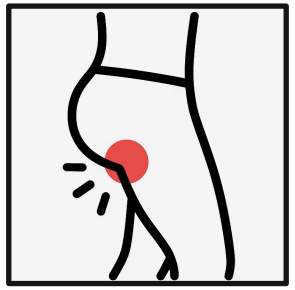
The effectiveness of shockwave therapy on patellar tendinopathy, Achilles tendinopathy, and plantar fasciitis: a systematic review and meta-analysis

Ravon Charles [1], Lei Fang [1 2 3], Ranran Zhu [1], Jinxiang Wang [1]

Xiong et al. (2024), Korakakis et al. (2018), Charles et al. (2023)

Common soft tissue conditions treated with ESWT

[Rotator cuff tendinopathy]



[Proximal hamstring tendinopathy]

[Achilles tendinopathy]

[Plantar fasciopathy]

Rotator cuff tendinopathy

Non-calcific

- No clear evidence favouring the use of ESWT (Speed, 2014)
- Conflicting evidence of improvement in pain and function over short / long term (Testa et al., 2020)

Calcific

- Constant evidence of effectiveness of **high dose** ESWT on pain and function (Speed, 2014)
- Low-energy ESWT improves function for calcific RC tendinopathy (Xiong et al., 2024)
- High-energy ESWT was more effective in relieving pain symptoms than low-energy in upper limb tendinopathies (Xiong et al., 2024)

Consider usage of ESWT in Calcific RC tendinopathy, not for those with non-calcific ones

What is the optimal dose of ESWT for calcific RC tendinopathy?

Parameters used?

Speed (2014), Testa et al. (2020), Xiong et al. (2024)

Calcific rotator cuff tendinopathy

Extracorporeal Shock Wave Therapy for the Treatment of Chronic Calcifying Tendonitis of the Rotator Cuff

A Randomized Controlled Trial

Effects of High-Energy Extracorporeal Shockwave Therapy on Pain, Functional Disability, Quality of Life, and Ultrasonographic Changes in Patients with Calcified Rotator Cuff Tendinopathy

Arooj Fatima ✉, Ashfaq Ahmad ✉, Syed Amir Gilani, Haider Darain, Shiza Kazmi, Kamran Hanif

Calcific rotator cuff tendinopathy

	Gerdesmeyer et al. 2003	Fatima et al. 2022
Design	Double-blinded, multi-centred RCT **High vs Low vs Sham** 144 patients, symptomatic, > 5mm Ca deposit	Parallel group, randomised trial **ESWT + physiotherapy vs Physiotherapy only** 42 patients, symptomatic, > 10 mm calcific changes
Intervention	2 sessions, 12-16 days interval Followed by 10 sessions of physiotherapy	12 sessions over 6 weeks Radial ESWT
Parameter	High - 1500 shocks @ 0.32 mJ/mm^2 Low – 6000 shocks @ 0.08 mJ/mm^2	2000 shocks @ 0.32 mJ/mm^2, 120 Hz, per session
Outcome measures	Constant and Murley Scale (CMS) Self-rated pain with VAS Presence of calcific deposits	Pain – NRS, Function – CMS QoL – Western Ontario Rotator Cuff index (WORC) Size of calcific deposits – Ultrasonographic result (US)
Findings	Both high and low-dose improve function 6-/12-month High-dose (vs low): superior **functional** improvement at 6 and 12-month **High-dose** (vs low and sham): superior improvement in **pain** and **calcific deposit size** at 3, 6, and 12-month	Both groups: sig improvement in all OMs **Pain** – ESWT superior at 6- and 12-week Function - no sig difference between groups **QoL** (WORC) – Sig post-treatment (6-week) for ESWT US – no sig difference between groups
Implication / limitation	Higher incidence of mod-severe pain in high dose group High energy ESWT appears to be more effective Long term improvement when combined with physio Did not specify type of ESWT used	Authors concluded ESWT produce sig improvement in function and size of calcific deposit – questionable Short-term pain and QoL improvement with ESWT

