



WHITE PAPER

---

**SHOCKWAVE**

## RADIAL SHOCKWAVE THERAPY FOR TREATMENT OF CHRONIC SOFT-TISSUE LESIONS: A Technology Worth a Close Look

By Joseph Gallo, DSc, ATC, PT and Kevin J. Silva, EdD, MSAT, ATC

*Joseph A. Gallo, DSc, ATC, PT, is a Professor of Athletic Training at Salem State University, Salem, MA*

*Kevin J. Silva, EdD, MSAT, ATC, is a Professor of Athletic Training at Salem State University, Salem, MA*

### INTRODUCTION

Extracorporeal shockwaves have been used successfully for more than 40 years in the form of lithotripsy, a non-invasive method to destroy kidney stones using high output shockwaves. During the past 30 years, shockwave therapy (SWT) has been used throughout Europe and Canada to treat chronic tendinopathies, plantar fasciopathy, and trigger points. Focused SWT technology was first cleared for use in the United States by the FDA in 2000, followed by Radial SWT in 2001. The first clearances were for treatment of plantar fasciopathy.

American-trained rehabilitation specialists generally receive limited, if any, exposure to SWT in their formal education. In the past, most rehabilitation specialists had less involvement with SWT because historically a local anesthetic was used prior to treatment. Interestingly, decreased success rates have been noted when a local anesthetic is used prior to the application of SWT.<sup>1-2</sup> The use of a local anesthetic impairs subjective patient feedback during the treatment session, which can lead to overdosing and unnecessary tissue damage. Therefore, the use of local anesthetic is not recommended when performing shockwave.<sup>3</sup> There has been a significant increase in research and

clinical use of Radial SWT, also referred to as radial pressure wave therapy, over the last decade (Figure 1). Radial SWT uses less energy per pulse than Focused SWT, yet is still capable of penetrating to depths of 3-4 cm.<sup>4</sup> Which is a suitable depth to treat most common types of tendinopathy, fasciopathy, and trigger points.

### THE SHOCKWAVE THERAPY CONCEPT

Shockwave therapy should not be confused with electrotherapy. It does not apply electric shocks. Rather, it applies mechanical pressure waves. Shockwave therapy delivers a well-controlled mechanical insult to connective tissue. At first thought, this might sound counterintuitive. However, “insulative” therapy is not something that is new to the field of rehabilitation. Our understanding of chronic tendinopathies (tendinosis) has grown extensively over the last two decades. We now know that a tendinosis lacks histologic signs of inflammation, and that it is not an “itis” that is stuck in the inflammatory phase of tissue healing. It is also now clear that significant tendon degeneration, mucoid accumulation, and adhesions develop with tendinosis. Early pioneers, such as Dr. James Cyriax, advocated for the use of cross friction massage techniques to provide a controlled “clinical insult”

Figure 1. Radial Shockwave Device



to chronic tendon lesions that had stalled in the healing process. The theory purports that cross friction techniques break down adhesions and restimulates the inflammatory response allowing for tissue healing to occur, which is in line with our current understanding of chronic tendinopathy. Research indicates that Cyriax's cross friction massage techniques combined with other therapies (stretching, eccentric training, joint mobilization, etc) can have positive outcomes on otherwise recalcitrant soft-tissue lesions.<sup>5</sup> Instrument assisted soft tissue mobilization is another example of an intervention that follows this paradigm of delivering a controlled insult to restimulate the healing response. Likewise, Radial SWT is a therapeutic modality that can be used to restimulate the healing response in chronic soft-tissue lesions that are not responsive to typical first line treatments. The mechanotransduction produced by the shockwave produces several physiological effects, including hyperstimulation analgesia and stimulation of neovascularization and collagen synthesis in degenerative tissues.<sup>6</sup>

## PRODUCTION OF MECHANICAL ENERGY USED IN RADIAL SWT

Radial pressure waves are generated by either an electromagnetic ballistic or pneumatic ballistic shockwave generator. The mechanical energy that is directed to the tissue is generated either through a ballistic projectile that is electromagnetically accelerated or by means of a pneumatic system. The projectile is accelerated to a high speed within the handpiece and then is suddenly decelerated by a transmitter.<sup>3,7</sup> (Figure 2) The transmitter is held in



Figure 2 – Handpiece and Transmitter

direct contact over the target tissue and transmits the pressure wave outward (radially) into the tissue. Standard ultrasound gel is used as the coupling medium to deliver the radial pressure waves to the underlying pathologic tissue.

