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INTRODUCTION TO SHOCKWAVE THERAPY

eBook



CONTENTS

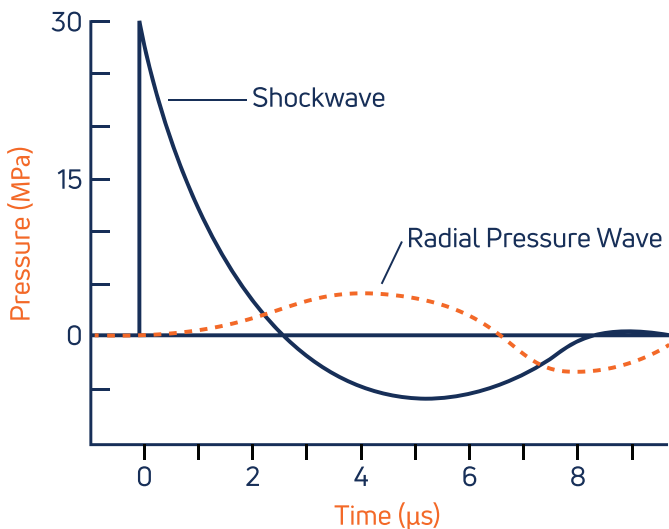
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WHAT IS EXTRACORPEAL SHOCKWAVE THERAPY (ESWT)?

Extracorporeal shockwave therapy (ESWT) was first introduced into clinical practice in 1982 for the non-invasive treatment of kidney stones, via a process referred to as “lithotripsy” which applies a high intensity focused sound wave to the kidney stone to help break it up. The success of these procedures provided the basis for therapeutic ESWT treatments which can be used to treat various soft tissue dysfunctions as well as upper and lower extremity tendinopathies.¹

Therapeutic shockwave devices impart energy levels (Energy Flux Density) that are significantly lower than lithotripsy devices, but are 1000 x more powerful than standard therapeutic ultrasound waves.²

The two therapeutic ESWT categories which Chattanooga carries include the Focused Shock Wave (FSW) and Radial Pressure Wave (RPW) units. While they produce different waveforms (see below) and have different penetration abilities, they both can impart energy to various tissue types.¹



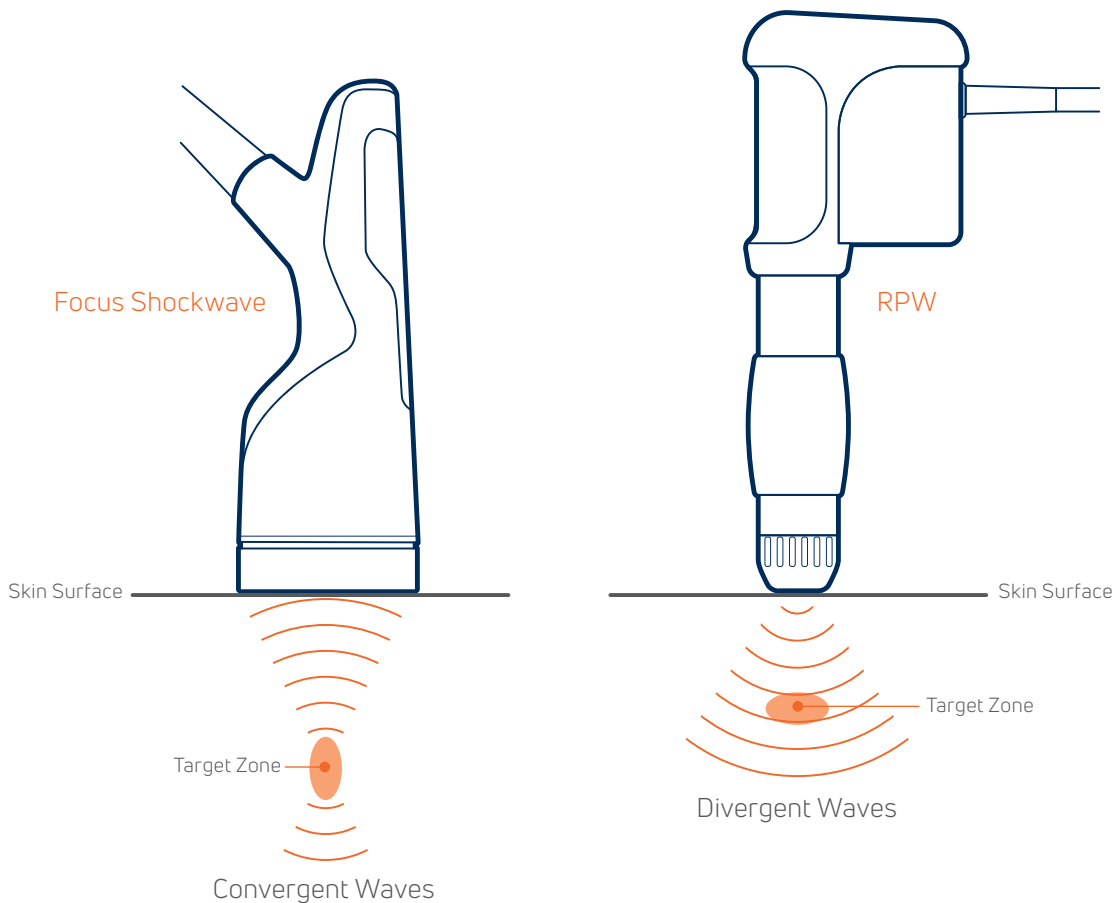
How RPW and FSW differ:

