

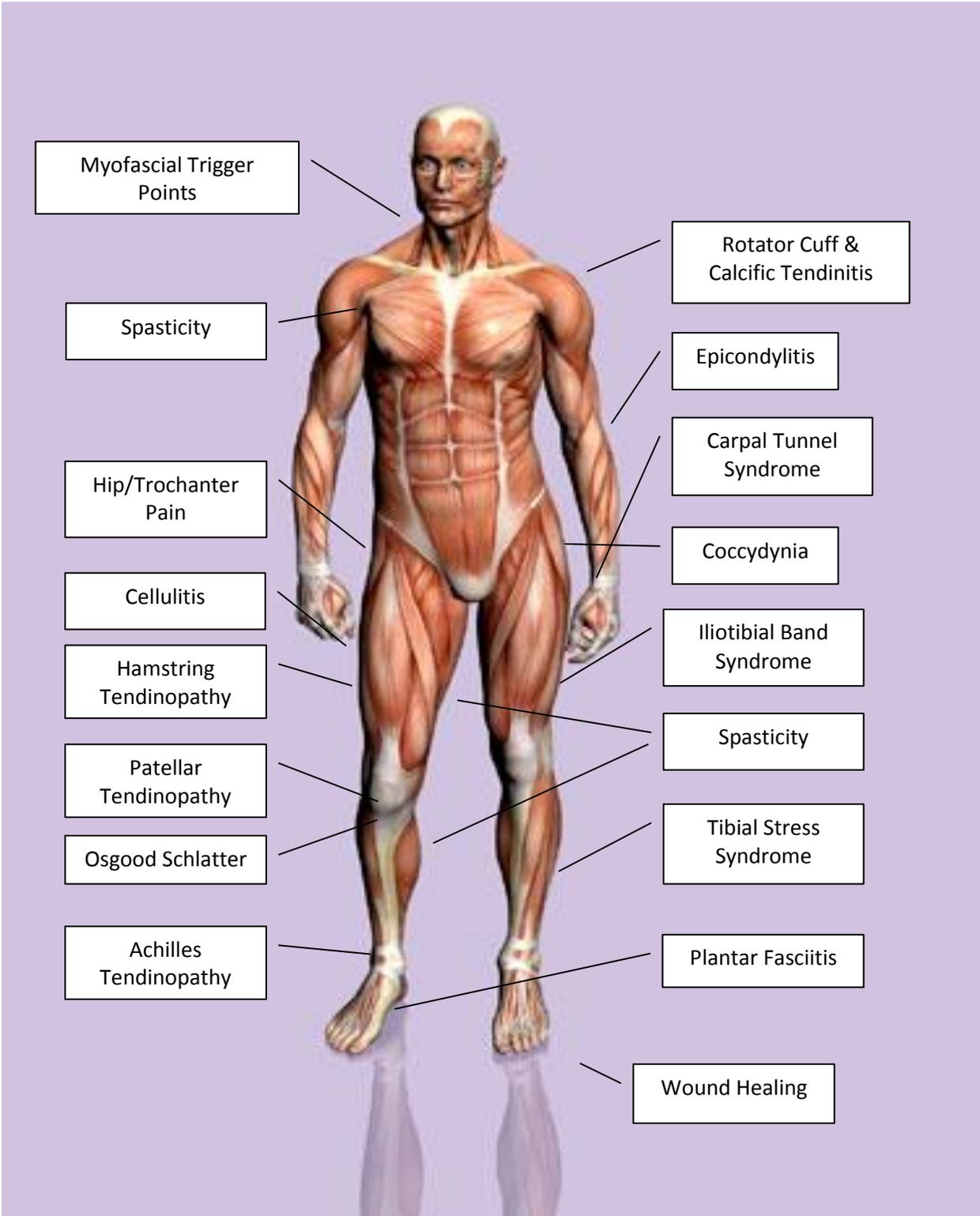
RPW Shockwave Therapy



Scientific Studies Overview



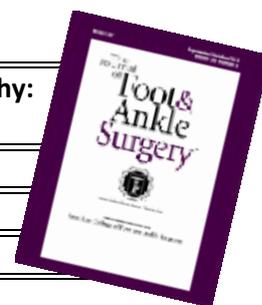
Evidence based indications



Shock wave as biological therapeutic tool: From mechanical stimulation to recovery and healing, through mechanotransduction.	
Authors	Cristina d'Agostino M, Craig K, Tibalt E, Respizzi S
Published	Int J Surg. 2015 Nov 23. [Epub ahead of print]
Date	Nov 2015
Place of origin	ESWT Center, Rehabilitation Department, Humanitas Research Hospital, Rozzano, Milan, Italy.
Background	After its original introduction in medicine as urological lithotripsy, shockwave technology has been increasingly applied also to a broad range of musculoskeletal diseases, up to present day, when it represents an interesting therapeutic tool in the field of Regenerative Medicine.
Objective	This article describes the biological actions of shockwaves that explain the beneficial effects on tissue healing and regeneration.
Study design & methods	Review article
Results	<p>The mechanisms of action of Shock Waves (SW), when applied in non-urological indications, are not related to the direct mechanical effect, but to the different pathways of biological reactions, that derive from that acoustic stimulations, through "mechano-transduction"</p> <p><u>Terminology</u></p> <ul style="list-style-type: none"> • Mechanobiology: analyze in detail the effects of the physical stimulus and, most of all, to correlate the interactions of physical energies with the various tissues and cell elements. • Mechanotransduction: all the molecular mechanisms, by which cells can sense mechanical stimulations and adapt their behavior to mechanical signals. It is a biological pathway to which many cell types are sensible: after sensing and processing the mechanical informations from the extracellular environment, these biomechanical forces are converted in biochemical responses, thus influencing some fundamental cell functions as migration, proliferation, differentiation, and apoptosis • Mechanotherapies: all therapeutic interventions that reduce and reverse injury to damaged tissues, or promote the homeostasis of healthy tissues by mechanical means at the molecular, cellular, or tissue level. Both focussed and radial shockwaves are 'mechanotherapies'. <p><u>Biological effects of shockwaves</u></p> <ul style="list-style-type: none"> • The mechanical stimulus of shockwaves is a trigger that activates a series of cellular events that have a positive effect on cell metabolism and cell cycle. • Basic science has shown that shockwaves induce proliferation, migration and differentiation of stem cells, which significantly contribute to tissue healing and regeneration. • Tenocytes are very sensible to mechanical stimulations. Shockwaves promote tenocyte proliferation and progressive tendon tissue regeneration and also induce biomechanical responses that promote tendon remodelling in tendinopathies,. • Bone cells are also sensible to mechanotransduction - shockwaves are an important therapeutic tool for enhancing osteoregenerative processes. Shockwaves not only act directly on bony and periosteal cells and their precursors, but also in the complex cross e talk between osteoblasts and osteoclasts, involving osseous vasculature as well. The clinical efficacy of shockwaves in bone healing is tightly related to its ability to induce neovascularization and matrix remodeling "in vivo". • There is increasing evidence that shockwaves act as "immunomodulator" in wound healing and tissue regeneration, mainly through an anti-inflammatory strategy. • Some experimental studies have shown that shockwaves could reduce capsule formation and may induce fibrotic tissue remodelling/resorption - they help restoration of tissue

	<p>integrity. Fibrous tissue can be reduced at the origin, or remodeled in a second phase as in scars. Also in cardiology where restoration of tissue integrity, instead of fibrous tissue, is vital for heart performance, shockwaves can play a role.</p> <ul style="list-style-type: none"> • Shockwaves can also interfere with the nervous system and neurophysiological processes and produce an analgesic effect and also reduce hypertonia in spastic muscles.
Conclusion	<p>SW are able to relieve pain, as well to positively regulate inflammation (probably as immunomodulator), to induce neovascularization and stem cells activities, thus improving tissue regeneration and healing. ESWT can be nowadays considered an effective, safe, versatile, repeatable, noninvasive therapy for the treatment of many musculo-skeletal diseases, and for some pathological conditions where regenerative effects are desirable, especially when some other noninvasive/conservative therapies have failed. Moreover, based on the current knowledge in SW mechanobiology, it seems possible to foresee new interesting and promising applications in the fields of Regenerative Medicine, tissue engineering and cell therapies.</p>
Key message	<p>Through the principle of 'mechanotransduction', shockwaves can positively influence the chain of biological reactions that lead tissue regeneration and healing.</p>
Pubmed ID	26612525

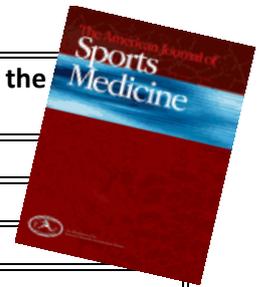
ACHILLES TENDINOPATHY



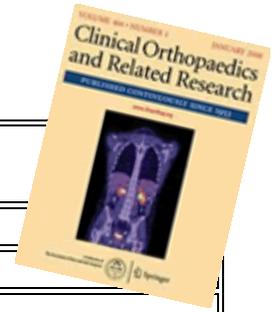
Extra-corporeal pulsed-activated therapy ("EPAT" sound wave) for Achilles tendinopathy: a prospective study.	
Authors	Saxena A, Ramdath S Jr, O'Halloran P, Gerdesmeyer L, Gollwitzer H.
Published	J Foot Ankle Surg. 2011;50(3):315-9.
Date	May 2011
Place of origin	Palo Alto Medical Foundation, Palo Alto, CA , USA.
Background	Achilles tendinopathy is common and extracorporeal shockwaves have become a popular treatment for this condition, even though previous research has not provided conclusive results regarding its efficacy in cases of Achilles tendinopathy.
Objective	To evaluate the effect of low-energy radial-pulsed-activated (EPAT) shockwave (sound wave) as an isolated treatment for Achilles tendinopathy.
Tested products	Storz D-Actor 200
Study design & methods	<p>Prospective cohort study.</p> <p><u>Subjects:</u> a total of 74 tendons in 60 patients, including 32 (43.24%) paratendinosis, 23 (31.08%) proximal tendinosis, and 19 (25.68%) insertional tendinosis.</p> <p><u>Methods:</u> patients received 3 low energy (<0.5mJ/mm²) shockwave treatments at weekly intervals, 2500 shocks per session, at 2.4 Bar ranging from 11 to 13 Hz.</p> <p><u>Outcomes:</u></p> <ul style="list-style-type: none"> • Roles and Maudsley score (functional disability score 1-4) • Subjective 'improvement' • Return to activities including sports <p>Patients were assessed at baseline and at least 1 year after administration of the shockwave therapy.</p>
Results	<ul style="list-style-type: none"> • 58 (78.38%) tendons 'improved' by at least 1 year posttreatment, including 75% in the paratendinosis, 78.26% in the proximal tendinosis, and 84.21% in the insertional tendinosis groups. • The Roles and Maudsley score improved from 3.22 to 1.84 (P < .0001) in the paratendinosis group, 3.39 to 1.57 (P < .0001) in the proximal tendinopathy group, and 3.32 to 1.47 (P = .0001) in the insertional tendinopathy group. • Athletic patients were able to continue their activity. • No adverse effects were observed.
Conclusion	<p>This study showed:</p> <ul style="list-style-type: none"> • Statistically and clinically significant improvements in 78.38% of tendons treated with the low-energy radial shockwave device at least 1 year after treatment. • Improvement in activity level, which is beneficial not only for athletic individuals but also for anyone required to work on their feet. <p>The authors conclude shockwave therapy serves as a safe, viable, and effective option for the treatment of Achilles tendinopathy.</p>
Key message	Radial shockwave therapy produces significant improvement of symptoms and activity level and is therefore considered as a viable non-surgical treatment option for Achilles tendinopathy.
Pubmed ID	21406328



