Comparative Efficacy of low level laser Therapy and Therapeutic Ultrasound in Extensor Carpi Ulnaris Tendinopathy, a RCT study

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***Abstract*—Background: The extensor carpi ulnaris (ECU) muscle is essential for stabilizing the ulnar side of the wrist as well as for the active motions of wrist extension and ulnar deviation. Pronation and supination of the forearm alter its position in relation to the other wrist structures. In order to carry out its many duties, the ECU tendon depends on particular stabilizing structures to keep it in the proper locations. Numerous actions can cause damage to these structures. The mechanism of damage causes discomfort and functional impairment in the wrist.**
Aim: this study proposed with comparison between the healing effects of low level laser and ultrasonic therapy in ECU tendinitis.
Method: this is 4weeks a RCT study done with 45 participants(age 25-45) having ECU tendinitis (at ANS Hospital, Jaipur,Rajasthan), divided in three groups with equal nos of sample size. One group introduced with LLT and next one introduced with UST for 10 mins, both the group provided k-tape for stabilization and wrist strengthening exercise for 10mins. Controlled group introduced with conventional physiotherapy for 20mins. Outcome measures taken as pain(NPRS) and functional status(PRWE).
Statisics: data was collected as pre and post intervention with pain and functional disability score. Data was calculated with JASP 16.0v. ANOVA did for both outcome measures for all groups. Significance took as "p< 0.05".
Results & Discussion: participants used LLT placed a significant recovery than other groups.
Conclusion: treatment of ECU tendinitis is still controversial, due to lack of literature and case study. As per the concerning effect the laser however placed a better outcome than others.

