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EFFECTIVENESS OF LASER THERAPY WITH TAPING VS ULTRASONIC WAVE THERAPY WITH ELBOW MOBILIZATION IN CASE OF LATERAL EPICONDYLITIS. A COMPARATIVE WITH RCT STUDY

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ABSTRACT
The leading cause of elbow discomfort and dysfunction is lateral epicondylitis, also known as "tennis elbow," which is mostly brought on by repeated gripping or wrist extension during different activities. With presumptive tendinosis, a symptomatic deterioration condition of the local tendon, the precise pathophysiology is still mostly unknown. Clinical exams are often used to diagnose it. Additional imaging may occasionally be necessary for a particular differential diagnosis. The best course of therapy for chronic lateral epicondylitis is still up for debate, despite the fact that the majority of patients may recover on their own. The pathophysiology, diagnosis, and therapy of lateral epicondylitis are the main topics of this article's panorama of new research, which helps medical professionals better comprehend and manage the condition. Among the conservative first-line treatment options include anti-inflammatory medications, braces, physical therapy, and reducing repeated activities. In patients with lateral epicondylitis, our study examined the effects of laser therapy with tapping (group A) and ultrasonic wave therapy with elbow mobilization (group B) on pain alleviation and loss of function. Two groups of 40 patients each were randomly assigned from an equal number of patients (n = 20) who were enrolled sequentially.
Patients in group A received laser therapy with tapping, whereas patients in group B received ultrasonic wave therapy with elbow mobilization, after the computation and recording of VAS (visual analogue scale) and DASH (disability of arm, shoulder, and hand) scores in both groups. Patients were told not to use any additional painkillers. VAS and DASH were used to reevaluate them at one, two, and three weeks. SPSS software was used to conduct the statistical analysis. At the three-week follow-up, substantial differences were seen in both groups. Laser with tapping was found to be better effective at 1st week, whereas Ultrasonic with elbow mobilization was found to be better effective at both 2nd weeks and 3 weeks. Both the group showed progressive effects at 3 weeks follow up. Finally we conclude that ultrasonic with elbow mobilization is a viable treatment method for lateral epicondylitis.
Keywords: lateral epicondylitis, tennis elbow, laser, elbow mobilization, ultrasonic wave, elbow tapping.

1. Introduction
Lateral epicondylitis was first described in English literature by Runge in 1873 (1). This condition was described as chronic degeneration of the tendon attachment in the forearm, where the common extensor tendon meets the humeral epicondyle, resulting in symptoms. This condition is one of the most frequently occurring overuse syndromes in primary medical care. LE affects 1-3% of the population, predominantly middle-aged

individuals without a gender disparity (2). LE injuries can result in significant social and economic consequences due to lost working days and may prevent some patients from working for weeks [3, 4]. Despite progress in treating LE, established standards are still lacking. In general, this condition is self-limiting, and most cases do not require treatment, with up to 80% of cases recovering within one year [5]. Individuals experiencing persistent symptoms may necessitate additional non-invasive or surgical interventions.

High-resolution musculoskeletal ultrasound is one of the gold standards for diagnosing lateral epicondylitis (6). Individuals with lateral epicondylitis undergo various treatments, including both non-surgical and surgical(7) methods. The most commonly preferred interventions are iontophoresis, friction massage, electrotherapy, strengthening exercises and corticosteroid injections. These treatment strategies demonstrate long-term outcomes, while oral medications produce short-term results (8). Routinely used to treat the swollen tendon and underlying adhesions are ultrasound therapy and friction massages. Ultrasound causes thermal effects that enhance metabolic activity in the affected area, improving blood circulation. However, its non-thermal effects involve the synthesis of collagen and tissue repair (9). Transverse friction massage helps to break down adhesions, improve blood flow, and reduce inflammation in chronic tendinopathies (10).

Conservative physiotherapy is usually recommended for lower extremity conditions,[11,12] and ultrasound has been utilized as a therapeutic tool in physiotherapy for many years as an adjunct treatment for various musculoskeletal issues. It produces non-thermal effects when used in pulsed mode, which helps reduce inflammation and increase collagen regeneration, whereas continuous ultrasound generates thermal effects.[13-14]

In physical medicine and rehabilitation (PM&R) clinics, laser treatments is a common non-invasive, pleasant approach. Recent studies have demonstrated the effectiveness of high-intensity laser therapy in treating various athletic injuries, such as tendon damage, bruises, and muscle cramps, as reported in references (15-16).

