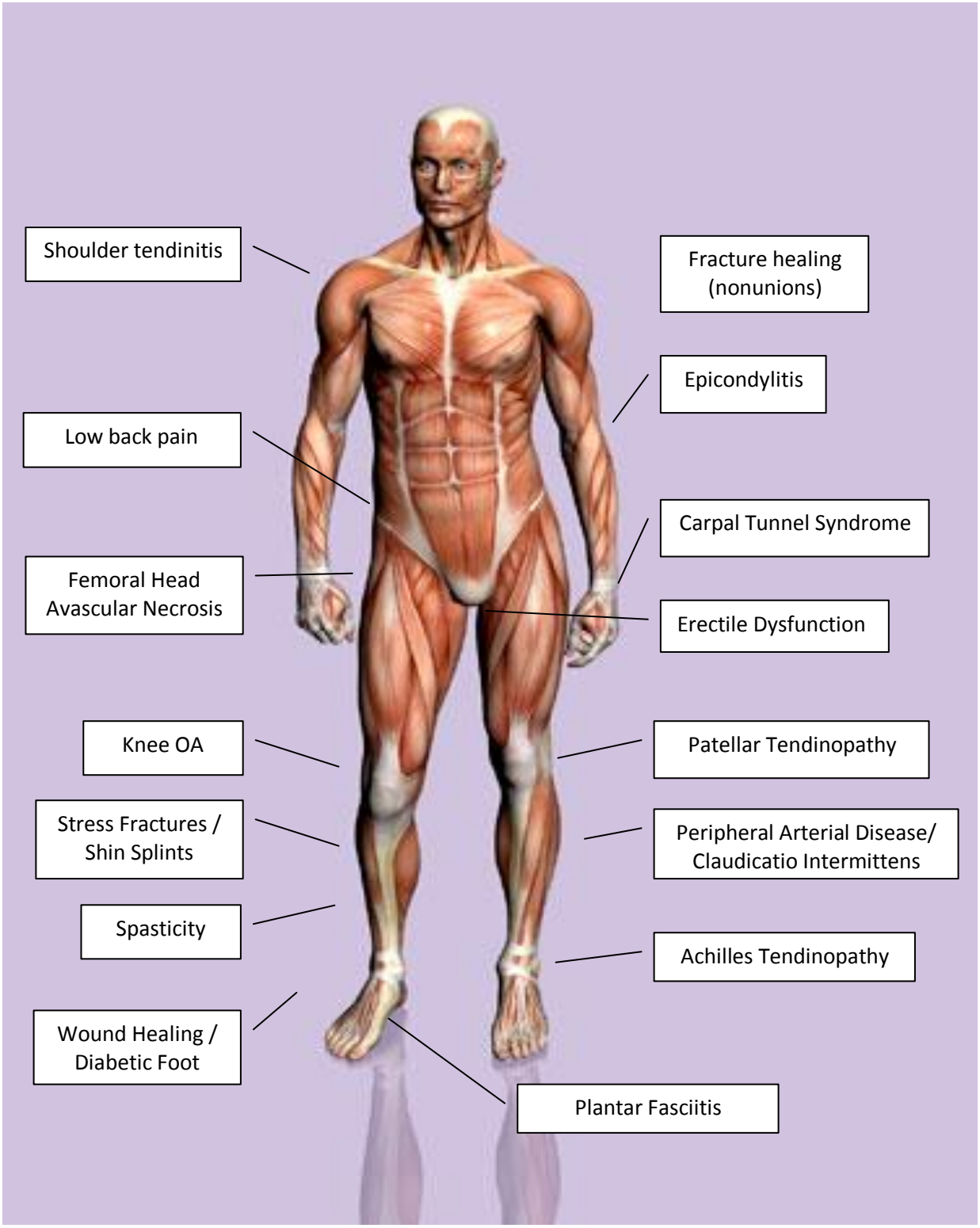
Focused Shockwave

Scientific Studies Overview

DJO GLOBAL

Evidence based indications

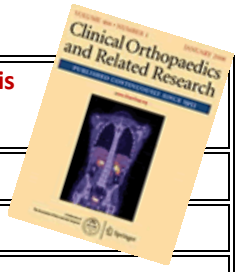


SHOULDER TENDINITIS

Prognostic factors for the outcome of extracorporeal shockwave therapy for calcific tendinitis of the shoulder.	
Authors	Chou WY, Wang CJ, Wu KT, Yang YJ, Ko JY, Siu KK.
Published	Bone Joint J. 2017 Dec;99-B(12):1643-1650.
Date	Dec 2017
Place of origin	Kaohsiung Chang Gung Memorial Hospital and Chang Gung University College of Medicine, Kaohsiung, Taiwan.
Objective	To identify factors that are prognostic of the outcome of extracorporeal shockwave therapy (ESWT) for calcific tendinitis of the shoulder.
Study design & methods	**Retrospective study.** *Subjects*: 268 patients with calcific shoulder tendinitis who were treated with ESWT since 1998. *Medthods*: Since 1998, patients with symptomatic calcific tendinitis of the rotator cuff have been treated with ESWT using an electrohydraulic mode shockwave device. One year after ESWT, patients were grouped according to the level of resorption of calcification. 241 shoulders (232 patients) were included in the study.
Results	• Of 241 symptomatic shoulders, complete resorption (CR) of calcification occurred in 134 (CR group). The remaining 107 shoulders had incomplete resorption (ICR) (ICR group). • Overall, 55.6% of the 241 shoulders were asymptomatic after shockwave therapy. 81% of the CR group and 23.4% of the ICR group were symptom free. • Gartner type I calcification was most common in the ICR group (64.5% versus 6.7%) . The mean duration of symptoms before ESWT was significantly longer in the ICR group. • Poor prognosis was significantly related to Gartner type I calcification, calcification extent > 15 mm and duration of symptoms > 11 months.
Conclusion	ESWT yields a good prognosis in symptomatic shoulder tendinitis with Gartner and Heyer type II and III calcification. For patients with negative prognostic factors, an alternative procedure other than ESWT is recommended in patients with calcifying tendinitis of the shoulder.
Key message	Some factors predict poor outcome of ESWT - Gartner type I calcification was the most negative prognostic factor.
Pubmed	29212688

Focused extracorporeal shock wave therapy combined with supervised eccentric training for supraspinatus calcific tendinopathy.	
Authors	Carlisi E, Lisi C, Dall'angelo A, Monteleone S, Nola V, Tinelli C, Dalla Toffola E.
Published	Eur J Phys Rehabil Med. 2016 Nov 8. [Epub ahead of print]
Date	Nov 2016
Place of origin	Rehabilitation Unit, I.R.C.C.S. Policlinico San Matteo Foundation, University of Pavia, Pavia, Italy.
Background	Extracorporeal shock wave therapy is effective in reducing shoulder pain and improving function in calcific supraspinatus tendinopathy. Eccentric exercise has been introduced as an effective treatment choice for Achilles tendinopathy, but poor evidence exists about its role in the treatment of rotator cuff tendinopathy.
Objective	To investigate if adding a supervised eccentric training of the shoulder abductor muscles could improve the outcome of extracorporeal shock wave therapy.
Tested products	PiezoSon 100Plus
Study design & methods	**Pre-post intervention pilot study with matched control-group.** *Subjects*: 22 subjects affected by painful supraspinatus calcific tendinopathy. *Methods*: • The study-group was assigned to receive focal extracorporeal shockwave therapy (f-ESWT) plus a supervised eccentric training (SET) of the shoulder abductor muscles. • The matched control-group received f-ESWT only. Patients were treated with ESWT once a week for 3 consecutive weeks, they received 1700 pulses per session (4Hz, 0.15mJ/cm²). After the 3rd ESWT session, patients from the study group received 6 week SET program. *Outcomes*: • Shoulder pain and function by the means of a numeric rating scale (p-NRS) and a DASH scale. • Isometric strength of the abductor muscles of the affected shoulder using a handheld dynamometer. Patients were assessed at 9 weeks (T1) after the enrollment.
Results	• At 9 weeks post-enrollment there was a significant decrease in pain ($p<0.001$) and an improvement in upper limb function ($p<0.001$) in both groups. • However, no statistical differences in favour of the study-group, in terms of p-NRS and DASH total score were observed. • A mild increase (13% from the baseline) of the maximum isometric abduction strength was noticed in the study- group at t1.
Conclusion	f-ESWT is effective in reducing shoulder pain and improving function in calcific supraspinatus tendinopathy. Adding a supervised eccentric training, focused on the abductor muscles, was useful to improve maximum isometric abduction strength, but appeared to give no advantage in the short-term outcome of shock wave therapy.
Key message	Focused shockwave provided significant improvement of pain and function, but there was no additional advantage from eccentric exercises.
Pubmed ID	27824237

Extracorporeal shockwaves therapy versus hyaluronic acid injection for the treatment of painful non-calcific rotator cuff tendinopathies: preliminary results. 
Authors: Frizziero A, Vittadini F, Barazzuol M, Gasparre G, Finotti P, Meneghini A, Maffulli N, Masiero S
Published: J Sports Med Phys Fitness. 2017 Sep;57(9):1162-1168.
Date: Sep 2017
Place of origin: Department of Physical and Rehabilitation Medicine, University of Padua, Padua, Italy.
Objective: To compare the clinical effectiveness of low molecular weight hyaluronic acid (LMW-HA) injection versus low-energy extracorporeal shock-wave therapy (ESWT) until 3 months of follow-up for the management of painful non-calcific rotator cuff tendinopathies, evaluating also the trend over time between the groups.
Tested products: Storz Modulith SLK
Study design & methods: **Prospective, randomized, single blind comparative pilot-study.** *Subjects*: 34 patients affected by painful rotator cuff tendinopathy. *Methods*: subjects were randomly divided into 2 groups of 17 individuals. • The first group (group A; mean age 58.2 years) underwent 3 injections of LMW-HA (Hyalgan®, 500-730 kDa) • The second group (group B; mean age 58.5 years) the treatment protocol consisted of 4 sessions of low-energy ESWT. Each session consisted of 1600 shots at a frequency of 4 hz. The applied energy was adjusted on the basis of the patient's tolerance, until a maximum level not exceeding 0.15 mJ/mm². *Outcomes*: • Pain level and function were assessed with the DASH and Constant-Murley questionnaires. • Parameters were evaluated at baseline (V0), at the end of the treatment (V1) and after 3 months of follow-up (V2).
Results: • Patients of both groups achieved statistically significant improvement in pain and function (P<0.0001). • Intra-articular injections of LMW-HA provide prompt clinical improvement compared to ESWT, which results in more gradual improvement over time.
Conclusion: LMW-HA and low-energy ESWT are effective and safe in patients suffering from non-calcific rotator cuff tendinopathy until 3 months of follow-up.
Key message: Both ESWT and Hyaluron injections provide significant improvement of pain and function in patients with non-calcific rotator cuff tendinopathy until 3 months follow-up.
Pubmed ID: 27070534