***Index Terms*—ECU, LLT, UST, NPRS, PRWE**

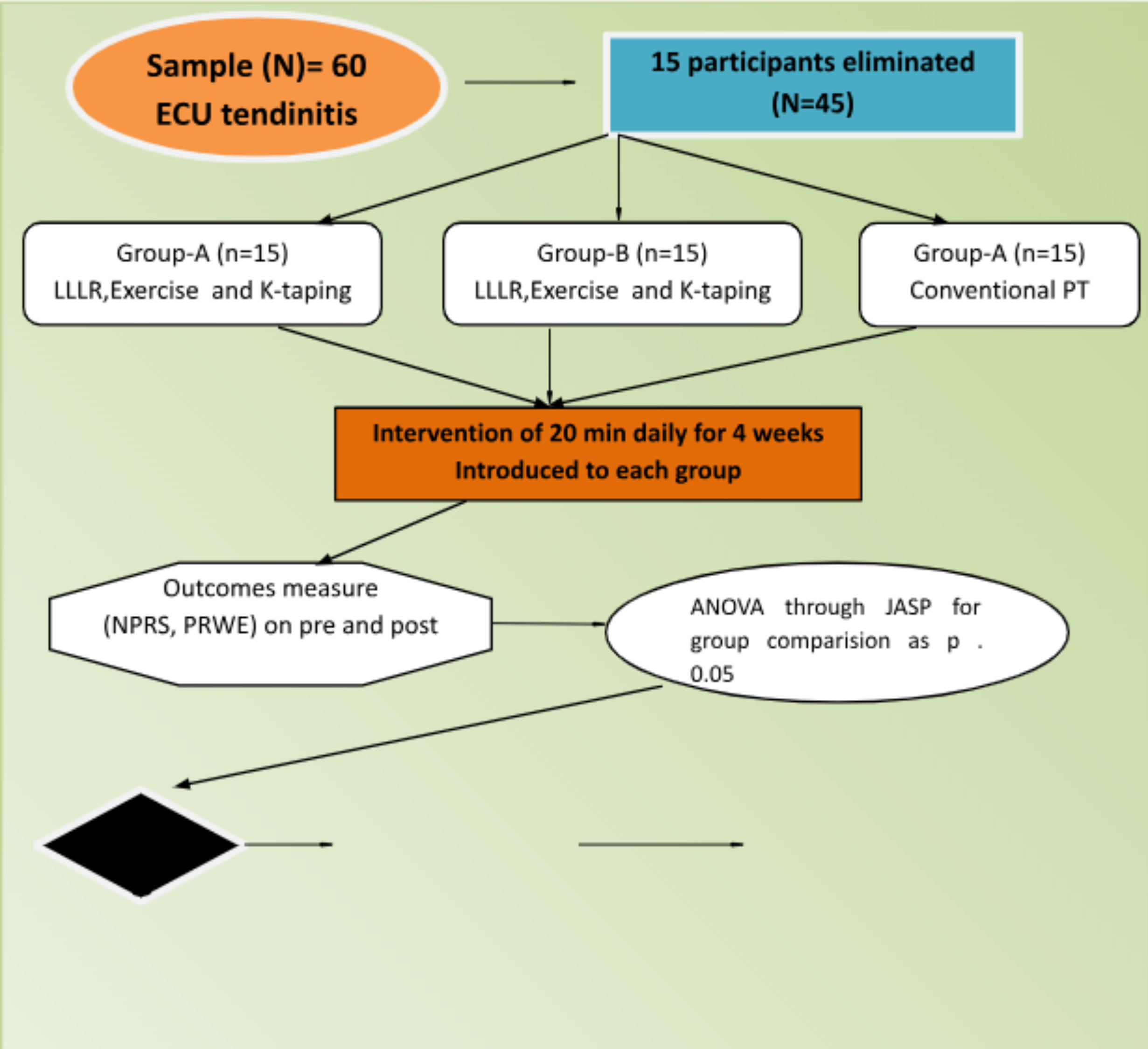
I. Introduction

Extensor carpi ulnaris (ECU) tendon injuries are known to occur in athletes who do repetitive wrist extension and ulnar deviation exercises. During rotating motions, particularly under strain, the ECU tendon is essential for supporting the ulnar side of the wrist(1). Because of its special anatomical location—it runs along the ulnar side of the wrist inside a fibrous sheath—the ECU tendon is especially susceptible in athletes. For the tendon to remain in place while moving, this sheath is essential(2). Acute lesions to the ECU tendon resulting in displacement or subluxation are rare in the research. However, they may be increasingly prevalent than previously anticipated because they are often mistakenly identified, contributing in repeated rupture and delaying treatment (3). It is thought that the ECU tendon and its sheath are important in the stability of the distal radio-ulnar joint and also in the dynamic stabilization of the wrist, through its pronating effect on the distal carpal row. Traumatic injuries leading to dislocation or subluxation of the ECU tendon are rarely reported in the literature. But they are frequently misdiagnosed and may therefore be much more common than originally suspected, leading to recurrent dislocation and delay of treatment (4,5). According to tendon tracking studies, when the forearm is positioned in either neutral rotation or pronation, the excursion of the ECU during extension decreases by 60%. This variation in the ECU tendon's position affects both its function and its relative stability. In full pronation, the ECU tendon leaves the wrist in a straight line(6). Patients with engaged tendinopathy and tenosynovitis of the ECU will commonly have a diffuse and subtle edema over the dorsoulnar side of the impacted wrist. The pain symptom has two characteristics: a constant dull aching feeling on the dorsoulnar region of the impacted wrist and a rapid, radiating lateral pain felt along the axis of the distal ECU tendon on active movement of the muscle (7). The first line of treatment for stenosing tenosynovitis or ECU tendinopathy is mainly conservative, involving rest, anti-inflammatory drugs, activity modification, a brief period of splint, and a trial steroid injection into the ECU tendon sheath. (8). Surgical procedures, percutaneous needle aspiration, extracorporeal shock-wave therapy (ESWT), therapeutic ultrasound, and other methods have been developed to treat tendinitis, depending on the kind of damage (9). T-US is frequently utilized to treat musculoskeletal disease because of its thermal and non-thermal effects (10). Acute disorders are frequently treated with pulse mode T-US, while chronic illnesses are typically treated with continuous mode (11). The depth of the targeted structure determines the T-US frequency: surface structures are treated at 3 MHz, while deeper structures (up to 5 cm) are treated at 1 MHz (12). The foundation of ECU tendinitis therapy is therapeutic exercises to enhance wrist function and wrist stabilizer muscle strength in order to restore full hand mobility, according to some Medical Specialists, Physical and Rehabilitation Medicine Section guidelines. Passive therapeutic procedures like therapeutic ultrasound, transcutaneous electrical nerve stimulation (TENS) and other types of electrotherapy are the treatment of choice(13). Since it has been successfully used to treat common musculoskeletal disorders with the goal of reducing pain and improving quality of life, Low Level Laser treatment (LLLT) has garnered a lot of attention in the last 25 to 30 years (14). Wrist extension and ulnar deviation are aided by the Extensor Carpi Ulnaris (ECU) Tendon, which runs down the ulnar (little-finger) side of the wrist. When used for ECU tendonitis, kinesio-tape offers both functional and mechanical advantages. It facilitates regular use of the wrist during rehabilitation, improves proprioception, lessens discomfort during wrist movement, and offers modest support to the ECU tendon (15).

