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Review Article

Extracorporeal shockwave therapy for tendinopathies: a comprehensive literature review

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ABSTRACT

Tendinopathies, including Achilles, patellar, lateral epicondylitis, and plantar fasciitis, are chronic musculoskeletal disorders with limited responsiveness to conventional therapies. Extracorporeal shockwave therapy (ESWT), a non-invasive intervention, has emerged as a promising modality targeting both symptomatic relief and structural regeneration. To synthesize high-level evidence on the efficacy and mechanisms of ESWT in managing tendinopathies, emphasizing randomized controlled trials (RCTs), treatment protocols, patient outcomes, and methodological quality. Following preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines, a comprehensive search of four databases was conducted for English-language RCTs published between 2000 to 2024. Inclusion criteria focused on ESWT interventions for tendinopathies with reported clinical outcomes. Quality was assessed using the PEDro scale and Cochrane Risk of Bias 2.0 tool. Four RCTs involving 432 participants were included, addressing plantar fasciitis, Achilles tendinopathy, lateral epicondylitis, and patellar tendinopathy. ESWT demonstrated significant reductions in pain (VAS), improved functional scores (VISA-A, RM, AOFAS), and structural recovery. Focused ESWT showed deeper penetration and neovascularization benefits, while radial ESWT was more effective for superficial lesions. Variability in energy flux densities and session protocols influenced therapeutic response. PEDro scores ranged from 6 to 9, with low-to-moderate risk of bias. ESWT offers effective, non-invasive treatment for various tendinopathies, especially when conventional options fall short. Future research should emphasize protocol standardization, long-term outcome evaluation, and comparative efficacy with other regenerative modalities.

Keywords: Extracorporeal shockwave therapy, Tendinopathy, Pain modulation, Randomized controlled trials, Physiotherapy

INTRODUCTION

Tendinopathies are a group of musculoskeletal disorders affecting both athletic and non-athletic populations. These conditions, encompassing Achilles tendinopathy, patellar tendinopathy, lateral epicondylitis, and plantar fasciitis, are characterized by chronic tendon pain, functional limitation, and structural abnormalities such as collagen disarray and neovascularization. The underlying pathology reflects a failed healing response triggered by repetitive micro-trauma, mechanical overload, or age-related degeneration.[1,2]

Conventional treatment options include rest, non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroid injections, eccentric exercise, and orthotics were often yield suboptimal results, particularly in chronic or recalcitrant cases. Emerging interventions such as platelet-rich plasma (PRP), dry needling, and extracorporeal shockwave therapy (ESWT) have been investigated to address the complex pathophysiology of tendinopathies with a mechanistic rather than symptomatic approach.[3]

Extracorporeal shockwave therapy, first introduced for lithotripsy in urology, is a non-invasive technique that delivers high-energy acoustic waves to targeted musculoskeletal tissues. It induces biological responses via mechano transduction, promotes angiogenesis, alters nociceptive signaling, and potentially reverses degenerative changes.[4] ESWT is categorized into focused and radial forms; each differing in wave propagation, energy delivery, and tissue penetration depth.

Growing literature suggests ESWT may provide durable improvements in pain, function, and tendon morphology across various tendinopathies. However, inconsistent protocols, varying energy flux densities, and mixed comparative results pose challenges to its generalizability and clinical adoption.

This review synthesizes available high-level evidence on the therapeutic role of ESWT in managing tendinopathies. Emphasis is placed on randomized controlled trials, treatment parameters, patient outcomes, PEDro scores, and risk-of-bias assessments to guide rehabilitation professionals in clinical decision-making.

METHODS

This literature review adhered to the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines to ensure methodological transparency and reproducibility.

Search strategy

An electronic search was conducted using PubMed, Scopus, Web of Science, and Google Scholar databases for articles published between January 2000 and December 2024. The following keywords and MeSH terms were used; "extracorporeal shockwave therapy" OR "ESWT", "radial shockwave therapy" OR "focused shockwave therapy", "tendinopathy" OR "tendon disorder", "Achilles," "patellar," "plantar fasciitis," "lateral epicondylitis" Boolean operators (AND/OR) were used to combine terms for specificity. Reference lists of included articles and relevant systematic reviews were also screened.