High-energy versus low-energy extracorporeal shock wave therapy for calcifying tendinitis of the shoulder: which is superior? A meta-analysis. 	
Authors	Verstraelen FU, In den Kleef NJ, Jansen L, Morrenhof JW
Published	Clin Orthop Relat Res. 2014 Sep;472(9):2816-25.
Date	Sep 2014
Place of origin	Viecuri Medical Centre, Venlo, The Netherlands.
Background	There are several treatment options for calcifying tendinitis of the shoulder. The next step treatment after conservative treatment fails is still a matter of dispute. Extracorporeal shock wave therapy (ESWT) has been shown to be a good alternative to surgery, but the best treatment intensity remains unknown. High-energy ESWT is much more painful, more expensive, and usually is done in an inpatient setting, whereas low-energy ESWT can be performed in an outpatient setting by a physical therapist.
Objective	To answer two clear research questions: 1. Is there a greater increase in the Constant-Murley score in patients treated with high-energy ESWT compared with those treated with low-energy ESWT by 3 months and by 6 months? 2. Is there a greater chance of complete resorption of the calcifications in patients treated with high-energy ESWT compared with those treated with low-energy ESWT by 3 months and by 6 months?
Study design & methods	**Systematic review and meta-analysis of randomized trials (level 1)** *Studies*: eligible for inclusion were all randomized controlled trials (RCTs) that compared high-energy ESWT (> 0.28 mJ/mm²) with low-energy ESWT (< 0.08 mJ/mm²). • 5 RCTs (359 participants) were included. *Outcomes*: • Constant-Murley score
Results	• All five RCTs showed greater improvement in functional outcome (Constant-Murley score) in patients treated with high-energy ESWT compared with patients treated with low-energy ESWT at 3 and 6 months. • The 3-month mean difference was 9.88 (95% CI, 9.04-10.72, p < 0.001; 6-month data could not be pooled). • Furthermore, high-energy ESWT more often resulted in complete resorption of the deposits at 3 months. The corresponding odds ratio was 3.40 (95% CI, 1.35-8.58) and p = 0.009 (6-month data could not be pooled). [odds ratio: the probablilty of calcification resorption is 3.4 times higher with high-energy than with low-energy shockwave]
Conclusion	High-energy ESWT is more effective than low-energy ESWT in terms of functional outcome (Constant-Murley score) and radiographic resorption (chance of complete resorption) of the deposits after 3 months.
Key message	High-energy shock wave therapy is more likely to result in improved shoulder function and resorption of the deposits compared with low-energy shockwave.
Pubmed ID	24872197

High-energy extracorporeal shock-wave therapy for treating chronic calcific tendinitis of the shoulder: a systematic review. 	
Authors	Bannuru RR, Flavin NE, Vaysbrot E, Harvey W, McAlindon T.
Published	Ann Intern Med. 2014 Apr 15;160(8):542-9.
Date	Apr 2014
Place of origin	Center for Treatment Comparison and Integrative Analysis, Division of Rheumatology, Tufts Medical Center, Boston, USA.
Background	Calcific and noncalcific tendinitis of the shoulder can be unresponsive to conventional therapies. Extracorporeal shock-wave therapy (ESWT) has been suggested as an alternative treatment.
Objective	To assess the efficacy of ESWT in patients with calcific and noncalcific tendinitis.
Study design & methods	**Systematic review.** *Studies*: Randomized, controlled trials (RCTs) comparing high-energy versus low-energy ESWT or placebo for treatment of calcific or noncalcific tendinitis of the shoulder. • 28 RCTs met the inclusion criteria. *Outcomes*: • Pain (visual analogue scale score) • Functional assessment (Constant-Murley score) • Resolution of calcifications.
Results	• 20 RCTs compared ESWT energy levels and placebo and consistently showed that high-energy ESWT was significantly better than placebo in decreasing pain and improving function and resorption of calcifications in calcific tendinitis. • The results for low-energy ESWT favored ESWT only for function, whereas results for pain and reduction of calcifications were inconclusive. • No significant difference was found between ESWT and placebo in treatment of noncalcific tendinitis. • No serious adverse events occurred in any of the included studies.
Conclusion	High-energy ESWT is effective for improving pain and shoulder function in chronic calcific shoulder tendinitis and can result in complete resolution of calcifications. This therapy may be underutilized for a condition that can be difficult to manage. The safety and efficacy of ESWT, coupled with its noninvasiveness, may offer an alternative to surgery.
Key message	This systematic review showed that high-energy ESWT (EFD ≥0.28 mJ/mm^2) was effective for the treatment of calcific tendinitis of the shoulder in terms of reducing pain, improving function, and inducing resorption of calcifications.
Pubmed ID	24733195

EPICONDYLITIS / TENNIS ELBOW

Extracorporeal shock wave therapy without local anesthesia for chronic lateral epicondylitis.	
Authors	Pettrone FA, McCall BR.
Published	J Bone Joint Surg Am. 2005 Jun;87(6):1297-304.
Date	2005
Place of origin	Commonwealth Orthopaedics, Arlington, VA, USA.
Objective	To evaluate the use of extracorporeal shock wave therapy without local anesthesia to treat chronic lateral epicondylitis.
Tested products	Sonocur, Siemens
Study design & methods	**Double-blinded randomised placebo-controlled trial.** *Subjects*: 114 patients with a minimum 6-month history of lateral epicondylitis that was unresponsive to conventional therapy. *Methods*: subjects were randomized into double-blind active treatment and placebo groups. The protocol consisted of three weekly treatments of either low-dose shock wave therapy without anesthetic or a sham treatment. • Active treatment consisted of one treatment each week with 2000 impulses at 0.06 mJ/mm² • Sham treatment used a sound-reflecting pad between the patient and the application head of the machine. *Outcomes*: • Patients had a physical examination, including provocation testing and dynamometry, at 1, 4, 8, and 12 weeks and at 6 and 12 months after treatment. • Radiographs, laboratory studies, and electrocardiograms were also evaluated prior to participation and at 12 weeks. • A visual analog scale was used to evaluate pain • An upper extremity functional scale was used to assess function. Crossover to active treatment was initiated for nonresponsive patients who had received the placebo and met the inclusion criteria after 12 weeks. A total of 108 of the 114 randomized patients completed all treatments and the 12 weeks of follow-up required by the protocol. 61 patients completed one year of follow-up, whereas 34 patients crossed over to receive active treatment.
Results	• A significant difference ($p = 0.001$) in pain reduction was observed at 12 weeks in the intent-to-treat cohort, with an improvement in the pain score of at least 50% seen in 61% (34) of the 56 patients in the active treatment group who were treated according to protocol compared with 29% (17) of the 58 subjects in the placebo group. • This improvement persisted in those followed to one year. • Functional activity scores, activity-specific evaluation, and the overall impression of the disease state all showed significant improvement as well ($p < 0.05$). • Crossover patients also showed significant improvement after 12 weeks of active treatment, with 56% (nineteen of thirty-four) achieving an improvement in the pain score of at least 50% ($p < 0.0001$).
Conclusion	These results demonstrate that low-dose shock wave therapy without anesthetic is a safe and effective treatment for chronic lateral epicondylitis that had been refractory to other nonoperative treatment modalities. In patients who have had failure of conventional treatment of lateral epicondylitis, shock wave therapy can significantly improve the pain scores, functional scores, and the subjective impression of the disease state.

Key message	3 sessions of low-energy shockwave therapy significantly improved pain and function in patients with lateral epicondylitis that had been refractory to other nonoperative treatment modalities.
Pubmed ID	15930540

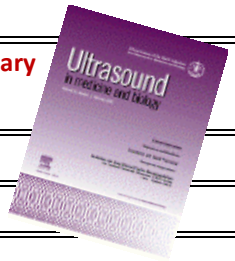
Repetitive low-energy shock wave treatment for chronic lateral epicondylitis in tennis players.	
Authors	Rompe JD, Decking J, Schoellner C, Theis C
Published	Am J Sports Med. 2004 Apr-May;32(3):734-43.
Date	2004
Place of origin	Department of Orthopaedic Surgery, Johannes Gutenberg University School of Medicine, Mainz, Germany.
Background	There is conflicting evidence regarding extracorporeal shock wave treatment for chronic tennis elbow.
Objective	To test whether treatment with repetitive low-energy extracorporeal shock wave treatment is superior to repetitive placebo extra-corporeal shock wave treatment.
Tested products	Sonocur Plus, Siemens
Study design & methods	**Double-blind randomised placebo-controlled trial.** *Subjects*: 78 tennis players with recalcitrant MRI-confirmed tennis elbow of at least 12 months duration. *Methods*: patients were randomly assigned to either • Treatment group 1: received active low-energy extracorporeal shock wave treatment given weekly for 3 weeks (2000 pulses per session, energy flux density of 0.09 mJ/mm², frequency 4Hz.) • Sham group 2: received an identical placebo extracorporeal shock wave treatment (sham group 2). *Outcomes*: • Main outcome measure was pain during resisted wrist extension at 3 months; • Secondary measures were >50% reduction of pain and the Upper Extremity Function Scale.
Results	• At 3 months, there was a significantly higher improvement in pain during resisted wrist extension in group 1 than in group 2 (mean [SD] improvement, 3.5 [2.0] and 2.0 [1.9]; P =.001 for between-group difference of improvement) • At 3 months, there was also a significantly higher improvement in the Upper Extremity Function Scale (mean [SD] improvement, 23.4 [14.8] and 10.9 [14.9]; P <.001 for between-group difference of improvement). • In the treatment group, 65% of patients achieved at least a 50% reduction of pain, compared with 28% of patients in the sham group (P =.001 for between-group difference).
Conclusion	There is a significant benefit of low-energy ESWT as applied in this study when compared to sham treatment for tennis elbow 3 months after intervention.
Key message	3 weekly sessions of low energy shockwave treatment produced significantly better results than placebo treatment in patients with tennis elbow.
Pubmed ID	15090392

Repetitive shock wave therapy for lateral elbow tendinopathy (tennis elbow): a systematic and qualitative analysis. 	
Authors	Rompe JD, Maffulli N.
Published	Br Med Bull. 2007;83:355-78.
Date	2007
Place of origin	OrthoTrauma Evaluation Center, Mainz, Germany.
Background	Pooled meta-analyses of statistically and clinically heterogeneous data of randomised-controlled studies are difficult to interpret. Therefore, a qualitative study-by-study assessment was thought to be of greater relevance, to physicians confronted with a therapy-resistant tennis elbow patient.
Objective	To determine the effectiveness of shock wave therapy (SWT) for lateral elbow tendinopathy.
Study design & methods	**Systematic review with qualitative analysis** (see background) Studies: 10 RCTs that randomized 948 participants to SWT or placebo or treatment control. • For each trial, two independent reviewers assessed the methodological quality and extracted data. Methodological quality criteria included appropriate randomization, allocation concealment, blinding, number lost to follow-up and intention-to-treat analysis.
Results	• Conflicting results of the 10 studies were found. • There was considerable heterogeneity in terms of methodological quality; treatment regimen; patient selection and follow-up period, precluding pooled analyses. Instead, individual trial results were described in the text. • Only 6 trials had a high-quality methodology. • 2 independent high-quality randomized placebo-controlled trials (196 participants) reported significant success of SWT over placebo (65 versus 28%; 61 versus 29%). Design of both trials included enrolment of chronic recalcitrant patients only; 1500-2000 shocks of low-energy flux density (0.1 mJ/mm(2)) applied to the site of maximal discomfort (clinical focusing) in weekly intervals; no use of local anaesthesia and main follow-up at least 3 months after the last application. • 3 other independent high-quality trials (406 participants) did not find any benefit of SWT over placebo (32 versus 33%; 35 versus 34%; 39 versus 31%). In these three trials, study designs deviated from the design described earlier, enrolling acute patients or applying SWT under local anaesthesia or expanding the application intervals to 4 weeks, while reducing the main follow-up to 4 weeks.
Conclusion	On the basis of well-designed studies showing favourable or unfavourable results, it seems that the literature supports a therapeutic benefit of SWT for managing chronic lateral elbow tendinopathy under restricted conditions only. In this context, this qualitative review identified common variables going along with satisfying results of SWT in the range of 60%: • chronic recalcitrant patients; • repetitive application of 2000 low-energy SWT at weekly intervals for 3–6 weeks; • clinical focusing; • without local anaesthesia; • follow-up at least 3 months after last application. This review has further identified components that may possibly have an adverse effect on the clinical outcome: • enrolment of acute, previously untreated patients; • repetitive application of low-energy SWT at monthly intervals; • use of local anaesthesia and follow-up less than 3 months.
Key message	In this qualitative systematic per-study analysis of 10 randomized-controlled trials, evidence was found for the effectiveness at mid-term follow-up (>3 months) of repetitive (weekly for 3-6 weeks) shock wave treatment for chronic recalcitrant tennis elbow.
Pubmed	17626054

