Achilles Tendinopathy Treatment with a Focus on Extracorporeal Shock Wave Therapy

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Abstract: Achilles tendinopathy has been an extremely common problem especially among active people and athletes. A multitude of previous and latest treatments have been studied and applied in clinical treatments, including the ESWT (Extracorporeal Shock Wave Therapy). While there is still a lack of systematic summary or review of the efficacy of ESWT. Therefore, this research will use a systematic review approach to review the existing effective non-surgical treatments for Achilles tendinopathy, with a focus on shock wave therapy. And the analysis and summary, in conclusion, suggest that ESWT has an excellent therapeutic effect on Achilles tendon diseases. At the same time, it can be widely used in medical practice as a non-invasive treatment alone or in combination with other therapies.

1 INTRODUCTION

Achilles tendinopathy is one of the most common lower limb motor function diseases in contemporary times. According to the available data, there are relatively limited studies on the incidence and epidemiology of Achilles tendinopathy in authoritative journals. However, existing studies have shown that it is a common condition. The Achilles tendon is a core structural component of the disease. This tendon is extremely strong and it is essential for walking, running, and jumping, as it helps push the foot off the ground. Despite its strength, it is prone to being in a damaged state, particularly in athletes and active individuals.

Types of Achilles tendinopathy encompass Achilles Tendinitis, Achilles Tendon Tear/Rupture, Insertional Achilles Tendinopathy and so on. It causes great discomfort to patients and seriously affects their lower limb functions such as walking and even standing. Despite of the manifold associative factors of the problem, it is commonly agreed the causes and mechanisms of Achilles tendinopathy remain not clear enough. However, what is currently known is that Achilles Tendinopathy usually develops from overuse, with healthcare professionals frequently identifying repetitive tendon overloading as a primary precipitating factor (Traweger et al.,2025). This can occur with excessive jumping and landing type activities. It can also occur as a consequence of trauma such as a direct blow to the tendon. Shoes that do not fit properly may also cause irritation of the tendon due to the repetitive rubbing forces on the tendon. Tendon vascularity, lifestyle, age, gender, body weight and height are firmly believed associated as well. For example, it is suggested that the peak incidence of ankle injuries occurs between 15 and 19 years old, with a rate of 7.2 per 1,000 person-years (Delahunt et al.,2019). In addition, there are a variety of options for diagnosing and evaluating Achilles tendon disorders. Professional palpation and testing are considered to be extremely effective in the diagnosis and assessment of Achilles tendinopathy. Modern imaging examinations are also crucially required to confirm the diagnosis and precisely locate the site of injury. In terms of the non-invasive treatments, as with general treatments for Achilles tendinopathy, plenty of common treatment options can also demonstrate efficacy in Achilles tendinopathy. Ice, adequate rest, lifting the injured foot above heart are widely considered beneficial, along with specific stretching and strengthening exercises and nonsteroidal anti-inflammatory drugs. While with the rapid advancement of modern technology, multitudes of new treatment methods have emerged including ESWT that will be focused on in this article. Extracorporeal shock wave therapy is a widely used medical therapy. It was first used for lithotripsy of kidney stones in 1980. Later, due to its characteristics of no side effects, simple operation, short treatment

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course, and ability to cure, the medical community in various countries began to conduct research and application in various aspects. At present, there are literatures discussing and promoting its application in orthopedics, rehabilitation, cardiology, urology, etc. According to the generation and treatment principles of shock waves, extracorporeal shock waves can be divided into focused and diffuse types. Focused Shock Wave is the main type of shock wave currently used in the medical community, which is essentially equivalent to ESWT. Radial Shock Wave was widely used in the massage shock wave type of rehabilitation in the past, usually as part of the pain relief course, but it has gradually been replaced by focused shock wave. ESWT is used in physical therapy to relieve pain, promote cell metabolism, blood vessel reconstruction, and restore normal muscle tension after various diseases. ESWT is considered as an extremely efficient non-invasive treatment option for managing Achilles tendinopathy, manifesting substantial effectiveness in relieving pain and improving functional outcomes(Fan et al.,2020).The increasing amount of evidence from clinical studies and trials corroborates ESWT's efficacy, demestrating that it can rival or even surpass other conservative treatments, including physical rehibilitation therapy and corticosteroid injections in certain curcumstances (Perwez et al.,2024).However, at present, there is still a lack of systematic summary or review of it. In addition, evaluation and comparison of the treatment (ESWT) effect of Achilles tendinopathy with other therapies are not very comprehensive and well-rounded. Thus, it is of great value to study and summarize the current application and research progress of non-surgical treatments especially the shockwave therapy mentioned above.