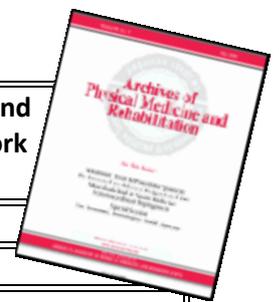
Eccentric Loading Versus Eccentric Loading Plus Shock-Wave Treatment for Midportion Achilles Tendinopathy. A Randomized Controlled Trial.	
Authors	Rompe, Furla, Maffulli
Published	American Journal of Sports Medicine, Volume 37, No. 3, pp. 463-471
Date	2009
Place of origin	Germany
Background	Results of a previous randomized controlled trial have shown comparable effectiveness of a standardized eccentric loading training and of repetitive low-energy shock-wave treatment (SWT) in patients suffering from chronic midportion Achilles tendinopathy. No randomized controlled trials have tested whether a combined approach might lead to even better results.
Objective	To compare the effectiveness of 2 management strategies: eccentric loading versus eccentric loading plus repetitive low-energy shock-wave therapy.
Tested products	EMS Swiss Dolorclast
Study design & methods	<p>Randomized controlled trial; Level of evidence, 1.</p> <p><u>Subjects:</u> 68 patients with a chronic recalcitrant (>6 months) noninsertional Achilles tendinopathy. All patients had received unsuccessful management for >3 months, including peritendinous local injections, nonsteroidal anti-inflammatory drugs, and physiotherapy.</p> <p><u>Methods:</u> patients were randomised to receive</p> <ul style="list-style-type: none"> • Group 1: 12-week eccentric training program alone (n=34) or • Group 2: same eccentric training program + 3 weekly sessions of RPW treatment (n=34). <p><u>Outcomes:</u> observer-blinded outcome assessments were performed before randomization and at 16 weeks after baseline assessment</p> <ul style="list-style-type: none"> • VISA-A score: a pain score validated for Achilles tendon problems. The VISA-A questionnaire contains 8 questions that cover the 3 domains of pain, function and activity. • General assessment was scored by the patient on a 6-point Likert scale. For the computation of success rates, patients who rated themselves 1 or 2 (ie, completely recovered or much improved) were counted as successes; patients who rated themselves 3 (somewhat improved), 4 (hardly improved), 5 (not improved), or 6 (worse) were rated as failures. • Pain Assessment: 11-point numerical rating scale (NRS; 0 = no pain to 10 = very severe pain).
Results	<ul style="list-style-type: none"> • At 4 months from baseline, the VISA-A score increased in both groups, from 50 to 73 points in group 1 (eccentric loading) and from 51 to 87 points in group 2 (eccentric loading plus shock-wave treatment). • Pain rating decreased from 7 to 4 points in group 1 and from 7 to 2 points in group 2. • 19 of 34 patients in group 1 (56%) and 28 of 34 patients in group 2 (82%) reported a Likert scale of 1 or 2 points ("completely recovered" or "much improved"). • For all outcome measures, groups 1 and 2 differed significantly in favor of the combined approach at the 4-month follow-up. • At 1 year from baseline, there was no difference any longer, with 15 failed patients of group 1 opting for having the combined therapy as cross-over and with 6 failed patients of group 2 having undergone surgery.
Conclusion	The likelihood of recovery after 4 months was higher after a combined approach of both eccentric loading and SWT compared to eccentric loading alone. Eccentric training plus SWT should be offered to patients with chronic recalcitrant midportion tendinopathy of the Achilles tendon.
Key message	The combined approach of eccentric loading plus repetitive low-energy SWT produced significantly better results (82% success rate) than eccentric calf muscle training alone.
Pubmed ID	19088057



Eccentric Loading, Shock-Wave Treatment, or a Wait-and-See Policy for Tendinopathy of the Main Body of Tendo Achillis A Randomized Controlled Trial	
Authors	Rompe JD, Nafe B, Furia JP, Maffulli N.
Published	Am J Sports Med. 2007 Mar;35(3):374-83
Date	2007
Place of origin	OrthoTrauma Clinic, Gruenstadt, Germany.
Background	Few randomized controlled trials compare different methods of management in chronic tendinopathy of the main body of tendo Achillis.
Objective	To compare the effectiveness of 3 management strategies - eccentric loading, repetitive low-energy shock-wave therapy (SWT), and wait and see - in patients with chronic tendinopathy of the main body of tendo Achillis.
Tested products	EMS Swiss Dolorclast
Study design & methods	<p>Randomized controlled trial; Level of evidence, 1.</p> <p>Subjects: 75 patients with a chronic recalcitrant (>6 months) noninsertional Achilles tendinopathy. All patients had received unsuccessful management for >3 months, including peritendinous local injections, nonsteroidal anti-inflammatory drugs, and physiotherapy.</p> <p>Methods: patients were randomly allocated to one of the three treatment groups.</p> <ul style="list-style-type: none"> • Group 1: eccentric loading • Group 2: radial shock wave • Group 3: wait-and-see <p>Outcomes: patients were assessed at baseline and at 4 months from baseline.</p> <ul style="list-style-type: none"> • VISA-A score : a validated questionnaire for assessing pain, function, activity • Pain Assessment: 11-point numerical rating scale (NRS; 0 = no pain to 10 = very severe pain). • Likert score : general assessment of recovery (6-points).
Results	<ul style="list-style-type: none"> • At 4 months from baseline, the VISA-A score increased in all groups, from 51 to 76 points in group 1 (eccentric loading), from 50 to 70 points in group 2 (repetitive low-energy SWT), and from 48 to 55 points in group 3 (wait and see). • Pain rating decreased in all groups, from 7 to 4 points in group 1, from 7 to 4 points in group 2, and from 8 to 6 points in group 3. • 15 of 25 patients in group 1 (60%), 13 of 25 patients in group 2 (52%), and 6 of 25 patients in Group 3 (24%) reported a Likert scale of 1 or 2 points (“completely recovered” or “much improved”). • For all outcome measures, groups 1 and 2 did not differ significantly. • For all outcome measures, groups 1 and 2 showed significantly better results than group 3.
Conclusion	At 4-month follow-up, eccentric loading and low-energy SWT showed comparable results . The wait-and-see strategy was ineffective for the management of chronic recalcitrant tendinopathy of the main body of the Achilles tendon.
Key message	Both eccentric loading and repetitive low-energy SWT led to a successful outcome in 50% to 60% of patients and should be offered to patients with chronic recalcitrant midportion tendinopathy as an alternative to surgery.
Pubmed ID	17244902



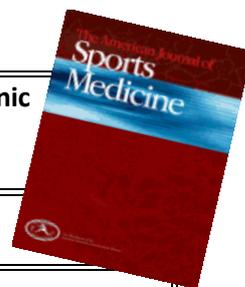
Extracorporeal Shock Wave Therapy Is Effective In Treating Chronic Plantar Fasciitis: A Meta-analysis of RCTs.	
Authors	Aqil A, Siddiqui MR, Solan M, Redfern DJ, Gulati V, Cobb JP.
Published	Clin Orthop Relat Res. 2013 Jun 28. [Epub ahead of print]
Date	Jun 2013
Place of origin	Department of Surgery and Cancer, Imperial College London, Charing Cross Hospital, London, UK
Background	Plantar fasciitis is the most common cause of heel pain. It may remain symptomatic despite conservative treatment with orthoses and analgesia.
Objective	To investigate whether there is a significant difference in the change of (1) VAS scores and (2) Roles and Maudsley scores from baseline when treated with ESWT and placebo.
Study design & methods	<p>Systematic review with meta-analysis.</p> <p><i>Methods:</i> included studies had to be prospective RCTs on adults who were irresponsive to conservative treatments for >3months; studies did not use local anesthesia as part of their treatment protocol.</p> <p><i>Included studies:</i> 7 prospective RCTs were included in this study (total 663 patients). There were 369 patients included in the placebo group and 294 in the ESWT group.</p> <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • overall improvement from baseline composite VAS (heel pain in the morning, doing daily activities, and application of dolorimeter), • reduction in overall VAS pain, • success rate of improving overall VAS pain by 60%, • success rate of improving VAS pain by 60% when taking first steps, doing daily activities, and during application of a pain pressure meter. • Roles and Maudsley scores: 4-pt patient assessment of pain and limitations of activity (1 = excellent result / no symptoms post-treatment; 2 = significant improvement from pretreatment; 3 = somewhat improved; 4 = poor, symptoms identical or worse than pretreatment).
Results	<ul style="list-style-type: none"> • Patients from the ESWT group had significantly better improvement of composite VAS scores compared with placebo. • Patients from the ESWT group had a significantly greater reduction in their absolute VAS scores compared with placebo. • Patients from the ESWT group had significantly greater success of improving heel pain by 60% when taking first steps and during daily activities. • Patients from the ESWT group had significantly better subjective measurement of pain using a pressure meter. • Significantly more patients in the ESWT group had a change to "excellent - good" Roles and Maudsley scores.
Conclusion	<ul style="list-style-type: none"> • ESWT is a safe and effective treatment of chronic plantar fasciitis refractory to nonoperative treatments. • Improved pain scores with the use of ESWT were evident 12 weeks after treatment. • The evidence suggests this improvement is maintained for up to 12 months. • The authors recommend the use of ESWT for patients with substantial heel pain despite a minimum of 3 months of nonoperative treatment.
Key message	ESWT is more effective than placebo for treating chronic plantar fasciitis and should be advised to patients not improving after other nonoperative measures.
Pubmed	23813184



Comparative Effectiveness of Focused Shock Wave Therapy of Different Intensity Levels and Radial Shock Wave Therapy for Treating Plantar Fasciitis: a Systematic Review and Network Meta-analysis	
Authors	Chang KV, Chen SY, Chen WS, Tu YK, Chien KL
Published	Arch Phys Med Rehabil. 93(7):1259-68.
Date	July 2012
Place of origin	National Taiwan University, Taipei, Taiwan
Objective	To compare the effectiveness of focused shock wave (FSW) therapy of different intensity levels and a new alternative, radial shock wave (RSW) for managing plantar fasciitis.
Study design & methods	<p>Systematic Review and Network Meta-analysis. <i>(Network Meta-analysis is a method used to determine the comparative effectiveness of treatments that have not been compared directly in a randomized trial. A network meta-analysis adds an additional variable to a meta-analysis. It is an extension of traditional meta-analysis but allows comparisons for more than two alternative therapies by integrating direct and indirect evidence.)</i></p> <p><u>Methods:</u></p> <ul style="list-style-type: none"> • Randomized control trials that compared shock wave and placebo therapy were included. • A total of 12 RCTs (n= 1431 participants) met the inclusion criteria and were enrolled into meta-analysis. <ul style="list-style-type: none"> - 2 compared low intensity FSW with placebo - 5 compared medium intensity FSW with placebo - 2 compared high intensity FSW with placebo, - 1 compared high intensity FSW with medium intensity FSW - 2 compared RSW with placebo • FSW of different intensity ranges were treated as three subgroups, whereas studies using RSW were regarded as a separated one. <p><u>Outcomes:</u> success rates of treatment and pain reduction magnitudes.</p>
Results	<p>1. Network meta-analysis revealed that:</p> <ul style="list-style-type: none"> • RSW had the highest effectiveness vs. placebo, followed by low, high and medium intensity FSW. <p>-> The probabilities of being ranked as the best treatment for RSW, and low, medium and high intensity FSW were 82.7%, 12.3%, 1.7% and 3.1%, respectively.</p> <ul style="list-style-type: none"> • RSW had the most significant pooled reduction in pain VAS, followed by low, medium, high intensity FSW and placebo treatment <p>-> The probabilities of being the best therapy to relieve pain were 91.0%, 2.8%, 4.2% and 1.8% regarding RSW, and low, medium and high intensity FSW, respectively.</p> <p>2. The meta-regression indicated that the success rate of FSW wasn't related to its intensity, but there was a dose-response relationship between pain reduction and energy flux density, whereas elevated energy efflux densities tended to relieve pain more.</p> <p>3. Overall the network meta-analysis revealed that the probability of being the best therapy was the highest in RSW, followed by low, medium or high intensity FSW.</p>
Conclusion	Setting the highest and mostly tolerable energy output within medium intensity ranges is the prior option when applying FSW on plantar fasciitis. RSW is considered as an appropriate alternative due to its lower price and probably better effectiveness. Its potential advantage over FSW comprises broader treatment area, less requirement of precisely focusing and free of adjunct local anesthesia.
Key message	Radial shock wave therapy is a good alternative choice for plantar fasciitis treatment because of its lower price and probably better effectiveness than traditional focused shock wave.
Pubmed ID	22421623