Laser classification is primarily based on power output. The low-power laser has a power output spanning from 2 milliwatts to 500 milliwatts, while high-power lasers surpass 500 milliwatts in power. Laser treatment leads to improved blood circulation, increased ATP and collagen production, and enhanced tissue repair processes. Research has shown the efficacy of laser treatment in alleviating pain associated with musculoskeletal conditions such as tennis elbow. Research has found that the impact of laser on pain is linked to its influence on inflammation, tissue repair, nerve guidance, and the release of endorphins; however, studies have also been conducted which failed to reveal a significant effect of laser therapy on pain reduction and changes in these other factors [17].

KT effectively reduces pain intensity and enhances function in patients with LE, as previously stated (18). This method may be used alone or in combination with other physiotherapy approaches or pharmacological treatments as an important option for LE rehabilitation [19].

The MMWM approach restores normal radius tracking across the capitulum, enabling forearm muscle growth without side effects and leading to pain-free grip strength [20]. Furthermore, it produces sensory information that is sufficient to activate descending pain inhibitory circuits, thereby alleviating pain [21].

This mobilization technique is commonly applied in treating musculoskeletal disorders, such as tennis elbow, to correct the elbow's misalignment and then mobilize the radius to the side where the extensor carpi-radialis brevis tendon is attached [22]. This technique diminishes pain and enhances pain-free grip strength.

The condition of lateral epicondylitis is generally temporary, so selecting the correct treatment is essential. This study compares the impact of laser therapy and tapping technique with ultrasonic therapy and elbow mobilization on pain alleviation, hand grip strength, and functional capabilities in patients with lateral epicondylitis.

Materials and Methods

1. **Study design:** the study was based on a randomized, controlled pretest-posttest experimental group design.

2. **Ethical Considerations.** The study received ethical clearance from our hospital's ethics subcommittee (RRC-2019-16) and gained registration in a well-established trials registry (ClinicalTrials.gov PRS; ID: NCT04589871). The study adhered to the ethical guidelines for human subjects research as outlined in the Hospital jaipur declaration. Each individual signed a written informed consent form accordingly.
3. **Sample Size.** The study employed a systematic random sampling technique to acquire the sample. The VAS and DASH outcome score was utilised to estimate the effective sample size using computer software based on the pilot study. A t-test for matched pairs was used to determine that a sample size of 40 would be required to achieve a 95% statistical power (0.95) while maintaining an observed effect size of 0.60, significance level of 0.05, mean differences of 1.57, and a standard deviation of 2.61.
4. **Inclusion criteria**

   Age between 40-60 years both genders with dominant hand (b/l) involvement of tennis elbow. Individuals with a typical history of localized pain and tenderness at the anterior inferior aspect of lateral epicondyle aggravated by gripping and wrist extension activities and relieved by rest. A Positive Cozen's test. A Positive Mill's test. Patients with more than 30 days duration of pain on the lateral epicondyle of elbow