This study adopts a systematic review approach to evaluate the therapeutic effects of shockwave therapy on Achilles tendinopathy. The literature selection process was guided by the aim of including the most recent and high-quality studies; therefore, only publications from 2020 onward were considered, except for very few special cases. A key inclusion criterion was the presence of strong empirical evidence, particularly studies reporting persuasive experimental or clinical results. This served as the primary benchmark for assessing the quality and credibility of each study.

To ensure comprehensive coverage, literature was retrieved primarily through Google Scholar, allowing access to a broader range of publications beyond conventional databases and high-impact journals. The search strategy included combinations of keywords such as "shockwave therapy," "Achilles tendinopathy," "treatment outcomes," and "clinical trial."

The included studies were categorized and analyzed based on the specific therapeutic outcomes they reported. This outcome-based classification enabled a more nuanced synthesis of the effectiveness of shockwave therapy across different dimensions of patient recovery, such as pain reduction, functional improvement, and recurrence rates.

2 THERAPEUTIC OUTCOMES

2.1 Pain Alleviation

Pain is often the primary reason why patients seek medical treatment. It also causes great physical and mental damage to patients. Especially psychological damage, it may even hinder the patient's recovery. Therefore, any treatment to relieve pain is extremely important, including shock wave therapy. Shockwave therapy has a complex mechanism for pain regulation of pain. Shockwaves are able to modulate the release of painmediating substances such as prostaglandins and cytokines, and affect neural mechanisms involved in pain modulation. Additionally, ESWT may activate endogenous pain control systems, including the release of endorphins and activation of descending inhibitory pathways. In a general controlled trial, 28 participants were assigned into an experimental (n=9) and control group (n=9). And the result demonstrates that the ESWT could improve the pain in patients with CAI (Chronic Ankle Instability) (Lee et al.2022). In addition, in another systematically completed randomized controlled trial , by six weeks following the completion of therapy, there was a notable reduction in Achilles tendon pain associated with physical activity (Stania et al.,2022). According to loads of multiple randomized controlled clinical trials, extracorporeal shock wave therapy (ESWT) has demonstrated significant efficacy in alleviating pain and discomfort associated with various Achilles tendon disorders. Thus, ESWT holds considerable potential for clinical application in pain management.

2.2 Restoration of Achilles Tendon Function

The function of the Achilles tendon is extremely important in daily life and lower limb movement. Its core function is plantar flexion of the foot, which is

derived from maintaining balance, stabilizing the body, absorbing and releasing energy, achieving force transmission and tiptoeing. In daily life, it is specifically reflected in running, jumping, walking and all other activities that require the body to move forward or upward.

One of the best standards for measuring Achilles tendon and ankle function is the VISA-A. The VISA-A(Victorian Institute of Sport Assessment–Achilles) is a validated questionnaire designed to assess the severity of Achilles tendinopathy. It consists of 8 items covering pain, function in daily living, and sporting activity. Scores range from 0 to 100, with higher scores indicating better function and fewer symptoms. A score of ≥90 is commonly used to indicate readiness to return to sport (Silbernagel and Crossley,2015).

In a retrospective cohort study, after treatment with radial shockwave therapy (n = 58) or combined radial and focused shockwave therapy (n = 29) for patients with Achilles tendinopathy refractory to exercise therapy, it was demonstrated overall functional improvement for both groups. Besides, it is suggested that combined radial and focused shockwave therapy may provide more predictable functional gains for treatment of Achilles tendinopathy compared to radial shockwave therapy (Robinson et al.,2022).