## APPLICATION OF RADIAL SWT

Shockwave devices typically deliver 1,500 to 3,000 shocks per session, with 2,000 shocks per session most cited.<sup>3</sup> Each session can be completed in 10 to 15 minutes, with the number of treatment sessions ranging from one to two times per week for three to eight treatments. The radial SWT application requires the use of ultrasound gel prior to placing the applicator directly on the skin over the target tissue. Once in contact, the clinician activates the series of pressure waves into the target tissue. During the treatment the patient will feel an uncomfortable, yet tolerable, sensation that ranges from 5-7 out of 10 discomfort level with 6/10 most cited as the dosing threshold.<sup>3</sup> Shockwave Therapy commonly induces analgesia within the first 500 shocks, likely through a gating mechanism. Some patients may feel post-treatment soreness in the treatment area.<sup>3</sup>

## PLANTAR FASCIOSIS

Eighty percent of patients with plantar fasciopathy improve within 12 months with standard conservative care.<sup>8</sup> Those with recalcitrant plantar fasciosis are candidates for radial shockwave therapy. It is the preferred treatment over cortisone injection and surgery. Patients that receive radial SWT can bear weight immediately and return to normal activity quickly. Success rates for the treatment of plantar fasciosis with SWT range from 34% to 88%, with most studies reporting positive clinical outcomes.<sup>9-10</sup> The International Society of Medical SWT recommends 2,000-3,000 shocks with an energy of 2-4 bars at a frequency of 10 Hz or less. Likewise, Ibrahim et al<sup>11</sup> reported positive outcomes with the application of 2,000 shocks with an energy of 3.5 bars at a frequency of 8 Hz to treat plantar fasciosis. These parameters are well tolerated without the need for a local anesthetic. Gerdesmeyer et al<sup>12</sup> showed an overall success rate of 61.0% compared

to 42.2% in the placebo group with three treatment sessions of radial SWT. Similar improvement in functional outcome scores and pain has been reported for both radial SWT and focused SWT, with radial SWT being a good alternative due to its lower cost.<sup>1,13</sup>

## PATELLAR TENDINOPATHY

Ultrasound examination revealed a significant increase in the vascularity of the patellar tendon and decreased patella tendon thickness after SWT compared to conservative treatment.<sup>14</sup> The International Society of Medical SWT recommends 2,000-3,000 shocks per session with an energy of 2-4 bars at a frequency of 10 Hz or less. Shockwave sessions can be completed once every one to two weeks for a total of three to five sessions.<sup>15</sup> Peers et al<sup>16</sup> compared functional outcomes for patella tendinosis in a group of patients who received surgical intervention to a non-surgical group that received SWT. They concluded that the outcomes were comparable and that SWT is an effective, non-invasive treatment for chronic tendinopathy. Zwerver

et al<sup>17</sup> studied SWT in athletes with chronic patella tendinopathy who continued to participate in their respective sport while using SWT as a stand-alone treatment. No significant differences were noted on the Victorian Institute of Sport Assessment-Patella Questionnaire. However, subjective ratings of the severity of symptoms were better in the SWT group. These findings once again support the concept that SWT is likely to be most effective when combined with other key interventions.<sup>3,17</sup>

## LATERAL EPICONDYLALGIA

A meta-analysis on SWT for lateral epicondylalgia revealed that six out of 10 studies showed positive outcomes.<sup>20</sup> Spacca et al<sup>21</sup> reported a decrease in pain, improved function, and an increase of the pain-free grip strength and elbow function after applying 2,000 impulses of Radial SWT one time per week for four weeks. Eighty-seven percent of the treatment group was satisfied with their outcome, whereas only 3% of the control group was satisfied. The authors concluded that Radial SWT is safe and effective alternative to surgery intervention.

**Figure 3. Radial Shockwave Therapy for Plantar Fasciopathy**



## TRIGGER POINT TREATMENT

The use of SWT to treat trigger points has become increasingly common. Radial SWT has been shown to be as effective as dry needling in decreasing pain and increasing range of motion in patients with upper trapezius trigger points.<sup>22</sup> Radial SWT has proven to be an effective, non-invasive intervention that can decrease myofascial trigger point pain by 62.5% with little post-treatment soreness.<sup>23</sup> Based on the available research, the recommended treatment parameters include 500-1000 shocks per trigger point, an energy between 1.6-3 bars at a frequency of 10-15 Hz for one to two treatment sessions per week for three to eight treatments.<sup>12,23</sup>