   Exclusion criteria

   Patients with radio-humeral joint arthritis, osteochondritis dissecans, osteonecrosis, cervical radiculopathy and interosseous nerve entrapment, Carpal tunnel syndrome, fracture of the upper limb with residual deformity, bilateral lateral epicondylitis, Corticosteroid injections to elbow within 3 months.
5. **Selection of Participants.** Forty individuals diagnosed with lateral epicondylitis as per the criteria indicated, were registered for this study from the outpatients' department at the rehabilitation center of the hospital jaipur. Individuals were diagnosed with unilateral lateral epicondylitis varied in age from 40 to 60 years old, with a pain score greater than 3 on the visual analog scale, had pain and tenderness when moving, and showed functional disability (i.e. positive cozen's test and mill's test) were included in this study. Individuals with radio-humeral joint arthritis, osteochondritis dissecans, osteonecrosis, cervical radiculopathy and interosseous nerve entrapment, Carpal tunnel syndrome, fracture of the upper limb with residual deformity and showed poor compliance were excluded from the study. All individuals were equally distributed into either group through a randomization process using the chit chat tool. The participant's group allocation was kept secret in a concealed envelop coded with a unique identifier number for each participant. The baseline scores for all the variables were taken on day 1 by an assistant.
6. **Outcome Measures.** This study assessed the outcomes, including the pain intensity and functional status of individuals with lateral epicondylitis, using the visual analog scale (VAS) for pain and the disability of arm shoulder and hand (DASH) for disability. The visual analog scale is a widely used, validated, responsive, and reliable subjective measure for assessing the level of pain. The participant was provided with a 10 cm horizontal line marked at the extremes with 0 (no pain) and 10 (worst pain), to assess their level of discomfort by drawing a vertical line between the two endpoints [23]. The DASH (or QuickDASH) is frequently utilised for lateral epicondylitis as a region-specific upper-limb disability assessment. The DASH is commonly utilised in lateral epicondylitis as specific tools to quantify functional limitation and track treatment effects. A validation study in lateral epicondylitis found DASH to be a highly valid functional outcome measure in this patient group (24).
7. **Procedures.** A total of 40 individuals with unilateral lateral epicondylitis were screened and recruited in the study based on inclusion and exclusion criteria. A written informed consent was obtained from all the individuals before onset of the study. After taking the demographic details and baseline measurements for all the outcome variables, all individuals were randomly divided into experimental Group-1 and Group-2. Elbow taping was applied in Group-A in addition to a supervised laser therapy program, while Group-B got elbow mobilization in addition to an ultrasonic therapy program. Both groups got the intervention for 21 days. At 21st day's postintervention, the same assessor collected the outcome data for all the individuals participating in the study.
8. **Interventions:**

Supervised Exercise Protocol for group-1:

In group A, patients received a combination of LASER and K-tapping. The patient assumed a supine position with the elbow flexed and supported at the side of the couch. The laser was administered through multi-frequency laser beam at a rate of 2.5w/sec2 for 10 min, using a continues mode, daily for a total of 21 days. The K-tapping was used as an adjunct to the laser for stabilization. The tapping was applied directly to the common extensor tendon at the lateral elbow in a parallel direction to the orientation of the tendon fibres. All the participants were evaluated at baseline (day 0), 10th day and at 21th day of the treatment**.**

Supervised Exercise Protocol for group-2:

In group B, patients received a combination of US and elbow mobilization. The patient assumed a supine position with the elbow semi flexed and placed at the side of the couch. The US was administered through multiple-frequency delivery head at a rate of 2.5w/sec2 for 10 min, using an irregular mode, daily for a total of 21 days. The elbow mobilization was used as an adjunct to the US for 10 min. The mobilization was applied directly to the lateral epicondyle of elbow in a perpendicular direction to the orientation of the joint range of motion. The pad of the thumb was used to apply firm, deep pressure in a latero-medial motion across the joint. The intensity of the pressure was estimated to be very firm and reliable. All the patients were evaluated at baseline, 10th day and at 21th day of the intervention**.**

9. **Statistical Analysis:** A statistical package for windows version 7 (SPSS) was used for the data analysis for the variables. The level of pain and functional status was assessed by using the VAS and a DASH functional scale at preintervention (baseline) and 10th day intermediate intervention and on 21th day at postintervention for the individuals of both groups A and B. Descriptive analysis (mean, standard deviation) was used to describe the demographic characteristics. Paired and unpaired t tests were used to evaluate the statistically significant differences in the outcome scores within group and between groups, respectively. For all the tests, 0.05 (p value) was set as the level of significance.

Results:

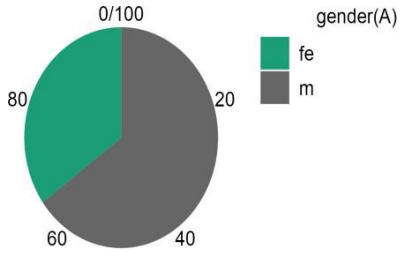
Fifty-five participants with unilateral epicondylitis were screened for the study. Out of 55 participants, 15 were excluded from the study: 10 did not meet the inclusion criteria, 3 declined to participate for genuine reasons, and 2 declined to participate without reason. A total of 40 participants were included in this study. Descriptive details for the demographic characteristics and baseline VAS and DASH functional status scores are described.