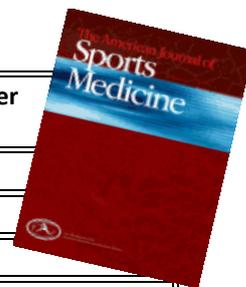


Chronic Plantar Fasciitis Treated with Two Sessions of Radial Extracorporeal Shock Wave Therapy	
Authors	Ibrahim MI, Donatelli RA, Schmitz C, Hellman MA, Buxbaum F.
Published	Foot Ankle Int. 2010 May;31(5):391-7.
Date	May 2010
Place of origin	Rocky Mountain University of Health Professions, Brooklyn, New York.
Background	In a previous study by Gerdesmeyer et al. (AJSM, 2008) was shown that RSWT is effective for plantar fasciitis treatment when administered in 3 sessions.
Objective	To test whether two sessions of RSWT can also be effective for treating plantar fasciitis.
Tested products	EMS Swiss Dolorclast.
Study design & methods	<p>Randomised controlled study.</p> <p><i>Subjects:</i> a total of 50 patients with unilateral, chronic PF</p> <p><i>Methods:</i> subjects were randomly assigned to either RSWT or placebo treatment (n = 25).</p> <ul style="list-style-type: none"> • RSWT (n = 25) - applied in 2 weekly sessions (2,000 impulses with energy flux density = 0.16 mJ/mm² per session). • Placebo treatment (n = 25) was performed with a clasp on the heel. <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Visual Analog Scale (VAS) Pain scores • modified Roles & Maudsley (RM) score <p>Changes from baseline to 4 weeks, 12 weeks and 24 weeks followup were assessed.</p>
Results	<p>The mean VAS scores were reduced after RSWT</p> <ul style="list-style-type: none"> • Mean changes from baseline: -92.5% at 4 weeks, -87.3% at 12 weeks and -93.9% at 24 weeks. <p>The mean RM scores were changed after RSWT</p> <ul style="list-style-type: none"> • Mean changes from baseline: -69.1% at 4 weeks -61.7% at 12 weeks -64.9% at 24 weeks. <p>These changes in mean VAS and RM scores were not observed after placebo treatment.</p> <ul style="list-style-type: none"> • Mean VAS scores changes of the placebo-treated patients were -15.2% at 4 weeks, 13.5% at 12 weeks -17% at 24 weeks from baseline. • Mean RM score changes of the placebo-treated patients were -6.3% at 4 weeks -15.8% at 12 weeks and -16.8% at 24 weeks from baseline. <p>Statistical analysis demonstrated that RSWT resulted in significantly reduced mean VAS scores and mean RM scores at all followup intervals compared to placebo treatment (each with p < 0.001).</p> <p>No serious adverse events of RSWT were observed.</p>
Conclusion	<p>The authors conclude that RSWT was a safe, effective and easy treatment for patients with chronic PF and successful treatment can be achieved with only two sessions of RSWT which increases the attractiveness of this treatment method.</p> <p>The authors recommend considering RSWT treatment for every patient with chronic plantar fasciitis who is irresponsive to conventional treatment.</p>
Key message	RSWT was successful in the treatment of chronic PF even when only two sessions with 2,000 impulses each were performed 1 week apart.
Pubmed ID	20460065



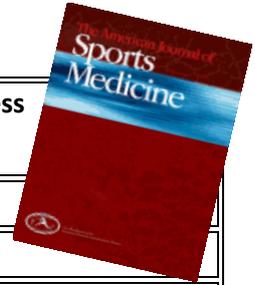
Radial Extracorporeal Shock Wave Therapy Is Safe and Effective in the Treatment of Chronic Recalcitrant Plantar Fasciitis. Results of a Confirmatory Randomized Placebo-Controlled Multicenter Study	
Authors	Gerdesmeyer L, Frey C, Vester J, Maier M, Weil L Jr, Weil L Sr, Russlies M, Stienstra J, Scurran B, Fedder K, Diehl P, Lohrer H, Henne M, Gollwitzer H.
Published	Am J Sports Med. 2008 Nov;36(11):2100-9.
Date	2008
Place of origin	Department of Orthopedic and Traumatology, Technical University Munich, Klinikum Rechts der Isar, Germany.
Background	Radial extracorporeal shock wave therapy is an effective treatment for chronic plantar fasciitis that can be administered to outpatients without anesthesia but has not yet been evaluated in controlled trials.
Objective	To evaluate the efficacy and safety of rESWT in patients with chronic painful heel syndrome.
Tested products	EMS Swiss Dolorclast
Study design & methods	<p>Randomized, controlled trial; Level of evidence, 1.</p> <p><i>Subjects:</i> 245 patients with chronic plantar fasciitis.</p> <p><i>Methods:</i> patients were randomised to receive three interventions of radial extracorporeal shock wave therapy (0.16 mJ/mm²; 2000 impulses) or placebo treatment.</p> <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • <i>Primary endpoints</i> were changes in visual analog scale composite score from baseline to 12 weeks' follow-up, overall success rates, and success rates of the single visual analog scale scores (heel pain at first steps in the morning, during daily activities, during standardized pressure force). • <i>Secondary endpoints</i> were single changes in visual analog scale scores, success rates, Roles and Maudsley score, SF-36, and patients' and investigators' global judgment of effectiveness 12 weeks and 12 months after extracorporeal shock wave therapy.
Results	<ul style="list-style-type: none"> • Radial extracorporeal shock wave therapy proved significantly superior to placebo with a reduction of the visual analog scale composite score of 72.1% compared with 44.7% (P = .0220), and an overall success rate of 61.0% compared with 42.2% in the placebo group (P = .0020) at 12 weeks. • Superiority was even more pronounced at 12 months, and all secondary outcome measures supported radial extracorporeal shock wave therapy to be significantly superior to placebo (P < .025, 1- sided). • No relevant side effects were observed.
Conclusion	Radial extracorporeal shock wave therapy significantly improves pain, function, and quality of life compared with placebo in patients with recalcitrant plantar fasciitis. Especially in the cases of failed nonsurgical treatment, rESWT represents an excellent alternative to surgery because anesthesia is not required and long recovery times are avoided.
Key message	Radial ESWT can be strongly recommended for patients with therapy-resistant plantar painful heel syndrome.
Pubmed ID	18832341

GREATER TROCHANTER PAIN

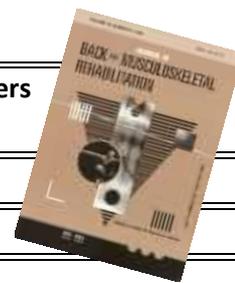


Home Training, Local Corticosteroid Injection, or Radial Shock Wave Therapy for Greater Trochanter Pain Syndrome	
Authors	Rompe JD, Segal NA, Cacchio A, Furia JP, Morral A, Maffulli N.
Published	Am J Sports Med. 2009 Oct;37(10):1981-90.
Date	2009
Place of origin	OrthoTrauma Evaluation Center, Mainz, Germany.
Background	A frequent painful overuse syndrome of the hip in adults engaging in recreational sports activities is commonly called trochanteric bursitis. Given the absence of bursal lesions and the presence of gluteal tendinopathy, it was suggested to rename the condition greater trochanter pain syndrome (GTPS). There are no controlled studies testing the efficacy of various nonoperative strategies for treatment of GTPS.
Objective	To compare the individual effectiveness of a single local corticosteroid injection, a standardized home training program, and a standardized shock wave treatment protocol.
Tested products	EMS Swiss Dolorclast
Study design & methods	<p>Randomized controlled clinical trial; Level of evidence, 2.</p> <p><i>Subjects:</i> 229 patients with refractory unilateral greater trochanter pain syndrome</p> <p><i>Methods:</i> subjects were assigned sequentially to</p> <ul style="list-style-type: none"> • Home training program – 12 weeks, 7 days/week, 2x/day • A single local corticosteroid injection (25 mg prednisolone), or • Low-energy radial shock wave treatment - 3 sessions, 1/wk <p><i>Outcomes:</i> subjects underwent outcome assessments at baseline and at 1, 4, and 15 months.</p> <ul style="list-style-type: none"> • Degree of recovery, measured on a 6-point Likert scale (subjects with rating completely recovered or much improved were rated as treatment success), • Severity of pain over the past week (0-10 points).
Results	<ul style="list-style-type: none"> • <u>1 month from baseline</u>, results after corticosteroid injection were significantly better than those after home training or shock wave therapy: success rate, 75% versus 7% and 13% resp.; pain rating: 2.2 points versus 5.9 points and 5.6 points resp. • <u>4 months from baseline</u>, radial shock wave therapy led to significantly better results than did home training and corticosteroid injection: success rate 68% versus 41% and 51% resp.; pain scores: 3.1 points versus 5.2 points and 4.5 points resp. • <u>15 months from baseline</u>, radial shock wave therapy and home training were significantly more successful than was corticosteroid injection: success rates were resp. 74%, 80% and 48%; pain scores were resp. 2.4, 2.7 and 5.3 points.
Conclusion	<ul style="list-style-type: none"> • The role of corticosteroid injection for greater trochanter pain syndrome needs to be reconsidered. Subjects should be properly informed about the advantages and disadvantages of the treatment options, including the economic burden. The significant short-term superiority of a single corticosteroid injection over home training and shock wave therapy declined after 1 month. • Both corticosteroid injection and home training were significantly less successful than was shock wave therapy at 4-month follow-up. • Corticosteroid injection was significantly less successful than was home training or shock wave therapy at 15-month follow-up.
Key message	Both radial shock wave therapy and home training were significantly more effective than was the single corticosteroid injection. Better results were achieved earlier after shock wave therapy than with the home training protocol. Corticosteroid injections offered only short term benefits.
Pubmed ID	19439758

MEDIAL TIBIAL STRESS SYNDROME (SHIN SPLINTS)