2.3 Anti-inflammatory Effect

Inflammation is often present to varying degrees in Achilles tendinopathy, commonly referred to as Achilles tendonitis. Many symptoms, including discomfort, swelling, warmth, and pain, are attributable to inflammatory processes. Therefore, for any therapeutic intervention to be effective in treating Achilles tendon disorders, anti-inflammatory effects are essential. However, there are very few clinical studies and literatures, especially after 2020, to study the anti-inflammatory effects of the shock wave therapy of Achilles tendon disease. However, many articles have discussed the anti-inflammatory effect of shock wave therapy and explained its mechanism. Therefore, at the same time, the materials cited in this chapter are relatively special and are not entirely literature after 2020 and clinical practice. As highlighted in this concise review, a potential molecular mechanism underlying the anti-inflammatory effects of extracorporeal shock waves (ESWs) appears to involve the maintenance of local nitric oxide (NO) concentrations within physiological ranges during the early phase of the inflammatory response. This effect may be mediated through the facilitation of both enzymatic and non-enzymatic pathways of NO molecule production (Mariotto et al.,2009). ESWT, therefore, has great potential to be applied in an increasing number of inflammatory diseases in the future.

No matter how effective a treatment may be, the emergence of adverse side effects warrants serious attention from both researchers and healthcare professionals. Over the past five years, few clinical studies and corresponding publications have specifically focused on the adverse effects of shockwave therapy. Nonetheless, a considerable number of clinical reports have included discussions on treatment-related side effects. Most of these studies reported no observable adverse reactions attributable to shockwave therapy throughout the research period. However, some accounts have noted the occurrence of typical side effects associated with extracorporeal shockwave therapy (ESWT), which were generally limited to localized skin erythema, mild bruising, swelling, pain, numbness, or tingling sensations within or around the treatment area during or within 24 hours post-treatment (Crevenna et al.,2021). Other types of adverse reactions were rarely documented. The most effective approach to mostly avoiding side effects remains the strict adherence to contraindication guidelines. Extracorporeal shock wave therapy should be contraindicated or used with caution under the following conditions: pregnancy (particularly when the treatment area is near the abdomen or pelvic region); the presence of bleeding disorders or ongoing use of anticoagulant medications; localized infections or malignancies at the treatment site; and patients with implanted cardiac pacemakers (depending on the type of device).Overall, shock wave therapy is a treatment with relatively few side effects and can be regarded as a safe method.

3 LIMITATIONS

The analysis and synthesis presented in this study are reasonably systematic. However, aside from the illustrative references explicitly discussed, the number of underlying studies identified and reviewed is fewer than ten. This limited scope of literature somewhat undermines the robustness of clinical evidence supporting each specific shockwave therapy system. Additionally, the study does not provide a comprehensive exploration of the underlying mechanisms through which various types of shockwave therapy exert their therapeutic effects;

instead, these mechanisms are only briefly mentioned.

Furthermore, a comparative evaluation between shockwave therapy and conventional treatment modalities is warranted. Such comparisons are crucial to better elucidate the unique advantages—and potential limitations—of shockwave therapy within clinical practice. Overall, a more extensive and in-depth synthesis of the available evidence will be necessary in future studies to strengthen the conclusions and broaden the applicability of the findings.

4 CONCLUSIONS

Achilles tendinopathy remains a prevalent condition, particularly among athletes and physically active individuals, with multiple factors contributing to its occurrence. Traditional management strategies, including rest, physical therapy have shown efficacy, but emerging evidence suggests that extracorporeal shock wave therapy (ESWT) offers significant therapeutic benefits, particularly in improving pain, Achilles tendon function recovery anti-inflammatory effect, and physical stability. Its mechanisms—such as promoting local blood flow, stimulating cellular activity, and accelerating tissue regeneration—make it a compelling therapeutic option. Despite ESWT showcases a promising non-invasive treatment option, more and further research is needed to optimize its protocols and long-term effectiveness.

Besides, it is worth noting that while ESWT is generally well-tolerated, some studies have reported mild and transient side effects, such as localized pain, skin reddening, or soft tissue swelling following treatment. These effects are typically self-limiting and do not compromise the overall safety profile of the therapy. Nevertheless, clinicians should remain cautious, particularly when determining treatment intensity and frequency.

Overall, ESWT can be considered a safe and effective option for the management of Achilles tendinopathy. Further standardized clinical trials and long-term outcome studies are recommended to better define its optimal application and to validate its role in evidence-based treatment protocols.

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