Case Report

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Physiotherapy Section

High Intensity Therapeutic Laser Induced Changes in Cross-sectional Area of Hamstring Muscle: A Case Report

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ABSTRACT

Ultrasonography can provide a clear depiction of Muscle Thickness (MT) and Cross-sectional Area (CSA) while monitoring muscle contraction. Estimating muscle contraction through ultrasonography with physiotherapy interventions has shown to be a beneficial method for training tightened muscles. A 26-year-old male patient presented to physical therapy with a diagnosis of acute hamstring tightness in both lower extremities, based on clinical examination. Muscle tightness was confirmed through the CSA of the hamstring muscles using ultrasonography. A total of six sessions over two weeks, three times per week, including High-Intensity Laser Therapy (HILT) on each hamstring muscle using the contact method, were applied. Circumference and area of each hamstring muscle were measured through ultrasonography, along with flexibility using the sit-toe and touch test and the Active Knee Extension (AKE) test, both pre- and post-intervention. At the end of the sessions, the subject reported clinically meaningful improvement in outcome scores. This case illustrates the improvement in hamstring muscle flexibility as observed in radiological ultrasonography findings following HILT intervention in a subject with hamstring muscle tightness.

Keywords: Flexibility, Hamstring, Therapeutic laser technique, Ultrasonography

CASE REPORT

A 26-year-old male patient, presented with an acute history (for the past 10 days) of bilateral posterior leg tightness, which included discomfort during Activities of Daily Living (ADLs) such as walking, sitting, and running. He presented without any previous history of trauma or injury to his lower extremities. He reported sensations of tightness and discomfort during ADLs, which put his posterior leg on the stretch, but otherwise did not have any other complaints in the spine or lower extremity. The subject was otherwise healthy without a significant past medical history.

A clinical examination revealed no evident deformity, erythema, oedema, ecchymosis, or gait or postural issues. He did not describe any localised pain in his spine, sacroiliac joint, or lower limbs, but a physical examination revealed palpable tension in his posterior thigh and leg. The 90/90 Active Knee Extension (AKE) [1] and Sit and Toe Touch (STT) test [2] were positive bilaterally [Table/Fig-1]. When the subject pulled his knees to his chest, he could move normally and without any pain (i.e., passive hip and lumbar flexion). The primary complaint of the subject and the examination results were in line with the clinical signs of tightness in the hamstring muscles. His symptoms could also be replicated using manual muscle tests and hamstring stretches. Musculoskeletal disorders were ruled out because the examination revealed no evidence of hip, sacroiliac, or lumbar joint involvement. Based on a review of the most recent research on photobiomodulation, High-Intensity Laser Therapy (HILT) intervention was chosen as the primary form of therapy [3].

Ultrasound examination was performed using the Phillips AFFINITY 50G model with a linear probe. Physical therapists who were blinded to the study assessment and the subject conducted all measurements. The semitendinosus, semimembranosus, and biceps femoris a muscles of the hamstring were all tested for thickness. Cross-Sectional Area (CSA) of the bilateral hamstrings was measured [Table/Fig-2]. The subject was in a relaxed position, and no muscles were contracted during any of the measurements. After the initial examination, the intervention was conducted in the physiotherapy outpatient department of a tertiary hospital.

Side of extremity	Active Knee Extension (AKE) test		Sit and Toe Touch (STT) test	
	Pre-test	Post-test	Pre-test	Post-test
Right lower extremity	650	750	13.5 cm	09.03 cm
Left lower extremity	550	740	15.4 cm	10.00 cm

[Table/Fig-1]: Pre and Post-intervention Active Knee Extension (AKE) test and Sit and Toe Touch (STT) test measures of hamstring muscles.

Class-IV laser therapy was employed using the contact method with continuous beam emission (non-pulsing). The Lite Cure Gallium-Aluminum-Arsenide (GaAlAs) near-infrared laser (Lite Cure, LCT-1000C Therapy Laser, Model Number LCT-1000C) was used. The dosage parameters employed were: wavelength 980nm, power 10 watts, intensity 3W/cm^2, 9 radiation points on the hamstring belly, 490 Joules, 70 seconds on each point, and treatment times ranging from 4-5 minutes for each extremity [4]. The protocol titled "Laser Therapy Application Protocol for Hamstring Muscle Flexibility/Tightness" by Adarsh Kumar Srivastav and Manu Goyal was copyrighted under the Copyright Office of the Government of India with unique registration number L-123236/2023 dated 2nd June 2023 (copyright filed with diary number 19492/2022-CO/L dated 16th September 2022).

The application was carried out using the scanning motion approach with the aid of a contact probe moving at a rate of 1 cm/s, and the muscle area was distributed using the grid method. The hamstring muscles of both extremities were treated with 6 treatment sessions over two weeks. No adverse events were observed during or after any of the High-Intensity Laser Therapy (HILT) sessions.

After two weeks of intervention, individuals were reassessed for hamstring muscle flexibility and CSA. The subject increased his Sit and Toe Touch (STT) by 4.47 cm on the right and 5.40 cm on the left, and his Active Knee Extension (AKE) test by 100 on the right and 190 on the left lower extremity [Table/Fig-2]. Individuals were instructed to incorporate a regimen of hamstring stretching exercises into their daily routine to enhance flexibility and alleviate tightness.