Low-Energy Extracorporeal Shock Wave Therapy as a Treatment for Medial Tibial Stress Syndrome	
Authors	Rompe JD, Cacchio A, Furia JP, Maffulli N.
Published	Am J Sports Med. 2010 Jan;38(1):125-32.
Date	2010
Place of origin	OrthoTrauma Evaluation Center, Mainz, Germany; Department of Medicine and Physical Rehabilitation, San Salvatore Hospital of L'Aquila, Italy
Background	Medial tibial stress syndrome (MTSS) is a pain syndrome along the tibial origin of the tibialis posterior or soleus muscle. Traditional treatment of MTSS is generally lengthy, associated with frequent recurrences, and in some cases, an unacceptable degree of improvement. An insertional malfunction is recognised as a potential source of pain. Extracorporeal shock wave therapy (SWT) is effective in numerous types of insertional pain syndromes.
Objective	To determine whether low energy SWT is a safe and effective management modality for chronic MTSS.
Tested products	EMS Swiss Dolorclast
Study design & methods	<p>Cohort study; Level of evidence, 3.</p> <p><i>Subjects:</i> 94 running athletes with an established diagnosis of unilateral chronic recalcitrant MTSS.</p> <p><i>Methods:</i></p> <ul style="list-style-type: none"> • Treatment group: 47 consecutive patients underwent a <u>standardized home training program plus repetitive low-energy radial SWT</u> (2000 shocks; 2.5 bars of pressure, which is equal to 0.1 mJ/mm²; total energy flux density, 200 mJ/mm²; no local anesthesia). Each subject received 3 low-energy treatments in weekly intervals (at weeks 2, 3, and 4 after start of the 12-week home training program) • Control group: 47 patients (selected as the best match of age and gender of the subjects in the treatment group) were not treated with SWT, but underwent a <u>standardized home training program only.</u> <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Assessment of pain by change in numeric rating scale (0= no pain to 10=very severe pain). • Degree of recovery was measured on a 6-point Likert scale (subjects with a rating of completely recovered or much improved were rated as treatment success). <p>Patients were assessed at baseline and at 1, 4 and 15 months after baseline.</p>
Results	<ul style="list-style-type: none"> • Degree of recovery (6-point Lickert scale): One month, 4 months, and 15 months from baseline, success rates for the control and treatment groups were 13% and 30% (P < .001), 30% and 64% (P < .001), and 37% and 76% (P < .001), respectively. • Pain severity : One month, 4 months, and 15 months from baseline, the mean numeric rating scale for the control and treatment groups were 7.3 and 5.8 (P < .001), 6.9 and 3.8 (P < .001), and 5.3 and 2.7 (P < .001), respectively. • At 15 months from baseline, 40 of the 47 subjects (85%) in the treatment group had been able to <i>return to their preferred sport at their preinjury level</i>, as had 22 of the 47 control subjects (47%).
Conclusion	The degree of recovery, pain reduction and return to sports was twice as high in the RPW group versus the control group. Satisfactory improvement was maintained for at least 1 year. Low-energy radial SWT is a safe and effective treatment for chronic MTSS, and that
Key message	Adding RPW to standard home exercise therapy offered significantly more improvement of pain, degree of recovery and return to sports.
Pubmed ID	19776340



Radial extracorporeal shockwave therapy compared with manual therapy in runners with iliotibial band syndrome.	
Authors	Weckström K, Söderström J.
Published	J Back Musculoskelet Rehabil. 2015 Jul 6. [Epub ahead of print]
Date	Jul 2015
Place of origin	IFK Mariehamn Fotboll, Wiklöf Holding Arena, Mariehamn, Finland. Muskelcentrum Uppsala AB, Uppsala, Sweden.
Background	Although different conservative treatment options have been proposed, there is a paucity of research on the management of iliotibial band syndrome (ITBS) in runners.
Objective	To compare two treatment protocols for ITBS; radial shockwave therapy (RSWT) and manual therapy (ManT) administered concurrently with an exercise rehabilitation programme.
Tested products	Storz MP 100
Study design & methods	<p>Randomised controlled trial.</p> <p><u>Subjects:</u> 20 runners with ITBS.</p> <p><u>Methods:</u> subjects were randomly assigned to 3 treatments at weekly intervals of either</p> <ul style="list-style-type: none"> • RSWT (n= 11) - 4600 pulses in total with intensity between 0.1 - 0.4 mJ/mm² and pressure between 2-4 bar. • Manual therapy (n= 13) - consisting of ITB massage, deep transverse frictions and triggerpoint therapy. <p>In addition, all subjects followed an exercise programme for at least 4 weeks.</p> <p><u>Outcomes:</u></p> <ul style="list-style-type: none"> • Total pain experienced during treadmill running • The secondary outcome measures were defined as the proportion of subjects performing a pain-free treadmill test <p>Subjects were followed up at 3 occasions: after 4 weeks, 8 weeks and 6 months.</p>
Results	<ul style="list-style-type: none"> • There was no significant difference in pain reduction between the two interventions at 4 weeks (p= 0.796), and 8 weeks (p= 0.155) follow-up. Thus, both groups reported similar magnitude of reduced pain during the intervention (p= 0.864). • The shockwave therapy group reported a 51% decrease in pain at week 4 (p= 0.022), and a 75% decrease at week 8 (p= 0.004). • The Man therapy group showed a 61% reduction in pain at week 4 (p= 0.059), and a 56% reduction at week 8 (p= 0.067). • At week 8, 55% of the shockwave group and 44% of the Man therapy group reported a pain-free treadmill test. • All pain-free subjects at week 8 remained pain-free at 6 months.
Conclusion	RSWT and ManT were equally effective in reducing pain in subjects with ITBS. Shockwave treatment provided 75% pain reduction at week 8; and 55% of patient were completely pain free at week 8 and still at 6 months.
Key message	Both RSWT and manual therapy added to an exercise program are equally effective treatment modalities for pain reduction in ITBS.
Pubmed ID	26406193



Shockwave Therapy for the Treatment of Chronic Proximal Hamstring Tendinopathy in Professional Athletes	
Authors	Cacchio A, Rompe JD, Furia JP, Susi P, Santilli V, De Paulis F.
Published	Am J Sports Med. 2011 Jan;39(1):146-53.
Date	Jan 2011
Place of origin	Department of Physical Medicine and Rehabilitation, University of Rome "La Sapienza," Italy.
Background	Chronic Proximal Hamstring Tendinopathy (PHT) is an overuse syndrome of unknown origin that is associated with a degenerative process of the hamstring tendons, particularly of the semimembranosus tendon. Clinically, patients with PHT report gradually increasing pain at the level of the ischial tuberosity. Some patients report radiating pain from the ischial tuberosity to the popliteal fossa while sitting for a prolonged time or during sports activities. PHT is usually managed by nonoperative methods. Shockwave therapy has proved to be effective in many tendinopathies.
Objective	To evaluate the effectiveness and safety of Shock Wave Therapy (SWT), and to compare the effects of SWT with those of traditional conservative therapy (TCT) in patients with chronic PHT.
Tested products	EMS Swiss Dolorclast
Study design & methods	<p>Randomized controlled clinical study; Level of evidence, 1.</p> <p>Subjects: 40 professional athletes with chronic proximal hamstring tendinopathy.</p> <p>Methods: Patients were randomly assigned to receive:</p> <ul style="list-style-type: none"> • shockwave therapy, consisting of 2500 impulses per session at a 0.18 mJ/mm² energy flux density without anesthesia, for 4 wks (SWT group, n = 20), • traditional conservative treatment consisting of NSAIDs, physiotherapy, and an exercise program for hamstring muscles (TCT group, n = 20). <p>Outcomes: Patients were evaluated before treatment, and 1 week and 3, 6, and 12 months after the end of treatment.</p> <ul style="list-style-type: none"> • Primary outcome measures: <ul style="list-style-type: none"> - Visual analog scale (VAS) score for pain - Nirschl phase rating scale (NPRS). The NPRS is a 7-phase (1-7) assessment of pain and activity limitations caused by overuse injuries. • Secondary outcome measures: <ul style="list-style-type: none"> - number of patients who achieved a reduction of at least 50% in the VAS score from the baseline to both 1 week after the end of treatment and 3 months after the end of treatment. - degree of recovery from the baseline to 3 months after the end of treatment, measured on a 6-point Likert scale ("completely recovered" to "much worse").
Results	<p>Primary follow-up was at 3 months after the beginning of treatment.</p> <ul style="list-style-type: none"> • VAS pain scores: a significant improvement in the mean VAS score was observed in the SWT group, while no significant difference was observed in the TCT group 3 months after the end of treatment. The VAS scores in the SWT and TCT groups were 7 points before treatment, and 2 points and 7 points, respectively, 3 months after treatment. • NPRS scores: a significant improvement was observed in the SWT group, whereas there was a significant worsening in the TCT group. NPRS scores in the SWT and TCT groups were 5 points in either group before treatment, and 2 points and 6 points, respectively, 3 months after treatment. • Pain reduction of >50%: At 3 months after treatment, 17 of the 20 patients (85%) in the SWT group and 2 of the 20 patients (10%) in the TCT group achieved a reduction of at least 50% in pain.

	<ul style="list-style-type: none"> • <u>Degree of recovery:</u> the percentage of patients with Likert scale scores of “1” (completely recovered) or “2” (much improved) (ie, successful results) at 3 months after the end of treatment was significantly higher in the SWT group than in the TCT group. No patients in the SWT group but 7 patients (35%) in the TCT group reported a worsening in symptoms compared with the pretreatment symptoms. • <u>Return to sports:</u> 3 months after the end of treatment, 16 (80%) of the 20 patients in the SWT group were able to return to their preinjury professional level of sports activity. The mean time taken to return to their preinjury professional level of sports activity was 9 weeks. None of these patients have had any reinjury during the 12-month follow-up period. By contrast, none of the patients in the TCT group were able to return to their preinjury professional level of sports activity at the same time point • <u>Complications:</u> there were no serious complications in the SWT group.
Conclusion	This study demonstrates that SWT is a safe and effective treatment for chronic PHT and adds to the growing number of favorable reports pointing to the efficacy of SWT as a treatment for chronic tendinopathies.
Key message	Significantly better results with radial shockwave therapy for Proximal Hamstring Tendinopathy than with traditional conservative (NSAID + PT) treatment.
Pubmed ID	20855554



No difference in effectiveness between focused and radial shockwave therapy for treating patellar tendinopathy: a randomized controlled trial.	
Authors	van der Worp H, Zwerver J, Hamstra M, van den Akker-Scheek I, Diercks RL.
Published	Knee Surg Sports Traumatol Arthrosc. 2013 May 12. [Epub ahead of print]
Date	May 2013
Place of origin	Center for Sports Medicine, University Center for Sport, Exercise and Health, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands.
Background	A systematic review of the literature (van Leeuwen, 2009) concluded that ESWT is a safe and promising treatment for patellar tendinopathy, but that further research was necessary, especially as different shockwave devices were used.
Objective	To compare the effectiveness of focused shockwave therapy (FSWT) and radial shockwave therapy (RSWT) for treating patellar tendinopathy.
Tested products	Storz Duolith SD1
Study design & methods	<p>Double blind randomised controlled trial.</p> <p><i>Subjects:</i> 43 patients (57 tendons) with chronic (≥ 3 months) patellar tendinopathy.</p> <p><i>Methods:</i> patients were randomized into two groups.</p> <ul style="list-style-type: none"> • One group (21 patients, 31 tendons) received 3 weekly sessions of FSWT; 2,000 pulses at 4 Hz and an intensity of 0.12 mJ/mm². • The other group (22 patients, 26 tendons) received 3 weekly sessions of RSWT; 2,000 pulses at 8 Hz and an intensity of 2.4 bar. • The intensities that were used during FSWT (0.12 mJ/mm²) and RSWT (2.4 bar) were comparable according to the manufacturer. • Both groups also received an eccentric training programme. <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Primary outcome measure: the Victorian Institute of Sport Assessment-Patella (VISA-P) questionnaire (pain, function and sports participation) from 0 to 100 points, with 100 points indicating complete symptom-free sports participation • Secondary outcome measures: pain during ADL, sports activities and the decline squat. <p>Follow-up measurements took place 1, 4, 7 and 14 weeks after the final shockwave treatment.</p>
Results	<ul style="list-style-type: none"> • Both groups improved significantly ($p < 0.01$) on the VISA-P score, but there were no significant differences in improvement between the FSWT group (15 p) and the RSWT group (9.6 p). • Both groups improved significantly over time on pain during ADL, pain during sport and pain during performance of the decline squat, but there were no significant differences between treatment groups. • There was no difference between the FSWT and the RSWT group in the percentage of subjects that indicated improvement of symptoms after 7 weeks (60 vs. 59 %) and 14 weeks (65 vs. 75 %) nor in pain experienced during the shockwave treatment (VAS score: 4.9 vs. 4.2). • A calculation of the costs for both methods shows that the costs of RSWT are lower than those of FSWT. Variable costs for an RSWT treatment of 2,000 pulses are around 20 % of the costs of FSWT. The yearly depreciation costs are also lower for RSWT, around 70 % of those of FSWT.
Conclusion	FSWT and RSWT in addition to eccentric training were equally effective for treatment of chronic patellar tendinopathy. On economic grounds, RSWT seems to be more cost-effective.
Key message	3 sessions of FSWT or RSWT produced significant improvement of symptoms in resp. 65% and 75% of patients at 14 weeks follow-up.
Pubmed ID	23666379



