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Review Article

Evidence-Based Update on Physical Modalities in Upper Limb Tendinopathies: A Systematic Review

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ABSTRACT

Introduction: The most prevalent conditions among upper limb tendinopathies are lateral elbow tendinopathy and rotator cuff tendinopathy. Physical modalities are administered as an extra kind of treatment, particularly to lessen pain and enhance function. This study aims to assess the efficacy of different physical modalities in the treatment of upper limb tendinopathies.
Methods: Between January 1, 2018, and October 31, 2022, PubMed and ScienceDirect were searched for randomized controlled studies, including physical modalities. The PEDro score was utilized to determine the risk of bias.
Results: Ten studies were included. Nine RCTs were conducted on lateral elbow tendinopathy compared to one on rotator cuff tendinopathy. Within-group improvements in pain and function were significant, although other studies found that between-group changes were inconsistent.
Conclusion: Several of these studies also included therapeutic exercise in addition to the pain—and function-improving effects of each modality. However, pain and function both improved with the addition of physical modalities. More research must be conducted before it can be decided which modality is optimal.

Keywords: physical therapy modalities, systematic review, tendinopathy, upper extremity.

INTRODUCTION

People use their upper extremities for a variety of daily activities and functional motions. Tendon injuries are more likely in these jobs because they usually call for physical stamina and repetitive motions.[1]
According to estimates, upper limb tendinopathies affect between 1 and 3% of the general population.[2] In the working population, lateral elbow tendinopathy is the most prevalent upper limb tendinopathy.[3]
Although the cause of lateral elbow tendinopathy is unknown, repeated motions and hand use frequently contribute to its development.[4] Extensor carpi radialis brevis tendon microtrauma sustained over time causes collagen degeneration and vascular hyperplasia, which in turn causes the common extensor tendon to grow angioblasts.[5] Extensor carpi radialis brevis tendon microtrauma sustained over time causes collagen degeneration and vascular hyperplasia, which in turn causes the common extensor tendon to grow angioblasts.[6]
The course of treatment is often conservative and includes a combination of NSAIDs, orthoses, eccentric contraction-based physical therapy, or infiltrations. [7]
The most often used physical modalities in

interventions include ultrasound, phonophoresis, iontophoresis, low-intensity laser therapy, extracorporeal shock wave therapy, thermotherapy, and transcutaneous electrical nerve stimulation. Even though conservative therapies are frequently successful, some individuals may eventually need surgical intervention.[8] 2% of the detected cases need surgical intervention.[9]

All treatments aim to reduce symptoms, especially pain, and to enhance function. There are not enough reliable, prospective, randomized clinical trials in the literature to help determine which course of treatment is best for lateral elbow tendinopathy. The majority of physical modalities interventions include manual therapy and exercise, which makes it difficult to determine the therapeutic advantages because they may be brought on by physical modalities alone or by other treatments used in conjunction with physical modalities. Therefore, it is still unclear how exactly physical modalities would affect individuals with lateral elbow tendinopathy. [10,11]

Another of the most prevalent tendinopathies of the upper limbs is rotator cuff tendinopathy. Specifically, rotator cuff tendinopathy describes discomfort and weakness caused by excessive strain on the rotator cuff tissues and is typically felt during shoulder external rotation and elevation.[12] Although load alteration is thought to be the main cause of this condition's clinical start, its pathophysiology is likely complex, which has led to a variety of treatment options, from conservative to minimally invasive[13] and surgical treatments[12].

This systematic review aimed to compare and update evidence-based using physical modalities to manage upper limb tendinopathies.

MATERIALS & METHODS

Design

This systematic review was created based on the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[14]

Data sources and searches

From 1 January 2018 to 31 October 2022, two reviewers searched PubMed and ScienceDirect. The location of the tendinopathy and the physical modalities were merged as the key search phrases: (“rotator cuff tendin*” OR “bicipital tendin*” OR “lateral epicondylitis” OR “tennis elbow” OR “medial epicondylitis” OR “golf elbow” OR “flexor tendin*” OR “extensor tendin*” OR “dequervain” OR “tendinopathy” OR “tendinitis” OR “tendonitis”) AND (“physical modalities” OR “diathermy” OR “ultrasound” OR “laser” OR “cryotherapy” OR “thermotherapy” OR “hydrotherapy” OR “electrotherapy” OR “tens” OR “shock wave therapy”).