The two devices' unique wave forms impact a variety of factors regarding how these devices transfer energy into tissue. Early ESWT research centered around FSW technology, but over recent years RPW technology has received more attention.

Chattanooga's FSW generates sound waves via an electromagnetic hand piece with a built-in water buffer, while the RPW utilizes a pneumatic/ ballistic design. These differences impact the waveforms they produce.^{13,14}

Focused shockwaves have higher peak energy and generate maximal force at a selected depth. FSW devices can reach tissue at depths of up to 12.5 cm.¹⁴

Radial pressure wave devices generate their maximal energy on the skin, which then dissipates as it travels to depth.³ Maximal treatment depth is 6.0 cm with RPW units. Energy levels at depth are dictated by the settings on the machine and the applicator used. The energy being delivered at depth is over a broader area than what is imparted by FSW devices (see below).



Mechanism:

The exact mechanism of ESWT treatment is unknown¹, however, there are a variety of proposed mechanisms which include: promoting neovascularization at the tendon-bone junction⁴, stimulating proliferation of tenocytes⁵ and stimulation of collagen synthesis via amplification of growth factor.⁵⁻⁸

In addition to these proposed mechanisms regarding tissue repair, ESWT may reduce pain through a variety of mechanisms that surround the gate-control theory of pain transmission. These include: hyperstimulation of nociceptors, altered pain receptor neurotransmission, and by increasing local pain-inhibiting substances.⁹⁻¹²

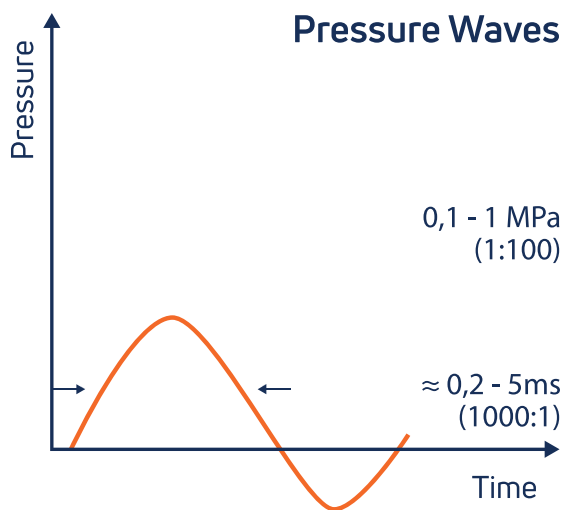
Treatment:

Treatment is performed directly on the skin, but is non-invasive. The time allotted for a specific treatment will depend on the area and depth of the tissue being treated. This will normally fall within 2-4 minutes per area treated.