1. Within-Group Analysis: all the participants are observed on the first day and the data collected as the pre-recorded as pain on VAS score and functional status as DASH score. Group-A were intervent with laser and k-tapping, whereas Group-B were intervent with ultrasonic and mobilization method. After 10 days of intervention, a mid data collected as pain and functional score. Finally on days 21st a post intervention data collected as pain and functional score. After the final data collection all the data calculated as progression of day0-day10, day10-day21 and day0-day21 as group-a and group-b.
2. Between-Groups Analysis: all the data collected as day0, day10 and day21 then compare the data as day0 between gp-A and Gp-B as pre intervention, day10 between Gp-A and Gp-B as mid intervention, similarly on post intervention data.

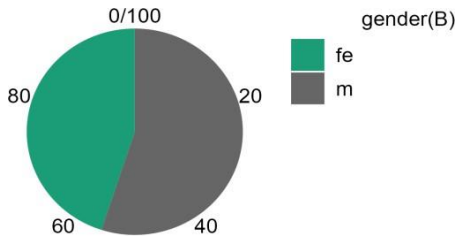
Descriptive Statistics

	gender(A)	gender(B)
Valid	20	20
Missing	0	0
Mean		
Std. Deviation		
Minimum		
Maximum		

gender(A)



gender(B)



Descriptive Statistics Group-A

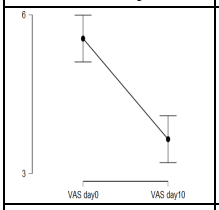
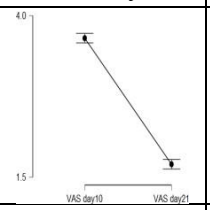
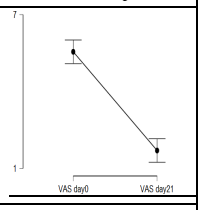
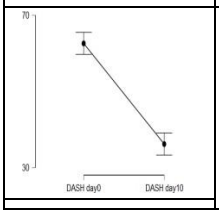
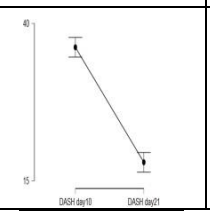
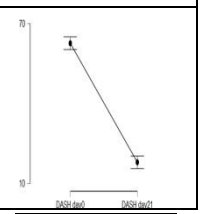
	age	VAS day0	VAS day10	VAS day21	DASH day0	DASH day10	DASH day21
Valid	20	20	20	20	20	20	20
Missing	0	0	0	0	0	0	0
Mean	50.400	5.550	3.650	1.700	62.600	36.200	17.950
Std. Error of Mean	1.550	0.235	0.182	0.179	1.837	1.966	0.933
Median	50.000	6.000	3.000	1.500	62.500	30.000	15.000
Std. Deviation	6.931	1.050	0.813	0.801	8.217	8.794	4.174
Variance	48.042	1.103	0.661	0.642	67.516	77.326	17.418
Range	20.000	3.000	2.000	2.000	28.000	25.000	13.000
Minimum	40.000	4.000	3.000	1.000	50.000	25.000	12.000
Maximum	60.000	7.000	5.000	3.000	78.000	50.000	25.000

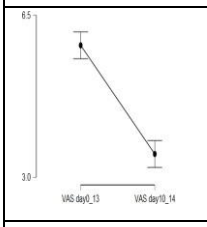
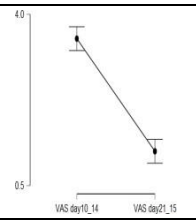
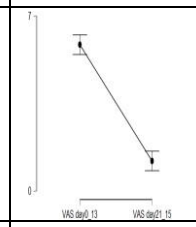
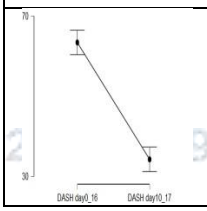
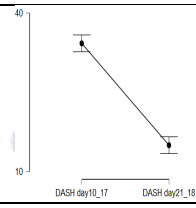
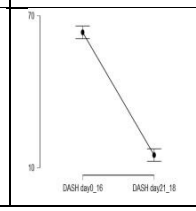
Descriptive Statistics Group-B

	age	VAS day0	VAS day10	VAS day21	DASH day0	DASH day10	DASH day21
Valid	20	20	20	20	20	20	20
Missing	0	0	0	0	0	0	0
Mean	49.600	5.850	3.500	1.200	63.400	34.250	15.000
Std. Error of Mean	1.290	0.221	0.136	0.138	1.873	1.971	0.918
Median	48.500	6.000	3.000	1.000	65.000	28.000	12.000
Std. Deviation	5.771	0.988	0.607	0.616	8.375	8.813	4.104
Variance	33.305	0.976	0.368	0.379	70.147	77.671	16.842
Range	20.000	3.000	2.000	2.000	30.000	25.000	12.000
Minimum	40.000	4.000	3.000	0.000	50.000	23.000	10.000
Maximum	60.000	7.000	5.000	2.000	80.000	48.000	22.000