Study selection

According to the PICO framework, all randomized controlled trials that satisfied the following eligibility requirements were included:

1. Population: patients >18 years diagnosed with upper limb tendinopathy.
2. Intervention: Physical modalities with or without exercise, which may include thermotherapy, especially diathermy, electrotherapy, hydrotherapy, and light therapy, including laser.
3. Comparison: other physical modalities, also in an isolated manner.
4. Outcomes: pain and or function.

The exclusion criteria were:

1. non-RCTs protocols;
2. studies of other languages besides English;
3. combine physical modalities with any other than exercises;
4. treatment modalities program not provided;
5. subjects with systemic diseases;
6. subjects with a history of cervical radiculopathy, neurologic abnormalities, or any other upper extremity pathology in the affected arm;
7. the subject has had treatment during the last three months, such as an injection of steroids, HA, or prolotherapy;

Data extraction

The following information was gathered: participant demographics, the length of the intervention, the treatment modalities, the characteristics of the modalities programs, the outcomes assessments at the beginning, the end of the intervention, and maybe the follow-up.

Risk of bias

Three reviewers independently evaluated the risk of bias using the PEDro (Physiotherapy Evidence Database) score.[15] The following criteria were used to assign a score of 0 to 10 to each study: random assignment, concealed assignment, baseline group similarity, subject blinding, therapist blinding, assessor blinding, measurements of at least one key outcome, intention-to-treat analyses, reporting of between-group statistical comparisons of at least one key outcome, and provision of variability measures for at least one key outcome. The higher the study's quality, the closer it comes to 10 points. Three researchers separately assessed the potential for bias, and a fourth reviewer resolved any differences.

Data synthesis and analysis

A narrative synthesis of the physical modalities' regimen used for treating upper limb tendinopathies. Regardless of the order of interventions in the original studies, the different intervention or control groups were arranged in the tables with a preference for physical modalities interventions over shame or control. In each case, the most recent major outcome measurement concerning outcome measurement change was chosen for analysis. Additionally, the included studies' heterogeneity was evaluated, and the outcomes were arranged according to methodological features (location of tendinopathy, intervention, type of control group used).

RESULT

Study selection

The databases yielded 2113 articles, leaving 1576 after duplications were eliminated. Following the screening, 41 papers were chosen for full-text evaluation, from which 10 unique works on qualitative synthesis were ultimately chosen. The flowchart in Fig. 1 gives more details regarding the selection procedure.

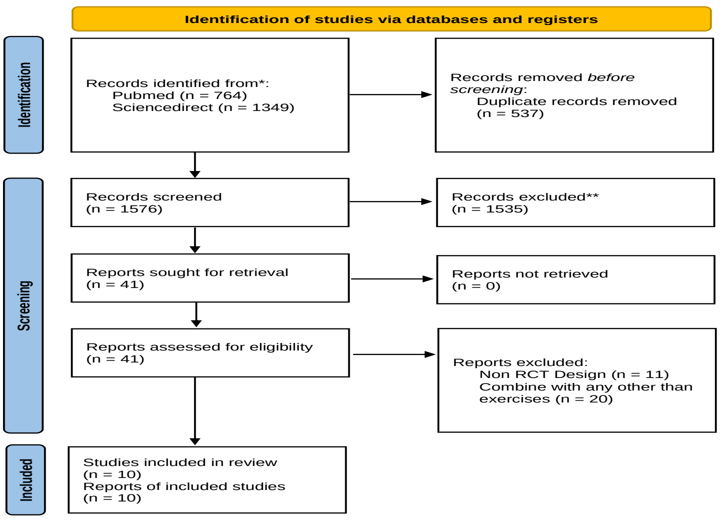

Figure 1. Flow diagram of the selection process

Study characteristics

Ten RCTs in all met the criteria and were reviewed. A total of 472 individuals were assessed, with a mean age of 45.2 years, 65.5% of patients being female, and clinical diagnoses of lateral epicondylitis (9 trials, n = 412) and rotator cuff tendinopathy (1 trial, n = 60). However, 1 RCT16 did not mention any of these conditions. The typical number of patients recruited was 47.2. (range 24–60). Table 1 provides more details regarding the baseline characteristics.