Side of extremity		Pre-test		Post-test	
		Circumference	Area	Circumference	Area
Right lower extremity	Biceps femoris	13.8 cm²	10.0 cm²	13.0 cm²	9.37 cm²
	Semimembranosus	13.1 cm²	11.1 cm²	12.7 cm²	10.9 cm²
	Semitendinosus	9.93 cm²	6.66 cm²	9.88 cm²	6.11 cm²
Left lower extremity	Biceps femoris	13.4 cm²	9.80 cm²	12.4 cm²	9.53 cm²
	Semimembranosus	10.7 cm²	7.82 cm²	10.5 cm²	7.24 cm²
	Semitendinosus	9.18 cm²	5.18 cm²	8.80 cm²	5.11 cm²

[Table/Fig-2]: Pre and Post-intervention ultrasonographic circumference and area of bilateral hamstring muscles.

DISCUSSION

In this case study, the authors initially assessed hamstring tightness using the AKE and STT tests, and ultrasonography was used to measure the mean Cross-Sectional Area (CSA) of the hamstring muscles. According to a study, individuals who engage in regular physical activity often experience hamstring tightness [5]. Measuring the prevalence and incidence of muscle tightness can be challenging. It has been shown that women are more likely than men to have hamstring tightness. In a study, it was reported that the prevalence of severe tightness in the right hamstring of female individuals was 45%, while the left hamstring of male subjects had a prevalence of severe tightness of 27.50% [6].

Through a series of six High-Intensity Laser Therapy (HILT) treatment sessions conducted over two weeks, the subject demonstrated significant improvements in various parameters. Notably, there was an increase in the normalised range of motion and a significant decrease in the mean CSA of the hamstring muscles. Most importantly, the subject remained asymptomatic at the end of the intervention. These improvements highlight the effectiveness of the HILT intervention in addressing the individual's hamstring tightness [7]. Ultrasonography played a crucial role in this assessment and treatment strategy. The advantages of ultrasonography over other diagnostic imaging modalities, such as Magnetic Resonance Imaging (MRI), are its accessibility, convenience, and cost-effectiveness, as well as its ability to provide real-time dynamic analysis. A transducer emits sound waves at a frequency of about 20 kHz, which enables ultrasound muscle analysis. To generate images, the sound waves are partially reflected, processed, and mixed with echo signals from the skin and muscle tissues. Muscle Thickness (MT), Echo-Intensity (EI), and CSA ultrasound measurements of lower leg muscles are commonly used in clinical practice and research [8]. In addition to measuring the mean CSA, ultrasonography allowed us to visualise and monitor changes in the structure of the hamstring muscles. Furthermore, it enabled us to confirm the presence of decreased muscle flexibility, which guided the treatment approach. By utilising ultrasonic imaging, the authors were able to individualise the dosage of HILT based on the specific muscle area involved, tailoring the treatment to the patient's needs and optimising its effectiveness [9].

A systematic review provides evidence for the benefits of various interventions in patients with hamstring tightness, including slump stretching, intramuscular actovegin injections, agility and trunk stability exercises, proprioceptive neuromuscular facilitation, dynamic stretching, and static stretching [10,11]. Photobiomodulation Treatment (PBMT), commonly known as phototherapy, is a non invasive and non-pharmacological therapy used to treat a variety of musculoskeletal problems. The application of LASER therapy over a target tissue has been shown to have beneficial effects on pain, inflammation, and tissue repair. High-Intensity Laser Therapy (HILT) is considered to be an efficient method for improving lower-extremity muscle performance and post-exercise recovery [12]. HILT can treat deeper areas quickly due to its stronger beams (power >0:5 watts), longer laser emission intervals, and shorter laser emission times compared to Low-Level Laser Therapy (LLLT). HILT also produces heat on the skin's surface due to its higher power density [3]. The observed improvements in muscle length and flexibility following HILT treatment align with potential physiological mechanisms through which HILT may exert its effects. HILT can penetrate tissues more deeply compared to LLLT, stimulating cellular processes such as enhanced Adenosine Triphosphate (ATP) production, reduced inflammation, and improved tissue repair. These processes collectively contribute to increased muscle extensibility and flexibility. While further research is needed to fully understand the exact mechanisms at play, these insights provide a plausible framework for understanding how HILT may lead to the observed outcomes [13].

It is important to acknowledge the inherent limitations of a single-case report. While the present findings are promising and indicative of the potential benefits of HILT in addressing hamstring tightness, they do not establish a definitive cause-and-effect relationship. Moreover, these results should not be generalised to all patients. However, the outcomes of this case report offer valuable initial insights that warrant further exploration. Larger controlled studies involving diverse patient populations are essential to gain a more comprehensive understanding of the effects of HILT, both as a standalone intervention and in combination with other treatments. These future research endeavours will contribute to the growing body of evidence on the therapeutic potential of HILT in managing musculoskeletal issues, including hamstring tightness. This case study highlights the potential of HILT as an effective intervention for addressing hamstring tightness, with ultrasonography serving as a valuable diagnostic and monitoring tool.

CONCLUSION(S)

This case report demonstrates the use of HILT intervention to achieve a positive outcome in an individual with hamstring tightness, with sonographic findings validating the changes in muscle CSA.

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