II. MATERIAL AND METHODS

sixty patients (age 25-45, both male & female) were under went for our study purpose (ECU tendinitis) since 12th aug 2025 to 25th dec 2025, at ANS Hospital, jaipur, rajasthan. Among of these participants 15 nos of patients did not consider for study due to some non provisional purpose. Then after this was taken about 45 nos of participants. All the patients were divided in three groups equally through block randomization method. Hence each group contains 15 nos of participants. Group-A introduced with LLLT for 10 mins having wave length 550nm and power density 2-5 W/cm2. Group-B introduced with T-US as pulsed pattern having intensity 0.7 W/cm2 for 10 mins. Both the group participants placed with strengthening exercises for 10 mis followed by K-tapping. As of the participants of Group-C (controlled group) introduced with conventional physiotherapy for 20 mins. Before proceeding to intervention all the participants diagnosed as ECU tendinitis. All the participants completed the inclusion criteria. All participants went for four weeks of intervention. All the participants duly signed with concerned letter. Data was collected on day 0 as pre data and day28 as post intervention through outcome measures (pain as NPRS, functional ststus as PRWE). Both the data was assessed and compared as among the group and between the group. For statistical study ANOVA was done through JASP 16.0 Vs. The significance was taken as “$p > 0.05$”.

consort chart



III. RESULT

ANOVA - age

Cases	Sum of Squares	df	Mean Square	F	p	η²
gender	0.860	1	0.860	0.022	0.883	5.542e -4
GROUP	14.333	2	7.166	0.184	0.833	0.009
gender ∗ GROUP	17.311	2	8.655	0.222	0.802	0.011
Residuals	1520.063	39	38.976			

Note. Type III Sum of Squares

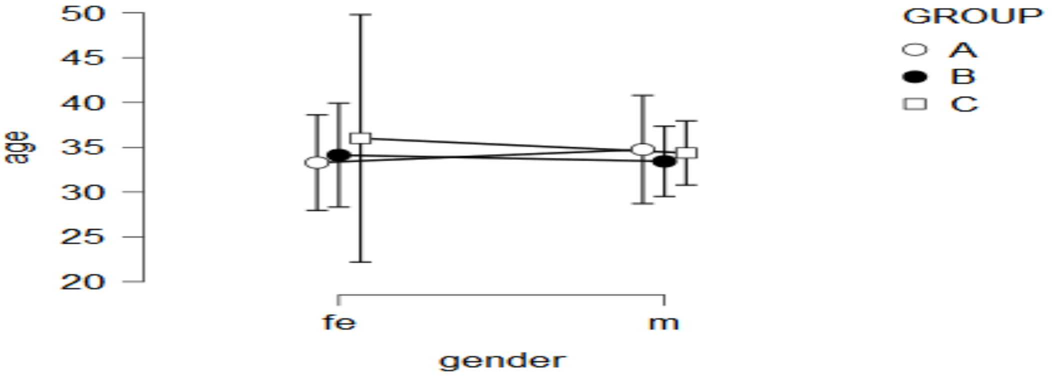
Descriptives - age

gender	GROUP	Mean	SD	N
fe	A	33.286	5.765	7
	B	34.125	6.937	8
	C	36.000	8.679	4
m	A	34.750	7.226	8
	B	33.429	4.237	7