Eligibility criteria

Randomized controlled trials (RCTs), studies involving human subjects diagnosed with tendinopathy, intervention with ESWT alone or in comparison with conventional therapies, outcomes assessing pain, function, or structural changes and full-text available in English were included for the study.

Cohort studies, systematic reviews, case studies, editorials, letters, or non-peer-reviewed publications, studies without clinical outcomes, animal models or in vitro studies and non-English publications were excluded from this study.

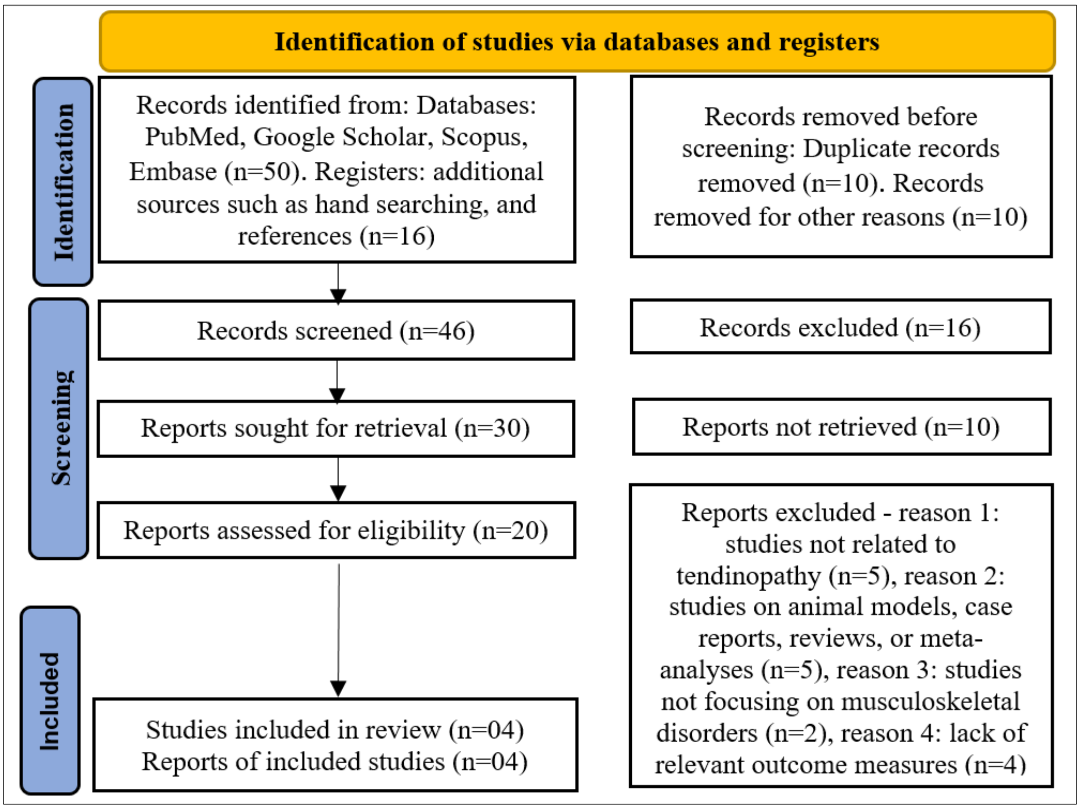

Figure 1: PRISMA checklist.

Study selection

Initial screening involved titles and abstracts by two independent reviewers. Full-text evaluation was conducted for potentially eligible studies. Discrepancies were resolved by discussion or consultation with third and fourth reviewer. Duplicates were removed manually and via reference management software.

Quality assessment

All included RCTs were evaluated using the physiotherapy evidence database (PEDro) scoring tool, which assesses methodological rigor on a 10-point scale focusing on randomization, blinding, allocation concealment, and follow-up. Additionally, the Cochrane risk of bias 2.0 (RoB 2) tool was applied to assess five domains of potential bias: randomization process, deviations from intended interventions, missing outcome data, measurement of the outcome, and selection of reported results.