Risk of bias

The average grade for the chosen papers, which ranged in quality from adequate to high, was 7.7. (range 6–10). All of the studies completed the requirements for random assignment, baseline comparability, statistical comparisons between groups, and variability/point assessments. In Table 2, the outcomes of the risk of bias analysis are shown.

Clinical Outcomes

All included studies analyzed at least three clinical outcomes. The most evaluated outcome was pain using the Visual Analogue Scale (VAS). [8,16-23] In lateral epicondylitis condition, another outcome was hand grip strength.[8,17-23] Patient-Rated Tennis Elbow Evaluation (PRTEE).[8,20,21,23,24] The Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire[17,19,24], Quick DASH[18,22,23], 36-Item Short Form Survey Instrument (SF-36)[22-24]. In rotator cuff tendinopathy condition, another outcome was Range of Motion (ROM) and Shoulder Pain and Disability Index (SPADI). Table 4 shows the percentage of change and the significance level (between-group comparison) of the main clinical outcome of each study.

DISCUSSION

Diathermy

There are five studies[8,17,18,21,23] using diathermy as therapy in lateral epicondylitis. One study[18] using SWD showed significant improvement in VAS and quick DASH. Three studies[17,21,23] using USD also show similar results. No superiority was found between the continuous and pulsed ultrasound therapy groups.[21] However, results were superior in the combined HILT and USD group than each alone17, and compared with ESWT are equally effective. [23] But in another study[8], phonophoresis shows not significantly decreased VAS but significant in PRTEE-Pain.

Through enhanced blood flow and cell metabolism, SWD could have sped up the healing process by increasing thermal energy in the deep tissue. By reducing sensory nerve conduction, regulating the gate control system, countering irritation, and ultimately reducing pain, it may have also contributed to improved pain relief. Additionally, it can improve tissue and tendon flexibility while reducing joint viscosity. It can be inferred that using SWD, patients performed the exercises better and more properly, which resulted in a superior functional outcome due to the larger pain reduction and alleged improvement in flexibility.[18] The other diathermy method, known as USD, is among the most widely utilized to treat a variety of wounds due to its potential to have an anti-inflammatory effect. To increase the range of motion (ROM) and reduce discomfort, its effect on tissue is concentrated on altering the extensibility of the collagenous tissues.[25]

Laser therapy

There are five studies[8,17,19,22,24] using laser therapy in lateral epicondylitis and 1 RCT[16] in rotator cuff tendinopathy. Two studies[16,17] used HILT, three studies[8,19,24] used LLLT, and 1 study[22] compared HILT and LLLT. Pain relief was not significantly different between HILT and LLLT, but Quick DASH, hand grip strength, and SF-36 physical component summary (PCS) scores showed better improvement compared to HILT.[22] Based on a study[8], LLLT only helps with pain, while iontophoresis helps with both pain and function. If the effect size is considered, LLLT is also more effective at reducing pain than iontophoresis. In another study[19], only the LLLT group showed improvements in VAS movement rather than the ESWT group, but in contrast with another study[23] where ESWT appeared to be more effective than LLLT in reducing pain and promoting functional recovery.

Table 1. Baseline Characteristics

Author, Year	**Design**	**Sample Size**	**Mean age**	**Condition**	**Duration of symptoms**	**Follow-up**	**Interventions**	**Outcomes**
Ali, 2021[17]	RCT	45	44.9 ± 7.3	Lateral Epicondylitis	> 3 months	Day after the day for 12 sessions.	HILT and US HILT only US only	VAS DASH Hand grip-strength
Babaei-Ghazani, 2020[18]	RCT	50	Experimental group: 35.7 ± 10.1 Control group: 39.8 ± 6.9	Lateral Epicondylitis	> 3 months	After 5 sessions (the day after the 5th session), 10 sessions (during 2 days after the 10th session) of the treatment, 3 months later (after the final session).	SWD Sham	VAS Quick DASH Hand grip-strength
Baktir, 2019[8]	RCT	37	LLLT group: 45.33 ± 6.22 Phonophoresis group: 43.75 ± 7.94 Iontophoresis group: 49.31 ± 9.23	Lateral Epicondylitis	> 1 month	15 sessions in 3 weeks	LLLT Phonophoresis Iontophoresis	VAS Pressure pain threshold PRTEE Hand grip-strength
Celik, 2019[19]	RCT	43	ESWT group: 48 ± 9.9 LLT Group: 48.2 ± 9.4	Lateral Epicondylitis	> 6 months	4 weeks	ESWT LLLT	VAS DASH MEPS Muscle strength Hand grip-strength SF-12
da Luz, 2019[20]	RCT	24	Iontophoresis group: 49.75 ± 8.09 Galvanic current	Lateral Epicondylitis	NA	4 weeks	Iontophoresis Galvanic current	VAS PRTEE Hand grip-strength