ANOVA - age

Cases	Sum of Squares	df	Mean Square	F	p	η²
C		34.364			5.334	11

Descriptives plots



Simple Main Effects - gender

Level of GROUP	Sum of Squares	df	Mean Square	F	p
A	8.005	1	8.005	0.205	0.653
B	1.811	1	1.811	0.046	0.830
C	7.855	1	7.855	0.202	0.656

Within Subjects Effects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_p
PAIN	6.992	1	6.992	18.091	0.034	0.306
PAIN ✻ GROUP	4.306	2	2.153	5.570	0.007	0.214
PAIN ✻ age	0.420	1	0.420	1.086	0.038	0.026
Residuals	15.847	41	0.387			

Note. Type III Sum of Squares
P= 0.034 as subject effects, p=0.007 as subject effect of group analysis, p=0.038 as subject effects with respect to age.
Hence within group study value of p indicates the significant values, as p<0.05.

Between Subjects Effects

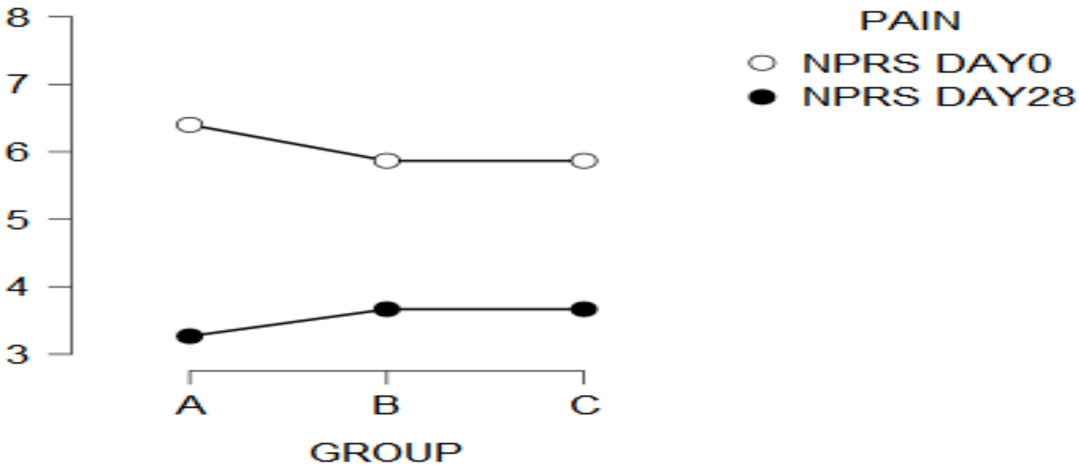
Cases	Sum of Squares	df	Mean Square	F	p	η^2_p
GROUP	0.085	2	0.043	0.079	0.025	0.004
age	0.164	1	0.164	0.303	0.0389	0.007
Residuals	22.236	41	0.542			

Note. Type III Sum of Squares

As per analysis p=0.025 with respect to group, p=0.0389 with respect to age. The p value between the group study shows the significance of "p".