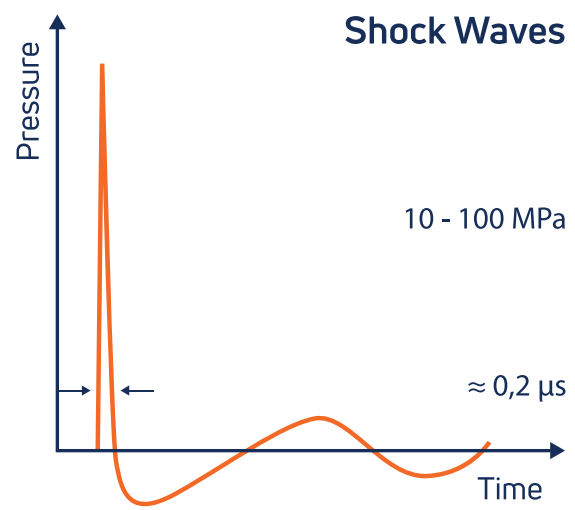
Treatment frequency is normally 3-4 sessions with FSW units (1 x week) and 5-6 sessions with RPW units (treatments spaced out 5-7 days). The frequency of RPW treatments can change based on the energy levels that are utilized.

Types of ESWT

- Radial Pressure Waves vs Focus Shock Waves
- Two technologies & two ways to generate high energy waves to tissue.



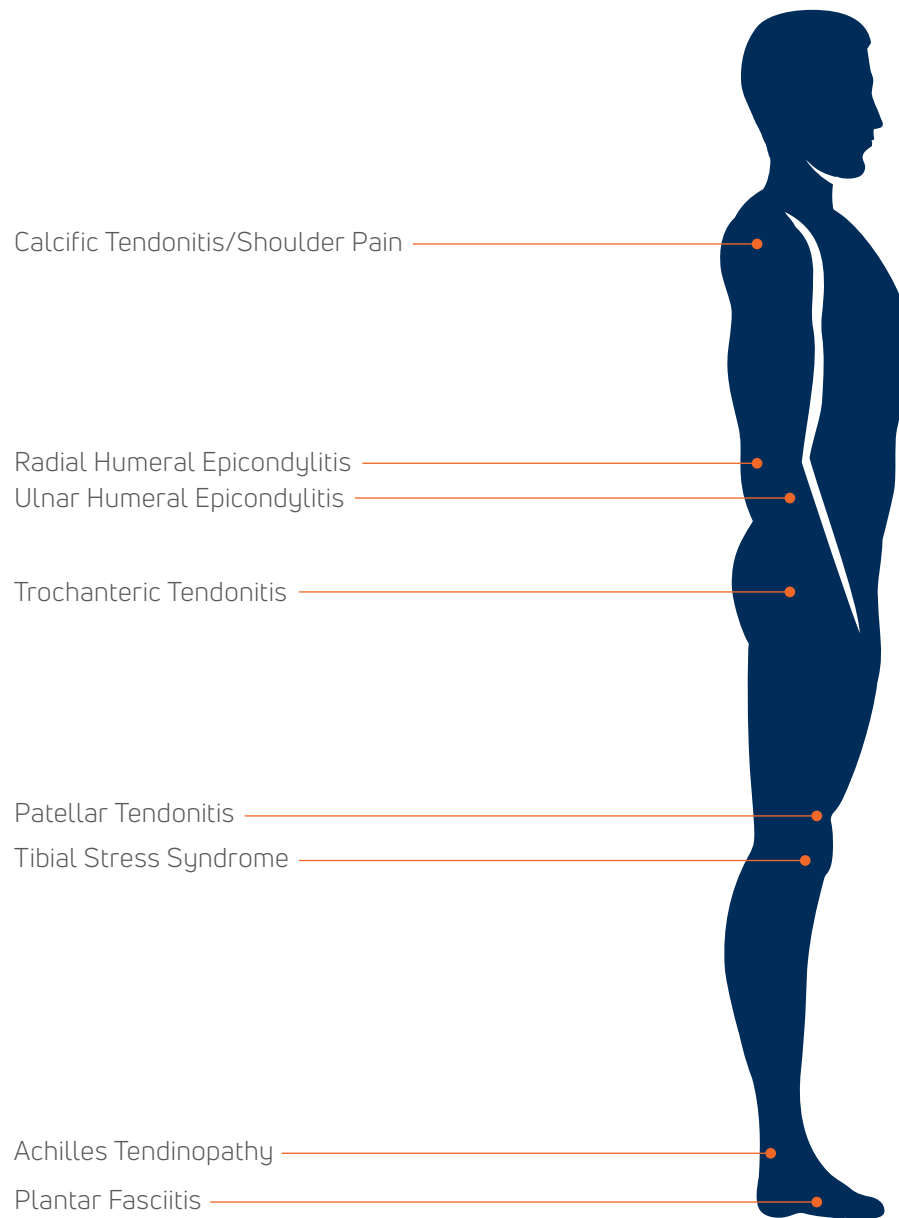
Radial pressure waves
Lower energy density



Focused shock waves
Higher energy density

Applications

Studied for: calcific tendonitis, chronic scars, tendinosis, myofascial problems



RESEARCH

Effectiveness of Focused Shockwave Therapy versus Radial Shockwave Therapy for Noncalcific Rotator Cuff Tendinopathies: A Randomized Clinical Trial

Scientific Literature Overview

RPW - Therapeutic

Authors Li C, Li Z, Shi L, Wang P, Gao F, Sun W.

