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Case Report

Physiotherapy Section

Effect of High-intensity Laser Therapy on Shear-wave Elastography Parameters in Achilles Tendinopathy: A Case Report

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ABSTRACT

Achilles tendinopathy is a common musculoskeletal occurrence primarily affecting athletes, but the general population is also prone to develop this pathology. Shear-wave elastography serves as a complement to traditional ultrasound imaging in assessing tendon properties in patients with Achilles tendinopathy. High Intensity Laser therapy (HILT) is a non-invasive and painless treatment option, exhibiting anti-inflammatory, analgesic, and bio-stimulant characteristics. However, limited evidence exists on the effectiveness of high-intensity laser therapy on shear-wave elastography parameters in patients with Achilles tendinopathy. This case study examines the case of a 22-year-old male with a complaint of pain in the Achilles region. He reported stiffness in the morning and difficulty with weight-bearing activities. To assess patient numeric pain rating scale, range of motion (using goniometer) and shear-wave elastography were used. High-intensity laser therapy was administered to the patient for three sessions alternately. Outcome measures were assessed at baseline and after the commencement of treatment. HILT demonstrated positive effects in reducing pain and improving tissue elasticity in patients with Achilles tendinopathy, as observed through shear-wave elastography. These results indicate that HILT may serve as a valuable complement in the conservative treatment of Achilles tendinopathy.

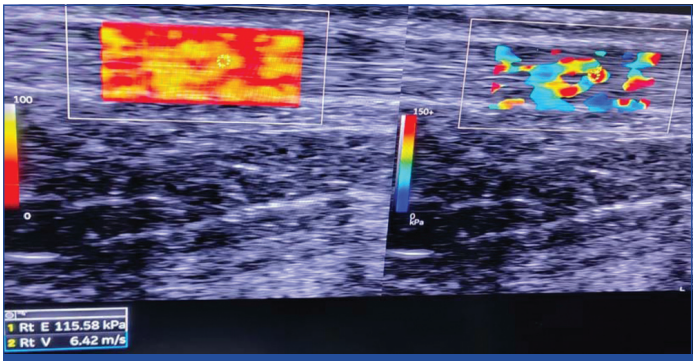
Keywords: Achilles tendon, Elasticity, Pain, Weight-bearing

CASE REPORT

A 22-year-old male student came to the Physiotherapy Outpatient Department (OPD) with a chief complaint of discomfort in the Achilles region and stiffness throughout the morning in the right ankle for the last seven months. Apart from the Achilles pain, the patient had no significant medical history, was not taking any medications, and maintained overall good health. The onset of pain was gradual and progressively increased in intensity, particularly during activities of daily living, including prolonged standing, walking and stair climbing. In the past few months, the duration of his standing and walking increased due to academic and routine commitments. The patient reported sharp-shooting type of pain, with intermittent episodes that was exacerbated during prolonged standing, walking, stair climbing or other weight-bearing activities.

Numeric Pain Rating Scale (NPRS) was utilised to quantify the pain severity and was rated as 4/10 at rest and 7/10 during weight-bearing activities, especially during extended standing. The right Achilles tendon revealed localised tenderness (grade 2) on the tenderness grading scale, approximately 3 cm proximal to Achilles tendon insertion on the calcaneum [1]. Mild redness and localised warmth were reported in the Achilles region, while no swelling or gross deformity was noted. The patient demonstrated an antalgic gait pattern, suggestive of altered biomechanics secondary to pain. Range of motion evaluation of the right ankle showed active plantarflexion of 0-36 degrees and passive 0-40 degrees, while that of active dorsiflexion was 0-11 degrees and passive was 0-13 degrees. Manual muscle testing revealed the strength of the plantar flexors to be 4/5 and that of the dorsiflexors to be 4+/5, with pain. The contralateral limb showed the active and passive range of motion for plantarflexion and dorsiflexion within normal limits, whereas the manual muscle testing revealed strength of plantar-flexors 5/5 and of dorsiflexors 5/5.

Based on a thorough assessment, differential diagnosis included plantar fasciitis, posterior ankle impingement and Achilles tendinopathy. To exclude the possibility of plantar fasciitis, the windlass test was conducted, which yielded a negative result [2]. For posterior ankle impingement, the forced plantarflexion test gave negative results [3]. To assess Achilles tendinopathy, the Royal London Hospital Test and the painful arc sign were administered, both yielding positive results [4]. As a part of diagnostic evaluation, shear wave elastography was performed to assess the tendon integrity and mechanical properties, which yielded with the values of shear wave velocity of 6.42 m/s and stiffness of 115.58 kPa, suggestive of altered tendon elasticity and increased stiffness as compared to healthy Achilles tendon with normal value of stiffness 103.6 kPa and shear-wave velocity ranging between 7.91 - 9.56 m/s [Table/Fig-1] [5,6].