Paired Samples T-Test (Group-A)

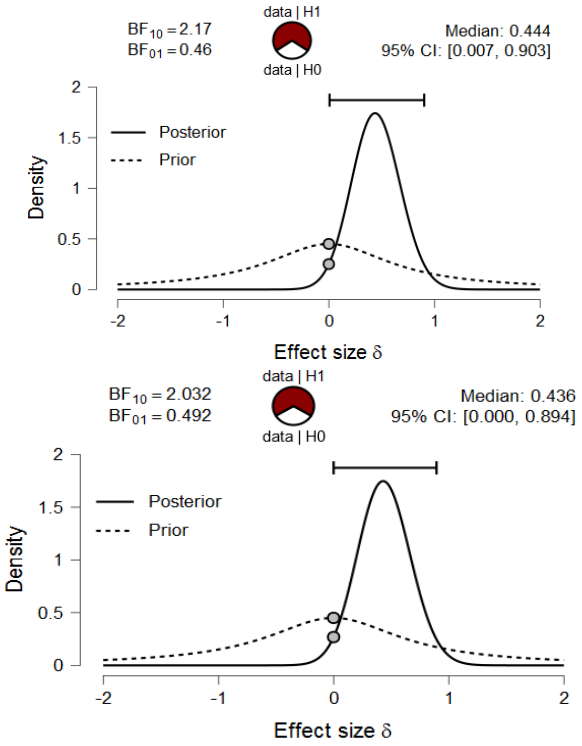
Measure 1		Measure 2	t	df	p
VAS day0	-	VAS day10	6.371	19	4.124e -6
VAS day10	-	VAS day21	39.000	19	1.337e -19
VAS day0	-	VAS day21	12.414	19	1.458e -10
DASH day0	-	DASH day10	13.465	19	3.618e -11
DASH day10	-	DASH day21	17.282	19	4.449e -13
DASH day0	-	DASH day21	27.939	19	6.802e -17

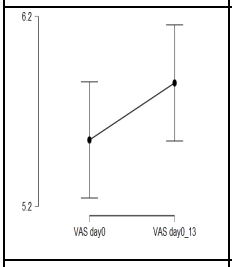
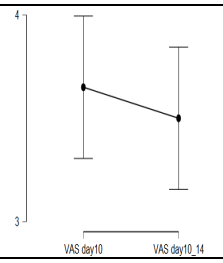
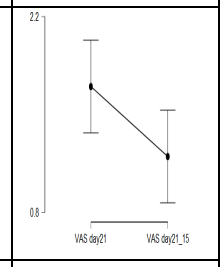
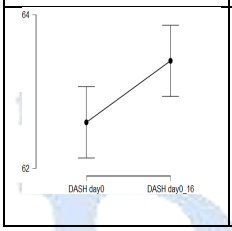
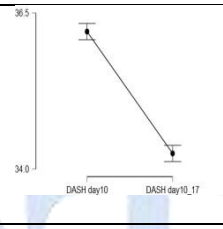
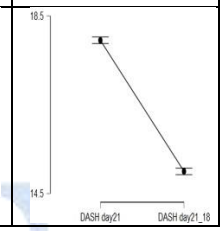
VAS day0 - VAS day10	VAS day10 – VAS day21	VAS day0 - VAS day21
		
DASH day0 - DASH day10	DASH day10 - DASH day21	DASH day0 - DASH day21
		

VAS day0_13 - VAS day10_14	VAS day10_14 - VAS day21_15	VAS day0_13 - VAS day21_15
		
DASH day0_16 - DASH day10_17	DASH day10_17 - DASH day21_18	DASH day0_16 - DASH day21_18
		