Descriptives

PAIN	GROUP	Mean	SD	N
NPRS DAY0	A	6.400	0.828	15
	B	5.867	0.834	15
	C	5.867	0.834	15
NPRS DAY28	A	3.267	0.458	15
	B	3.667	0.488	15
	C	3.667	0.488	15



Post Hoc Comparisons – GROUP

		Mean Difference	SE	t	p_{holm}
A	B	0.069	0.190	0.361	1.000
	C	0.061	0.190	0.322	1.000
B	C	-0.007	0.191	-0.038	1.000

Note. P-value adjusted for comparing a family of 3
Note. Results are averaged over the levels of: PAIN

Post Hoc Comparisons - GROUP

		Mean Difference	SE	t	p_{holm}
A	B	0.069	0.190	0.361	1.000
	C	0.061	0.190	0.322	1.000
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Note. P-value adjusted for comparing a family of 3
Note. Results are averaged over the levels of: PAIN

Post Hoc Comparisons - GROUP ✻ PAIN

		Mean Difference	SE	t	p_{holm}
A, NPRS.DAY0	B, NPRS.DAY0	0.538	0.249	2.163	0.201
	C, NPRS.DAY0	0.519	0.249	2.085	0.202

Post Hoc Comparisons - GROUP

		Mean Difference	SE	t	p_{holm}
	A, NPRS.DAY28	3.130	0.227	13.785	7.149e -16
	B, NPRS.DAY28	2.729	0.249	10.960	1.996e -16
	C, NPRS.DAY28	2.733	0.249	10.972	1.996e -16
B, NPRS.DAY0	C, NPRS.DAY0	-0.019	0.249	-0.076	1.000
	A, NPRS.DAY28	2.591	0.249	10.409	1.764e -15
	B, NPRS.DAY28	2.190	0.227	9.639	2.986e -11
	C, NPRS.DAY28	2.195	0.249	8.806	1.958e -12
C, NPRS.DAY0	A, NPRS.DAY28	2.610	0.249	10.480	1.411e -15
	B, NPRS.DAY28	2.209	0.249	8.865	1.669e -12
	C, NPRS.DAY28	2.214	0.227	9.735	2.568e -11
A, NPRS.DAY28	B, NPRS.DAY28	-0.401	0.249	-1.612	0.444
	C, NPRS.DAY28	-0.397	0.249	-1.592	0.444
B, NPRS.DAY28	C, NPRS.DAY28	0.004	0.249	0.018	1.000

Note. P-value adjusted for comparing a family of 15

Within Subjects Effects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_p
FUNCTIONAL STATUS	505.801	1	505.801	38.623	0.0279	0.485
FUNCTIONAL STATUS ✻ GROUP	709.452	2	354.726	27.087	0.038	0.569
FUNCTIONAL STATUS ✻ age	12.602	1	12.602	0.962	0.0332	0.023
Residuals	536.932	41	13.096			

Note. Type III Sum of Squares
For functional status p=0.0279 with respect to within the group, p=0.038 with complete score with respect to following groups, p=0.0332 functional status with respect to age. P shows the significance as analysis.

Between Subjects Effects

Cases	Sum of Squares	df	Mean Square	F	p	η^2_p
GROUP	166.807	2	83.404	1.902	0.0162	0.085
age	19.837	1	19.837	0.452	0.027	0.011
Residuals	1798.229	41	43.859			

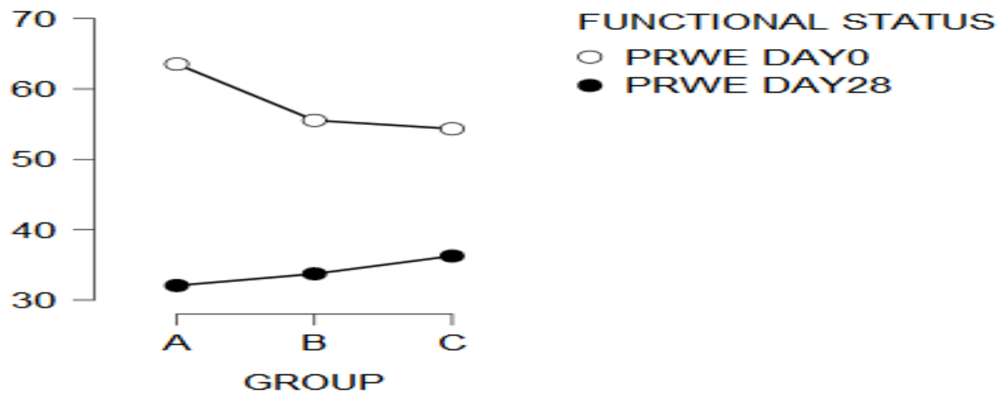
Note. Type III Sum of Squares
The group between study indicated the significant ‘p’, as p=0.0162 with respect to group and p=0.027 with respect to age. As per analysis concern p< 0.05 indicated the significant.