CARPAL TUNNEL SYNDROME

Effect of extracorporeal shock wave therapy on the treatment of patients with carpal tunnel syndrome.	
Authors	Vahdatpour B, Kiyani A, Dehghan F
Published	Adv Biomed Res. 2016 Jul 29;5:120.
Date	Jul 2016
Place of origin	Department of Physical Medicine and Rehabilitation, Isfahan University of Medical Sciences, Isfahan, Iran.
Objective	The aim of this study was to evaluate the effect of a new and noninvasive treatment including extracorporeal shock wave therapy (ESWT) in the treatment of CTS.
Study design & methods	**Single-blind randomised controlled trial.** *Subjects*: 60 patients with moderate CTS in selected health centers of Isfahan Medical University from November 2014 to April 2015. *Methods*: subjects were randomly divided into two groups. • The active ESWT group received conservative treatment plus ESWT, one session per week for 4 weeks. Focus probe with 0.05, 0.07, 0.1, and 0.15 energy and shock numbers 800, 900, 1000, and 1100 were used from the 1st session to the 4th, respectively. • The sham group received conservative treatment plus sham ESWT. Conservative treatment included wrist splint at night for 3 months, consumption of nonsteroidal anti-inflammatory drugs for 2 weeks, and oral consumption of Vitamin B1 for a month. *Outcomes*: • Electrodiagnostic measurements: distal latency of median sensory nerve action potential (SNAP) of third finger; distal latency of median compound muscle action potential (CMAP) of abductor pollicis brevis muscle • VAS pain score • Boston questionnaire (severity of symptoms and functional status) - lower score means less symptom severity and less difficulties to perform ADL functions. Patients were assessed before treatment and after 3 and 6 months.
Results	• A signif. reduction was seen in pain score in both groups after 3 months from the baseline. However, the amount of this reduction was more significant in the ESWT group ($P < 0.05$). • This reduction almost was maintained after 6 months of treatment in the ESWT group but was significantly increased in the control group. • After 3 months from the beginning of treatment, a reduction was seen in the mean score of symptoms severity, but it was only significant in the treatment group ($P > 0.05$). • After 6 months from the beginning of treatment, the symptoms' mean score did not change significantly compared to the previous 3 months in the ESWT group ($P < 0.05$) but was increased in the control group even further of baseline. • After 3 months from the starting of treatment, a significant decrease was seen in the mean score of functional status in both groups, but this value was more in the ESWT group ($P < 0.05$). • The mean of functional status reduction after 6 months of treatment was continued significantly compared to the status at 3 months in the ESWT group ($P < 0.05$), but it was increased in the control group after 6 months compared to 3 months after the treatment. • Assessing electrodiagnostic parameters including CMAP and SNAP distal latency showed the mean values were decreased in both group, but in the treatment group, it is more significant after 3 months of treatment ($P < 0.05$).
Conclusion	All parameters were significantly decreased in the ESWT group after 3 months. These results remained almost constant after 6 months compared with 3 months after treatment. However,

	only two parameters considerably improved after 3 months of treatment in the control group.
Key message	4 weekly sessions of ESWT significantly improved symptoms and function at 3 months. The results were significantly better than in the sham control group and were maintained up to 6 months follow-up.
Pubmed ID	27563630

Extracorporeal shock wave therapy in pillar pain after carpal tunnel release: a preliminary study. 	
Authors	Romeo P, d'Agostino MC, Lazzerini A, Sansone VC.
Published	Ultrasound Med Biol. 2011 Oct;37(10):1603-8.
Date	2011
Place of origin	Orthopaedic Department of the Università degli Studi di Milano, Istituto Ortopedico Galeazzi, Milano, Italy.
Background	"Pillar pain" is a relatively frequent complication after surgical release of the median nerve at the wrist. Its etiology still remains unknown although several studies highlight a neurogenic inflammation as a possible cause. Pillar pain treatment usually includes rest, bracing and physiotherapy, although a significant number of patients still complain of painful symptoms two or even three years after surgery.
Objective	To investigate the efficacy of low-energy, flux density-focused extracorporeal shock wave therapy (ESWT) in the treatment of pillar pain.
Tested products	Storz Modulith SLK
Study design & methods	**Prospective clinical study.** *Subjects*: 40 patients who had pillar pain for at least 6 m after carpal tunnel release surgery. *Methods*: all patients underwent 3 treatments of ESWT, performed at weekly intervals, with an average of 2800 shocks at very low EFD of 0.03 mJ/mm². The pulse repetition frequency was 4 Hz. *Outcomes*: • Pain VAS • Scar redness • Edema Outcomes were clinically evaluated by a single evaluator pre-treatment (T0) and post treatment at 40 d (T1) and 120 d (T2).
Results	In all of the treated patients, there was a marked improvement: • The mean visual analogue scale (VAS) score decreased significantly from 6.18 (±1.02) to 0.44 (±0.63) 120 d after treatment. • Redness and swelling of the surgical scar had also decreased significantly. • At T2 (120 d post treatment), 60% of patients had no pain (i.e., VAS score 0) and of the remaining 40%, no patient had a VAS score .2. • At T2, 83% of patients had no skin redness and 100% had no edema.
Conclusion	ESWT proved to be a valid, safe and noninvasive tool that significantly reduced the recovery time from symptoms.
Key message	ESWT produced significant improvement of pain, redness and swelling in all patients.
Pubmed ID	21856074

The effectiveness of extracorporeal shock wave therapy vs. local steroid injection for management of carpal tunnel syndrome: a randomized controlled trial. 	
Authors	Seok H, Kim SH.
Published	Am J Phys Med Rehabil. 2013 Apr;92(4):327-34.
Date	2013
Place of origin	Department of Physical Medicine and Rehabilitation, College of Medicine, Soonchunhyang University, Bucheon, Republic of Korea.
Background	Local corticosteroid (CS) injection has been widely used to treat carpal tunnel syndrome, but its invasiveness can cause several complications.
Objective	To investigate the efficacy of ESWT for the treatment of CTS and compared the efficacy of ESWT with that of local CS injection, with a follow-up of 3 months.
Tested products	Piezowave
Study design & methods	**Randomized controlled trial.** *Subjects*: 36 patients with carpal tunnel syndrome. *Methods*: subjects were randomized to receive • One session of ESWT - 1000 shots at the maximal tolerable intensity (0.09 - 0.29 mJ/mm²) • One session of CS injection *Outcomes*: • Nerve conduction studies • Pain VAS • Levine Self-assessment Questionnaire Measurements were performed at baseline and at 1 and 3 mos after treatment.
Results	• At baseline, there were no significant differences between the groups with respect to the outcome parameters. • Both groups showed a significant reduction in the visual analog scale at 1 and 3 mos after treatment compared with baseline. • For the symptom severity score on the Levine Self-assessment Questionnaire, the ESWT group showed a significant reduction at 1 and 3 mos after treatment, whereas the CS injection group showed a significant reduction at 3 mos after treatment. • For the nerve conduction parameters, there were mild but no significant improvements in the ESWT group, whereas the sensory nerve conduction velocity, the sensory nerve action potential amplitude, and the distal sensory and motor latencies of the median nerve were significantly improved in the CS injection group.
Conclusion	Compared with CS injection, which was effective but invasive, ESWT also produced significant pain reduction in patients with CTS. ESWT is a potentially safe and noninvasive therapeutic interventional option for decreasing pain in patients with mild to moderately severe CTS.
Key message	ESWT can be as useful as CS injection for relieving symptoms of carpal tunnel syndrome. Furthermore, in contrast to CS injection, it has the merit of being noninvasive.
Pubmed ID	23044704

LOW BACK PAIN

Mechano-transduction effect of shockwaves in the treatment of lumbar facet joint pain: comparative effectiveness evaluation of shockwave therapy, steroid injections and radiofrequency medial branch neurotomy.	
Authors	Nedelka T, Nedelka J, Schlenker J, Hankins C, Mazanec R
Published	Neuro Endocrinol Lett. 2014;35(5):393-7.
Date	2014
Place of origin	Charles University in Prague, 2nd Faculty of Medicine, Department of Neurology, Prague, Czech Republic.
Background	Lumbar facet joints (FJ) is a common source of low back pain and contributes approximmately on one third of chronic low back pain. Medial branch radiofrequency neurotomy is considered as a gold standard in the treatment of facet joint pain. Corticosteroid injections have also presented effect in FJ pain. As an interventional procedures, they carry not-negligible risk of possible complications including infection, damage to nerve root or medial branch structures. Shockwave therapy (SWT) is a non-invasive method for treatment of various musculoskeletal disorders. Its effect is based on transduction of mechanical energy, transferred to cascade of various biochemical processes in target tissue. Its efficacy was proved in the treatment of different painful conditions. The efficacy of SWT was not yet studied in FJ pain.
Objective	To compare the efficacy of SWT against interventional treatment procedures - radiofrequency neurotomy and corticosteroid FJ injections.
Tested products	Storz Duolith SD1
Study design & methods	**Retrospective study.** *Subjects*: 62 patients with unilateral chronic lumbar facet pain. *Methods*: patients were divided into • Group A: SWT group - 3.8 bars, EFD approx. 0.12 mJ/mm2; Procedure was applied in 5 weekly sessions with 3000 shocks per session with initial ultrasound guidance to set the correct angle of applicator head • Group B: Corticosteroid injections group • Group C: Radiofrequency group. *Outcomes*: • Nociceptive pain intensity on VAS scale • Neuropathic pain using PainDETECT validated questionnaire • Severity of pain using the Oswestry low back pain validated score Outcomes were measured before the treatment, after 2,6 and 12 months follow-up.
Results	*Pain VAS score* • At 2 months follow up, there was a significant decrease in average VAS against the baseline value in all 3 groups (p=0.03 in group A, p=0.02 in group B and p=0.007 in group C). • After 6 months, SWT (group A, p=0.02) and RMBN (group C, p=0.009) showed significant changes in average VAS against the baseline, however FJ injections group B revealed increase in average pain with nonsignificant results against baseline VAS (p=0.08). • After 12 months follow-up, there were still significant differences in group A (p=0.04) and group C (p=0.01) in comparison to initial values. *Oswestry low back pain score* • Oswestry low back pain score was improved in all groups after 2 an 6 months, and in group A and C after one year follow-up.

	Neuropatic pain • Among individuals with neuropatic pain, significant change (p<0.05) in SWT and FJ injections group was found in 2 month follow-up only. • In the RMBN group however, a decrease in PainDETECT score was observed at 2, 6 and 12 months followup. The authors did not observe any adverse effects and complications in SWT group. Moreover, in SWT and RMBN groups, significant longterm improvement in daily activities limitation, was observed.
Conclusion	SWT showed better long term pain relief compared to FJ injections and little inferior efficacy compared to medial branch radiofrequency neurotomy.
Key message	SWT appears to be a safe and effective option in the treatment of FJ pain with negligible side effects.
Pubmed ID	25275264

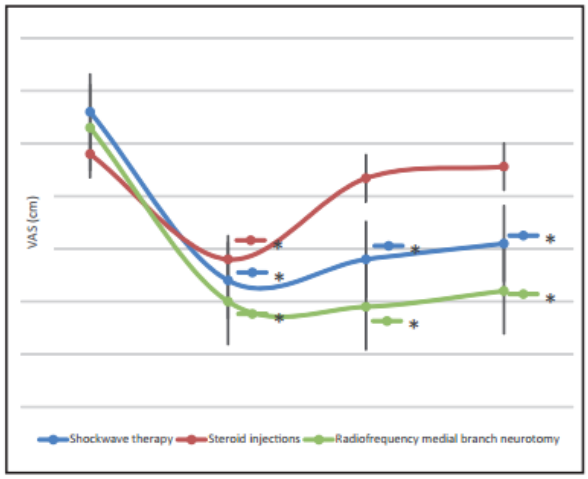


Fig. 2. VAS (cm) values comparison between SWT, FJ medial branch injections and RMBN at baseline, 2, 6 and 12 months follow-up. Mean, maximum and minimal values for each parameter are stated graphically. Significant results (p<0.05) marked with *.