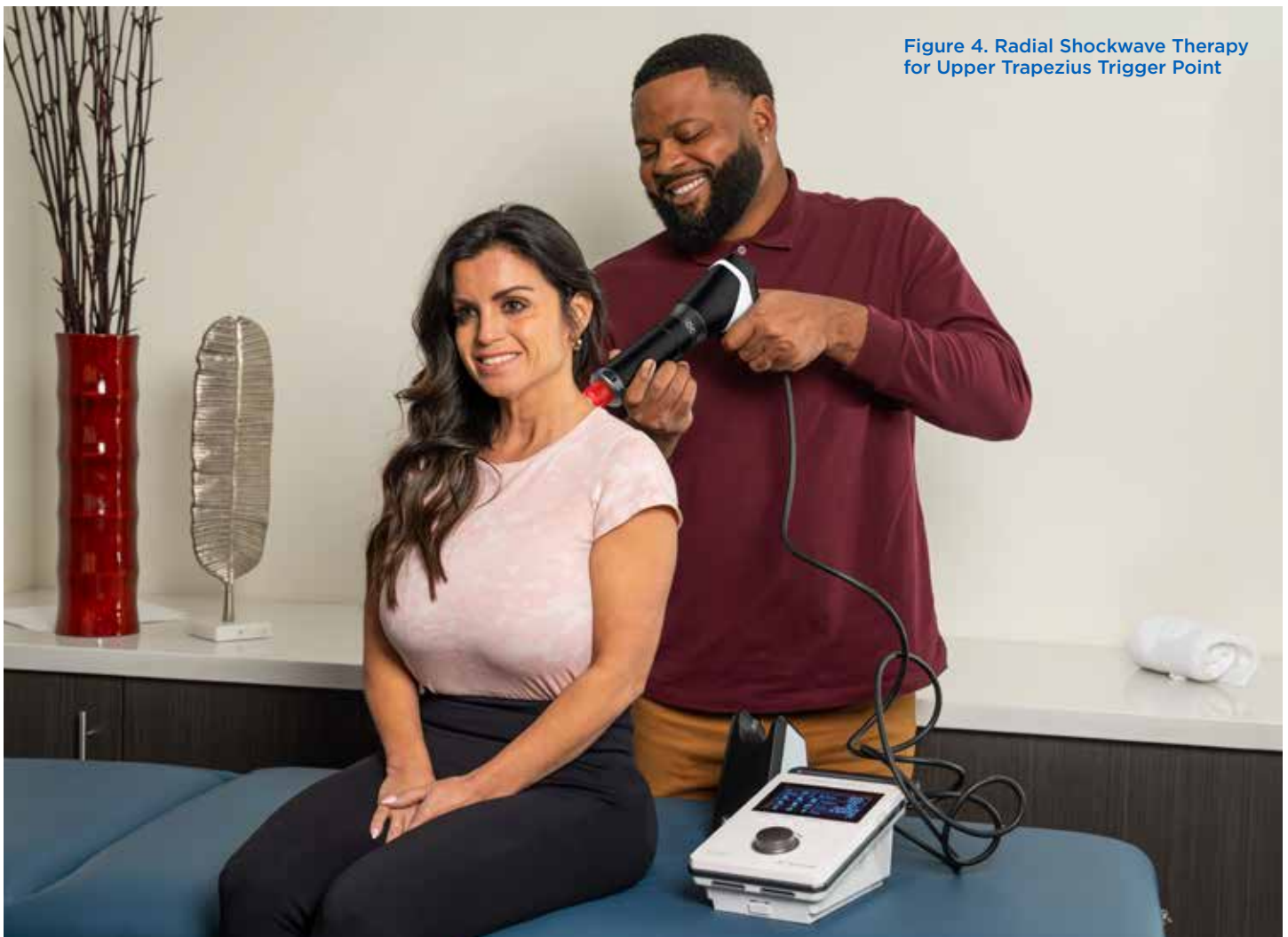
## OTHER CONDITIONS

The International Medical Society for Shockwave Therapy lists over 40 specific clinical indications for shockwave therapy.<sup>15</sup> In addition to common chronic

tendinopathies the list includes decreasing spasticity, acceleration of bone healing, adhesive capsulitis, osteoarthritis, medial tibial stress syndrome, and other conditions.<sup>3</sup> A commonality between clinical outcomes for all conditions is that Radial SWT is most effective when integrated into the patient's standard care, including therapeutic exercise, manual therapy, and load management.<sup>3</sup>

## SUMMARY SWT

Shockwave therapy is an adjunctive treatment that when added to standard care can provide a solution to the problem of persistent recalcitrant soft tissue lesions. The approach is consistent with the long standing Cyriax approach and with our current understanding of chronic soft tissue lesions. In addition to its impact on angiogenesis and the healing process, radial SWT can also provide effective non-pharmaceutical pain management.