A single application of low-energy radial extracorporeal shock wave therapy is effective for the management of chronic patellar tendinopathy.	
Authors	Furia JP, Rompe JD, Cacchio A, Del Buono A, Maffulli N
Published	Knee Surg Sports Traumatol Arthrosc. 2013 Feb;21(2):346-50.
Date	Feb 2013
Place of origin	SUN Orthopedics and Sports Medicine, Lewisburg, PA, USA
Background	Traditional treatments of chronic patellar tendinopathy are generally lengthy, with frequent recurrences and, in many instances, provide no significant improvement of the symptoms. Extracorporeal shock wave therapy (SWT) is effective for the management of chronic recalcitrant tendinopathy.
Objective	To assess whether a standardized, single treatment SWT is effective for the management of chronic patellar tendinopathy.
Tested products	EMS Swiss DolorClast
Study design & methods	<p>Retrospective study with control group.</p> <p><u>Subjects:</u> 66 patients with chronic patellar tendinopathy.</p> <p><u>Methods:</u></p> <ul style="list-style-type: none"> • 33 patients received 1 application radial SWT: 2,000 shocks at 4.0 bars (equal to an energy flux density of approximately 0.18 mJ/mm²), treatment frequency 10 Hz. • 33 patients received other forms of non-operative therapy (control group). <p><u>Outcomes:</u> change at 1, 3 and 12 months after treatment in</p> <ul style="list-style-type: none"> • Visual Analogue Scale (VAS), • Victoria Institute of Sport Assessment score for patellar tendinopathy (VISA-P) score • Roles and Maudsley Score.
Results	<ul style="list-style-type: none"> • Mean VAS score in the control and SWT groups decreased significantly from resp. 7.5 and 7.8 pre-treatment to 6.7 and 4.3 at 1 month, 5.9 and 3.5 at 3 months and 5.1 and 2 at 12 months follow-up. • One month, 3 months, and 12 months after treatment, the mean VISA for the control and SWT groups were 50.7 and 65.5, 52.1 and 71, and 54.9 and 74.5, respectively. The differences between both groups were significant (p<0.001) in favour of the SWT group. • At final follow-up, the number of excellent, good, fair, and poor results for the SWT and control groups were 8 and 3, 17 and 10, 5 and 16, and 3 and 4, respectively. The differences between both groups were significant (p<0.001) in favour of the SWT group. • The percentage of patients with 'excellent' or 'good' Roles and Maudsley Scores (i.e. successful results) 12 months after treatment was statistically greater in the SWT group compared to the control group (p < 0.001).
Conclusion	SWT is safe and effective up to 12 months from the last application, and provides significantly better results than current conservative care.
Key message	A single application of radial SWT is an effective treatment for chronic patellar tendinopathy.
Pubmed ID	22627667



Extracorporeal Shock Wave Therapy for Patients Suffering from Recalcitrant Osgood-Schlatter Disease.	
Authors	Lohrer H, Nauck T, Schöll J, Zwerver J, Malliaropoulos N.
Published	Sportverletz Sportschaden. 2012 Dec;26(4):218-22.
Date	Oct 2012
Place of origin	Sportmedizinisches Institut Frankfurt am Main, Germany.
Background	Intensive physical load can damage epi-/apophyseal growth. Osgood-Schlatter disease is a well-known and sport-associated overuse injury of the tibial tuberosity apophysis. Long-lasting load-associated pain and a reduced ability to play sports can be the consequence.
Objective	To analyse the safety and effectiveness of extracorporeal shock wave therapy (ESWT) for recalcitrant Osgood-Schlatter disease.
Tested products	Radial Pressure Waves by <ul style="list-style-type: none"> • Storz Duolite SD1 • EMS Swiss Dolorclast
Study design & methods	<p>Retrospective study.</p> <p><i>Subjects:</i> 14 adolescent patients, median age 14 years, suffering from recalcitrant Osgood-Schlatter disease (16 symptomatic knees).</p> <p><i>Methods:</i></p> <ul style="list-style-type: none"> - Patients who were treated with RPW between 1999 and 2010 were retrospectively followed up mean 5.6 years later using the disease specific VISA-P-G questionnaire which is validated for jumper's knee. - RPW therapy consisted of 3-7 sessions, 1500-2000 pulses per session, 2.0-2.5 bar, 0.06-0.09mJ/mm². <p><i>Outcomes:</i> VISA-P-G score: maximal score is 100 when completely symptom free.</p>
Results	<ul style="list-style-type: none"> • At follow up the median VISA-P-G score was 100 (82.9-100.9). 12 of 16 knees (75%) reached 100 out of 100 VISA-P-G points. • Four patients changed their sports activity due to persisting problems at the distal patellar tendon insertion. • Four knees had persisting tibial tuberosity pain when playing sport. • Pain induced by activities of daily living (stair climbing) was stated in two cases. • No side effects or long-term complications were reported.
Conclusion	This pilot study demonstrates that radial ESWT is a safe and promising treatment for adolescent athletes with recalcitrant Osgood-Schlatter disease.
Key message	75% of patients became free of symptoms following RPW treatment.
Pubmed	23047459

CARPAL TUNNEL SYNDROME



Effect of radial shock wave therapy for carpal tunnel syndrome: A prospective randomized, double-blind, placebo-controlled trial.	
Authors	Wu YT, Ke MJ, Chou YC, Chang CY, Lin CY, Li TY, Shih FM, Chen LC
Published	J Orthop Res. 2015 Nov 26. [Epub ahead of print]
Date	Nov 2015
Place of origin	Department of Physical Medicine and Rehabilitation, Tri-Service General Hospital, School of Medicine, National Defense Medical Center, Taipei, Taiwan, Republic of China.
Background	Three recent studies demonstrated the positive effect of extracorporeal shock wave therapy (ESWT) for treating carpal tunnel syndrome (CTS). However, all studies had a small sample size and lacked a placebo-controlled design.
Objective	To assess the analgesic effect and prognosis of patients with CTS in the median nerve after receiving rESWT.
Tested products	Physio Shock Wave Therapy (Pagani Elettronica, Milano, Italy)
Study design & methods	<p>Prospective randomized, controlled, double-blinded study.</p> <p><i>Subjects:</i> 34 patients with CTS (40 wrists)</p> <p><i>Methods:</i> subjects were randomized into</p> <ul style="list-style-type: none"> Intervention group (20 wrists): underwent three sessions of rESWT (2000 shots, 4 Bar, 5 Hz) with nightly splinting. The treated area ranged from the pisiform level to 2 cm proximal to the median nerve. Control group (20 wrists): underwent sham rESWT (sound but no energy) with nightly splinting. <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> The primary outcome was visual analog scale (VAS), The secondary outcomes included the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ), cross-sectional area (CSA) of the median nerve, sensory nerve conduction velocity of the median nerve, and finger pinch strength. <p>Evaluations were performed before treatment and at 1, 4, 8, and 12 weeks after the third rESWT session.</p>
Results	A significantly greater improvement in the VAS, BCTQ scores, and CSA of the median nerve was noted in the intervention group throughout the study as compared to the control group (except for BCTQ severity at week 12 and CSA at weeks 1 and 4) ($p < 0.05$).
Conclusion	rESWT is a safe and effective method for relieving pain and disability in patients with CTS.
Key message	Significant improvement of pain and disability in CTS patients with rESWT treatment versus placebo.
Pubmed	26610183

LATERAL EPICONDYLITIS (TENNIS ELBOW)

Radial shock wave therapy for lateral epicondylitis: a prospective randomised controlled single-blind study	
Authors	Spacca G, Necozone S, Cacchio A.
Published	Eura Medicophys. 2005 Mar;41(1):17-25.
Date	2005
Place of origin	Physical Medicine and Rehabilitation Unit, Department of Neuroscience, San Salvatore Hospital, L'Aquila, Italy.
Background	Despite lateral epicondylitis or tennis elbow is a common cause of pain in orthopaedic and sports medicine, the results of the different modalities of conservative treatment are still contradictory.
Objective	To evaluate the efficacy of radial shock wave therapy (RSWT) in the treatment of tennis elbow.
Tested products	Physio Shock Wave Therapy (Pagani Elettronica, Milano, Italy)
Study design & methods	<p>Prospective randomised controlled single-blind study.</p> <p><i>Subjects:</i> 62 patients with tennis elbow</p> <p><i>Methods:</i> patients were randomly assigned to study group and control group.</p> <ul style="list-style-type: none"> • Both groups had received one treatment a week for 4 weeks; • The study group received 2000 impulses of RSWT and the control group 20 impulses of RSWT. <p><i>Outcomes:</i> all patients were evaluated 3 times: before treatment, at the end of treatments and at 6 months follow-up.</p> <ul style="list-style-type: none"> • Pain (VAS at rest, by palpation, by Thomson test = resisted wrist dorsiflexion), • Pain-free grip strength test, • Functional impairment (DASH questionnaire) • Subjective satisfaction for treatment • Number needed to treat (NNT) were evaluated.
Results	<ul style="list-style-type: none"> • The treatment group showed significantly better results than the control group for visual analogue scale (VAS), disabilities of the arm, shoulder, and hand (DASH) questionnaire and pain-free grip strength test scores, both after treatment and at the 6-month follow-up ($p < 0.001$). • The treatment group showed significant improvements on all parameters, whereas in the control group the DASH score remained stable and the pain scores increased. • Percentage of satisfied patients in the study group was 87% post-treatment; 84% at follow-up, compared to 10% and 3% in the control group. • Number needed to treat (NNT) was 1.15 post-treatment and 1.25 at the 6-month follow-up.
Conclusion	<p>The use of radial shock wave therapy allowed a decrease of pain and functional impairment, and an increase of the pain-free grip strength test, in patients with tennis elbow, without device related adverse effects.</p> <p>RSWT is safe & effective and offers high patient satisfaction. It must therefore be considered as possible therapy for the treatment of patients with tennis elbow.</p>
Key message	Offering reduced pain and improved elbow function and grip strength, RSWT is a safe and effective treatment alternative for patients with tennis elbow
Pubmed ID	16175767