Descriptives

FUNCTIONAL STATUS	GROUP	Mean	SD	N
PRWE DAY0	A	63.533	4.549	15

Descriptives

FUNCTIONAL STATUS	GROUP	Mean	SD	N
	B	55.533	5.617	15
	C	54.333	5.538	15
PRWE DAY28	A	32.067	4.399	15
	B	33.733	5.106	15
	C	36.267	6.386	15



Post Hoc Comparisons - GROUP

		Mean Difference	95% CI for Mean Difference Lower	Upper	SE	t	p_{holm}
A	B	3.188	-1.081	7.457	1.710	1.864	0.208
	C	2.441	-1.833	6.715	1.712	1.426	0.323
B	C	-0.747	-5.026	3.532	1.714	-0.436	0.665

Note. P-value and confidence intervals adjusted for comparing a family of 3 estimates (confidence intervals corrected using the bonferroni method).
Note. Results are averaged over the levels of: FUNCTIONAL STATUS

Post Hoc Comparisons - FUNCTIONAL STATUS

		Mean Difference	95% CI for Mean Difference Lower	Upper	SE	t	p_{holm}
PRWE.DAY0	PRWE.DAY28	23.778	22.237	25.319	0.763	31.167	3.581e-30

Note. Results are averaged over the levels of: GROUP

Post Hoc Comparisons - GROUP ✻ FUNCTIONAL STATUS

		Mean Difference	95% CI for Mean Difference Lower	Upper	SE	t	p_{holm}
A, PRWE.DAY0	B, PRWE.DAY0	8.038	2.094	13.983	1.949	4.125	5.501e -4
	C, PRWE.DAY0	9.094	3.143	15.046	1.951	4.661	9.978e -5
	A, PRWE.DAY28	31.447	27.327	35.566	1.322	23.795	1.937e -24
	B, PRWE.DAY28	29.784	23.839	35.730	1.949	15.280	8.385e -22

Post Hoc Comparisons - GROUP ✻ FUNCTIONAL STATUS

		Mean Difference	95% CI for Mean Difference Lower	Upper	SE	t	p holm
	C, PRWE.DAY28	27.235	21.284	33.185	1.951	13.961	6.706e -20
B, PRWE.DAY0	C, PRWE.DAY0	1.056	-4.903	7.014	1.953	0.540	0.794
	A, PRWE.DAY28	23.408	17.463	29.354	1.949	12.009	5.949e -17
	B, PRWE.DAY28	21.746	17.624	25.868	1.323	16.442	1.418e -18
	C, PRWE.DAY28	19.196	13.241	25.152	1.952	9.833	1.580e -13
C, PRWE.DAY0	A, PRWE.DAY28	22.353	16.402	28.303	1.951	11.458	4.271e -16
	B, PRWE.DAY28	20.690	14.735	26.646	1.952	10.598	9.164e -15
	C, PRWE.DAY28	18.141	14.015	22.266	1.324	13.706	6.011e -16
A, PRWE.DAY28	B, PRWE.DAY28	-1.662	-7.607	4.283	1.949	-0.853	0.794
	C, PRWE.DAY28	-4.212	-10.164	1.740	1.951	-2.159	0.139
B, PRWE.DAY28	C, PRWE.DAY28	-2.550	-8.508	3.409	1.953	-1.305	0.590

Note. P-value and confidence intervals adjusted for comparing a family of 15 estimates (confidence intervals corrected using the bonferroni method).

from above analysis $p< 0.05$ indicates the significant effects of interventions were analytically proven and satisfying the experimental hypothesis