			group: 50.25 ± 10.19					
Unver, 2021[21]	RCT	51	46.53 ± 6.16	Lateral Epicondylitis	< 6 months	1 month	Continuous US Pulsed US Sham US	VAS Duruöz's Hand Index (DHI) PRTEE Hand grip-strength The thickness of the common extensor tendon using US
Kaydok, 2020[22]	RCT	60	44 ± 9.3	Lateral Epicondylitis	> 4 weeks	3 weeks	High-intensity laser therapy (HILT) Low-intensity laser therapy (LILT)	VAS Quick DASH Hand grip-strength SF-36
Turgay, 2020[24]	RCT	52	ESWT group: 48 ± 10 LLLT group: 48.2 ± 11	Lateral Epicondylitis	> 6 months	1 week	ESWT LLLT	DASH PRTEE SF-36
Yalvac, 2018[23]	RCT	50	US group: 43.75 ± 4.52 ESWT group: 46.04 ± 9.24	Lateral Epicondylitis	> 3 months	after treatment, 1 month following treatment.	US ESWT	VAS Quick DASH Algometer Hand grip-strength PRTEE SF-36
Elsodany, 2018[16]	RCT	60	50.2 ± 3.6	Rotator Cuff Tendinopathy	> 3 months	immediately after treatment, 3 months post-treatment, 6 months post-treatment.	HILT Sham	VAS ROM SPADI

Table 2. PEDro Score

Author, Year	Random allocation	Concealed allocation	Baseline comparability	Blinding of subjects	Blinding of therapists	Blinding of assessors	Measure of one key outcome from 85% of patients	Intention-to-treat analysis	Between-group statistical comparisons	Variability and point measure-ments	Final score
Ali, 2021[17]	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10
Babaei-Ghazani, 2020[18]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	10/10
Baktir, 2019[8]	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	8/10
Celik, 2019[19]	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	7/10
da Luz, 2019[20]	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	9/10
Unver, 2021[21]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	8/10
Kaydok, 2020[22]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	9/10
Turgay, 2020[24]	Yes	No	Yes	No	No	No	Yes	Yes	Yes	Yes	6/10
Yalvac, 2018[23]	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	6/10
Elsodany, 2018[16]	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	8/10

Table 3. Physical Modalities Program

Author, Year	Intervention	Frequency	Duration	Characteristics
Ali, 202[17]	HILT and US HILT only US only	12 sessions	5 minutes	The HILT employed had dual emission wavelengths and 3.2 Watts of total power (808 and 915 nm). 5 Joules (J)/cm^2 of energy were delivered over 5 minutes. 9 cm^2 of the region was treated, receiving 960 J per session. The US therapy was delivered for 5 minutes at a frequency of 3 MHz and an intensity of 1.5 W/cm^2.
Babaei-Ghazani, 2020[18]	SWD Sham	10 sessions	15 minutes	For ten sessions, every other day, continuous shortwave 27.12 MHz capacitive diathermy was given over the elbow for 15 minutes.
Baktir, 2019[8]	LLLT Phonophoresis	5 times a week, 15 sessions	approximately 20 minutes	The power was automatically found to be 0.12 mW using a GaAs diode laser device operating at a 50 Hz frequency and a wavelength of 904 nm.