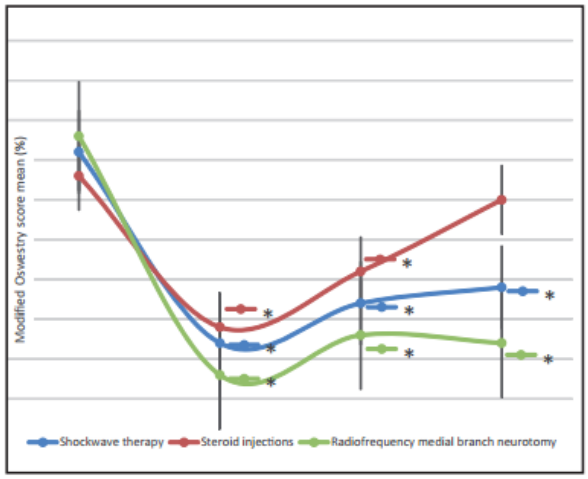


Fig. 3. Modified Oswestry score (%) values comparison between SWT, FJ medial branch injections and RMBN at baseline, 2, 6 and 12 months follow-up. Mean, maximum and minimal values for each parameter are stated graphically. Significant results (p<0.05) marked with *.

Effects of extracorporeal shockwave therapy on patients with chronic low back pain and their dynamic balance ability. 	
Authors	Lee S, Lee D, Park J.
Published	J Phys Ther Sci. 2014 Jan;26(1):7-10.
Date	Jan 2014
Place of origin	Department of Physical Therapy, Youngdong University, Republic of Korea.
Objective	The purpose of the present study was to examine the effects of extracorporeal shockwave therapy (ESWT) for patients with chronic low back pain and their dynamic balance ability.
Tested products	JEST-2000 (Joeun Medical)
Study design & methods	**Comparative clinical study, no randomisation, no control group.** *Subjects*: 28 patients with chronic low back pain. *Methods*: subjects were divided into • Extracorporeal shockwave therapy group (ESWTG: n=13) • Conservative physical therapy group (CPTG, n=15). An exercise program that included Williams' exercises and McKenzie's exercises was performed by both groups. The program was implemented twice a week for 6 weeks. *Outcomes*: • The visual analog scale (VAS) was used to measure the low back pain • Dynamic balance ability was measured with BioRescue (surface area per left side (SAPLS), surface area per right side (SAPRS), surface area per forward side (SAPFS), surface area per back side (SAPBS), and total surface area (TSA) were measured with this system)
Results	• The within-group comparison of the VAS of the ESWTG and the CPTG showed significant improvements after the intervention. • In the VAS comparison between the groups after the treatment, the ESWTG showed a significantly larger improvement. • In the within-group comparison of dynamic balance ability, the ESWTG showed significant improvements after the intervention in SAPLS, SAPRS, SAPFS, SAPBS, and TSA, and the CPTG showed significant improvements in SAPLS and SAPBS. • In the between-group comparison of the dynamic balance ability after the treatment, the ESWTG showed significantly larger improvements in their SAPLS, SAPRS, SAPFS, and TSA.
Conclusion	The exercise program combined with the ESWT relieved chronic back pain more than the exercise program combined with the CPT. ESWT was also more effective at improving the patients' dynamic balance ability.
Key message	Combined with an exercise program, ESWT provided significantly larger improvement of pain and dynamic balance than traditional physical therapy.
Pubmed ID	24567665

Extracorporeal Shock Wave Therapy Versus Trigger Point Injection in the Treatment of Myofascial Pain Syndrome in the Quadratus Lumborum.

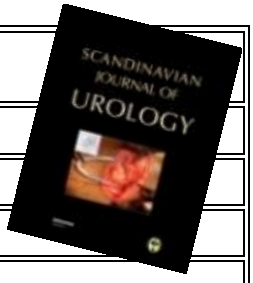
Authors	Hong JO, Park JS, Jeon DG, Yoon WH, Park JH
Published	Ann Rehabil Med. 2017 Aug;41(4):582-588.
Date	Aug 2017
Place of origin	Yonsei University College of Medicine & Gangnam Severance Hospital, Seoul, Korea.
Objective	To compare the effectiveness of extracorporeal shock wave therapy (ESWT) and trigger point injection (TPI) for the treatment of myofascial pain syndrome in the quadratus lumborum.
Tested products	Dornier
Study design & methods	**Retrospective study.** *Subjects & methods*: 30 patients with myofascial pain syndrome in the quadratus lumborum were assigned to ESWT or TPI groups. • ESWT was applied in 3 sessions (with 3-days intervals); 2,000 pulses per session at an intensity of 0.085–0.148 mJ/mm2 • TPI was also applied three times at the tender point of the QL at 3-day intervals. *Outcomes*: • Pain assessment with a visual analogue scale score and pain pressure threshold. • Disability assessment with Oswestry Disability Index, Roles and Maudsley, and Quebec Back Pain Disability Scale scores. Clinical outcomes were assessed three times: before the initial treatment (pre-treatment assessment), immediately after the third treatment (post-treatment assessment), and 1 month after treatment at the outpatient clinic (follow-up assessment). To compare the treatment efficacies, the differences seen in the post-treatment and follow-up assessment, compared to the pre-treatment assessment were recorded and compared.
Results	• Both groups demonstrated statistically significant improvements in pain and disability measures after treatment. • However, in comparing the treatments, we found ESWT to be more effective than TPI for pain relief. • There were no statistically significant differences between the groups with respect to disability.
Conclusion	Compared to TPI, ESWT showed superior results for pain relief. ESWT is considered as an effective treatment for myofascial pain syndrome in the quadratus lumborum.
Key message	Better pain relief with ESWT than with TPI for myofascial pain syndrome in the quadratus lumborum.
Pubmed	28971042

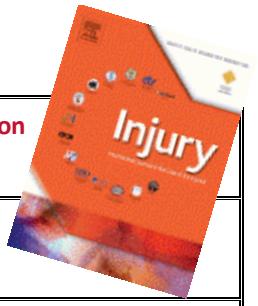
Extracorporeal shock wave therapy for sacroiliac joint pain: A prospective, randomized, sham-controlled short-term trial	
Authors	Moon YE, Seok H, Kim SH, Lee SY, Yeo JH
Published	J Back Musculoskelet Rehabil. 2017 Mar 27. doi: 10.3233/BMR-150405. [Epub ahead of print]
Date	Mar 2017
Place of origin	Catholic University Seoul St. Mary's Hospital, Seoul, Korea. Soonchunhyang University Hospital, Bucheon, Korea.
Background	Sacroiliac joint (SIJ) pain can cause lower back pain and pelvic discomfort. However, there is no established standard treatment for SIJ pain. Extracorporeal shock wave therapy (ESWT) is a novel, non-invasive therapeutic modality for musculoskeletal disorders. The mechanism underlying shockwave therapy is not fully understood, but the frequency with which ESWT is applied clinically has increased over the years.
Objective	To evaluate the efficacy of using ESWT to treating SIJ pain.
Tested products	Dornier
Study design & methods	**Randomised controlled trial.** *Subjects*: 30 patients with SIJ pain. *Methods*: subjects were assigned randomly to • ESWT (n = 15): patients received a single session of 2,000 shockwaves with energy set to the maximum level tolerable by the patient (energy density = 0.09-0.25 mJ/mm2). The probe was oriented perpendicular to the posterior SIJ line, and moved up and down along the joint line • Sham control (n = 15) groups: patients received 2,000 shockwaves with the probe oriented parallel to the posterior SIJ line. Participants were instructed to refrain from using any other conservative treatment, including anti-inflammatory medication and other physical modalities during the study. *Outcomes*: • 10-cm numeric rating scale (NRS) • Oswestry Disability Index (ODI) Scores were assessed before the intervention, and 1 and 4 weeks post-intervention.
Results	• In the ESWT group, NRS decreased significantly at post-treatment week 4 (3.64 (95% confidence interval, 2.29-4.99)) compared to baseline (6.42 (5.19-7.66); P < 0.05). ODI improved at 1 and 4 weeks compared to baseline, but not significantly. • In the sham group, NRS and ODI did not differ at any post-treatment time point. • There was a significant group difference in NRS at week 4 post-treatment (3.64 (2.29-4.99) in the ESWT group vs. 6.18 (5.34-7.02) in the sham control group; P < 0.05), but this was not the case for ODI.
Conclusion	A single session of ESWT on the posterior SIJ line significantly reduced pain. ESWT represents a potential therapeutic option for decreasing SIJ pain.
Key message	ESWT is a potential effective and safe alternative for improving pain and disability in SI joint pain.
Pubmed ID	28372309

ERECTILE DYSFUNCTION

Effects of Low-Intensity Extracorporeal Shockwave Therapy on Erectile Dysfunction: A Systematic Review and Meta-Analysis.	
Authors	Clavijo RI, Kohn TP, Kohn JR, Ramasamy R
Published	J Sex Med. 2017 Jan;14(1):27-35.
Date	Jan 2017
Place of origin	Department of Urology, University of California, Los Angeles, CA, USA.
Objective	To use systematic review and meta-analysis to assess the efficacy of Li-ESWT by comparing change in erectile function as assessed by the erectile function domain of the International Index of Erectile Function (IIEF-EF) in men undergoing Li-ESWT vs sham therapy for the treatment of ED.
Study design & methods	**Systematic review and Meta-analysis.** *Methods*: • Systematic search was conducted of MEDLINE, EMBASE, and ClinicalTrials.gov for randomized controlled trials that were published in peer-reviewed journals or presented in abstract form of Li-ESWT used for the treatment of ED from January 2010 through March 2016. • Randomized controlled trials were eligible for inclusion if they were published in the peer-reviewed literature and assessed erectile function outcomes using the IIEF-EF score. • Estimates were pooled using random-effects meta-analysis. *Studies*: • 7 trials involving 602 participants met the inclusion criteria. The average age was 60.7 years and the average follow-up was 19.8 weeks. *Outcome*: • Change in IIEF-EF score after treatment with Li-ESWT in patients treated with active treatment vs sham Li-ESWT probes.
Results	• There was a statistically significant improvement in pooled change in IIEF-EF score from baseline to follow-up in men undergoing Li-ESWT vs those undergoing sham therapy (6.40 points vs 1.65 points; between-group difference, P = .047). • All studies included in the present analysis used an energy flux density of 0.09 mJ/mm².
Conclusion	In this meta-analysis of seven randomized controlled trials, treatment of ED with Li-ESWT resulted in a significant increase in IIEF-EF scores.
Key message	Based on 7 randomised controlled trials including 602 patients it can be concluded low intensity ESWT is significantly more effective than sham treatment for ED treatment.
Pubmed	27986492