SHOULDER TENDINITIS & ROTATOR CUFF



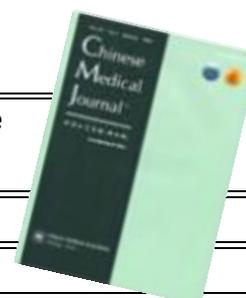
Clinical improvement and resorption of calcifications in calcific tendinitis of the shoulder after shock wave therapy at 6 months' follow-up: a systematic review and meta-analysis.	
Authors	Ioppolo F, Tattoli M, Di Sante L, Venditto T, Tognolo L, Delicata M, Rizzo RS, Di Tanna G, Santilli V.
Published	Arch Phys Med Rehabil. 2013 Sep;94(9):1699-706.
Date	Sep 2013
Place of origin	Physical Medicine and Rehabilitation Unit, Azienda Policlinico Umberto I, Rome, Italy.
Background	Several studies have demonstrated the efficacy of SWT for pain relief, clinical improvement, and disappearance of calcifications in patients with CTS. The cost of SWT is higher than other conservative treatments, but less than a surgical procedure and the ensuing rehabilitation. Moreover, patients who undergo surgery often need to take a lengthy leave of absence from work.
Objective	To evaluate the effectiveness of shock wave therapy (SWT) for functional improvement and the reduction of pain in patients with calcific tendinitis of the shoulder, and to determine the rate of disappearance of calcifications after therapy at 6 months' follow-up.
Study design & methods	<p>Systematic review with meta-analysis.</p> <p>Studies: 6 randomised controlled trials (460 patients) comparing shockwave therapy with placebo or no treatment were included in the review.</p> <ul style="list-style-type: none"> In 4 of the 6 studies included for review, the resorption of calcifications was evaluated using meta-analysis because the studies had 2 treatment groups, while the other 2 studies were analyzed descriptively because they had 3 treatment groups. 5 studies used focussed SW and 1 study used radial SW <p>Outcomes:</p> <ul style="list-style-type: none"> clinical improvement, evaluated by shoulder functional scales, resorption of calcific deposits, defined through radiographic examinations.
Results	<ul style="list-style-type: none"> SWT increases shoulder function and reduces pain. SWT is effective in dissolving calcifications: pooled total resorption ratio of 27.19 (95% confidence interval [CI], 7.20-102.67) and a pooled partial resorption ratio of 16.22 (95% CI, 3.33-79.01). These results were maintained over the following 6 months.
Conclusion	SWT increases shoulder function, reduces pain, and is effective in dissolving calcifications. These results were maintained over the following 6 months.
Key message	Shock wave treatment is effective for relieving pain, improving shoulder function and dissolving calcifications.
Pubmed ID	23499780



Effectiveness of Radial Shock-Wave Therapy for Calcific Tendinitis of the Shoulder: Single-Blind, Randomized Clinical Study	
Authors	Cacchio A, Paoloni M, Barile A, Don R, de Paulis F, Calvisi V, Ranavolo A, Frascarelli M, Santilli V, Spacca G.
Published	Phys Ther. 2006 May;86(5):672-82.
Date	2006
Place of origin	Dipartimento di Neuroscienze, Unità Operativa di Medicina Fisica e Riabilitazione, Ospedale San Salvatore di L'Aquila, Coppito-L'Aquila, Italy.
Background	Although RSWT has been successfully used since the late 1990s for the management of various orthopedic disorders such as epicondylitis of the elbow and chronic heel pain, which represent 2 of the 3 musculoskeletal indications for ESWT (plantar fasciitis, lateral epicondylitis, and calcific tendinitis), no randomized clinical study has yet been performed in the treatment of shoulder calcifications.
Objective	To evaluate the effectiveness of RSWT on pain relief, restoration of shoulder function, and resolution of calcific tendinitis of the shoulder.
Tested products	Physio Shock Wave Therapy (Pagani Elettronica, Milano, Italy)
Study design & methods	<p>Single-blind, randomized controlled study.</p> <p><i>Subjects:</i> 90 patients with radiographically verified calcific tendinitis of the shoulder</p> <p><i>Methods:</i> subjects were randomly assigned to either a treatment group (n=45) or a control group (n=45).</p> <ul style="list-style-type: none"> The treatment group received 4 weekly RPW sessions, with 2,500 impulses per session (500 impulses with pressure of 1.5 bar and frequency of 4.5 Hz and 2,000 impulses with pressure of 2.5 bar and frequency of 10 Hz), EFD of 0.10 mJ/mm², and a fixed impulse time of 2 msec. The control group received 'less active similar therapy': the total number of impulses administered was only 25 (5 impulses with a pressure of 1.5 bar and a frequency of 4.5 Hz and 20 impulses with a pressure of 2.5 bar and a frequency of 10 Hz). <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> Primary outcome: Pain (VAS score) and functional level (UCLA (University of California Los Angeles) rating scale) were evaluated before and <i>after treatment</i> and at a <i>6-month follow-up</i>. Secondary outcome: Radiographic modifications in calcifications were evaluated before and after treatment.
Results	<p>The treatment group displayed significant improvement in all of the parameters analyzed after treatment and at the 6-month follow-up while this was not the case in the control group.</p> <ul style="list-style-type: none"> Mean UCLA value: 10.25 before treatment, 33.12 after treatment, 32.12 at follow-up in treatment group, versus resp. 10.14 before, 11.28 after, 10.57 at follow-up in control group. VAS score: 7.96 before treatment, 0.90 after treatment, 0.95 at follow-up in treatment group, versus resp. 7.72 before, 5.85 after, 6.84 at follow-up in control group. Calcifications disappeared completely in 86.6% of the subjects in the treatment group and partially in 13.4% of subjects; only 8.8% of the subjects in the control group displayed partially reduced calcifications, and none displayed a total disappearance.
Conclusion	<p>RSWT effectively reduces pain and increases shoulder function without device-related adverse effects. The results seen after the treatment were maintained over the following 6 months. Moreover, RSWT was unexpectedly better in dissolving calcifications of the shoulder than focussed shock wave therapy in the literature: all patients showed partial to full resorption of calcifications.</p>
Key message	The use of RSWT for the management of calcific tendinitis of the shoulder is safe and effective, leading to a significant reduction in pain and improvement of shoulder function after 4 weeks, without adverse effects.
Pubmed	16649891

The Effects of Extracorporeal Shock Wave Therapy in Patients with Coccydynia: A Randomized Controlled Trial.	
Authors	Lin SF, Chen YJ, Tu HP, Lee CL, Hsieh CL, Wu WL, Chen CH
Published	PLoS One. 2015 Nov 10;10(11):e0142475.
Date	Nov 2015
Place of origin	Kaohsiung Medical University, Kaohsiung, Taiwan.
Background	Coccydynia is pain in the coccygeal region, and usually treated conservatively. Extracorporeal shock wave therapy (ESWT) was incorporated as non-invasive treatment of many musculoskeletal conditions. However, the effects of ESWT on coccydynia are less discussed.
Objective	To evaluate the effects of non-invasive ESWT on the outcomes of coccydynia.
Tested products	BTL-5000 (radial shockwave)
Study design & methods	<p>Randomised controlled study.</p> <p><i>Subjects:</i> 41 patients with first-time diagnosis of coccydynia with pain score ranging from 1 to 10.</p> <p><i>Methods:</i> subjects were randomly assigned to</p> <ul style="list-style-type: none"> • Radial SW treatment - 4 sessions (1 session per week for 4 weeks) - 2000 pulses per session, 3-4 Bar, 5Hz. • Standard physical therapy with IFC (100Hz) and Shortwave Diathermy, both 20 min, 3x/week for 4 weeks. <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Pain on a visual analog scale (VAS) • Oswestry disability index (ODI) • Self-reported satisfaction score
Results	<ul style="list-style-type: none"> • The VAS and ODI scores were significantly decreased after treatment in both groups. • The decrease in the VAS score was significantly greater in the ESWT group. • The mean proportional changes in the ODI scores were greater in the ESWT group than in the standard PT group, but the between-group difference was not statistically significant. • The patients in the ESWT group had significantly higher subjective satisfaction scores than the standard PT group.
Conclusion	ESWT is more effective and satisfactory in reducing discomfort and disability caused by coccydynia than the use of combined IFC and SWD. Thus, ESWT is recommended as an alternative treatment option for patients with coccydynia.
Key message	4 session of radial shockwave treatment was more effective than 12 PT sessions with IFC and SWD for improving pain and disability in coccydynia.
Pubmed ID	26556601

SPASTICITY TREATMENT



Usefulness of radial extracorporeal shock wave therapy for the spasticity of the subscapularis in patients with stroke: a pilot study	
Authors	Kim YW, Shin JC, Yoon JG, Kim YK, Lee SC.
Published	Chin Med J (Engl). 2013 Dec;126(24):4638-43.
Date	Dec 2013
Place of origin	Yonsei University College of Medicine, Seoul and Kwandong University College of Medicine, Gyunggi; Republic of Korea
Background	Shoulder spasticity is considered to play an important role in hemiplegic frozen shoulder. However, the subscapularis muscle, unlike the pectoralis major muscle, is located deep beneath scapula, where conventional injection is difficult to perform. As extracorporeal shock wave therapy (ESWT) has been reported to be effective for spasticity relief, and we thought spasticity of subscapularis muscle located deep beneath the scapula would be a good candidate for ESWT treatment.
Objective	To evaluate the beneficial effects of radial ESWT on spastic subscapularis muscle in stroke patients.
Tested products	Masterplus MP200® (Storz Medical)
Study design & methods	<p>Uncontrolled, prospective, unicenter, clinical pilot study.</p> <p><i>Subjects:</i> 57 stroke patients (mean age 55.4 years) with spastic shoulders;</p> <p><i>Methods:</i> rESWT was administered to each patient every 2 or 3 days for two weeks (5 total treatments).</p> <ul style="list-style-type: none"> • The frequency applied was 8 Hz. • There were 3000 pulses per session with an energy flux density 0.63 mJ/mm²(1.6 bar). • Deep impact (diameter 15 mm) with the depth of 0–60 mm was used for the head of the rESWT machine. <p>Evaluation consisted of 11 measurements for each patient; at the start of each of the five treatments (ESWT1-5) and once per week (Week 1-6) during the following 6 weeks.</p> <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Spasticity was measured at external rotator muscles of the shoulder using the modified Ashworth scale (MAS), • Passive range of motion (ROM) of the shoulder in external rotation, • Pain was measured using a visual analogue scale (VAS) during passive ROM of the shoulder in external rotation, and was additionally recorded for patients who preserved cognitive and communicative ability (Pain group).
Results	<ul style="list-style-type: none"> • rESWT significantly reduced MAS and VAS and improved ROM during and after rESWT treatments compared to baseline. • The reduction in MAS and VAS and improvement of ROM continued 4 weeks after the last treatment: the highest improvements compared to baseline were measured at 4 weeks post-treatment. • After 4 weeks the effects of the treatment decreased.
Conclusion	5 sessions of rESWT treatment of the spastic subscapularis reduced spasticity and pain, and improved the ROM of the shoulder in stroke patients. Improvements continued for 4 weeks after the last treatment.
Key message	rESWT can provide an effective and safe procedure for the reduction of spasticity and pain as well as for the improvement of ROM of spastic shoulders.
Pubmed ID	24342303