Proximal hamstring tendinopathy

Shockwave Therapy for the Treatment of Chronic Proximal Hamstring Tendinopathy in Professional Athletes

Angelo Cacchio, MD ✉, Jan D. Rompe, MD, [...], and Fosco De Paulis, MD +3 View all authors and affiliations

- RCT, 40 professional athlete (18-27y) with chronic PHT
- ESWT vs multi-modal management
- Outcome measure: **Pain** – VAS + **Disability** – Nirschl phase rating scale (NPRS)
- Findings:
  - R-ESWT produce superior results on pain and function at 3 and 12-month
  - 80% of ESWT group RTS (previous level) at 3-month, vs 0%
- Limitations:
  - Generic exercise programme of insufficient time
  - Small sample size
  - May not be representative of wider (non-athletic) population

Cacchio et al. (2011)

Consider using R-ESWT with athletic population with PHT

4x weekly session of R-ESWT 2500 shocks @ 0.18 mJ/mm^2 delivered at 10 Hz

Uncertainty regarding if ESWT superior to individualised physiotherapy intervention

Achilles tendinopathy

> Sports Med Open. 2022 May 13;8(1):68. doi: 10.1186/s40798-022-00456-5.

Extracorporeal Shockwave Therapy for Mid-portion and Insertional Achilles Tendinopathy: A Systematic Review of Randomized Controlled Trials

Marc A Paantjens [1] [2], Pieter H Helmhout [3], Frank J G Backx [4], Faridi S van Etten-Jamaludin [5], Eric W P Bakker [6]

Achilles tendinopathy

	Mid-portion Achilles Tendinopathy	Insertional Achilles Tendinopathy
Inc. studies	3 RCTs	4 RCTs
Interventions	1) ESWT vs eccentric loading vs wait-and see 2) ESWT + eccentric loading vs Eccentric loading alone 3) ESWT + eccentric + stretch vs Eccentric + stretch	1) Eccentric + ESWT vs Eccentric + sham-ESWT 2) Standard care + ESWT vs Standard care + CHELT 3) Standard care + ESWT vs standard care + sham-ESWT 4) ESWT vs eccentric loading programme
Parameters	1) R-ESWT – 0.1mJ/mm^2, 2000 pulses, 8 Hz, weekly x 3 2) Same as (1), performed after 4 weeks of ecc. training 3) Same as (1) but 4 sessions + exercises	1) R-ESWT – 0.08-0.12 mJ/mm^2, 2-3000 pulses, 7-10 Hz. 3x 2) F-ESWT - 0.05-0.07 mJ/mm^2, 1600 pulses, 3-4d interval, 3x 3) R-ESWT – 0.12-0.16 mJ/mm^2, 2000 pulses, 8-12 Hz, 4x 4) R-ESWT – 0.12 mJ/mm^2, 2000 pulses, 8 Hz, 3x
Outcome measures	VISA-A (Victorian Institute of Sport Assessment-Achilles) Pain NRS / VAS Likert scale for self-perceived recovery	VISA-A Pain VAS / NRS Likert / Roles and Maudsley for self-perceived recovery
Findings	ESWT as monotherapy – non-significant effect on VISA-A ESWT + standard care superior to standard care alone or sham-ESWT	Conflicting results from 2 studies regarding effect on VISA-A with the use of ESWT, The other 2 showed no significant difference between ESWT and sham-ESWT
Limitation	Limited studies exploring effects of ESWT as monotherapy for mid-portion AT or insertional AT Might not be applicable to patients suffering from both mid-AT and ins-AT due to study design No optimal parameter determined for insertional AT	

Achilles tendinopathy

- Addition of ESWT to tendon loading programme for mid-portion Achilles tendinopathy produce clinically significant improvement in VISA-A
- Usage of ESWT in the management of insertional Achilles tendinopathy is not supported
- Effective programmes uses the following parameter:
  - R-ESWT – 0.1mJ/mm^2, 2000 pulses, 8 Hz
  - 1x / week, 3-4 sessions