Data extraction

A structured data extraction form was used to record; author/year, study design and sample size, tendinopathy type, ESWT protocol (type, intensity, duration), comparators, outcome measures (VAS, VISA scores), follow-up duration, and key findings.

RESULTS

A total of 432 participants across four selected were included in this review comprising RCTs. Tendinopathy types addressed were plantar fasciitis, Achilles tendinopathy, lateral epicondylitis, and patellar tendinopathy. Collectively, these studies represent participants with varying age ranges, chronicity of tendinopathy, and ESWT protocols.

Tendinopathy subtypes and treatment efficacy

Plantar fasciitis most extensively studied, with radial and focused ESWT showing significant pain reduction (VAS scores reduced by up to 50%) and improvements in foot function indices such as RM and AOFAS scores. Comparative trials demonstrated superior outcomes over corticosteroid injections after 12–24 weeks of follow-up.[5,6]

Achilles tendinopathy, focused ESWT demonstrated improvements in VISA-A scores and sonographic reduction in tendon thickening. Studies highlighted early pain relief and better midterm functional recovery.[7,8] Lateral Epicondylitis, ESWT was comparable or superior to corticosteroid injections. Pain relief and grip strength improved significantly, although results varied depending on energy flux density and session count.[9] Patellar Tendinopathy, though limited in number, available studies suggested better outcomes when ESWT was combined with eccentric exercises versus monotherapy alone.[10]

ESWT protocol variations

Energy flux densities (EFDs) ranged from 0.08 to 0.40 mJ/mm², with higher EFDs associated with faster relief but sometimes increased discomfort during therapy. Frequency and Duration in most protocols used 3–5 sessions over 2–3 weeks. Some studies extended therapy over 6 weeks for chronic cases. Focused ESWT, tends to penetrate deeper tissues, while radial wave treatment may be preferred for broader surface areas.

Table 1: Summary of included studies.

Author (year)	Tendinopathy	Sample size	ESWT type	Sessions	Comparator	Outcome measures	Follow-up
Rompe et al (2008)[11]	Achilles	60	Focused	3	Eccentric exercise	VAS, VISA-A	4 months
Gerdesmeyer et al (2008)[12]	Plantar fasciitis	245	Radial	3	Sham ESWT	VAS, RM score	12 months
Speed et al (2002)[13]	Lateral epicondylitis	75	Radial	4	Placebo	VAS	3 months
Zwerver et al (2017)[14]	Patellar	52	Focused	5	Exercise therapy	VAS, VISA-P	6 months

Table 2: PEDro scores of RCTs.

Author (year)	Random	Concealed	Blinded	Follow-up	PEDro score (max 10)
Rompe et al (2008)[11]	Yes	Yes	No	Yes	7
Gerdesmeyer et al (2008)[12]	Yes	Yes	Yes	Yes	9
Speed et al (2002)[13]	Yes	No	No	Yes	6
Zwerver et al (2017)[14]	Yes	Yes	Yes	Yes	8

Table 3: Risk of bias assessment.

Author (year)	Random -ization	Protocol deviations	Missing data	Outcome measurement	Reporting bias	Overall risk
Rompe et al (2008)[11]	Low	Low	Low	Moderate	Low	Moderate
Gerdesmeyer et al (2008)[12]	Low	Low	Low	Low	Low	Low
Speed et al (2002)[13]	Low	Moderate	Low	High	Moderate	High
Zwerver et al (2017)[14]	Low	Low	Low	Low	Low	Low