Effect of radial shock wave therapy on muscle spasticity in children with cerebral palsy.	
Authors	Gonkova MI, Ilieva EM, Ferriero G, Chavdarov I.
Published	Int J Rehabil Res. 2013 Apr 17. [Epub ahead of print]
Date	Apr 2013
Place of origin	Department of Physical and Rehabilitation Medicine, Medical University, Plovdiv, Bulgaria.
Background	Extracorporeal shock wave therapy is a treatment of choice in patients with musculoskeletal disorders. The fact that the treatment procedure in RSWT is less painful and has wider effective regions than in FSWT, without the need for precise locating with image guidance and anesthesia, reduces the patient's treatment risk and makes it very appropriate for children.
Objective	To investigate the effect of radial shock wave therapy (RSWT) on muscle spasticity of plantar flexor muscles in children with cerebral palsy.
Tested products	BTL-5000
Study design & methods	<p>Observational, placebo-controlled double-blinded study in which each child served as its own control.</p> <p><i>Subjects:</i> 25 children, mean age 4.84±3.11 years, with spastic diplegia and hemiplegia.</p> <p><i>Methods:</i> the patients received one placebo treatment session, followed 4 weeks later by one active treatment session to the plantar flexors of the foot.</p> <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Passive range of motion and Modified Ashworth Scale were measured before and after treatment, and at 2 and 4 weeks post-treatment. • Baropodometric measurements (force plate for static and dynamic analysis of the foot and gait) were performed before and after the placebo and active session.
Results	<ul style="list-style-type: none"> • After placebo application, no changes measured by clinical or instrumental methods were found. • After RSWT, a significant increase in passive range of motion was observed: 47.00° versus 33.25° (P<0.001), which persisted at the second (46.87°, P<0.001) and fourth week (44.12°, P<0.001) after treatment. • The Modified Ashworth Scale score decreased from 2.77 to 2.00 points (P<0.001), which persisted at the second (mean 2.05 points, P<0.001) and fourth week (2.15 points, P<0.001) after treatment. • Baropodometric measurement showed a significant increase in the contact plantar surface area of the affected foot (from 81.32 to 101.58 cm, P<0.001) and in heel pressure (from 50.47 to 75.17 N/cm², P<0.001).
Conclusion	There is a significant reduction in the spasticity of plantar flexor muscles in children with cerebral palsy after a single session of RSWT and this improvement remains at the 4-week follow-up.
Key message	RSWT is a safe, noninvasive, and well-tolerated method of treatment in children with CP for reduction of muscle spasticity in plantar flexors of the lower limbs.
Pubmed	23603803



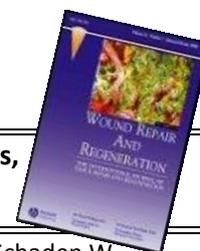
Radial extracorporeal shock wave therapy (rESWT) in the treatment of spasticity in cerebral palsy: A randomized, placebo-controlled clinical trial.	
Authors	Vidal X, Morral A, Costa L, Tur M.
Published	NeuroRehabilitation. 2011;29(4):413-9.
Date	Dec 2011
Place of origin	Cerebral Palsy Association (ASPACE), Centre Pilot Arcàngel Sant Gabriel, Barcelona, Spain Blanquerna School of Health Science, Universitat Ramon Llull, Barcelona, Spain.
Background	Despite all the existing treatments, the authors believe that shock wave therapy, being a non-invasive therapy may be an interesting alternative in the treatment of spasticity in CP patients.
Objective	To evaluate the efficacy and safety of radial extracorporeal shock wave therapy (rESWT) in the treatment of spasticity in patients with cerebral palsy.
Tested products	EMS Swiss Dolor Clast
Study design & methods	<p>Randomized, placebo-controlled clinical trial.</p> <p><u>Subjects:</u> 15 patients with spastic cerebral palsy, 12 men and 3 women, aged 10-46 years (mean age 31).</p> <p><u>Methods:</u> the 15 patients presented 40 spastic muscles that were randomly divided in three groups:</p> <ul style="list-style-type: none"> • Group 1 received rESWT in spastic muscle. • Group 2 received rESWT in spastic muscle + rESWT in antagonist muscle. • Group 3 received placebo. <p>The patients were treated in 3 sessions at intervals of one week.</p> <ul style="list-style-type: none"> • <u>Shockwave treatment parameters:</u> Number of impulses: 2000 in each spastic muscle in group I and 4000 in group II (2000 in spastic muscle and 2000 in antagonist muscle). Energy flux density: 0.10 mJ/mm². (2 bar). Frequency: 8 Hz. <p><u>Outcomes:</u></p> <ul style="list-style-type: none"> • Range of motion • Ashworth Scale
Results	<ul style="list-style-type: none"> • There are significant differences between groups treated with rESWT and placebo group. • A significant decrease in the Ashworth Scale, an increase in the range of motion, were observed in all patients that were treated with rESWT., while in the placebo group no effect was observed. • Positive results were maintained for at least 2 months after treatment. • There were no significant differences between group 1 and group 2.
Conclusion	This experimental study shows that the treatment with rESWT is more effective than placebo in decreasing spasticity of patients with CP, with an effect that is maintained up to two months later. At three months, it loses its effectiveness; therefore, it would be interesting to do another rESWT application before three months.
Key message	The treatment with rESWT is more effective than placebo in decreasing spasticity of patients with CP.
Pubmed ID	22207070



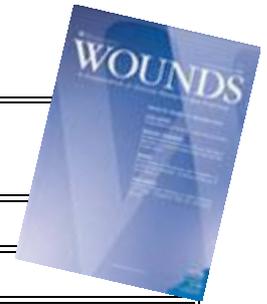
Effect of radial shock wave therapy on pain and muscle hypertonia: a double-blind study in patients with multiple sclerosis.	
Authors	Marinelli L, Mori L, Solaro C, Uccelli A, Pelosin E, Currà A, Molfetta L, Abbruzzese G, Trompetto C
Published	Mult Scler. 2014 Sep 25. [Epub ahead of print]
Date	Sep 2014
Place of origin	University of Genova, Italy.
Background	Radial shock wave therapy (RSWT) has been extensively used in rehabilitative medicine to treat pain, and more recently muscle hypertonia, in patients with cerebral palsy and stroke.
Objective	To assess the long-term effects of RSWT in a cohort of subjects affected by multiple sclerosis (MS) who were suffering from painful hypertonia of ankle extensor muscles.
Tested products	BTL-6000
Study design & methods	<p>Randomised, double blind, placebo-controlled study.</p> <p><i>Subjects:</i> 68 MS patients with ankle plantar flexor hypertonia.</p> <p><i>Methods:</i> patients were randomised to receive 4 weekly sessions of:</p> <ul style="list-style-type: none"> • RSWT: 2000 shots were delivered per session (600 shots in each gastrocnemius muscle, 600 shots in the soleus muscle and 200 shots in the Achilles tendon). Frequency 4 Hz, pressure 1.5 Bars. • Placebo RSWT <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Pain: visual analogue scale for pain (VAS) • Muscle tone: modified Ashworth scale • Spinal excitability: H-reflex. <p>Participants were assessed at baseline, 1 week after the first session, and 1 week and 4 weeks after the last session.</p>
Results	<ul style="list-style-type: none"> • After RSWT, muscle tone decreased 1 week after the last session • After RSWT, pain decreased at all the follow-up evaluations • Spinal excitability was unaffected. • No significant changes were found after the placebo treatment.
Conclusion	RSWT can reduce pain and muscle tone in MS patients without adverse effects. The lack of RSWT effects on spinal excitability supports the idea that RSWT is likely to act on non-reflex hypertonia, for example reducing muscle fibrosis.
Key message	RSWT can reduce pain and muscle tone in MS patients and should be integrated into the rehabilitation program.
Pubmed ID	25257616



Trigger point treatment with radial shock waves in musicians with nonspecific shoulder-neck pain: data from a special physio outpatient clinic for musicians.	
Authors	Damian M, Zalpour C.
Published	Med Probl Perform Art. 2011 Dec;26(4):211-7.
Date	Dec 2011
Place of origin	Institute of Applied Physical Therapy, University of Applied Sciences Osnabrück, Osnabrück, Germany.
Background	Radial shock wave therapy is increasingly used in trigger point treatment, but only few high-level studies have examined of shock wave therapy used together with physical therapy in the treatment of musicians.
Objective	To examine the effect of shock wave therapy in addition to current physical therapy on the symptoms and quality of life of the musicians as well as their habits of playing musical instruments.
Tested products	Storz MASTER PULS® MP 200
Study design & methods	<p>Randomised controlled trial.</p> <p><i>Subjects:</i> 26 musicians with nonspecific shoulder-neck problems.</p> <p><i>Methods:</i> subjects were randomised to</p> <ul style="list-style-type: none"> • Intervention group receiving radial shock wave treatment + standard physical therapy • Reference group receiving placebo shock wave + standard physical therapy <p>Subjects were treated for 5 weeks, 1 (25min) treatment per week.</p> <p><i>Outcomes:</i></p> <ul style="list-style-type: none"> • Pain (VAS and other instruments) • A questionnaire designed specifically for musicians (with initial and final questions) recorded intensity and manifestation of pain and handicaps in daily life, especially when practicing and playing • Shoulder Pain and Disability Index (SPADI) • Neck Pain Disability Index Questionnaire (NPDIQ).
Results	<ul style="list-style-type: none"> • Pain VAS scores improved significantly in both groups with no significant difference between the groups. • SPADI and NPDIQ were significantly improved in the intervention group. These improvements did not occur in the reference group. • In the questionnaire analysis, it became apparent that the subjects in the intervention group, as well as the reference group, considered both the massage and shock wave therapy appropriate and helpful.
Conclusion	Trigger point treatment with radial shock wave used in combination with physical therapy makes the subjects feel temporarily relieved of neck and shoulder pains.
Key message	Neck and shoulder pain & disability indexes were significantly more improved in the radial shockwave group than the placebo group.
Pubmed	22211198



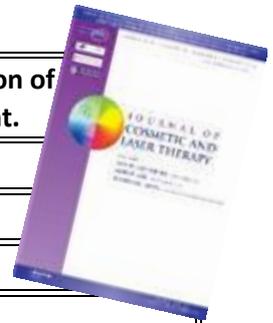
Extracorporeal shock wave therapy (ESWT) for wound healing: technology, mechanisms, and clinical efficacy.	
Authors	Mittermayr R, Antonic V, Hartinger J, Kaufmann H, Redl H, Téot L, Stojadinovic A, Schaden W.
Published	Wound Repair Regen. 2012 Jul-Aug;20(4):456-65.
Date	Jul 2012
Place of origin	Ludwig Boltzmann Institute for Experimental and Clinical Traumatology, Austrian Cluster for Tissue Regeneration, Vienna, Austria.
Background	<p>Delayed/nonhealing or chronic wounds constitute a burden for each patient affected, significantly impairing quality of life. Intensive wound care is required, and this places an enormous burden on society in terms of lost productivity and healthcare costs. Therefore, cost-effective, noninvasive, and efficacious treatments are imperative to achieve both (accelerated and complete) healing of problematic wounds and reduce treatment-related costs.</p> <p>Several experimental and clinical studies show efficacy for extracorporeal shock wave therapy as means to accelerate tissue repair and regeneration in various wounds. However, the biomolecular mechanism by which this treatment modality exerts its therapeutic effects remains unclear.</p>
Objective	This review aims to provide an overview of shock wave therapy, its history and development as well as its current place in clinical practice. Recent research advances are discussed emphasizing the role of extracorporeal shock wave therapy in soft tissue wound healing.
Study design & methods	Review article.
Results	<ul style="list-style-type: none"> • ESWT supporting healing of problematic wounds represents an innovative therapeutic modality, which thus far shows clinical efficacy, reproducibility, and safety. • Although the mechanism of action is still under investigation, it was shown that the physical properties of shock waves are translated to complex biological responses including release of factors, cytokine, and chemokines involved in enhanced tissue perfusion and angiogenesis, both essential for the wound healing cascade. • Chronic inflammation and bacterial burden also negatively affect wound healing and, therefore, the suppression of pro-inflammatory status as well as the antimicrobial effect of shock waves could further lead to improved wound healing. • The application of shock waves to wounds is technically easy to perform, allows treatment in an outpatient setting (well tolerated without the need for analgesia), saves time, and does not require anesthetics. • Due to the noninvasive nature, comparatively low costs, and the rare complications associated with this therapy, ESWT may be a valid alternative to conservative and surgical treatments in patients with chronic wound conditions.
Conclusion	<p>ESWT for the treatment of soft tissue wounds is novel approach to treat soft tissue indication. In studies currently available, shock wave therapy has been showed great potential and promising data for treatment of some of the difficult to heal/nonhealing wounds.</p> <p>However, current clinical evidence is weak with only several studies with low patient numbers included. Therefore, it is essential to perform further randomized and controlled clinical studies with sufficient number of subjects to confirm these promising results.</p>
Key message	Several experimental and clinical studies show efficacy for extracorporeal shock wave therapy as means to accelerate tissue repair and regeneration in various wounds.
Pubmed ID	22642362