Use ESWT as an adjunct but not a monotherapy for the management of mid-portion AT

Usage of EWST for ins-AT not supported by current evidence

3-4 weekly session of R-ESWT 2000 shocks @ 0.1 mJ/mm^2 delivered at 8 Hz

Paantjens et al. (2022)

Plantar fasciopathy

Extracorporeal shock wave therapy on pain and foot functions in subjects with chronic plantar fasciitis: systematic review of randomized controlled trials

Haimanot Melese, Abayneh Alamer, Kefale Getie, Fetene Nigussie & Sileshi Ayhualem

Plantar fasciopathy

Extracorporeal shock wave therapy on pain and foot functions in subjects with chronic plantar fasciitis: systematic review of randomized controlled trials. Melese et al. 2021	
Number of studies	11 RCTs, 658 participants
Interventions	ESWT vs comparisons (injections/taping/orthotics/laser therapy/dry needling/home exercises) 15 – 30 mins per session, 1-5 times per week, for 3-12 week period
Parameters	F-ESWT / R-ESWT 0.09 – 0.3 mJ/mm^2 , 1500-3000 pulses, 2-15 Hz, 2-5 sessions / 2-8 weeks
Outcome measures	Pain VAS Foot function index (FFI) Roles and Maudsley scale (RM) for foot pain American Orthopedic Foot and Ankle Association Score (AOFAS) for functional and QoL
Findings	ESWT effective in improving pain and foot function ESWT effective in reducing plantar fascia thickness
Limitation	Lacks meta-analysis No optimal / suggested parameters

Plantar fasciopathy

Comparative effectiveness of treatment options for plantar heel pain: a systematic review with network meta-analysis FREE

Opeyemi O Babatunde [1], Amardeep Legha [1, 2], Chris Littlewood [1], Linda S Chesterton [1], Martin J Thomas [1, 3], Hylton B Menz [1, 4], Danielle van der Windt [1, 2], Edward Roddy [1, 3]

- ESWT combined with orthoses more effective than other treatments in pain reduction
- ESWT consistently ranked in the top 3 treatments most likely to improve functional ability across short to long term (vs. exercise, steroid injection)

Management of plantar heel pain: a best practice guide informed by a systematic review, expert clinical reasoning and patient values

Dylan Morrissey [1,2,✉], Matthew Cotchett [3], Ahmed Said J'Bari [1], Trevor Prior [1], Ian B Griffiths [1], Michael Skovdal Rathleff [4], Halime Gulle [1], Bill Vicenzino [5], Christian J Barton [3,6]

- Significant and positive effect for pain in short and long term for R-ESWT
- Moderate evidence for the efficacy of F-ESWT for pain and function in the short-term
- ESWT recommended when core approach failed

Melese et al. (2021), Babatunde et al. (2018), Morrissey et al. (2021)

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

Usage of ESWT supported by guidelines / reviews

Trial of ESWT if core approach failed

R-ESWT used in high quality studies mentioned:
0.16 mJ/mm²
8Hz
2000 impulses
Once a week, 2-3 sessions
(Ibrahim et al. 2016, Gerdesmeyer et al. 2008)

Summary

- Evidence supports the use of ESWT in Plantar fasciopathy, mid-portion Achilles tendinopathy, Proximal hamstring tendinopathy, and Calcific rotator cuff tendinopathy
  - Level of evidence varies
  - Heterogeneity among studies
- No established ESWT treatment protocols for these conditions

Implications for clinical practice

- Clinical decision making
- Patient population – chronic, tendinopathy, failed conservative Rx
- Communicate – potential risks and side effects
- Not used alone as a sole treatment modality
- Consider activity / loading
- Don’t forget to address other factors / impairments

Thank you

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