Published Li C, Li Z, Shi L, Wang P, Gao F, Sun W.

Date Jan 2021

Place of origin Department of Orthopedics, Peking University China-Japan Friendship School of Clinical Medicine, 2 Yinghuadong Road, Chaoyang District, Beijing 100029, China

Background The superiority of focused shockwave therapy (F-SWT) versus radial shockwave therapy (R-SWT) for treating noncalcific rotator cuff tendinopathies remains controversial.

Objective This study is aimed at comparing the effectiveness of F-SWT versus R-SWT for the management of noncalcific rotator cuff tendinopathies

Tested products

- Dornier Aries FSW device
- ZhuHai Hema RPW device with an R15 applicator

Study design & methods

Randomised Clinical Trial

Subjects:

- A total of 46 patients affected by noncalcific rotator cuff tendinopathies were randomly divided into 2 groups of 23 individuals.
- Patients in group A received 4 sessions of F-SWT, while patients in group B were treated by 4 sessions of R-SWT.

Method

- In each session, mean energy flux density (EFD) for F-SW 3000 shots was 0.09 ± 0.018 mJ/mm² with 5.1 ± 0.5 Hz, while average pressure for R-SW 3000 shots was 4.0 ± 0.35 bar with 3.2 ± 0.0 Hz.

Outcome measures

- Pain level and shoulder function were assessed with the numerical rating scale (NRS) and Constant-Murley Scale (CMS). The primary endpoint was the change in the mean NRS pain score from baseline to 24 weeks after the intervention.
- Secondary endpoints were changes in the mean NRS pain scores at all other follow-up points, changes in the mean CMS scores, and radiographic findings.

Results	There were no significant differences between the two groups regarding NRS pain score and CMS score within 24 weeks after intervention (all $p > 0.05$). However, F-SWT resulted in significantly lower NRS compared with R-SWT at 24 weeks and 48 weeks after treatment (2.7 ± 1.0 vs. 4.5 ± 1.2 and 1.4 ± 1.0 vs. 3.0 ± 0.8 , respectively, all $p < 0.001$). Similar results were found in CMS changes and radiographic findings.
Conclusion	Both F-SWT and R-SWT are effective in patients with noncalcific rotator cuff tendinopathy. F-SWT proved to be significantly superior to R-SWT at long-term follow-up (more than 24 weeks)
Key message	Both Focused shockwave and radial pressure are effective for pain relief in rotator cuff tendinopathies in the short term
Pubmed	https://pubmed.ncbi.nlm.nih.gov/33506031/

Short- and Intermediate-Term Results of Extracorporeal Shockwave Therapy for Noninsertional Achilles Tendinopathy.

Scientific Literature Overview

RPW - Therapeutic

Authors	Abdelkader NA, Helmy MNK, Fayaz NA, Saweeres ESB.
Published	Foot Ankle Int. 15. Epub ahead of print.
Date	Jan 2021
Place of origin	Faculty of Physical Therapy, Cairo University, Giza, Egypt.
Background	Earlier randomized controlled trials (RCTs) reported only midterm (3-4 months) results of extracorporeal shockwave therapy (ESWT) as a treatment for non insertional Achilles tendinopathy (NAT).
Objective	This study compared the effectiveness of an eccentric loading program followed by stretching exercises combined with ESWT (study group) or sham ESWT (control group) for treating chronic NAT in both the short and long term.
Tested products	Storz Duolith SD1 Radial Pressure Wave device

Study design & methods

Double blind randomised control trial

Subjects:

- Twenty-two men and 28 women aged 18 to 40 years were allocated into 2 equally matched groups.