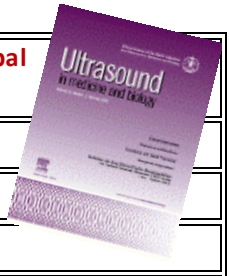
Low-intensity Extracorporeal Shock Wave Treatment Improves Erectile Function: A Systematic Review and Meta-analysis. 	
Authors	Lu Z, Lin G, Reed-Maldonado A, Wang C, Lee YC, Lue TF
Published	Eur Urol. 2016 Jun 16. [Epub ahead of print]
Date	June 2016
Place of origin	University of California, San Francisco, CA, USA The First Hospital of Jilin University, Changchun, People's Republic of China.
Background	As a novel therapeutic method for erectile dysfunction (ED), low-intensity extracorporeal shock wave treatment (LI-ESWT) has been applied recently in the clinical setting.
Objective	To perform a systematic review of the evidence with a meta-analysis regarding LI-ESWT for patients with ED to identify the efficacy of the treatment modality.
Study design & methods	**Systematic review with meta-analysis.** *Methods*: a comprehensive search of the PubMed and Embase databases to November 2015 was performed. • There were 14 studies including 833 patients from 2005 to 2015. 7 studies were randomized controlled trials (RCTs); however, in these studies, the setup parameters of LI-ESWT and the protocols of treatment were variable. *Outcomes*: • The International Index of Erectile Function (IIEF) and the Erection Hardness Score (EHS) were the most commonly used tools to evaluate the therapeutic efficacy of LI-ESWT.
Results	• The meta-analysis revealed that LI-ESWT could significantly improve IIEF (mean difference: 2.00; 95% confidence interval [CI], 0.99-3.00; p<0.0001) and EHS (risk difference: 0.16; 95% CI, 0.04-0.29; p=0.01). • Therapeutic efficacy could last at least 3 mo. • The patients with mild-moderate ED had better therapeutic efficacy after treatment than patients with more severe ED or comorbidities. • Energy flux density, number of shock waves per treatment, and duration of LI-ESWT treatment were closely related to clinical outcome, especially regarding IIEF improvement. The EFD used varied from 0.09 to 0.25 mJ/mm² among the studies included in our analysis. The meta-analysis showed that 3000 pulses per treatment brought more improvement than 1500 or 2000 pulses per treatment; however, more frequent treatment and longer treatment course did not improve erectile function significantly. The optimal treatment protocol remains to be defined. • In addition, It seemed that more sites treated might produce better results.
Conclusion	The number of studies of LI-ESWT for ED have increased dramatically in recent years. Most of these studies presented encouraging results, regardless of variation in LI-ESWT setup parameters or treatment protocols. These studies suggest that LI-ESWT could significantly improve the IIEF and EHS of ED patients. From this review, the authors state it is clear that LI-ESWT may have the potential to be **the first-choice noninvasive treatment for patients with ED**.
Key message	Shockwave treatment significantly improves erectile dysfunction and the efficacy can last up to 3 months and more.
Pubmed ID	27321373

Can low-intensity extracorporeal shockwave therapy improve erectile dysfunction? A prospective, randomized, double-blind, placebo-controlled study. 	
Authors	Olsen AB, Persiani M, Boie S, Hanna M, Lund L.
Published	Scand J Urol. 2015;49(4):329-33.
Date	2015
Place of origin	Department of Urology, Viborg Hospital, Viborg, Denmark.
Objective	The aim of this study was to investigate whether low-intensity extracorporeal shockwave therapy (LI-ESWT) can be used as a treatment for men with erectile dysfunction of organic origin.
Tested products	Storz Duolith SD1
Study design & methods	**Prospective, randomized, blinded, placebo-controlled study.** *Subjects*: 112 men with erectile dysfunction unable to have intercourse either with or without medication. *Methods*: The men were randomly assigned either to • LI-ESWT (n = 51, active group) - shockwave therapy was set at 0.15 mJ/mm², 5 Hz, with a total of 3000 impulses & a total energy of 12.8 J per treatment, and performed in 6 positions on the penis (distal, centre and proximal part of each corpus cavernosum) and given by a doctor. • Placebo (n = 54, placebo group). They received five treatments over 5 weeks. • After 10 weeks, the placebo group received active treatment (active placebo group). *Outcomes*: Erectile dysfunction was assessed at screening and 5, 12 and 24 weeks after treatment. Assessment was performed by • Interview • Erection Hardness Scale (EHS) • International Index of Erectile Function (IIEF-15) questionnaire.
Results	• The EHS after 5 weeks showed that 29 men (57%) in the active group were able to obtain an erection after treatment and to have sexual intercourse without the use of medication. In the placebo group, only 5 men (9%) showed similar results. the difference between both groups is significant (p = 0.0001). • No significant result was found with the use of the IIEF - Erectile Function domain. • After 24 weeks, 7 men (19%) in the active group and 9 men (23%) in the active placebo group were still able to have intercourse without medication.
Conclusion	This placebo-controlled study over 5 weeks shows that 57% of the men who suffered from erectile dysfunction had an effect from LI-ESWT. The treatment is patient friendly, has no side-effects requiring treatment and can be used for all patients.
Key message	Low intensity focused shockwave therapy provided significantly better results than placebo treatment.
Pubmed ID	25470423



Extracorporeal shockwave therapy (ESWT) ameliorates healing of tibial fracture non-union unresponsive to conventional therapy.	
Authors	Haffner N, Antonic V, Smolen D, Slezak P, Schaden W, Mittermayr R, Stojadinovic A
Published	Injury. 2016 Jul;47(7):1506-13.
Date	Jul 2016
Place of origin	Orthopaedic Hospital Gersthof, Vienna, Austria.
Background	Tibial non-unions are common cause of demanding revision surgeries and are associated with a significant impact on patients' quality of life and health care costs. Extracorporeal shockwave therapy (ESWT) has been shown to improve osseous healing in vitro and in vivo.
Objective	To evaluate the efficacy of ESWT in healing of tibial non-unions unresponsive to previous surgical and non-surgical measures.
Tested products	OrthoGold280 (MTS Medical)
Study design & methods	**Retrospective study.** *Subjects*: 56 patients with tibia non-union. • Fracture non-union was clinically defined as a painful weight bearing as well as pressure soreness over the fracture. • Radiologically, non-unions were characterised by absence of restitution of cortical continuity of at least 3 of 4 cortices. • On average patients underwent 1.9 times (±1.3SD) surgical interventions prior to ESWT displaying the rather negatively selected cohort and its limited therapy responsiveness. *Methods*: all patients received 3000-4000 impulses of electrohydraulic shockwaves at an energy flux density of 0.4mJ/mm² (-6dB). *Outcomes*: • Complete healing was assessed on the basis of clinical and radiological data collected during the follow-up.
Results	• In 88.5% of patients receiving ESWT complete bone healing was observed after 6 months irrespective of underlying pathology. • The multivariant analysis showed that time of application is important for therapy success. Patients achieving healing received ESWT earlier: mean number of days between last surgical intervention and ESWT (healed - 355.1 days±167.4SD vs. not healed - 836.7 days±383.0SD; p<0.0001).
Conclusion	• ESWT proved to be a safe, effective and non-invasive treatment modality in tibial non-unions recalcitrant to standard therapies. • The procedure is well tolerated, time-saving, lacking side effects, with potential to significantly decrease health care costs. • ESWT should be considered the treatment of first choice in established tibial non-unions.
Key message	ESWT is effective, safe, with virtually no negative side effects for the treatment of tibial non-unions. Its application is strongly recommended by the authors even before non-union has fully developed.
Pubmed	27158008

Extracorporeal shock-wave therapy compared with surgery for hypertrophic long-bone nonunions	
Authors	Cacchio A, Giordano L, Colafarina O, Rompe JD, Tavernese E, Ioppolo F, Flamini S, Spacca G, Santilli V.
Published	J Bone Joint Surg Am. 2009 Nov;91(11):2589-97.
Date	2009
Place of origin	San Salvatore Hospital of L'Aquila, L'Aquila, Italy.
Background	The authors of several studies have recommended extracorporeal shock-wave therapy as an alternative to surgical treatment for long-bone nonunions.
Objective	• To assess the effectiveness of extracorporeal shock-wave therapy in the treatment of long-bone nonunions, • To compare extracorporeal shock-wave therapy with surgical treatment of long-bone nonunions • To ascertain any differences in effectiveness between two different extracorporeal shock-wave generators in the treatment of long-bone nonunions.
Tested products	Dornier Epos Ultra lithotripter Storz Modulith SLK
Study design & methods	**Double blinded randomised clinical trial.** *Subjects*: 126 patients with a long-bone nonunion (femur, tibia, radiuls, ulna). *Methods*: patients were randomly assigned to receive either • extracorporeal shock-wave therapy - 0.40 mJ/mm² (Group 1, n= 42) • extracorporeal shock-wave therapy - 0.70 mJ/mm² (Group 1, n= 42) • Surgical treatment (Group 3, n=42). Patients treated with shockwave therapy received 4 ESWT sessions at one-week intervals, with 4000 impulses applied to the center of the fracture. *Outcomes*: • Radiographic results: healing of the nonunion at 6 months was the primary outcome. • Clinical results: pain VAS and functional status (DASH for uper limb and LEFS for lower limb scores) Outcomes were determined before and 3, 6, 12, and24 months after treatment.
Results	• The radiographic findings did not differ among the three groups of patients. • At 6 months, 70% of the nonunions in Group 1, 71% of the nonunions in Group 2, and 73% of the nonunions in Group 3 had healed. • 3 and 6 months after treatment, the clinical outcomes in the two shock-wave groups were significantly better than those in the surgical group ($p < 0.001$). • However, at both 12 and 24 months after treatment, there were no differences among the three groups, with the exception of the DASH score, which differed significantly between Groups 1 and 3 ($p = 0.038$) and between Groups 2 and 3 ($p = 0.021$) at 12 months.
Conclusion	Extracorporeal shock-wave therapy is as effective as surgery in stimulating union of long-bone hypertrophic nonunions and yields better short-term clinical outcomes. The results of this randomized controlled trial strongly suggest that extracorporeal shock-wave therapy is a simple and safe alternative to surgical treatment of hypertrophic long-bone nonunions.
Key message	Extracorporeal shock-wave therapy is as effective as surgery in stimulating union of long-bone hypertrophic nonunions and yields better short-term clinical outcomes.
Pubmed ID	19884432

Extracorporeal shockwaves versus surgery in the treatment of pseudoarthrosis of the carpal scaphoid. 	
Authors	Notarnicola A, Moretti L, Tafuri S, Gigliotti S, Russo S, Musci L, Moretti B.
Published	Ultrasound Med Biol. 2010 Aug;36(8):1306-13.
Date	2010
Place of origin	Department of Clinical Methodology and Surgical Techniques, Orthopedics Section, Faculty of Medicine and Surgery of University of Bari, General Hospital, Bari, Italy.
Background	The peculiar anatomical characteristics and precarious vascularization of the carpal scaphoid are responsible for a difficult healing of fractures and a fairly frequent subsequent evolution to pseudoarthrosis. Recently, extracorporeal shockwaves therapy (ESWT) has yielded encouraging results in the treatment of pseudoarthrosis of various bone segments.
Objective	To compare the efficacy of extracorporeal shock waves therapy (ESWT) with that of a standard surgical procedure to treat pseudoarthrosis of the carpal scaphoid.
Tested products	Storz MiniLith
Study design & methods	**Retrospective study.** *Subjects*: 118 patients with pseudoarthrosis of the carpal scaphoid. *Methods*: • Group 1 (58 patients) received 3 sessions of shockwaves therapy (SW) with energy flux density (EFD) impulses of 0.09 (SD = 0.02) mJ/mm². • Group 2 (60 patients) had surgical treatment consisting of stabilization and bone graft according to the Matti-Russe technique. Outcomes: • Mayo Wrist Score • Radiographic consolidation of the pseudoarthrosis.
Results	• Mayo Wrist Score, showed a significantly improved score, rising from 28-74.6 in group I already after 2 mo ($p < 0.001$), with 86.3% of the results judged as satisfactory or excellent; in group II the mean score rose from 27.5-74.2 after 2 mo, with 83.4% of the results judged as satisfactory or excellent ($p < 0.001$). • At the same two-months follow-up (FU), radiographic consolidation was shown in 75.9% of patients in group I and 76.7% in group II. • These improvements persisted at the subsequent controls at six and 12 mo in both groups. • The Mayo Wrist Score and X-rays did not show statistically significant differences at the various FU visits in the two groups ($p > 0.05$).
Conclusion	The results of ESWT are comparable with those of surgical stabilization and bone graft in the treatment of scaphoid pseudoarthrosis. In view of their minimal invasiveness, shockwaves should therefore be considered the treatment of choice of this disorder.
Key message	Focused SW treatment was equally effective as surgical stabilisation for the management of scaphoid pseudoarthrosis while less invasive and should therefore be considered the treatment of choice of this disorder.
Pubmed ID	20691920