[Table/Fig-1]: Pre-intervention shear-wave elastography readings.

Based on clinical history, examination findings, special test results and elastography readings and in accordance with American Physical Therapy Association (APTA) guidelines, a diagnosis of mid-portion Achilles tendinopathy of the right side was established [7].

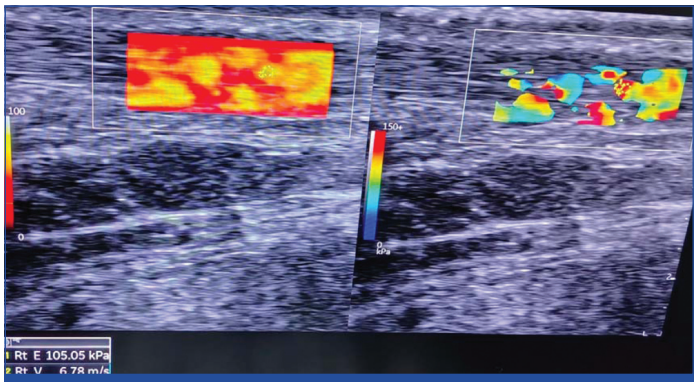
The patient received HILT, which included a total of three alternate sessions for a period of one week. It was administered to the patient at a wavelength of 980 nm in continuous, static mode. A total of 3120 Joules of energy was delivered to the patient per session [Table/Fig-2]. The distribution of energy is given in [Table/Fig-3] [8]. Apart from HILT, no other intervention was administered to the patients to isolate the effect of HILT.

[Table/Fig-2]: Administration of High Intensity Laser Therapy (HILT).

Session	Energy delivered
1st	900 J
2nd	1020 J
3rd	1200 J

[Table/Fig-3]: Distribution of energy delivered per session.

After the completion of the defined sessions of HILT, patients reported a decrease in pain levels and significant differences were observed in ankle range of motion and shear-wave elastography parameters [Table/Fig 4,5]. The patients, after the completion of the intervention session, were advised of the structured home exercise programme consisting of calf muscle strengthening and achilles tendon loading exercise. It was advised to perform the exercises once a day for three sets of 10 to 15 repetitions, progressing gradually according to pain tolerance [7,8]. Long-term follows up assessments were not conducted, limiting conclusions regarding the durability of effects.



[Table/Fig-4]: Post intervention shear-wave elastography readings.

Outcome measure	Pre intervention readings	Post-intervention readings
Shear-wave velocity	6.42 m/s	6.78 m/s
Shear-wave elasticity	115.58 kPa	105.05 kPa
Numeric Pain Rating Scale (NPRS)	7/10	4/10
Ankle plantarflexion active ROM	0-36 degrees	0-41 degrees
Ankle plantarflexion passive ROM	0-40 degrees	0-43 degrees
Ankle dorsiflexion active ROM	0-11 degrees	0-14 degrees
Ankle dorsiflexion passive ROM	0-13 degrees	0-16 degrees

[Table/Fig-5]: Outcome measures evaluation.

DISCUSSION

Achilles tendinopathy is a prevalent overuse disorder characterised by pain, functional impairment, and progressive structural changes within the tendon matrix. Degenerative alterations such as collagen fibre disorganisation, increased proteoglycan content, and neovascularisation lead to decreased mechanical behaviour and altered load transmission capacity of the tendon [9]. Objective measurement of these alterations has gained importance in recent years, notably with the emergence of Shear Wave Elastography (SWE), which permits quantitative assessment of tendon stiffness and elasticity.

In the present study, baseline characteristics of SWE showed alterations in the mechanical properties of Achilles tendon with the shear wave velocity of 6.42 m/s and elasticity of 115.58 kPa, findings consistent with previous studies focusing on the pathological tendons [10,11]. Several studies exhibit that symptomatic Achilles tendon shows different SWE parameters as compared to asymptomatic or healthy tendons, indicating compromised tissue organisation and alteration in the viscoelastic properties [12,13]. Shear-wave velocity increased slightly, and stiffness values decreased after the intervention. However, since minimal clinically significant differences for Achilles tendon SWE parameters have not yet been established, the clinical significance of these changes is still unknown [14]. It has also been suggested as a sensitive tool for detecting changes in the tendons as compared to conventional B-mode ultrasonography [15].

Following the application of HILT, the present case study demonstrated measurable improvements in tendon mechanical behaviour with increased shear wave velocity and reduced shear wave elasticity post-intervention. These changes may suggest the changes in the mechanical behaviour of the tendon; the definitive realignment of collagen fibres cannot be confirmed within such a short intervention period. Similar trends have been observed in the longitudinal studies that assess the response of the tendon with respect to rehabilitation interventions [16-18].