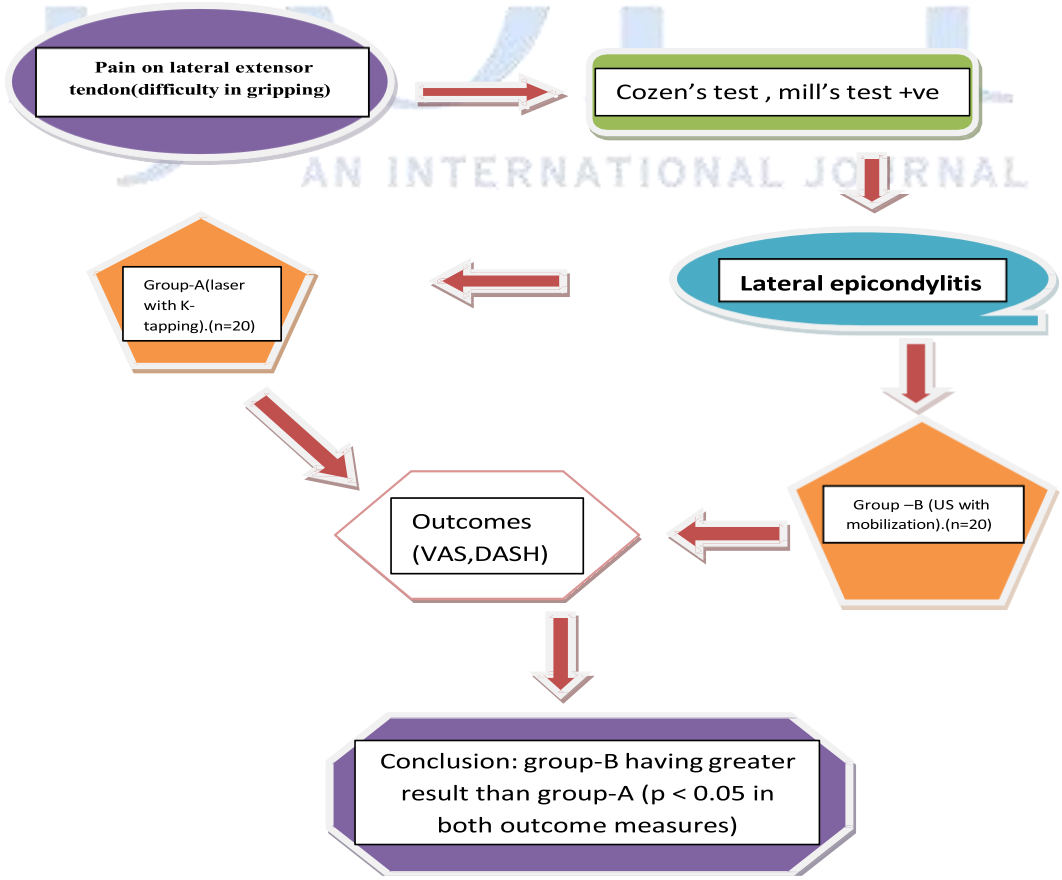
Paired Samples T-Test(Group-B)						
Measure 1		**Measure 2**	**t**	**df**	**p**	
VAS day0	-	VAS day10	12.010	19	2.556e -10	
VAS day10	-	VAS day21	14.038	19	1.755e -11	
VAS day0	-	VAS day21	17.592	19	3.235e -13	
DASH day0	-	DASH day10	14.168	19	1.495e -11	
DASH day10	-	DASH day21	17.895	19	2.381e -13	
DASH day0	-	DASH day21	28.968	19	3.472e -17	

Unpaired Samples T-Test (between Gp-A & Gp-B)						
Measure 1		**Measure 2**	**t**	**df**	**p**	
VAS day0	-	VAS day0_13	0.9305	19	0.3580	
VAS day10	-	VAS day10_14	0.6613	19	0.5124	
VAS day21	-	VAS day21_15	2.213	19	0.0330	
DASH day0	-	DASH day0_16	0.3049	19	0.7621	
DASH day10	-	DASH day10_17	0.7005	19	0.4879	
DASH day21	-	DASH day21_18	2.254	19	0.0300	



VAS day0 - VAS day0_13	VAS day10 - VAS day10_14	VAS day21 - VAS day21_15
		
DASH day0 - DASH day0_16	DASH day10 - DASH day10_17	DASH day21 - DASH day21_18
		

Flow chart



Discussion:

Both laser-based and ultrasound-based treatments can temporarily alleviate pain and enhance functionality for lateral epicondylitis, but available data does not definitively prove that laser therapy with taping outperforms ultrasound therapy with mobilization. A randomised controlled trial directly comparing "laser + taping" to "ultrasound + elbow mobilization" has not been published yet, so a new comparative RCT is methodologically justifiable (25).