	Iontophoresis			The application of phonophoresis was done with an ultrasonic device. Aqua Sonic US gel was used with topical prednisolone (2 mg/d). Using a 1 W/cm2 dosage and 1 MHz frequency for 7 minutes, a 5 cm2 US head in perpendicular contact with the skin to sustain longitudinal movements was employed. Iontophoresis was carried out using direct current. For each session, prednisolone-saline solution (5 mL of 0.4% prednisolone) was applied solely to the sponge of the active rubber electrode. A dose of 40 mA/min and a current in the range of 3-5 mA are required.
Celik, 2019[19]	ESWT LLLT	ESWT: once a week, 4 weeks LLLT: 3 times a week, 4 weeks	NA	Focused low-dose ESWT. 2,000 pulses with an energy of 0.09 mJ/mm^2 were administered based on each patient's ability to tolerate discomfort and the highest level of therapy. GaAs served as the laser's activation medium in this investigation, which used a 3B M1000 laser. The spot size was set at 0.5 cm2; the duty cycle was 50%; the energy density was set at 2.4 J/cm2; the continuous wavelength mode was set at 904 nm; the frequency level at 50Hz; the power intensity on the skin at 40 mW, and the spot size at 0.5 cm^2.
da Luz, 2019[20]	Iontophoresis Galvanic current	3 times a week, 4 weeks	15 minutes	For four weeks, there were three sessions per week of iontophoresis and direct (galvanic) current intervention. A 3mL amount of a solution containing 4% lidocaine and 4 mg/mL dexamethasone was injected into the negatively charged electrode using a syringe. A base gel solution was then applied to the positively charged electrode. The electrical stimulator Endophasys was employed. The 5-mA starting intensity was applied for 15 minutes. If irritation was reported due to the electrical current, the time was extended to 20 minutes, and the current strength was reduced to 3 mA. The same approach was applied to those in the galvanic current group, except both electrodes were coated with a base gel solution.
Unver, 2021[21]	Continuous USD Pulsed USD	5 different days in 2 weeks	5 minutes	With a 5-cm-diameter applicator, continuous ultrasonic waves of 1.5 MHz frequency and 1 W/cm2 power were administered for 5 minutes per session in the continuous USD group. The waves were applied in circular motions to the lateral epicondyle with the probe at a straight angle to ensure maximal energy absorption. The identical USD equipment was used in the pulsed USD group, but it was tuned to a frequency of 1.5 MHz, a power of 1 W/cm2, and a pulsed mode duty cycle of 1:4.
Kaydok, 2020[22]	High-intensity laser therapy (HILT) Low-intensity laser therapy (LILT)	HILT: 9 sessions in 3 weeks LILT: once a week in 3 weeks	NA	The HILT was accomplished using a 1,064 nm BTL-6000 high-intensity laser. The laser was applied in phases I and II in a continuous circular motion. The first three sessions (phase I) applied a 75 sec, 8 W, 6 J/cm2 treatment for a total of 150 J of energy to give analgesic effects during an intermittent phase. The following six sessions (phase II) were to apply a 30 sec, 6 W, 120 to 150 J/cm2. A gallium aluminum arsenide infrared diode laser delivered the LILT treatment at a wavelength of 904 nm, output power of 240 MW, and frequency of 5,000 Hz. With a power density of 2.4 J/cm2 and a treatment time of 30 seconds per point, the spot size was around 0.5 cm2, with six spots over the lateral epicondyle.
Turgay, 2020[24]	ESWT LLLT	ESWT: once a week, in 5 weeks LLLT: 15 sessions	ESWT: NA LLLT: 5 minutes	ESWT was carried out on the common extensor origin of the afflicted elbow using the Masterpuls MP 100 device at 2000 pulses in each session. A treatment head with a 15 mm diameter was used for therapy. For maximum acoustic energy transmission, ultrasound gel was applied to the elbow during

		on consecutive days.		the treatment. The six trigger points of the lateral extensor group of the forearm were treated with laser treatment using The MLS (®) equipment for 5 min at a wavelength of 905 nm pulse current laser with dosages of 0.25-1,2 joules per point/area.
Yalvac, 2018[23]	US ESWT	US: once a day, 5 days a week, 10 sessions total ESWT: once a week for three sessions	US: 5 minutes ESWT: NA	Using a BTL-58205 device with a transducer that has a 1 cm2 application area, 1.5 W/cm2, 1 MHz frequency, and continuous mode in the painful area, therapeutic US was applied. The full contact approach and aqua sonic gel were applied in circular motions at a vertical angle to the skin. Using aquasonic gel as the transmitting medium, ESWT therapy was administered at 10e15 Hz, 1.5e2.5 bar energy density, and 2000 pulses.
Elsodany, 2018[16]	HILT Sham	3 times a week, 12 sessions	15 minutes	In the treatment group, patients got HILT, which is a product of the HIRO 3 device. There were three phases to the treatment: the first, the second, and the last. The first and final scanning phases featured fast scanning over the rotator cuff muscles, the upper fibers of the trapezius, deltoid, and pectoralis major muscles in the initial phase and slow scanning in the final phase, with a total energy of 1000 J in each phase. During the intermediate phase, a laser probe with a mean energy of 50 J was fastened to the predetermined trigger and tender spots at 90 degrees perpendicular to the skin. 2050 J total energy was administered. to the individual throughout three treatment phases in a single session lasting 15 minutes.