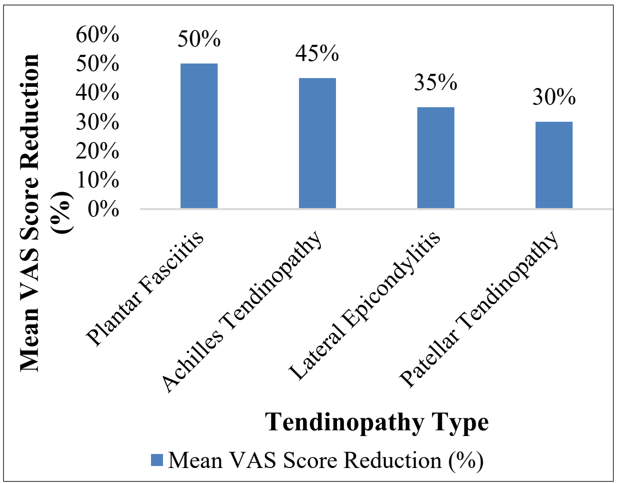

Figure 2: Comparative VAS score reduction across tendinopathies.

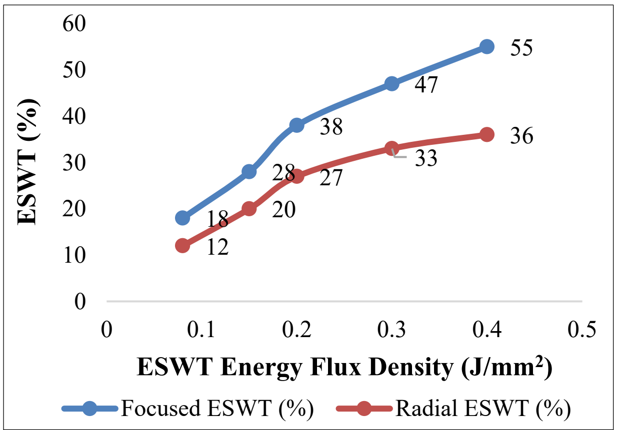

Figure 3: ESWT protocol variability.

DISCUSSION

This review synthesizes findings from four studies on ESWT's therapeutic potential in treating tendinopathies. Evidence from randomized trials underscores positive outcomes across multiple tendon sites, yet methodological variability requires critical appraisal.

Mechanism of action of ESWT

ESWT delivers high-amplitude acoustic pulses that interact with biological tissues, initiating a cascade of mechanobiological responses. These effects vary depending on wave type (focused versus radial), energy flux density (EFD), and anatomical site. The key mechanisms relevant to tendinopathy treatment include mechanotransduction, neovascularization, pain modulation, disruption of calcific deposits and immune mediated response.

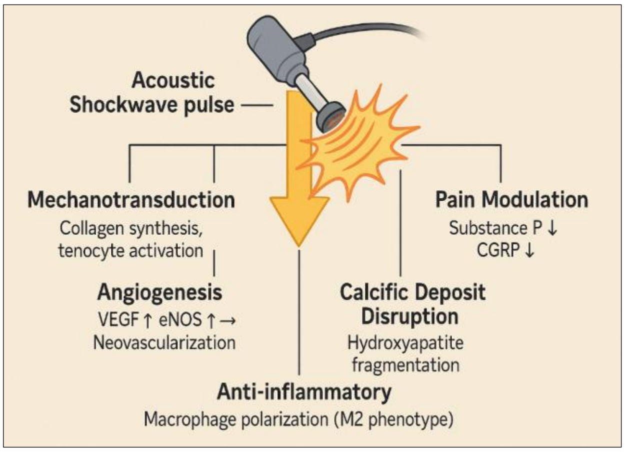

Figure 4: Mechanism of action of ESWT.

Mechanotransduction in shockwaves induce physical strain on tenocytes and surrounding extracellular matrix, converting mechanical stimuli into biochemical signals. This stimulates cellular proliferation, collagen synthesis, and matrix remodelling which is crucial for tendon regeneration.[15] Neovascularization by focused ESWT promotes the expression of angiogenic growth factors like VEGF and endothelial nitric oxide synthase (eNOS), facilitating the formation of new capillaries. Enhanced vascularity improves oxygenation and nutrient delivery to degenerative tendon regions.[16] Pain modulation by shockwaves disrupt nociceptor pathways through hyperstimulation analgesia and downregulation of substance P and calcitonin gene-related peptide (CGRP). Additionally, they may modulate gate control mechanisms, temporarily altering pain perception.[17]