Evidence on laser with taping

- Low-level laser therapy alone has consistently demonstrated no clear benefit over a placebo in cases of lateral epicondylitis, with randomised controlled trials and systematic reviews categorising the evidence as insufficient or negative (26).
- Combining high intensity laser therapy with a splint can lead to short-term improvements in pain, DASH scores, and grip strength, potentially offering greater benefits than using a splint on its own (27).
- Kinesio taping, either on its own or in conjunction with exercise, enhances pain relief and grip strength, and in one RCT involving tennis elbow, taping yielded greater pain reduction and grip improvements than did therapeutic ultrasound combined with exercise (28).

Laser Therapy + Taping	Ultrasound Therapy + Mobilization
Enhanced Pain Reduction Mobilization Restores proper arthrokinematics of the radiohumeral and humeroulnar joints, Improves elbow and forearm range of motion. Peritendinous stiffness is lessened by ultrasound, making movement more efficient and pleasant.	Superior Pain Reduction By increasing local tissue temperature (thermal effects), enhancing blood circulation, and lessening muscular spasms and sensitivity to pain stimuli, therapeutic ultrasonography reduces pain. Techniques for elbow mobilization, such as Mulligan mobilization with movement, provide instant pain alleviation by: Stimulating mechanoreceptors, and suppressing pain via the gate control mechanism. Combining the two techniques results in more significant pain alleviation than ultrasound therapy alone.
Acceleration of Tissue Healing In the afflicted tendon, laser treatment promotes angiogenesis, collagen production, fibroblast proliferation, and tendon remodeling. This encourages deteriorated tendon tissue to heal more quickly, particularly in long-term situations.	Improvement in Joint Mobility and Function Mobilization Restores proper arthrokinematics of the radiohumeral and humeroulnar joints, Improves elbow and forearm range of motion. Peritendinous stiffness is lessened by ultrasound, making movement more efficient and pleasant.
Improved Functional Outcomes Grip strength and upper limb function increase more when used in tandem. While a laser encourages tissue restoration, taping facilitates functional mobility during regular activities.	Enhanced Functional Outcomes Grip strength, painless wrist extension, and practical tasks like lifting and grasping are all enhanced by the combination.
Immediate and Sustained Effects Immediate symptom alleviation is provided by taping. Long-term biological effects from laser therapy result in persistent improvement. Both immediate symptoms and long-term healing are addressed by the combo.	Immediate Treatment Effects Mobilization offers immediate symptom alleviation, which is frequently apparent over the course of treatment.Because of the "warm-up effect" that ultrasound produces, mobilization is safer and more efficient.
Reduction of Mechanical Load on the Tendon Taping (kinesio or counterforce taping) Redistributes stress away from the lateral	Reduction of Tendon and Periarticular Stiffness Ultrasound improves tendon mechanics by increasing collagen extensibility, reducing

epicondyle, alleviating tension on the common extensor tendon during extending the wrist and gripping, This makes it possible to utilize the arm painlessly and promotes an early return to function.	adhesions around the common extensor tendon, and promoting tissue glide and joint nourishment through mobilization.

Evidence on ultrasound with mobilization

- Research conducted using placebo-controlled trials demonstrated that therapeutic ultrasound can provide statistically and clinically significant short-term pain relief compared to sham treatments, but the magnitude of this benefit is relatively small and long-term effects are uncertain (26).
- A recent randomised controlled trial comparing ultrasound to focused shock wave therapy showed that both treatments enhanced pain and grip strength, but the shock wave group reported a more significant subjective improvement, indicating that while ultrasound is effective, it is not the most potent treatment approach (29).
- Systematic reviews of physiotherapy for lateral epicondylalgia have found manual therapy and eccentric strengthening to have the strongest supporting evidence, while the effectiveness of ultrasound and mobilization techniques remains uncertain and is not conclusively proven (30).

Conclusion:

When taken as a whole, the results of the publications included in this systematic review indicated that manual therapy combined with ultrasonic wave therapy treatments had the greatest beneficial effects on LE and have a highly favorable cost-benefit ratio. Even when some methods work well, they ultimately produce worse results. So it is vital to deplete all the conservative therapy alternatives together with these approaches are irrelevant of growth factors in lateral epicondylitis.

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