Table 4. Changes of Outcomes

No	Author, Year	Group Comparison	Outcomes	% Change between groups			p between groups
1	Ali, 2021[17]	HILT and US HILT only US only	VAS DASH Hand grip-strength	89.9%* vs 78.6%* vs 59.7%* 89.6%* vs 85.9%* vs 71.1%* 98.1%* vs 64.6%* vs 38.7%*			0.0001 0.001 0.28
2	Babaei-Ghazani, 2020[18]	SWD Sham	VAS Quick DASH Hand grip-strength	5th session	10th session	Follow up	
				28.9%* vs 12.3%* 5.1%* vs 5.8%* 4.3% vs 4%	84.8%* vs 48.1%* 68.8%* vs 35.1%* 25.6% vs 20.2%	56.3%* vs 28%* 69%* vs 43.4%* 6.6% vs 5.6%	< 0.000 < 0.000 0.024
3	Baktir, 2019[8]	LLLT Phonophoresis Iontophoresis	VAS-rest VAS-activity VAS-night Pressure pain threshold PRTEE PRTEE-pain PRTEE-function (specific + usual) Hand grip-strength	50.6%* vs 2.8% vs 34.8%* 34.7%* vs 27.6% vs 29.1%* 48.2%* vs 42.3% vs 53.8%* 21.4% vs 5.6% vs 10.3% 28.5%* vs 37.6% vs 30.7%* 34.5%* vs 30%* vs 32.4%* 19% vs 32% vs 31.6%* 5.7% vs 2.4% vs 21.3%*			0.07 0.65 0.52 0.89 0.97 0.58 0.74 0.24
4	Celik, 2019[19]	ESWT		Post-intervention	12 weeks follow-up		

		LLLT	VAS rest	29.7% vs 19.4%	7.7% vs 17.2%	0.25
			VAS movement	17.9% vs 25.6%*	12.7% vs 3.4%	0.75
			DASH	7.7% vs 10.5%	10.4% vs 2.0%	0.18
			MEPS	4.2% vs 11.7%	11.5% vs 3.6%	0.20
			Hand grip-strength	33.3% vs 12.5%	30.9%* vs 36.3%*	0.02
5	da Luz, 2019[20]	Iontophoresis	VAS rest	84.9%* vs 28.6%*		0.002
		Galvanic current	VAS movement	78%* vs 39.8%		0.001
			PRTEE	71.6%* 35.2%*		0.000
			PRTEE-pain	71.7%* vs 39%*		0.000
			PRTEE-function	71.6%* vs 31.8%*		0.000
			Hand grip-strength	22.2%* vs 52.9%*		0.517
6	Unver, 2021[21]	Continuous US		2nd weeks	6th weeks	
			VAS rest	26.7% vs 28.1% vs 12.1%	4.5% vs 8.7% vs 3.4%	<0.05
		Pulsed US	VAS movement	30.8%* vs 28.4%* vs 22.4%*	24.1% vs 36.2%* vs 6.8%	<0.05
		Sham US	DHI	42.8%* vs 39.6%* vs 18.5%	12.6% vs 49.1%* vs 9.7%	<0.05
			PRTEE	35.8%* vs 31.6%* vs 12.6%*	21.1% vs 35.6%* vs 2.7%	<0.05
			Hand grip-strength	9.5%* vs 7.5%* vs 5.9%*	0.8% vs 1.1% vs 2.1%	>0.05
			The thickness of the common extensor tendon using US	10.3%* vs 20%* vs 3.6%*		<0.05
7	Kaydok, 2020[22]	HILT	VAS	59.7%* vs 53.5%*		0.360
		LILT	Quick DASH	55.8%* vs 49.1%*		0.046
			Hand grip-strength	27.6%* vs 17.2%*		0.018
			SF-36 (physical component)	63.7%* vs 55.5%*		0.014
			SF-36 (mental component)	38.8%* vs 43.3%*		0.809
8	Turgay, 2020[24]	ESWT	DASH	64.4%* vs 37.8%*		<0.001
		LLLT	PRTEE	53.5%* vs 27.7%*		0.005
			PRTEE-pain	50%* vs 26%*		0.002
			PRTEE-function	57.1%* vs 29.6%*		0.004
9	Yalvac, 2018[23]	US		After Treatment	1 month follow up	
			VAS	NA* vs NA*	NA* vs NA*	0.392
		ESWT	Quick DASH	NA* vs NA*	NA* vs NA*	0.070
			Algometer	48.2%* vs 59.2%*	23.7%* vs 34.2%*	0.029
			Hand grip-strength	NA* vs NA*	NA* vs NA*	0.552
			PRTEE	29.7%* vs 20.8%*	22.7%* vs 25.3%*	0.636
10	Elsodany, 2018[16]	HILT	VAS	77.7%* vs 44.2%*		<0.001
		Sham	SPADI	70.8%* vs 52.8%*		<0.001

