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Effectiveness of Ultrasound on Gait and Range of Motion among Athletes with Achilles Tendinitis - A Narrative Review

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Abstract

Background: Achilles tendinitis is a common condition among sports players. It is caused by repetitive action and overuse of the Achilles tendon, with clinical characteristics such as inflammation, increased pain, improper gait, and decreased range of motion in the ankle. The objective of this study is to identify the potential effects of therapeutic ultrasound and range of motion in athletes with Achilles tendinitis.
Method: This review includes studies obtained from Google Scholar, PubMed, Cochrane, and ResearchGate databases. Therapeutic ultrasound is specifically examined in all the studies included in the analysis of gait and the range of motion of the ankle. A systematic narrative review form is used to analyze the studies that meet the present study criteria. In total, five studies were included: one pilot study, one case study, three randomized control trials, one experimental study, and two longitudinal studies.
Conclusion: From this review, we conclude that therapeutic ultrasound was found to be effective in improving the participants' gait and ankle range of motion following Achilles tendinitis.

Keywords

Achilles tendon, Achilles tendinitis, athletes, gait pattern, ultrasound.

Introduction

Achilles tendinitis is a prevalent condition observed in athletes who engage in activities such as running and jumping, including sports like football. This chronic degenerative issue has the potential to progress to tendon rupture, causing substantial morbidity and potentially terminating an athlete's career (He et al., 2016). Given its high occurrence rate and negative impact on performances, ultrasound is a frequently utilized modality in the treatment of tendinitis. It enhances microcirculation, promotes migration, and aids in the synthesis of collagen fibres within the Achilles tendon (Maffulli et al., 2004).

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The soleus and gastrocnemius muscles combine to generate the Achilles tendon. The posterior surface of the upper tibia is where the soleus muscle originates, and it inserts into the calcaneus. It is encircled by a vascularized paratendon but lacks a genuine synovial sheath. Transverse vincula and veins from muscle and bone connections provide the tendon with blood supplies (Maffulli et al., 2004). The Achilles tendon spirals around 90 degrees, rotating about 12–15 cm above its insertion. A hypovascular zone extends 2–7 cm from the point of implantation. White, fibroelastic tendons are those that are in good health. Ninety to ninety-five percent of tendon cells are tenoblasts and tenocytes, with the remainder being fibrochondrocytes and synovial cells (Maffulli et al., 2004).

A tendon's ability to withstand 500–1000 kg per square centimeter depends on its thickness and collagen composition. Achilles tendon loading can reach up to 9 kN (equal to 12.5 times body weight) while running, 2.6 kN while slowly walking, and less than 1 kN while cycling (Kudron et al., 2019). The effectiveness of therapeutic ultrasonography in the treatment of musculoskeletal disorders like tendinopathy is not well established in clinical research. Sports-related tendon problems are common in lower limb (Kang & Ramalingam, 2018), with estimates of Achilles tendinopathy in runners at 11% and supraspinatus tendinopathy in competitive swimmers at 69%. Ultrasound is one of many treatments used to treat tendinopathy (Purushothaman et al., 2023; Tsai et al., 2011).

Piezoelectric crystals made of ceramic and quartz are used in ultrasound equipment to transform electric signals into ultrasonic sound waves. These waves penetrate tissue, absorb energy, and then transform into heat. Pressure waves that oscillate at a frequency corresponding to the applied electric current are produced by mechanical vibrations in the crystals (Ooi et al., 2016). A coupling medium, such as water-soluble gel, is utilized to convey ultrasonic waves to the patient. With frequencies of 1 or 3 MHz, typical dosages are in the range of 0.5 to 2.0 W/cm2 for 5 to 10 minutes, applied daily or every other day. For thermal effects, a 1-MHz setting penetrates farther (2–5 cm), whereas 3 MHz is only applied briefly (less than 2.5 cm) (Tsai et al., 2011).

Ultrasound waves can be continuous or pulsed. Continuous mode raises tissue temperature, while pulsed low-intensity settings create nonthermal effects like cavitation and microstreaming. Thermal effects are used for conditions like chronic sprains and pain relief, while non-thermal effects promote tissue regeneration, protein synthesis in fibroblasts, and tendon repair. The widespread use of ultrasound by physiotherapists is backed by animals and in vitro research that points to its beneficial benefits on tendon recovery. There isn't much human research on its therapeutic efficacy, especially in terms of how it affects chronic Achilles tendon repair and pain management (Chester et al., 2008).