MEDIAL TIBIAL STRESS SYNDROME

Shockwave treatment for medial tibial stress syndrome in athletes; a prospective controlled study.	
Authors	Moen MH, Rayer S, Schipper M, Schmikli S, Weir A, Tol JL, Backx FJ.
Published	Br J Sports Med. 2012 Mar;46(4):253-7.
Date	Mar 2012
Place of origin	Rehabilitation and Sports Medicine Department, University Medical Center Utrecht, Utrecht, The Netherlands.
Objective	The purpose of this study was to describe the results of two treatment regimens for medial tibial stress syndrome (MTSS); a graded running programme and the same running programme with additional shockwave therapy (extracorporeal shockwave therapy; ESWT).
Tested products	Storz Duolith SD1
Study design & methods	**Prospective observational controlled trial.** *Subjects*: 42 athletes with MTSS, from two different sports medicine departments. *Methods*: • Patients from one hospital were treated with a graded running programme • Patients from the other hospital were treated with the same graded running programme and focused ESWT (5 sessions in 9 weeks). EFD increased over the sessions from 0.10 to 0.30 J/cm² - number of shocks was 1000 in the first session and 1500 in the 2nd to 5th session. *Outcome* : main outcome measure was • Time to full recovery (the endpoint was being able to run 18 min consecutively without pain at a fixed intensity)
Results	The time to full recovery was significantly faster in the ESWT group compared with the patients who only performed a graded running programme, respectively 59.7±25.8 and 91.6±43.0 days (p=0.008).
Conclusion	This prospective observational study showed that MTSS patients may benefit from ESWT in addition to a graded running programme.
Key message	Significantly faster return to full recovery was obtained when adding ESWT to a graded running programme.
Pubmed ID	21393260

Effect of Extracorporeal Shockwave Therapy Versus Intra-articular Injections of Hyaluronic Acid for the Treatment of Knee Osteoarthritis.	
Authors	Lee JK, Lee BY, Shin WY, An MJ, Jung KI, Yoon SR
Published	Ann Rehabil Med. 2017 Oct;41(5):828-835.
Date	Oct 2017
Place of origin	Department of Rehabilitation Medicine, Gwangju Veterans Hospital, Gwangju, Korea.
Objective	To evaluate and compare the effects and outcomes of extracorporeal shock wave therapy (ESWT) and intra-articular injections of hyaluronic acid (HA) in patients with knee osteoarthritis (OA).
Tested products	Dornier EPOS Ultra
Study design & methods	**Prospective randomized controlled study.** *Subjects*: 61 patients with knee OA (KL grade II-III) *Methods*: patients were randomly divided into two groups: • The ESWT group underwent 3 sessions of 1,000 shockwave pulses performed on the affected knee with the dosage adjusted to 0.05 mJ/mm2 energy. • The HA group was administered intra-articular HA once a week for 3 weeks with a 1-week interval between each treatment. *Outcomes*: • Pain on visual analogue scale (VAS), • Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), • Lequesne index, • 40-m fast-paced walk test, • Stair-climb test (SCT). A baseline for each test was measured before treatment and then the effects of the treatments were measured by each test at 1 and 3 months after treatment.
Results	• In both groups, the scores of the VAS, WOMAC, Lequesne index, 40-m fast-paced walk test, and SCT were significantly improved in a time-dependent manner ($p<0.01$). • There were no statistically significant differences measured at 1 and 3 months after treatment between the two groups ($p>0.05$).
Conclusion	The ESWT can be an alternative treatment to reduce pain and improve physical functions in patients with knee OA.
Key message	ESWT is equally effective as hyaluronic acid injections for imporving pain and function in knee OA and can be considered a treatment alternative to injections.
Pubmed	29201822

Shockwave treatment for medial tibial stress syndrome in military cadets: A single-blind randomized controlled trial.	
Authors	Gomez Garcia S, Ramon Rona S, Gomez Tinoco MC, Benet Rodriguez M, Ch Cardenas Letrado FP, Lopez-Illescas Ruiz Á, Alarcon Garcia JM
Published	Int J Surg. 2017 Oct;46:102-109.
Date	Oct 2017
Place of origin	Colombia - Spain
Objective	To assess whether one session of focused ESWT is effective in the treatment of military cadets with MTSS
Tested products	Storz Duolith SD1
Study design & methods	**Randomized, prospective, controlled, single-blind, parallel-group clinical study.** *Subjects*:42 military cadets with unilateral chronic MTSS *Methods*: subjects were randomly assigned to either • one session of focused electromagnetic ESWT (1500 pulses at 0.20 mJ/mm2) plus a specific exercise programme (muscle stretching and strengthening exercises), or • the exercise programme alone. *Outcomes*: • The primary endpoint was change in asymptomatic running test (RT) duration at 4 weeks from baseline. • Secondary endpoints were changes in the visual analogue scale (VAS) after running and modified Roles and Maudsley (RM) score also at 4 weeks from baseline.
Results	• ESWT patients were able to run longer. Mean RT after four weeks was 17 min 33 s (SE: 2.36) compared to 4 min 48 s (SE: 1.03) in the exercise-only group (p = 0.000). • Mean VAS after running was 2.17 (SE: 0.44) in the ESWT group versus 4.26 (SE: 0.36) in the exercise-only group (p = 0.001). • The ESWT group had a significantly higher RM score, with excellent or good results for 82.6% of patients vs. 36.8% in the exercise-only group (p = 0.002). • No significant adverse effects of ESWT were observed.
Conclusion	A single application of focused shockwave treatment in combination with a specific exercise programme accelerates clinical and functional recovery in military cadets with MTSS.
Key message	A single application of focused extracorporeal shockwave treatment in combination with a specific exercise programme produced a success rate of 82.6% at 4 weeks
Pubmed ID	28882773

Extracorporeal shockwave therapy in osteonecrosis of femoral head: A systematic review of now available clinical evidences.	
Authors	Zhang Q, Liu L, Sun W, Gao F, Cheng L, Li Z.
Published	Medicine (Baltimore). 2017 Jan;96(4):e5897
Date	Jan 2017
Place of origin	Beijing, China.
Background	Osteonecrosis is an incapacitating disorder with high morbidity. Though extracorporeal shockwave therapy (ESWT) provides a noninvasive treatment option, controversial subjects still exist about its effectiveness, indications, and mechanism of action.
Objective	To investigate the effect of extracorporeal shockwave therapy in the treatment of osteonecrosis of femoral head.
Study design & methods	**Systematic review.** **Methods:** An electronic databases search was performed using PubMed, Embase, and the Cochrane library to collect clinical trials, case reports, and cases series on this topic and then useful data were extracted and appraised by experienced clinicians. The quality of included evidences was evaluated by using the Oxford Centre for evidence-based medicine (EBM) Levels of Evidence. *Studies*: a total of 17 articles including 2 case reports, 9 open label trials, 2 cohorts, and 6 randomized controlled trials were considered to be eligible for this systematic review. *Outcomes*: frequently-used outcome estimates of included studies were: • Visual analog scale (VAS), • Harris hip scores, • Imaging results.
Results	• ESWT could act as a safe and effective method to improve the motor function and relieve the pain of patients with osteonecrosis of femoral hip, especially those at early stage. • Imaging revealed that bone marrow edema was significantly relieved, but the necrotic bone could not be reversed after ESWT. • ESWT could slow or even block the progression of ONFH and therefore reduce the demand for surgery. • Collaboration with other conservative modalities would not improve the curative benefits of ESWT. • ONFH with various risk factors (SLE, SARS, leukemia) showed similar positive reaction to ESWT.
Conclusion	ESWT provides a conservative modality to improve the motor function and relieve the pain of patients with osteonecrosis of femoral head. It possesses advantages such as non-invasiveness, safety, convenience to conduct and economy.
Key message	ESWT is a safe and effective conservative modality for treating osteonecrosis of the femoral head
Pubmed ID	28121934

Treatment for osteonecrosis of the femoral head: comparison of extracorporeal shock waves with core decompression and bone-grafting. 	
Authors	Wang CJ, Wang FS, Huang CC, Yang KD, Weng LH, Huang HY.
Published	J Bone Joint Surg Am. 2005 Nov;87(11):2380-7.
Date	2005
Place of origin	Department of Orthopaedic Surgery, Chang Gung Memorial Hospital Medical Center, Taiwan.
Background	There is continuing controversy regarding the optimal treatment for patients with symptomatic early-stage osteonecrosis of the femoral head.
Objective	To evaluate the effects of extracorporeal shock-wave treatment for early stages of osteonecrosis of the femoral head and to compare the results with those of core decompression and nonvascularized fibular grafting.
Tested products	Ossatron
Study design & methods	**Randomised comparative study.** *Subjects*: 48 patients with stage-I, II, or III osteonecrosis. *Methods*: patients were randomly asssigned to be treated with either • Shockwaves (23 patients ,29 hips) - received a single treatment with 6000 impulses of shock waves with EPD 0.62 mJ/mm² • Core decompression and nonvascularized fibular grafting (25 patients, 28 hips) *Outcomes*: • Clinical assessment of pain with a visual analog pain scale • Harris hip scores • Assessment of activities of daily living and work capacity • Radiographic assessment was performed with serial plain radiographs and magnetic resonance imaging.
Results	• Before treatment, the two groups had similar pain and Harris hip scores. • At an average of 25 months after treatment, the pain and Harris hip scores in the shock-wave group were significantly improved compared with the pretreatment scores ($p < 0.001$). In this group, 79% of the hips were improved, 10% were unchanged, and 10% were worse. • Of the hips treated with a nonvascularized fibular graft, 29% were improved, 36% were unchanged, and 36% were worse. • In the shock-wave group, imaging studies showed regression of 5 of the 13 lesions that had been designated as stage I or II before treatment and no regression of a stage-III lesion. Two stage-II and two stage-III lesions progressed. • In the surgical group, 4 lesions regressed and 15 (of the 19 graded as stage I or II) progressed. The remaining 9 lesions were unchanged.
Conclusion	Extracorporeal shock-wave treatment appeared to be more effective than core decompression and nonvascularized fibular grafting in patients with early-stage osteonecrosis of the femoral head. Long-term results are needed to determine whether the effect of this novel method of treatment for osteonecrosis of the femoral head endures.
Key message	ESWT provided improvement of pain & function in 79% of the hips treated, compared to 29% of the hips treated surgically.
Pubmed ID	16264111

LOWER LIMB TENDINOPATHIES

The effectiveness of extracorporeal shock wave therapy in lower limb tendinopathy: a systematic review. 	
Authors	Mani-Babu S, Morrissey D, Waugh C, Screen H, Barton C
Published	Am J Sports Med. 2015 Mar;43(3):752-61.
Date	Mar 2015
Place of origin	Centre for Sports and Exercise Medicine, Queen Mary University of London, London, UK.
Background	There is accumulating evidence for the effectiveness of extracorporeal shock wave therapy (ESWT) when treating lower limb tendinopathies including greater trochanteric pain syndrome (GTPS), patellar tendinopathy (PT), and Achilles tendinopathy (AT).
Objective	To evaluate the effectiveness of ESWT for lower limb tendinopathies.
Study design & methods	**Systematic review and meta-analysis.** Studies: 20 studies were included • 2 evaluating ESWT in GTPS, • 7 evaluating ESWT in PT, • 11 evaluating ESWT in AT. Design of the included studies: • 9 randomized controlled trials (RCTs), • 6 single-cohort prospective studies, • 5 retrospective studies. 13 studies provided sufficient data to compute effect size calculations.
Results	*Greater trochanteric pain syndrome* • Moderate evidence indicates that ESWT is more effective than home training and corticosteroid injection in the short (<12 months) and long (>12 months) term for GTPS. *Patellar tendinopathy* • Limited evidence indicates that ESWT is more effective than alternative nonoperative treatments including nonsteroidal anti-inflammatory drugs, physical therapy, and an exercise program and equal to patellar tenotomy surgery in the long term for PT. *Achilles tendinopathy* • Moderate evidence indicates that ESWT is more effective than eccentric loading for insertional AT and equal to eccentric loading for midportion AT in the short term. • Additionally, there is moderate evidence that combining ESWT and eccentric loading in midportion AT may produce superior outcomes to eccentric loading alone.
Conclusion	ESWT appears to be an effective intervention for lower limb tendinopathies, with moderate-level evidence of efficacy for all 3 tendinopathies reviewed. • ESWT seems to be a suitable alternative to home training and corticosteroid injection in the short- and long-term management of GTPS. • For PT, ESWT seems to be superior to other nonoperative treatments and equal to surgery in the long term. • For AT, the results suggest that ESWT is superior to eccentric loading in the short term for insertional tendinopathy, effective when combined with eccentric loading in midportion tendinopathy, and superior to various alternative nonoperative treatments, particularly in recalcitrant presentations.
Key message	Extracorporeal shock wave therapy is an effective intervention and should be considered for GTPS, PT, and AT particularly when other nonoperative treatments have failed.
Pubmed ID	24817008