High-intensity laser therapy delivers the energy deeper into the tissues with greater penetration as compared to low-level laser therapy. It results in enhanced microcirculation, modulation of inflammatory mediators, stimulation of mitochondrial activity, increased collagen synthesis and remodelling of tissues [19]. The evidence on the effect of HILT in the management of Achilles tendinopathy remains limited. A study conducted by Mårdh A and Lund I showed significant improvements in the reduction of pain and improvement in pain pressure threshold in patients with achilles tendinosis [8].

Systematic reviews evaluating the impact of HILT in various conditions related to tendons have reported the promising effects in reducing pain and improving function while focusing on the differences in the laser parameters and the lack of high-quality studies related to Achilles tendon [20]. In contrast, multiple randomised trials investigating low-level laser therapy in Achilles tendinopathy have reported inconsistent or minimal benefits, particularly when combined with eccentric exercise protocol [21-23]. This distinction suggests that the therapeutic effects of HILT may differ mechanistically from those of low-energy laser applications.

In the present case study, imaging improvements were accompanied by clinically meaningful outcomes. Pain intensity reduced from 7/10 to 4/10 on the numeric pain rating scale, and improvements were observed in both active and passive ankle plantarflexion and dorsiflexion ranges. Restricted ankle dorsiflexion is a recognised biomechanical risk factor for Achilles tendinopathy, contributing to increased tendon loading during gait and functional activities [24]. Therefore, improved ankle mobility may reflect reduced pain-related inhibition.

Previous elastography-based investigations have suggested that tendon mechanical changes may not be detectable immediately after a single therapeutic session but may occur progressively following repeated exposure to therapeutic loading or physical modalities [19]. The present findings support this observation, as measurable changes in SWE parameters were observed after completion of the HILT protocol. This highlights the potential role of SWE as an objective outcome measure for monitoring tendon adaptations during rehabilitation. The contralateral tendon was not measured. Small variations may occur depending on probe positioning and ankle angle, even though SWE has shown acceptable intra- and inter-rater reliability in prior studies [6]. Additionally, the magnitude of observed changes should be interpreted cautiously because minimal clinically significant differences for Achilles tendon SWE parameters have not yet been established [15]. Previous similar studies from the literature are presented in [Table/Fig-6] [8,10,14,25-27].

Author and year	Place of study	Population	Objectives	Outcome measures	Key findings
Crawford SK et al., 2023 [10]	USA	Patients with unilateral Achilles tendinopathy	To compare SWE parameters between the symptomatic and Contralateral Achilles tendons.	Shear-wave velocity, tendon stiffness	Symptomatic tendons showed significantly altered regional shear wave elastography values compared with asymptomatic contralateral tendons.
Albano D et al., 2024 [14]	Italy	Patients with tendinopathies	To evaluate the diagnostic value of SWE in tendinopathies.	Shear-wave velocity, elasticity	SWE effectively differentiated pathological tendons from healthy tendons, showing altered mechanical properties in tendinopathy.
Shriya S et al., 2024 [25]	India	Patients with mid portion achilles tendinopathy	To evaluate the effectiveness of LLLT combined with eccentric exercise	Visual Analogue Scale, VISA-A	Both groups showed equal improvement.
Stania M et.al 2024 [26]	Poland	Patients with non-insertional achilles tendinopathy	To compare shockwave therapy with ultrasound therapy	Pain intensity VISA-A	Shockwave therapy resulted in better improvement.
Demir Benli M et al., 2021 [27]	Australia	Patients with chronic mid portion achilles tendinopathy	To assess the additional benefits of shockwave therapy with exercise	VISA-A	Shockwave therapy plus exercise showed modest improvement as compared to exercise alone.
Mårdh A and Lund I 2016 [8]	Sweden	Patients with chronic achilles tendinosis	To evaluate the efficacy of high-power laser therapy.	Pain intensity, pressure pain threshold	High Intensity Laser Therapy (HILT) resulted in significant pain reduction and improved pain thresholds compared to placebo.

[Table/Fig-6]: Comparison of previous literature with the present case report [8,10,14,25-27].

This case report provides some relevant findings, as well as major drawbacks. The findings of this study, which is a single case report, can only be applied to individuals with Achilles tendinopathy and cannot be extended to a larger group. The lack of a control group and long-term follow-up on the patient limits drawing solid conclusions about causality or long-term outcomes. Nonetheless, this case report contributes to the literature by combining objective elastography with clinical results following HILT for the treatment of Achilles tendinopathy, filling an important gap.

CONCLUSION(S)

The HILT may positively influence pain reduction and tissue elasticity enhancement in individuals with Achilles tendinopathy, as evidenced by shear-wave elastography.

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