Table 1: Studies on Ultrasound Therapy for Achilles Tendinitis

Author	Sample Size	Sample Design	Study Description	Outcome Measure	Conclusion
Chester, et.al. (2008)	N=16	pilot study	16 subjects were assigned into 2 groups. Group-A=8 subjects are given eccentric loading exercise Group-B=8 subjects are given ultrasound. Duration-Group A The exercises wereperformed once a day,7 days a week. the performance and exercise progression took place at subsequent appointments at 2, 4 and 6 weeks. Treatment was applied for 2 minutes per square centimeter (min/cm²) to the painful tendon. This treatment regimen was repeated twice a week. The entire treatment period spanned 6 weeks. Dose: frequency of 3 MHz with intensity of the ultrasound was 0.5 watts per square centimeter.	The functional index of the leg and lower limb (FILLA)visual analogue scale (VAS)	There were improvements in pain levels, particularly within the ultrasound group, in the management of Achilles tendon pain.
Balius et.al. (2012)	N=55	Randomized control trail	Patients with tendinopathy were evaluated using VISA-A, VAS, and ultrasound. Three treatment groups were examined: eccentric training, eccentric training + dietary supplement, and passive stretching + supplement. The patients were randomly assigned and categorized as reactive or degenerative tendinopathy	visual analog scale (VAS)Victorian institute of sport assessment	It found that the supplement provided additional benefit in improving symptoms, especially in patients with reactive tendinopathies
Best et.al. (2015)	N=25	Case study	25 subjects were assigned into 2 groupGroup A had 5 samples with Achilles tendinopathy treated by ultrasound with duration of 6 weeks were 2 week,3week, and 4 weeksare taken for consideration. Group b had 20 subjects with elbow tendinopathy by ultrasound with duration of 6weeks where 18 samples are treated and 2 samples were inconvenienced with the study.After completion of 2 weeks 2 samples got discontinued the treatment, In between the completion of 4th week , 4 samples were discontinued the treatment And In the 6 week of completion 1 samples got discontinued the treatment,finally 11 subjects followed up treatmentDose: The device delivers stationary, hands-free ultrasound 3 MHz frequency, 0.132 W/cm2 intensity per applicator, continuous wave form, time duration 4 h per treatment session.	The Numeric pain rating scale (NPRS)Victoria n institute of sports assessment–achilles universal goniometry parametric test	Low Intensity Therapeutic Ultrasound treatment resulted in improved exerted force and grip strength
Kousar et.al. (2022)	N=76	Randomized control trail	Eccentric exercises (EE) and transverse friction massage (TFM) were administered to Group A, while ultrasonic treatment (UST) and EE were administered to Group B. As one patient from the TFM group (n=36) and two from the UST group (n=37) dropped out, a total of n=73 patients from n=76 samples were included in the data analysis.	American Institute of Ultrasound Medicine practice guidelines	The study concluded that adding eccentric exercises to TFM or UST could have significant positive effects

			Duration: -6 weeks with 3 sessions per week. Dose: The Ultrasound settings were pulse 20% duty cycle 8ms interval/2ms emission, 2ms burst of 1.0 MHz sinewaves repeating at 100Hz, 0.5 w/cm² of intensity. Transverse friction massage was performed by thumb for 3 min over 3cm-5cm area		on Achilles tendinopathy.
Tsai et.al., 2011	-	Randomized control trail	The up-regulation of TGF-beta is the molecular mechanism behind the stimulation of tendon cells. Therapeutic ultrasound can enhance tendon healing by promoting cell migration, proliferation, and collagen synthesis. The effectiveness of ultrasound treatment in tendon healing varies and further research is needed to optimize its use.	-	While some studies have demonstrated positive effects, others have shown no significant improvement

Results and Discussion

Therapeutic ultrasound may be effective in treating Achilles tendon discomfort, according to a study (Chester et al., 2008), which showed a decrease in pain levels, especially in the ultrasound group. A different investigation of the daily usage of a supplement comprising type I collagen, vitamin C, and mucopolysaccharides discovered that it was advantageous, particularly for people with reactive tendinopathies (Balius et al., 2012). With significant pain reduction, improved exerted force, and enhanced grip strength, sustained acoustic therapy (LITUS treatment) showed potential improvement. However, a study contrasting transverse friction massage (TFM) and ultrasonic therapy (UST) found that TFM was superior in lowering pain intensity and improving ankle range of motion (Best et al., 2015).