Evidence Supporting Extracorporeal Shockwave Therapy for Acute and Chronic Soft Tissue Wounds	
Authors	Antonic V, Mittermayr R, Schaden W, Stojadinovic A.
Published	Wounds 2011;23(7):204–215
Date	2011
Place of origin	Diagnostics and Translational Research Center, Combat Wound Initiative Program, Walter Reed Army Medical Center, Washington, DC, USA.
Background	<p>Wounds, particularly among the elderly population, can show delayed or disturbed healing; however, delayed or disturbed healing is also evident in patients with comorbidities such as diabetes, atherosclerosis, venous/arterial insufficiency, reduced mobility due to chronic infirmity, and hypercholesterolemia.</p> <p>Chronic wounds consist of a wide range of inflammatory and degenerative conditions of the musculoskeletal system. Management of chronic, difficult to heal, or non-healing soft tissue wounds requires a multidisciplinary approach. Often these treatment options have inconsistent and irregular outcomes. Poor response or failure to conservative treatments places a substantial burden on patients, their families, the healthcare system, and society in general. Therefore, the development of a new, effective method of treatment to improve healing of problematic wounds and reduce treatment-related costs is extremely valuable; new such therapy is Extracorporeal Shockwave Therapy (ESWT).</p>
Objective	The aim of this review is to provide a general overview of shockwave therapy and its role in the treatment of acute and chronic soft tissue wounds.
Study design & methods	Review article
Results	<ul style="list-style-type: none"> • In animal models, ESWT has been shown to produce favorable molecular microenvironment in the wound tissue, suppress early pro-inflammatory cytokines and chemokines, and enhance expression of several wound healing relevant genes: ELR-positive CXC chemokines, CC chemokines, and cytokines. • In contrast to the focused ESWT, shockwaves for the treatment of acute and chronic wounds are unfocused with low energy flux densities. • In wound care, typically a larger surface area is necessary to achieve energy transfer via the shockwave therapy, and the head has a parabolic instead of an ellipsoid reflector. • Current literature supports ESWT treatment modality due to its efficacy, reproducibility, and virtually no adverse events. • Negative effects of chronic inflammation are suppressed after the treatment leading to improved wound healing, improved tissue perfusion, and increased blood vessel formation. • Difficult to heal and chronic wounds show significant improvement after the treatment with a low rate of wound recurrence.
Conclusion	Shockwave wound treatment is clinically effective, non-invasive (no morbidities related to surgery), is well tolerated by patients, does not require anesthesia, and is cost-effective and easy to apply on an outpatient basis.
Key message	Shockwave therapy is safe and effective for wound healing. Unfocused shockwaves with low energy flux densities and larger treatment area are recommended.
Pubmed	/



Extracorporeal shock wave therapy (ESWT) for the treatment of cellulite – A current meta-analysis.	
Authors	Knobloch K, Kraemer R
Published	Int J Surg. 2015 Jul 22. [Epub ahead of print]
Date	Jul 2015
Place of origin	University of Schleswig Holstein, Lubeck, Germany.
Background	
Objective	The aim of this metaanalysis was to investigate the effectiveness of extracorporeal shock wave therapy (ESWT) in cellulite.
Study design & methods	<p>Meta-analysis.</p> <p>Methods: Electronic databases (such as Ovid MEDLINE, Scopus and Ovid) as well as reference lists of the available studies were evaluated in June 2015 by two expert examiners. Assessment of each study's methodological quality was performed with the help of the published quality index tool by Downs and Black.</p> <p>Studies: bthis metanalysis included a total of 11 clinical trials on the effects of ESWT on cellulite with a total of 294 included females.</p> <ul style="list-style-type: none"> • 5 randomised controlled trials (123 subjects) • 5 cohort studies (170 subjects) • 1 case study
Results	<ul style="list-style-type: none"> • Both, focused as well as radial ESWT devices have been found effective in treating cellulite so far. • Typically, 1 or 2 sessions per week and 6 to 8 sessions overall were studied in the published clinical trials. • Overall, outcome parameters mainly focused on digital standardized photographs, circumference measurements and specific ultrasound examinations. • Reporting quality showed substantial heterogeneity. <p>Possible suggested mechanisms:</p> <ul style="list-style-type: none"> • Shockwave energy weakens the fibrous septae and thus, smoothens the afflicted skin. • Reduction of lymphedema. • Shockwave therapy might somewhat influence mesenchymal stem cells.
Conclusion	<ul style="list-style-type: none"> • Radial as well as focused ESWT and the combination of both are able to improve the degree of cellulite both in terms of appearance as well as in terms of ultrasound improvement of the subcutaneous fat. • The authors also suggest that in the future, combining ESWT and laser therapy may further enhance the beneficial effect in cellulite.
Key message	There is growing evidence that both, radial as well as focused ESWT and the combination of both are able to improve the degree of cellulite.
Pubmed	26209782



Placebo controlled, prospectively randomized, double-blinded study for the investigation of the effectiveness and safety of the acoustic wave therapy (AWT®) for cellulite treatment.	
Authors	Russe-Wilflingseder K, Russe E, Vester JC, Haller G, Novak P, Krotz A.
Published	J Cosmet Laser Ther. 2013 Jun;15(3):155-62.
Date	Jun 2013
Place of origin	Praxis und Laserzentrum, Innsbruck, Austria.
Objective	To demonstrate the efficacy and safety of AWT in the treatment of cellulite.
Tested products	D-ACTOR® 200 (Storz Medical AG) Two different transmitters were used, the Deep Impact® DI15 and the D-Actor® D20-S transmitter.
Study design & methods	<p>Prospective randomised double blinded placebo controlled study.</p> <p><u>Subjects:</u> 17 patients with cellulite.</p> <p><u>Methods:</u> patients were randomly assigned into a verum (11) and a placebo (5) group.</p> <ul style="list-style-type: none"> • The patients were treated once a week for 7 weeks, a total of 8 treatments. • The treatment was performed with the DI15 transmitter within an energy range of 2–3 bar and the D20-S transmitter at 3–5 bar pressure setting, depending on pain sensation that was tolerated by the patient. Each area was treated with a dose of 1000 pulses with the DI15 transmitter and 2500 pulses with the D-20S transmitter. • The placebo group was treated with a specially designed placebo hand piece, where the energy transfer to the transmitter was blocked and thus an effective treatment prevented. <p><u>Outcomes:</u></p> <ul style="list-style-type: none"> • 3D imaging topography system providing an objective measure of cellulite. The changes in height and depth of dimples before and after AWT was evaluated by four efficacy criteria for the waviness of the skin surface and the volume of depressions and elevations • Patient's questionnaire: number of dimples, depths of dimples, skin firmness, skin texture, shape of the treated area and reduction of the circumference at the treated area. • 2D pictures evaluated from blinded observers using the "Modified Hexsel Scale (CSS)", which ranges from 0 points (no cellulite) to 12 points (maximum cellulite).
Results	<ul style="list-style-type: none"> • Patient's questionnaire in the verum group revealed an improvement in number and depth of dimples, skin firmness and texture, in shape and in reduction of circumference. • 2D pictures photo documentation results: all four examiners saw a significant decrease of the appearance of cellulite from baseline to follow-up 2 in the verum group, whereas no statistically significant decrease could be seen in the placebo group. • 3D topography results: in the verum group the two parameters for the waviness of skin surface and the two parameters for the volume of depressions and elevation evidence a significant improvement. • The overall result of the 3D topography at two follow-up visits indicates a more than medium sized superiority (MW = 0.6706) and is statistically significant (pWei-Lachin = 0.0106). The placebo group revealed no statistical significance. • No side effects were seen.
Conclusion	<p>Objective 3D imaging, blinded 2D photo evaluation and subjective patient evaluation indicate a significant improvement of cellulite with AWT® (= RPW) compared to placebo.</p> <p>The improvement in the appearance of cellulite increases continually up to 3 months and can be considered at least as temporary.</p>
Key message	Radial shock wave therapy is safe and effective for cellulite treatment.
Pubmed ID	23688206

Controlled, randomized study evaluating the effects of treating cellulite with AWT/EPAT.	
Authors	Adatto M, Adatto-Neilson R, Servant JJ, Vester J, Novak P, Krotz A
Published	J Cosmet Laser Ther. 2010 Aug;12(4):176-82.
Date	Aug 2010
Place of origin	Skinpulse Dermatology & Laser Center, Geneva, Switzerland
Background	Cellulite affects 95% of women and can lead to negative consequences.
Objective	To demonstrate the efficacy and safety of acoustic wave therapy (AWT®) using extracorporeal pulse activation technology (EPAT®) to manage cellulite.
Tested products	D-ACTOR 200 by Storz Medical AG
Study design & methods	<p>Randomised controlled clinical study.</p> <p><i>Subjects:</i> 25 women with cellulite.</p> <p><i>Methods:</i> subjects were treated with AWT on one leg (assignment of treated leg was randomised).</p> <ul style="list-style-type: none"> • 6 AWT treatment sessions were performed over the course of 4 weeks. • 3000 pulses were applied to an area measuring approximately 10 x 15 cm on the thigh. <p><i>Outcomes:</i> follow-up visits were performed 1 week and 12 weeks after treatment.</p> <ul style="list-style-type: none"> • <i>Primary outcome:</i> Changes in the skin structure were evaluated with 3D imaging using the DermaTOP System (Eotech, Paris, France). • <i>Secondary outcome:</i> Skin elasticity measurements were performed using the DermaLab Device (Cortex Technology, Hadsund, Denmark).
Results	<ul style="list-style-type: none"> • The difference between treated and untreated legs was statistically significant with regard to depressions, elevations, roughness and elasticity after the first follow-up visit. • At follow-up 2 (3 months after the last treatment), the result was not only maintained, but the treated leg showed even further improvement. • While this study focused on the cosmetic effects of EPAT, it is theorized that the results achieved by acoustic wave stimulation may have resulted in improved lymph-drainage and microcirculation within the tissue.
Conclusion	The study showed that the AWT/EPAT treatment using the D-ACTOR 200 appears to be a safe and effective treatment alternative for the temporary improvement in the appearance of cellulite.
Key message	Radial shockwave therapy significantly improves the visual appearance of cellulite.
Pubmed ID	20590369