ESWT protocol

- All patients in the study group received 4 sessions of shockwave at weekly intervals using an ESWT machine.
- Each session of ESWT consisted of 2000 pulses with 3 bar pressure (equals an energy flux density of 0.1 mJ/mm²) and frequency of 8 pulses/s.
- The patients in both groups were instructed to perform eccentric heel drops for 3 sets of 15 repetitions (with a 1-minute rest between sets), twice a day (morning and evening), 7 d/wk, for 4 weeks

Outcome measures

- Function and pain were assessed at baseline, 1 month, and 16 months using the Victorian Institute of Sport Assessment-Achilles questionnaire (VISA-A) and visual analog scale (VAS), respectively.
- Mixed-design analysis of variance and nonparametric statistics were performed

Results

- Both groups significantly improved posttreatment (VISA-A: 85 ± 6.2 vs 53.4 ± 7.7 and VAS: 1 ± 2 vs 7 ± 2, respectively).
- At the 16-month follow-up, outcome scores declined slightly but significantly in the study group (VISA-A: 80 ± 5.3; VAS: 3 ± 2) and improved in the control group (VISA-A: 67 ± 5.6; VAS: 5 ± 1).
- Both groups were significantly better than baseline.
- At both time points, the study group had significantly superior scores (statistically and clinically) than the control group (P = .0001)

Conclusion

Combining calf eccentric loading with stretching exercises resulted in significant improvements in the pain and functional scores in patients with NAT. Adding ESWT to this combined protocol resulted in significantly greater improvements in both the short and long term

Key message

Combining Radial Pressure Wave and eccentric exercise provides significant improvement in pain and function for non-insertional Achilles tendinopathy

Pubmed

<https://pubmed.ncbi.nlm.nih.gov/33451253/>

Effectiveness of Radial Extracorporeal Shock-Wave Therapy Versus Ultrasound-Guided Low-Dose Intra-Articular Steroid Injection in Improving Shoulder Pain, Function, and Range of Motion in Diabetic Patients With Shoulder Adhesive Capsulitis

Scientific Literature Overview

RPW - Therapeutic

Authors	El Naggar TEDM, Maaty AIE, Mohamed AE.
Published	J Shoulder Elbow Surg. 2020 Jul;29(7):1300-1309.
Date	Jul 2020
Place of origin	Department of Physical Medicine, Rheumatology and Rehabilitation, Faculty of Medicine, Suez Canal University, Ismailia, Egypt.
Objective	To compare the efficacy of radial extracorporeal shock-wave therapy (rESWT) vs. an ultrasound-guided low-dose intra-articular steroid injection in pain reduction and functional improvement in diabetic patients with shoulder adhesive capsulitis (AC).
Tested products	BTL-5000
Study design & methods	<p>Double blind randomised control trial</p> <p>Subjects:</p> <ul style="list-style-type: none">• 103 diabetic patients with shoulder AC <p>Methods:</p> <p>Subjects were randomised to receive 4 sessions of either</p> <ul style="list-style-type: none">• rESWT group (n = 52): received 4 sessions of rESWT, 1 week apart, 2000 pulses per session, 3.5 bar, 10Hz.• Steroid group (n = 51): received a single ultrasound-guided low-dose intra-articular steroid injection of 20 mg of triamcinolone acetonide. <p>RPW protocol:</p> <ul style="list-style-type: none">• The shock waves were delivered to 2 separate locations.• The first 1000 impulses were applied in an anterior-to-posterior direction at the anterior shoulder joint, and the upper margin of the treatment zone was about 1 fingerbreadth lateral to the coracoid process.• The remaining 1000 impulses, of the total 2000 impulses per session, were applied in a posterior-to-anterior direction on the posterior side of the shoulder joint located beneath the lateral border of the scapular spine. <p>Outcomes:</p> <ul style="list-style-type: none">• The primary outcome measure was functional improvement evaluated by the Quick Disabilities of the Arm, Shoulder and Hand (qDASH) score.• Secondary outcome measures were pain evaluated by the visual analog scale score and shoulder range of motion (ROM). <p>An assessor who was blinded to treatment assignment assessed both groups at baseline and at 4, 8, and 12 weeks thereafter.</p>

- Results**
- By 12 weeks, both groups demonstrated a significant reduction in the qDASH score and pain severity, as well as improvement in ROM.
 - However, significantly improved function (qDASH score, 40.4 ± 12.9 vs. 50.5 ± 13.3 ; $P < .001$) and shoulder pain reduction (visual analog scale score, 1.6 ± 1.2 vs. 2.8 ± 1.7 ; $P < .001$) were found in the rESWT group vs. the steroid group.
 - Similar improvement in shoulder ROM was observed in both groups.