Additionally, studies on the molecular mechanisms underlying ultrasonic therapy have shown that it can accelerate tendon recovery by promoting cell migration, proliferation, and collagen synthesis, however the efficiency of this therapy varied with intensity and frequency (Tsai et al., 2011). According to (Chester et al., 2008), a prospective randomized experiment contrasting eccentric loading workouts and therapeutic ultrasound is one potential area for future research.These studies collectively reveal a variety of therapeutic alternatives for treating Achilles tendonitis, highlighting the significance of individualized treatment plans that take into account aspects including pain management, enhanced function, and safety.

Conclusions

This review suggested therapeutic ultrasound as a potential treatment modality for Achilles tendinopathy and associated conditions, which is induced by the up-regulation of transforming growth factor beta (TGF-beta). However, the overall effectiveness of ultrasound therapy varies depending on factors such as intensity and frequency, as many authors have shown. Studies found that other methods, like eccentric exercise, dietary supplements, and transverse friction massage, are valuable for easing symptoms and initiating tendon healing. To address Achilles tendinopathies, therapeutic ultrasound must be combined with holistic management to meet the individual patient's needs.

References

Balius, R., Álvarez, G., Baró, F., Jiménez, F., Pedret, C., Costa, E., Martínez-Puig, D. (2012). A three-arm randomized trial for Achilles tendinopathy: eccentric training, eccentric training plus a dietary supplement containing mucopolysaccharides, or passive stretching plus dietary supplement containing mucopolysaccharides.Current Therapeutic Research, 7, 1-7. doi: http://dx.doi.org/10.1016/j.curtheres.2016.11.001.

Best, T. M., Moore, B., Jarit, P., Moorman, C. T., & Lewis, G. K. (2015). Sustained acoustic medicine: wearable, long duration ultrasonic therapy for the treatment of tendinopathy. The Physician and Sportsmedicine, 43(4), 366–374. https://doi.org/10.1080/00913847.2015.1095617

Chester, R., Costa, M. L., Shepstone, L., Cooper, A., Donell, S. T. (2008). Eccentric calf muscle training compared with therapeutic ultrasound for chronic Achilles tendon pain. Manual Therapy, 13(6), 484-91. doi: 10.1016/j.math.2007.05.014.

He, L., Genin, J., & Delzell, P. B. (2016). Ultrasound diagnosis and percutaneous treatment of Achilles tendon tethering: a case series. Skeletal Radiology, 45(9), 1293–1298. https://doi.org/10.1007/s00256-016-2416-5.

Kang, A. L., & Ramalingam, V. (2018). Risk factors for lower extremity injuries in young badminton players. Scientia Medica, 28(2), 5.

Kousar, R., Sanaullah, M., Ikram, M., Aleem, A., Memon, A. G., & Rehman, S. S. U. (2022). Effects of ultrasound therapy versus transverse friction massage along with eccentric exercise program on chronic achilles tendinopathy. The Rehabilitation Journal, 6(2), 333–337. https://doi.org/10.52567/trj.v6i02.110

Kudron, C., Carlson, M. J., Meron, A., Sridhar, B. V., & Holman, R. B. (2019). Using ultrasound measurement of the achilles tendon in asymptomatic runners to assist in predicting tendinopathy. Journal of Ultrasound in Medicine, 39(3), 491–496. https://doi.org/10.1002/jum.15125

Maffulli, N., Sharma, P., & Luscombe, K. L. (2004). Achilles tendinopathy: aetiology and management. Journal of the Royal Society of Medicine, 97(10), 472–476. https://doi.org/10.1258/jrsm.97.10.472

Ooi, C. C., Schneider, M. E., Malliaras, P., Jones, D., Saunders, S., McMahon, A., Connell, D. (2016). Sonoelastography of Achilles tendon: Prevalence and prognostic value among asymptomatic elite Australian rules football players. Clinical Journal of Sport Medicine, 26(4), 299-306. doi:10.1097/JSM.0000000000000265.

Purushothaman, V. K., Ramalingam, V., Khan, M., Subbarayalu, A. V., Subramaniam, A., Vasanthi, R. K., ... & Marimuthu, P. R. (2023). Foot posture and landing error scores in recreational basketball players: a novel approach to prevent lower-limb injuries. Pedagogy of Physical Culture and Sports, 27(6), 456-466.

Tsai, W., Tang, S., & Liang, F. (2011). Effect of therapeutic ultrasound on tendons. American Journal of Physical Medicine & Rehabilitation, 90(12), 1068–1073. https://doi.org/10.1097/phm.0b013e31821a70be