High-energy extracorporeal shock wave therapy as a treatment for chronic noninsertional Achilles tendinopathy. 	
Authors	Furia JP
Published	Am J Sports Med. 2008 Mar;36(3):502-8.
Date	2008
Place of origin	SUN Orthopedics and Sports Medicine, Lewisburg, USA.
Background	High-energy extracorporeal shock wave therapy has been shown to be an effective treatment for chronic insertional Achilles tendinopathy. The results of high-energy shock wave therapy for chronic noninsertional Achilles tendinopathy have not been determined.
Objective	To determine the effectiveness of high-energy SWT should in the treatment of noninsertional Achilles tendinopathy.
Tested products	Dornier Epos lithotripter
Study design & methods	**Case control study; Level of evidence, 3.** *Subjects*: 68 patients with an established diagnosis of chronic noninsertional Achilles tendinopathy for at least 6 months before treatment who had at least 3 forms of traditional nonoperative measures fail for a minimum of 6 months. *Methods*: • 34 patients were treated with a single dose of high-energy shock wave therapy (shock wave therapy group; 3000 shocks; 0.21 mJ/mm²; total energy flux density, 604 mJ/mm²). All shock wave therapy procedures were performed using regional anesthesia. • 34 patients were treated not with shock wave therapy but with additional forms of nonoperative therapy (control group). *Outcomes*: • Pain VAS score • Roles and Maudsley score (patient satisfaction) Patients were assessed 1month, 3 months, and 12 months after treatment.
Results	• One month, 3 months, and 12 months after treatment, the mean visual analog scores for the control and shock wave therapy groups were 8.4 and 4.4 (P < .001), 6.5 and 2.9 (P < .001), and 5.6 and 2.2 (P < .001), respectively. • At final follow-up, the number of excellent, good, fair, and poor results for the shock wave therapy and control groups were 12 and 0 (P < .001), 17 and 9 (P < .001), 5 and 17 (P < .001), and 0 and 8 (P < .001), respectively. • A chi(2) analysis revealed that the percentage of patients with excellent ("1") or good ("2") Roles and Maudsley scores, that is, successful results, 12 months after treatment was statistically greater in the shock wave therapy group than in the control group (P < .001).
Conclusion	Shock wave therapy is an effective treatment for chronic noninsertional Achilles tendinopathy.
Key message	Single-treatment, high-energy SWT is a safe and effective procedure that can be used to treat patients with chronic noninsertional Achilles tendinopathy.
Pubmed ID	18006678

High-energy extracorporeal shock wave therapy as a treatment for insertional Achilles tendinopathy. 	
Authors	Furia JP
Published	Am J Sports Med. 2006 May;34(5):733-40.
Date	2006
Place of origin	SUN Orthopedics and Sports Medicine, Lewisburg, PA, USA.
Background	Results of high-energy extracorporeal shock wave therapy for the treatment of insertional Achilles tendinopathy are not determined. It is unclear how local anesthesia alters the outcome of this procedure.
Objective	To determine the efficacy of high-energy ESWT for the treatment of adults with chronic insertional Achilles tendinopathy and to determine if the use of a local anesthesia field block had an adverse effect on outcome.
Tested products	Dornier Epos lithotripter
Study design & methods	**Case control study; Level of evidence, 3.** *Subjects*: 68 patients with an established diagnosis of chronic insertional Achilles tendinopathy for at least 6 months before treatment who had failure with at least 3 forms of traditional nonoperative measures for a minimum of 6 months. • 35 patients were treated with 1 dose of high-energy extracorporeal shock wave therapy (ESWT group; 3000 shocks; 0.21 mJ/mm2; total energy flux density, 604 mJ/mm2). • 33 were treated with nonoperative therapy (control group). The shockwave group was divided into two subgroups: • 12 patients received local anesthesia field block (LA subgroup) • 23 patients were treated with an anesthesia other than local (NLA subgroup) *Outcomes*: • Pain by visual analog score • Subjective satisfaction rating by Roles and Maudsley score. Patients were assessed 1, 3 and 12 months post-treatment.
Results	• One month, 3 months, and 12 months after treatment, the mean visual analog score for the control and ESWT groups were 8.2 and 4.2 ($P < .001$), 7.2 and 2.9 ($P < .001$), and 7.0 and 2.8 ($P < .001$), respectively. • 12 months after treatment, the number of patients with successful Roles and Maudsley scores was statistically greater in the ESWT group compared with the control group ($P > .0002$), with 83% of ESWT group patients having a successful result versus 39% in the control group. • Subgroup comparison: the mean improvement in visual analog score for the LA subgroup was significantly less than that in the NLA subgroup ($F = 16.77$ vs $F = 53.95$, $P < .001$). The percentage of patients with successful Roles and Maudsley scores did not differ among the LA and NLA subgroups.
Conclusion	Extracorporeal shock wave therapy is an effective treatment for chronic insertional Achilles tendinopathy. Local field block anesthesia may decrease the effectiveness of this procedure.
Key message	ESWT provided significantly better pain relief and patient satisfaction than traditional non-operative therapy.
Pubmed ID	16627628

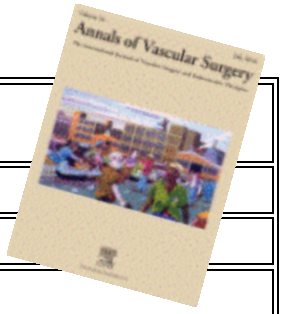
PLANTAR FASCIITIS

Effectiveness of Extracorporeal Shock Wave Therapy Without Local Anesthesia in Patients With Recalcitrant Plantar Fasciitis: A Meta-Analysis of Randomized Controlled Trials.	
Authors	Lou J, Wang S, Liu S, Xing G.
Published	Am J Phys Med Rehabil. 2016 Dec 9. [Epub ahead of print]
Date	Dec 2016
Place of origin	Fourth Military Medical University, Xian Shi, Shaanxi Sheng (SL), China.
Objective	The objective of this meta-analysis was to investigate the efficacy of extracorporeal shock wave therapy in the treatment of recalcitrant plantar fasciitis (RPF) without local anesthesia.
Study design & methods	**Systematic review with meta-analysis.** *Studies*: 9 randomized controlled trials (involving 1,174 participants) comparing ESWT without local anesthesia versus placebo for treatment of plantar fasciitis in adults. *Outcomes*: tThe primary outcome was the 12-week post-intervention success rate of • reducing the visual analog scale score by 60% from baseline at the first step in the morning, • reducing the VAS score by 60% from baseline during daily activities, • reducing the Roles and Maudsley score, • reducing overall heel pain, • reducing pain after applying a force meter.
Results	Compared with placebo, ESWT significantly • improved the success rate of reducing overall heel pain, • reduced the VAS score by 60% at the first step in the morning and during daily activities, • improved the Roles and Maudsley score to excellent or good, and • reduced heel pain after application of a pressure meter.
Conclusion	ESWT seems to be particularly effective in relieving pain associated with RPF. ESWT should be considered when traditional treatments have failed.
Key message	ESWT is very effective in reducing plantar heel pain in recalcitrant plantar fasciitis.
Pubmed	27977431

Magnetic resonance imaging findings of chronic plantar fasciitis before and after extracorporeal shock wave therapy.	
Authors	Maki M, Ikoma K, Kido M, Hara Y, Sawada K, Ohashi S, Kubo T
Published	Foot (Edinb). 2017 Dec;33:25-28.
Date	Dec 2017
Place of origin	Department of Orthopaedics, Graduate School of Medical Science, Kyoto Prefectural University of Medicine, Kyoto, Japan.
Background	Four MRI findings have been reported in plantar fasciitis: thickening of the PF, edema around the PF, HSIA inside the PF, and BME of the calcaneus.
Objective	The objective of this study is to examine the relationships between treatment outcome and changes in magnetic resonance (MR) imaging findings after extracorporeal shock wave therapy (ESWT) for chronic plantar fasciitis.
Tested products	Dornier Epos Ultra
Study design & methods	**Clinical outcome study.** *Subjects*: 23 patients (23 feet) with refractory plantar fasciitis. *Methods*: *MRI measurements:* • The thickness of the plantar fascia (PF) and findings of a high-signal intensity area (HSIA) inside the PF, edema around the PF, and bone marrow edema (BME) of the calcaneus were investigated on MR images. *Clinical outcomes:* • The Japanese Society for Surgery of the Foot (JSSF) ankle-hindfoot scale • Visual analogue scale (VAS) Correlations between an improvement in symptoms and changes in the MRI findings were analyzed.
Results	• The mean thickness of the PF was 4.4±1.6mm before ESWT and 4.6±1.8mm six months after ESWT. • After ESWT, there was a decrease in the numbers of feet showing HSIA inside the PF from 15 to 6, in edema around the PF from 16 to 2, and in BME of the calcaneus from 11 to 4. • Clinical outcomes improved with ESWT from 70.3±5.5 to 88.6±9.1 points (JSSF), 74.1±25.3 to 28.5±24.4 points (VAS), respectively. • **Improvements in symptoms according to the JSSF and VAS scores and improvement in edema around the PF on MR images showed a significant correlation.**
Conclusion	Edema around the PF improved significantly in association with an improvement in symptoms after ESWT.
Key message	The improvement in symptoms with ESWT treatment in recalcitrant plantar fasciitis is associated with improvement of the edema on MRI.
Pubmed	29126038