Conclusion At short-term follow-up, rESWT was superior to a low-dose intra-articular steroid injection in improving function and pain in diabetic patients with shoulder AC. Therefore, rESWT might be considered a safe alternative to steroid injections in diabetic patients with shoulder AC.

Key message Significantly better improvement of pain & function with 4 sessions of RPW than with a single corticosteroid injection.

Pubmed <https://pubmed.ncbi.nlm.nih.gov/32553435/>

Effect of Radial Extracorporeal Shock Wave Therapy on Pain Intensity, Functional Efficiency, and Postural Control Parameters in Patients with Chronic Low Back Pain: A Randomized Clinical Trial.

Scientific Literature Overview

RPW - Therapeutic

Authors Walewicz K, Taradaj J, Dobrzyński M, Sopol M, Kowal M, Ptaszkowski K, Dymarek R.

Published J Clin Med. 2020 Feb 19;9(2).

Date Feb 2020

Place of origin Faculty of Physiotherapy, Opole Medical School, 45-060 Opole, Poland.

Background Low back pain (LBP) is the leading cause of disability worldwide, placing a significant economic burden on healthcare systems. Radial extracorporeal shock wave therapy (rESWT) is useful in the rehabilitation of orthopedic diseases; however, there is still limited evidence for patients with LBP.

Objective The aim of this study was to assess the effect of rESWT on pain level, functional efficiency, and parameters of postural control in patients with LBP.

Tested products Storz Cellactor SC1

Study design & methods

Randomised placebo controlled trial.

Subjects:

- 40 patients with discopathy of the L5–S1 spine segment (MRI diagnosed) with chronic pain lasting more than 3 months.

Methods:

Subjects were randomised to receive 4 sessions of either

- rESWT group (n = 52): received 4 sessions of rESWT, 1 week apart, 2000 pulses per session, 3.5 bar, 10Hz.
- Steroid group (n = 51): received a single ultrasound-guided low-dose intra-articular steroid injection of 20 mg of triamcinolone acetonide.

RPW protocol:

- The shock waves were delivered to 2 separate locations.
- The first 1000 impulses were applied in an anterior-to-posterior direction at the anterior shoulder joint, and the upper margin of the treatment zone was about 1 fingerbreadth lateral to the coracoid process.
- The remaining 1000 impulses, of the total 2000 impulses per session, were applied in a posterior-to-anterior direction on the posterior side of the shoulder joint located beneath the lateral border of the scapular spine.

Outcomes:

- The primary outcome measure was functional improvement evaluated by the Quick Disabilities of the Arm, Shoulder and Hand (qDASH) score.
- Secondary outcome measures were pain evaluated by the visual analog scale score and shoulder range of motion (ROM).

An assessor who was blinded to treatment assignment assessed both groups at baseline and at 4, 8, and 12 weeks thereafter.

Results

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- Similar improvement in shoulder ROM was observed in both groups.

Conclusion

At short-term follow-up, rESWT was superior to a low-dose intra-articular steroid injection in improving function and pain in diabetic patients with shoulder AC. Therefore, rESWT might be considered a safe alternative to steroid injections in diabetic patients with shoulder AC.

Key message

Significantly better improvement of pain & function with 4 sessions of RPW than with a single corticosteroid injection.

Pubmed

<https://pubmed.ncbi.nlm.nih.gov/32553435/>

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Objective The aim of this study was to assess the effect of rESWT on pain level, functional efficiency, and parameters of postural control in patients with LBP.

Tested products Storz Cellactor SC1

Study design & methods **Randomised placebo controlled trial.**

Subjects:

- 40 patients with discopathy of the L5–S1 spine segment (MRI diagnosed) with chronic pain lasting more than 3 months.

Methods:

Patients were randomised to receive real or sham rESWT

- rESWT group received 10 sessions (2x/week) of 2000 pulses, 2.5 bars, 5 Hz, 7 min (D-Actor D20 transmitter)
- Sham group received 10 sham treatment sessions

Both groups received conventional physiotherapy, including core stability exercises.

Outcomes:

- Pain: Laitinen Pain Scale (LPS, 0-16 points)
- Function: Roland-Morris Questionnaire (RMQ)
- ROM: Original Schober Test (OST)
- Stabilometric platform for the assessment of postural sway, including total sway path (TSP)

Subjects were assessed before and after the rESWT and at 1- and 3-month follow-up

- Results**
- Both groups showed improvement of all parameters.
 - In the rESWT group the improvement was more pronounced than in the control group.
 - In the rESWT group, the improvements increased over time - at the 3m follow-up there was a significant difference between rESWT group and control group.