The analgesic effects of laser therapy may result from the release of bradykinin and histamine from injured tissue as well as an increase in pain threshold due to increased substance P release from peripheral nociceptors.[26]

HILT has been shown to have anti-inflammatory, anti-edema, analgesic, and restorative therapeutic benefits since it is thought to have both photochemical and photothermal actions.[22] HILT boosts circulation using photochemical and photothermic actions, as well as lymphatic drainage and edema reduction.[27,28] As it raises serotonin and b-endorphin levels and modulates pain, HILT decreases inflammation and pain.[27]

LLLT stimulates the synthesis of calcium ions (Ca2+), ATP, and other intracellular secondary messengers. It can also facilitate the growth of tenocytes and the production of collagen[29], which guards against oxidative stress and lessens tendon fibrosis.[30] These mechanisms enable it to reduce tendinous inflammation and pain while also accelerating tendon recovery.[22]

Electrotherapy

There are only two studies[8,20] using electrotherapy in lateral epicondylitis. The first study[8] compares LLLT, phonophoresis, and iontophoresis, whereas iontophoresis is beneficial for both pain and function rather than LLLT only for pain. The second study[20] demonstrated that iontophoresis is a more efficient method than galvanic current for decreasing pain and enhancing strength and function.

In iontophoresis, a local electrical current is used to deliver a medication into tissues as a form of electrotherapy. It is based on the idea that positively charged drug ions (cations) are attracted to a negative electrode (cathode) in an electrical field but resist positively charged electrodes (anodes) (negative electrode).[31] Drugs with negative ions are then attracted to the anode and repelled by the negative electrode (cathode) (positive electrode). Direct current and alternating current are both used in iontophoresis.[32] Applications of this method have generated a significant lot of interest in terms of different musculoskeletal illnesses like LE. It is frequently applied using a low-voltage direct current to apply physiologically active ions to the human surface topically.[33]

Shock wave therapy

Three studies[19,23,24] have used shock wave therapy in lateral epicondylitis. The first and second studies[19,24] compared ESWT and LLLT with disparate outcomes. According to the third study's [23] findings, ESWT and USD both effectively treat LE, and ESWT also yields higher algometer scores.

ESWT works as acoustic waves, which boosts energy in the diseased area and promotes bone, tendon, and soft tissue regeneration there. This is the explanation behind the therapy's success.[34] Additionally, increasing the growth factor production in the diseased area enhances the development of new blood vessels there, aiding in regeneration.[35]

CONCLUSION

Despite its limitations, this systematic review provides a thorough overview of the most recent research on physical treatment options for upper limb tendinopathy. This comprehensive study shows that physical modalities can reduce pain and increase function. Before it can be determined which modality is best, more research must be done. Diathermy with USD and laser therapy was the most often utilized physical modality in the research that made up this systematic review. Even when combined, the results are superior. It is also more cost-efficient than ESWT, which might be more expensive. It should be noted that while each modality improves pain and function, therapeutic exercise is also given in several of these studies. Furthermore, there are nine RCTs on lateral elbow tendinopathy compared to one on rotator cuff tendinopathy; thus, these findings may not be applied to all cases of upper limb tendinopathy.

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