Disruption of calcific deposits in calcific tendinopathy, ESWT fragments hydroxyapatite deposits via high-energy pulses. This facilitates phagocytosis and resolution of calcium build up, often accompanied by radiographic improvements.[18] Immune-mediated responses by ESWT, recent research indicates that ESWT influences macrophage polarization toward an M2 reparative phenotype, suggesting an anti-inflammatory effect conducive to tendon healing.[19] Collectively, these processes promote functional restoration and structural recovery in tendinopathic tissues especially when conservative modalities fall short.

Clinical efficacy across tendinopathies

Studies consistently report pain reduction and improved function, particularly in plantar fasciitis and Achilles tendinopathy. For example, Gerdesmeyer et al demonstrated superior VAS improvements and RM scores with focused ESWT compared to sham therapy.[12] Similarly, Rompe et al found radial ESWT to be more effective than eccentric training alone for midportion Achilles lesions.[11]

In lateral epicondylitis, ESWT outcomes are mixed: while Speed et al observed comparable efficacy to corticosteroid injections, other trials show modest superiority in long-term pain control.[13] For patellar tendinopathy, integration of ESWT with exercise regimens appears more beneficial than monotherapy.[20]

Protocol heterogeneity

Treatment efficacy is highly dependent on ESWT parameters. Energy levels (high EFDs) may expedite analgesia but increase discomfort, Sessions varying from 1–6 across studies, with most protocols averaging 3. Wave type which includes Radial ESWT suits superficial lesions; focused ESWT penetrates deeper. Such variability complicates meta-analysis and cross-study comparisons. Future research must prioritize parameter standardization.

Limitations of current evidence

Several challenges temper the generalizability of current findings. Sample size constraints (many RCTs involved ≤100 participants), short follow-up (functional gains beyond 6 months remain understudied), Bias susceptibility (incomplete blinding, allocation concealment, and reporting heterogeneity). Table 3 indicated high or moderate risk of bias in studies like Speed et al and Rompe et al, impacting confidence in results. Moreover, disparities in outcome metrics of VAS, VISA scores, ultrasonography, electromyography limit data integration.

Cost-effectiveness and accessibility

While ESWT avoids surgical risks and pharmaceutical side effects, its cost and access remain restrictive in some regions. Its relative efficacy versus cost-effective options like physiotherapy or NSAIDs must be considered.

Future directions

Recommendations for future research include multicentre, adequately powered RCTs with standardized ESWT protocols, longitudinal follow-up (≥12 months) to assess durability of outcomes, comparative trials against other regenerative techniques (e.g., PRP, dry needling) and objective imaging biomarkers for tendon healing assessment.

CONCLUSION

Extracorporeal shockwave therapy represents a promising non-invasive modality for the management of tendinopathies, particularly where traditional conservative therapies fail to yield sustained recovery. Through mechanisms involving mechanotransduction, angiogenesis, and neuromodulation, ESWT addresses both symptomatic pain and structural degeneration.

Evidence from randomized trials supports its effectiveness across multiple tendon sites, most notably in plantar fasciitis and Achilles tendinopathy. However, variability in treatment parameters, patient populations, and outcome measures limits widespread adoption and standardization.