**Figure 4. Radial Shockwave Therapy for Upper Trapezius Trigger Point**



## REFERENCES:

1. Chang KV, Chen SY, Chen WS, Tu YK, Chien KL. Comparative effectiveness of focused shock wave therapy of different intensity levels and radial shock wave therapy for treating plantar fasciitis: a systematic review and network meta-analysis. *Arch Phys Med Rehabil.* 2012; 93: 1259-68.
2. Tenforde AS, Borgstrom HE, DeLuca S, et al. Best practices for extracorporeal shockwave therapy in musculoskeletal medicine: Clinical application and training consideration. *PM R.* 2022;14(5):611-619. doi:10.1002/pmrj.12790
3. Rhim HC, Singh M, Maffulli N, et al. Recommendations for use of extracorporeal shockwave therapy in sports medicine: an international modified Delphi study. *Br J Sports Med.* Published online March 11, 2025. doi:10.1136/bjsports-2024-109082
4. Speed CA. A systematic review of shockwave therapies in soft tissue conditions: focusing on the evidence. *Br J Sports Med.* 2014; 48(21): 1538-1542
5. Joseph MF, Taft K, Moskwa M, Denegar CR. Deep friction massage to treat tendinopathy: a systematic review of a classic treatment in the face of a new paradigm of understanding. *J Sport Rehabil.* 2012; 21: 343-53.
6. Rhim HC, Kwon J, Park J, Borg-Stein J, Tenforde AS. A systematic review of systematic reviews on the epidemiology, evaluation, and treatment of plantar fasciitis. *Life.* 2021; 11(12):1287.
7. Wiel LS. What you should know about shockwave therapy. *Podiatry Today.* 2004; 17 : 60-66.
8. Rompe JD. Plantar fasciopathy. *Sports Med Arthrosc.* 2009;17:100-4.
9. Wang CJ. Extracorporeal shockwave therapy in Musculoskeletal disorders. *J Orthop Surg Res.* 2012; 7: 1-8.
10. Malliaropoulos N, Crate G, Meke M, et al. Success and Recurrence Rate after Radial Extracorporeal Shock Wave Therapy for Plantar Fasciopathy: A Retrospective Study. *Biomed Res Int.* 2016;2016:9415827. doi:10.1155/2016/9415827
11. Ibrahim MI, Donatelli RA, Hellman M, Hussein AZ, Furia JP, Schmitz C. Long-term results of radial extracorporeal shock wave treatment for chronic plantar fasciopathy: A prospective, randomized, placebo-controlled trial with two years follow-up. *Journal of Orthopaedic Research.* 2017;35(7):1532-8.
12. Gerdesmeyer L, Frey C, Vester J, 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 multicenter study. *Am J Sports Med.* 2008; 36: 2100-9.
13. Lohrer H, Nauck T, Dorn-Lange NV, et al. Comparison of radial versus focused extracorporeal shock waves in plantar fasciitis using functional measures. *Foot Ankle Int.* 2010;31:1-9.
14. Wang CJ, KO JY, Chan YS, Weng LH, HSU SL. Extracorporeal shockwave for chronic patellar tendinopathy. *AM J Sports Med.* 2007;35:972-8.
15. International Society for Medical Shockwave Treatment. ESWT guidelines English version: updated and agreed by the ISMST Managing Board, in close cooperation with the Society for Extracorporeal Shockwave Therapy (DIGEST), Daegu, South Korea, July 20, 2023. ISMST. [www.ismst.com](http://www.ismst.com), 2023.
16. Peers KH, Lysens RJ, Brys P, Bellemans J. Cross-sectional outcome analysis of athletes with chronic patellar tendinopathy treated surgically and by extracorporeal shock wave therapy. *Clin J Sports Med.* 2003;13: 79-83.
17. Zwerver J, Verhagen E, Hartgens F, et al. The TOPGAME-study; effectiveness of extracorporeal shockwave therapy in jumping athletes with patellar tendinopathy. *BMC Musculoskelet Disord.* 2010; 11:28-33.
18. Rasmussen S, Christensen M, Mathiesen I, Simonson O. Shockwave therapy for chronic Achilles tendinopathy: a double-blind, randomized trial of efficacy. *Acta Orthop.* 2008;79: 249-56.
19. Wang CJ, Huang HY, Pai CH. Shock wave enhanced neovascularization at bonetendon junction: a study in a dog model. *J Foot Ankle Surg.* 2002;41 16-22.
20. Rompe JD, Maffulli N. Repetitive shock wave therapy for lateral elbow tendinopathy (tennis elbow): a systematic and qualitative analysis. *British Medical Bulletin.* 2007;83: 355-378.
21. Spacca G, Necozone S, Cacchio A. Radial shock wave therapy for lateral epicondylitis: a prospective randomized controlled single-blind study. *Europa Medicophysica.* 2005;41:17-25.
22. Toghtamesh M, Tajali SB, Jalaei S. Comparing between the effects of dry needling and shock wave in the treatment of trapezius myofascial pain. *Journal of Modern Rehabilitation.* 2020 Oct 27;14(4):225-32.
23. Sugawara AT, Lima MD, Dias CB. Predictive factors of response in radial Extracorporeal Shock-waves Therapy for Myofascial and Articular Pain: A retrospective cohort study. *Journal of Back and Musculoskeletal Rehabilitation.* 2021 May;34(3):485-90.