Conclusion The rESWT had a significant effect on the reduction of pain and the improvement of functional condition compared to a conventional physiotherapy program. Also, rESWT with core stability exercises led to significant improvements in postural sway compared with conventional physiotherapy in patients with LBP.

Key message rESWT added to conventional PT and core stability exercises provides significant improvement of pain, ROM, function and postural sway, especially at long term (3m) follow-up compared to sham placebo treatment.

Pubmed <https://pubmed.ncbi.nlm.nih.gov/32092987/>

Efficacy of Extracorporeal Shock Wave Therapy for Achilles Tendinopathy: A Meta-analysis.

Scientific Literature Overview

RPW - Therapeutic

Authors Fan Y, Feng Z, Cao J, Fu W.

Published Orthop J Sports Med. 27;8

Date Feb 2020

Place of origin West China School of Medicine, Sichuan University, Chengdu, Sichuan, China

Background Achilles tendinopathy is a frequent sports injury, and extracorporeal shock wave therapy (ESWT) has been proposed as a treatment.

Objective To compare outcomes between ESWT and other nonsurgical intervention (including sham shock wave therapy) in Achilles tendinopathy patients.

Tested products Focused and Radial Pressure Wave devices

Study design & methods

Systematic review and meta analysis; Level of evidence, 2.

Methods:

- A total of 766 related studies were identified: Duplicates were removed.
- After we reviewed titles, abstracts, and full text of the remaining 467 studies, 8 were included; these involved 442 cases of midportion Achilles tendinopathy, of which half received ESWT and the other half received a comparison treatment, including sham ESWT (2 studies), eccentric loading (4 studies), traditional nonoperative measures (2 studies), or wait and-see
- 5 randomized controlled trials and 3 case-control studies published between 2005 and 2018.
- We analyzed pain scores and other outcomes that were reported in more than 3 of the 8 studies.

Inclusion criteria

- A controlled design, randomized or not
- Involve patients with Achilles tendinopathy of any age treated with ESWT or, as the control arm, traditional nonsurgical treatments or sham ESWT
- Evaluate pain and functional outcomes using any accepted instrument
- Be written in English.

Exclusion criteria

- Involved animals or cadavers
- Were reviews or case reports
- Did not report treatment or clinical outcomes.

Results

- ESWT was associated with significantly better scores than comparison therapy on the visual analog scale for pain ($P < .01$), American Orthopaedic Foot & Ankle Society scale ($P = .01$), Likert scale for satisfaction ($P = .03$), Roles and Maudsley scale ($P < .01$), Victorian Institute of Sports Assessment - Achilles questionnaire ($P < .01$), and numerical rating scale ($P = .02$).
- The 2 patient groups did not differ significantly in tenderness ($P = .34$) or pain threshold ($P = .24$).
- Subgroup analysis showed that ESWT led to better VAS pain scores than comparison treatments at both low-energy level (0.06-0.11 mJ/mm²) and medium-energy level (0.12-0.25 mJ/mm²) and at both shorter (<6 months) and longer (≥ 6 months) follow-up.

Conclusion

ESWT improves pain and functional outcomes in patients with Achilles tendinopathy. Further research is needed to determine the optimal energy level.

Opinion

Search keywords and subject headings, included: extracorporeal shockwave therapy (extracorporeal shockwave therapies, shockwave therapies, extracorporeal, shockwave therapy, extracorporeal, therapy, extracorporeal shockwave, shock wave therapy, shock wave therapies, therapy, shock wave, extracorporeal shock wave therapy, extracorporeal high intensity focused ultrasound therapy, extracorporeal high intensity focused ultrasound therapy, HIFU therapy, HIFU therapies, therapy, high-intensity focused ultrasound therapy, high intensity focused ultrasound therapy

More studies with less bias to focused shockwave may have been found if the search keywords included Radial Pressure Wave and Extracorporeal Activation Therapy.

Key message

There appears to be good evidence to support the use of ESWT in the management of Achilles tendinopathies

Pubmed

<https://pubmed.ncbi.nlm.nih.gov/33283015/>

*Data on file.

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djoglobal.com/shockwave

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