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REFERENCES

1. Griffin C, Daniells K, Hill C, Franklyn-Miller A, Morin J B. A criteria-based rehabilitation program for chronic mid-portion Achilles tendinopathy: study protocol for a randomized controlled trial. BMC Musculoskeletal Disord. 2021;22:695.
2. Malliaras P, Barton CJ, Reeves ND, Langberg H. Achilles and patellar tendinopathy loading programmes. Sports Med. 2013;43:267-86.
3. Andres BM, Murrell GA. Treatment of tendinopathy: what works, what does not, and what is on the horizon. Clin Orthop Relat Res. 2008;466(7):1539-54.
4. Simplicio CL, Purita J, Murrell W, Santos GS, Dos Santos RG, Lana JFSD. Extracorporeal shock wave therapy mechanisms in musculoskeletal regenerative medicine. J Clin Orthop Trauma. 2020;11(S3):S309-18.
5. Vahdatpour B, Sajadieh S, Bateni V, Karami M, Sajjadieh H. Extracorporeal shock wave therapy in patients with plantar fasciitis. A randomized, placebo-controlled trial with ultrasonographic and subjective outcome assessments. J Res Med Sci. 2012;17(9):834-8.
6. Sun J, Gao F, Wang Y, Sun W, Jiang B, Li Z. Extracorporeal shock wave therapy is effective in treating chronic plantar fasciitis: A meta-analysis of RCTs. Medicine (Baltimore). 2017;96(15):e6621.
7. Stania M, Juras G, Chmielewska D, Polak A, Kucio C, Król P. Extracorporeal Shock Wave Therapy for Achilles Tendinopathy. Biomed Res Int. 2019;3086910.
8. Feeney KM. The Effectiveness of Extracorporeal Shockwave Therapy for Midportion Achilles Tendinopathy: A Systematic Review. Cureus. 2022;14(7):e26960.

9. Yao G, Chen J, Duan Y, Chen X. Efficacy of Extracorporeal Shock Wave Therapy for Lateral Epicondylitis: A Systematic Review and Meta-Analysis. Biomed Res Int. 2020;2064781.
10. Charles R, Fang L, Zhu R, Wang J. The effectiveness of shockwave therapy on patellar tendinopathy, Achilles tendinopathy, and plantar fasciitis: a systematic review and meta-analysis. Front Immunol. 2023;14:1193835.
11. Rompe JD, Furia JP, Maffulli N. Eccentric loading versus eccentric loading plus shock-wave treatment for midportion Achilles tendinopathy. Am J Sports Med. 2009;37(3):463-70.
12. Gerdesmeyer L, Frey C, Vester J, Maier M, Weil L Jr, et al. Radial extracorporeal shock wave therapy is safe and effective in the treatment of chronic recalcitrant plantar fasciitis: results of a confirmatory randomized placebo-controlled multicentre study. Am J Sports Med. 2008;36(11):2100-9.
13. Speed CA, Nichols D, Richards C, Humphreys H, Wies T, Burnet S, et al. Extracorporeal shock wave therapy for lateral epicondylitis: a double blind randomised controlled trial. J Orthop Res. 2002;20(5):895-8.
14. Zwerver J, Thijs KM, Backx FJ, Steeneken V, Rayer S, Groenenboom P, et al. Effectiveness of Shockwave Treatment Combined With Eccentric Training for Patellar Tendinopathy: A Double-Blinded Randomized Study. Clin J Sport Med. 2017;27(2):89-96.
15. Wang C J. An overview of shock wave therapy in musculoskeletal disorders. Chang Gung Med J. 2003;26(4):220-32.
16. Romeo P, Lavanga V, Pagani D, Sansone V. Extracorporeal shock wave therapy in musculoskeletal disorders: a review. Med Princ Pract. 2014;23(1):7-13.
17. Hausdorf J, Lemmens MA, Heck KD, Grolms N, Korr H, Kertschanska S, et al. Selective loss of unmyelinated nerve fibers after extracorporeal shockwave application to the musculoskeletal system. Neuroscience. 2008;155(1):138-44.
18. Weihs AW, Fuchs C, Teuschl AH, Hartinger J, Slezak P, Mittermayr R. Shock wave treatment enhances cell proliferation and improves wound healing by ATP release-coupled extracellular signal-regulated kinase (ERK) activation. J Biol Chem. 2014;289(39):27090-104.
19. D’Agostino MC, Craig K, Tibalt E, Respizzi S. Shock wave as biological therapeutic tool: from mechanical stimulation to recovery and healing, through mechanotransduction. Int J Surg. 2015;24:147-53.
20. Leal C, Ramon S, Furia J, Fernandez A, Romero, Hernandez-Sierra L. Current concepts of shockwave therapy in chronic patellar tendinopathy. Int J Surg. 2015;24:160-4.

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