Clinically relevant effectiveness of focused extracorporeal shock wave therapy in the treatment of chronic plantar fasciitis: a randomized, controlled multicenter study.	
Authors	Gollwitzer H, Saxena A, DiDomenico LA, Galli L, Bouché RT, Caminear DS, Fullem B, Vester JC, Horn C, Banke IJ, Burgkart R, Gerdesmeyer L.
Published	J Bone Joint Surg Am. 2015 May 6;97(9):701-8.
Date	May 2015
Place of origin	Clinic of Orthopedics and Sports Orthopedics, Klinikum Rechts der Isar, Technische Universität München, Munich, Germany.
Background	The effectiveness of extracorporeal shock wave therapy in the treatment of plantar fasciitis is controversial.
Objective	To test whether focused extracorporeal shock wave therapy is effective in relieving chronic heel pain diagnosed as plantar fasciitis.
Tested products	Storz Duolith SD-1
Study design & methods	**Prospective, multicenter, double-blind, randomized, placebo-controlled study.** *Subjects*: 250 patients with a history of plantar fasciitis resistant to nonsurgical treatment for at least 6 months. All participants had failed at least 4 nonsurgical treatment modalities, including at least 2 nonpharmacological and at least 2 pharmacological treatments. *Methods*: subjects were randomized to • Focused extracorporeal shock wave therapy (0.25 mJ/mm²) with 3 sessions of 2000 impulses in weekly intervals, or • Placebo intervention (also with 3 sessions of 2000 impulses in weekly intervals). *Outcomes*: • The percentage change of heel pain on the visual analog scale composite score (pain during first steps in the morning, pain with daily activities, and pain with a force meter) • Roles and Maudsley score • Secondary outcome measures related to overall success rate, patient satisfaction and investigator's effectiveness rating. Outcomes at 12 weeks after the last intervention were compared with the scores at baseline.
Results	• 246 patients (98.4%) were available for intention-to-treat analysis at the 12-week follow-up. • The VAS composite score for heel pain was significantly more decreased (p = 0.0027, one-sided) in the ESWT group (69.2%) compared with the placebo therapy group (34.5%). • Extracorporeal shock wave therapy was also significantly superior to the placebo therapy for the Roles and Maudsley score (p = 0.0006, one-sided). • The combined overall result of the secondary criteria showed significance (p = 0.0015, one-sided) in favor of extracorporeal shock wave therapy. • Temporary pain and swelling during and after treatment were the only device-related adverse events observed. This study has also been reviewed & discussed in an ACE report.
Conclusion	The results of the present study provide proof of the clinically relevant effect size of focused extracorporeal shock wave therapy without local anesthesia in the treatment of recalcitrant plantar fasciitis, with success rates between 50% and 65%.
Key message	Focused ESWT applied in 3 weekly interventions without local analgesia demonstrated significant clinical effectiveness in the treatment of chronic plantar fasciitis.
Pubmed ID	25948515

PERIPHERAL ARTERIAL DISEASE / CLAUDICATIO INTERMITTENS



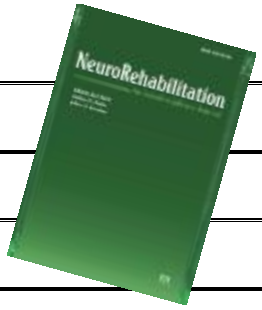
A Systematic Review of Extracorporeal Shockwave Therapy as a Novel Treatment for Intermittent Claudication.	
Authors	Cayton T, Harwood A, Smith GE, Chetter I.
Published	Ann Vasc Surg. 2016 Jun 14. [Epub ahead of print]
Date	Jun 2016
Place of origin	Academic Vascular Surgery Unit, University of Hull, Hull York Medical School, Hull, UK.
Background	Extracorporeal shockwave therapy (ESWT) is emerging as a potential new treatment option for a variety of clinical scenarios including promotion of wound healing and symptom control in end-stage ischemic heart disease. A number of small trials have investigated ESWT in the management of peripheral arterial disease (PAD).
Objective	The aim of this review is to identify evidence regarding the safety, tolerability, efficacy, and mechanism of action of ESWT in treating IC.
Study design & methods	**Systematic review.** *Studies*: all types of studies were included including observational studies, comparative studies (prospective or retrospective), and randomized controlled trials. • 5 studies were included in the final review. *Outcomes*: • Walking distance • Disease severity • Quality of life • Skin & Muscle perfusion • Degree of arterial stenosis • Patient Tolerance of ESWT and Adverse Events
Results	• Although participant numbers within the identified studies were small, significant improvements in pain-free walking distance and maximum walking distance were demonstrated. • Most studies also showed significant improvements in tissue perfusion • The mechanism of action is thought to be due to mechanotransduction and subsequent angiogenesis. • ESWT was highly acceptable to participants when specifically interviewed regarding discomfort and tolerance of treatment.
Conclusion	ESWT shows promise as a potentially efficacious novel treatment for symptomatic PAD with potential to improve walking distances, pain scores, and tissue perfusion.
Key message	Available evidence, albeit low level, suggests that ESWT is a safe noninvasive treatment for PAD patients.
Pubmed ID	27311948

Extracorporeal shockwave therapy for the treatment of chronic wound of lower extremity: current perspective and systematic review.	
Authors	Omar MT, Gwada RF, Shaheen AA, Saggini R
Published	Int Wound J. 2017 Dec;14(6):898-908.
Date	Feb 2017
Place of origin	Cairo University, Giza, Egypt.
Objective	The purpose of this study was to provide an up-to-date review for the accurate estimation of the efficacy of extracorporeal shock wave therapy (ESWT) on the healing of chronic wounds on the lower extremity (CWLE).
Study design & methods	**Systematic Review.** *Studies*: 11 studies with 925 patients. Studies compared shockwave treatment with any standard wound care, sham and other physical modalities and different ESWT protocols. *Outcomes*: Wound healing, measured objectively: • Time to complete healing (days) • Percentage of reduction in wound surface area (WSA) • Proportion of wounds completely healed at a specified time point • Blood perfusion measurements • Adverse effects (e.g. neurovascular complications, infection, dermatitis, erythema, excessive granulation and necrotic tissue).
Results	• In all studies, re-epithelialisation and time to wound closure were significantly lower in the ESWT groups compared with standard therapy or HBOT (hyperbaric oxygen therapy). • ESWT speeds up time to healing. • A significant reduction of WSA was observed in 4 studies. • ESWT improves blood flow perfusion rate (measured with laser Doppler perfusion imaging). • None of the included studies reported adverse reactions secondary to ESWT application.
Conclusion	This review demonstrated mild to moderate evidence to support the use of ESWT as an adjuvant therapy with a standardised wound care programme.
Key message	The use of ESWT as an adjuvant therapy with a standardised wound care programme promotes wound closure and reepithelialisation, reduces WSA and improves blood flow perfusion and the time required to complete healing.
Pubmed ID	28198141

Extracorporeal shock wave therapy as an adjunct wound treatment: a systematic review of the literature.	
Authors	Dymarek R, Halski T, Ptaszkowski K, Slupska L, Rosinczuk J, Taradaj J
Published	Ostomy Wound Manage. 2014 Jul;60(7):26-39.
Date	Jul 2014
Place of origin	University of Medicine in Wroclaw, Wroclaw, Poland.
Background	Standard care procedures for complex wounds are sometimes supported and reinforced by physical treatment modalities such as extracorporeal shock wave therapy (ESWT).
Objective	To evaluate available evidence of ESWT effectiveness for wound treatment in humans.
Study design & methods	**Systematic review.** *Methods*: a systematic review of the literature was conducted using MEDLINE, PubMed, Scopus, EBSCOhost, and PEDro databases. • Of the 393 articles found, 13 met the publication date (year 2000-2013), study type (clinical study), language (English only), and abstract availability (yes) criteria. • The 13 studies (n = 919 patients with wounds of varying etiologies) included 7 randomized controlled trials that were evaluated using Cochrane Collaboration Group standards. • Only studies with randomization, well prepared inclusion/exclusion criteria protocol, written in English, and full version available were analyzed. • An additional 6 publications reporting results of other clinical studies including a total of 523 patients were identified and summarized.
Results	• ESWT was most commonly applied once or twice a week using used low or medium energy, focused or defocused generator heads (energy range 0.03 to 0.25 mJ/mm^2; usually 0.1 mJ/mm^2), and electrohydraulic or electromagnetic sources. • Few safety concerns were reported • In the controlled clinical studies statistically significant differences in rates of wound closure were reported in favour of shockwave compared to a variety of standard topical treatment modalities, sham ESWT treatment, and hyperbaric oxygen therapy. • Substantial supporting clinical evidence confirms ESWT utility and the range of positive results, such as completed wound closure and reepithelialization, enhanced tissue granulation, reduced necrotic fibrin tissue, improved blood flow perfusion and angiogenesis, reduced period of total wound treatment, and decreased necessity of antibiotic treatment.
Conclusion	• The results of this literature review suggest ESWT can be used as an adjunct therapy for healing chronic and acute soft tissue wounds. • ESWT can be characterized as noninvasive, mostly painless, and safe. • In the future, ESWT may play an important role in wound care once evidence-based practice guidelines are developed.
Key message	Available literature, including 7 randomized controlled clinical studies, suggests ESWT facilitates healing compared to control treatments studied.
Pubmed ID	25019247

Efficacy of shock wave therapy on chronic diabetic foot ulcer: a single-blinded randomized controlled clinical trial. 	
Authors	Omar MT, Alghadir A, Al-Wahhabi KK, Al-Askar AB
Published	Diabetes Res Clin Pract. 2014 Dec;106(3):548-54.
Date	Dec 2014
Place of origin	Faculty of Physical Therapy, Cairo University, Giza, Egypt; Rehabilitation Research Chair, King Saud University, Riyadh, Saudi Arabia.
Objective	To evaluate the efficacy of extracorporeal shock wave therapy (ESWT) on the healing rate, wound surface area and wound bed preparation in chronic diabetic foot ulcers (DFU).
Study design & methods	**Single-blinded randomized controlled clinical trial.** *Subjects*: 38 patients with 45 chronic DFU. *Methods*: subjects were randomly assigned into: • ESWT-group (19 patients/24 ulcers) - received shock wave therapy twice per week for a total of 8 treatments. Each ulcer was received ESWT at a frequency of 100 pulse/cm², and energy flux density of 0.11mJ/cm². • Control-group (19 patients/21 ulcers). All patients received standardized wound care consisting of debridement, blood-glucose control agents, and footwear modification for pressure reduction. *Outcomes*: • Wound surface area (WSA), • Percentage of reduction in the WSA, • Rate of healing • Wound bed preparation Outcomes were evaluated at baseline, after the end of the interventions (W8), and at 20-week follow-up (W20).
Results	• The overall clinical results showed completely healed ulcers in 33.3% and 54% in ESWT-groups and 14.28% and 28.5% in the control group after intervention (W8), and at follow-up (W20) respectively. • The average healing time was significantly lower (64.5 ± 8.06 days vs 81.17 ± 4.35 days, $p<0.05$) in the ESWT-group compared with the control group.
Conclusion	ESWT-treated ulcers had a significant reduction in wound size and median time required for ulcer healing, with no adverse reactions. So, the ESWT is advocated as an adjunctive therapy in chronic diabetic wound.
Key message	Better healing rates and healing time when ESWT was added to standard wound care.
Pubmed ID	25451894

SPASTICITY



Effect of shock wave therapy on ankle planter flexors spasticity in stroke patients.	
Authors	Sawan S, Abd-Allah F, Hegazy MM, Farrag MA, El-Den NH
Published	NeuroRehabilitation. 2017;40(1):115-118.
Date	Oct 2016
Place of origin	Cairo University, Cairo, Egypt.
Background	Large number of patients with first-ever stroke developed spasticity. Spasticity can reduce the range of motion, hinder voluntary movements, provoke pain, and result in impairment of functional activities of daily living.
Objective	Demonstrate the effect of shock wave therapy on ankle planter flexors spasticity in stroke patients.
Study design & methods	**Placebo controlled study** (no randomisation) *Subjects*: 40 ischemic stroke patients *Methods*: subjects were divided into 2 groups. • group I (n=20) were subjected to the selected physical therapy program and shock wave therapy (1500 pulses, 1x/week, 6 weeks) • group II (n=20) received the selected physical therapy program as well as placebo shock wave (1x/week, 6 weeks). *Outcomes*: Both groups were subjected to pre- and post-treatment assessment by • H/M ratio, • Dorsiflexion active range of motion, • Time of 10-meters walking.
Results	• Baseline characteristics showed no significant difference between the two groups regarding the grades of spasticity. • After treatment, there were a highly significant difference between both groups regarding the grades of spasticity according to the 3 parameters, H/M ratio, dorsiflexion active range of motion, and time of ten-meters walking test (P values; <0.001, 0.006, and 0.009 respectively).
Conclusion	Shock wave therapy is effective in controlling spasticity, increase dorsiflexion active range of motion of ankle and improving ten- meters walking test in stroke patients.
Key message	ESWT provided significant improvement of spasticity, ankle active ROM and walking performance in stroke patients.
Pubmed	27814307

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