IV. DISCUSSION

Effects of K-Taping in ECU Tendinitis: In Extensor Carpi Ulnaris Tendinopathy, K-taping is thought to produce several physiological effects: **Pain Moderation: It reduces discomfort during wrist movements, triggers the gate control system of pain, and stimulates the skin's cutaneous mechanoreceptors. **Enhanced Proprioception: it increases awareness of joint position and movement, improves sensory feedback from the wrist and forearm, may assist optimize movement patterns, and lessens excessive tendon stress. **Reduction of Mechanical Stress on the Tendon: it Provides gentle external support to the ECU tendon, Helps disperse stresses throughout the wrist and forearm, and minimize tension on the inflamed tendon during functional activities. **Enhanced Microcirculation: The tape's lifting action may somewhat widen the gap between the skin and underlying tissues, promote local lymphatic and blood circulation, and perhaps lessen inflammatory byproducts and localized edema. **Enhanced Neuromuscular Control: It enhances dynamic wrist stability during grasping, raising, and forearm rotation by facilitating the synchronized activation of the wrist stabilizing muscles. **Functional Improvement: Patients may be able to carry out everyday tasks more easily as a result of decreased pain and enhanced proprioception..

“Specifically In ECU Tendinitis K-taping is believed to: Reduce pain along the ulnar side of the wrist, Improve wrist stability during extension and ulnar deviation, Allow more comfortable participation in strengthening and rehabilitation exercises.”

Effects of Low-Level Laser Therapy (LLLT) in ECU Tendinitis: Low-Level Laser Therapy (LLLT), also known as photobiomodulation, is used to reduce pain and promote healing in Extensor Carpi Ulnaris Tendinopathy. **Anti-inflammatory Effect: It helps lessen tendon irritation and inflammation by reducing inflammatory mediators including prostaglandins and cytokines. It may also lessen edema surrounding the tendon. **Pain Reduction: It reduces pain during wrist movement and gripping exercises, modifies nerve conduction and pain signaling, and stimulates the production of endogenous opioids (endorphins). **Increased Cellular Energy Production: Because laser light is absorbed by mitochondria, more ATP (adenosine triphosphate) is produced, which supplies energy for cellular regeneration and repair. **Enhanced Tissue Healing: it supports the healing of micro-damage inside the ECU tendon, stimulates fibroblast proliferation, and encourages collagen formation and tendon remodeling. **Improved Microcirculation: It facilitates the elimination of metabolic waste products, improves blood flow and oxygen supply, and causes local vasodilation. **Reduction of Oxidative Stress: It helps shield cells from excessive oxidative damage during the healing process by regulating reactive oxygen species (ROS). **Improved Tendon Function: Better wrist mobility, stronger grips, enhanced functional performance, etc. can result from less discomfort and enhanced tissue repair.

“LLLT is typically applied over: The ECU tendon at the ulnar side of the wrist with Areas of maximal tenderness and Sometimes multiple points along the tendon course”

Effects of Therapeutic Ultrasound (T-US) in ECU Tendinitis: In Extensor Carpi Ulnaris Tendinopathy, therapeutic ultrasound (T-US) produces both thermal and non-thermal effects that may help reduce symptoms and promote tissue healing. **Increased Tissue Temperature (Thermal Effect): Constant ultrasound elevates soft tissue temperatures, increases tissue extensibility, lessens stiffness and spasms in the surrounding muscles, and may enhance wrist movement. **Increased Blood Flow: Local heating produces vasodilation, Enhances transport of oxygen and nutrients to the tendon and Facilitates elimination of metabolic waste products. **Enhanced Cellular Activity: Ultrasound increases cellular metabolism, Increases fibroblast activity and Promotes collagen formation and tendon healing. **Acoustic Streaming: Movement of fluid around cells generated by ultrasonic waves, Alters cell membrane permeability and Facilitates nutrient delivery and tissue repair. **Stable Cavitation: An advantageous non-thermal impact that increases cellular activity and healing processes through the formation and oscillation of small gas bubbles within tissues. **Pain Reduction: Increased circulation, less inflammation, improved tissue repair, and altered nerve transmission can all help reduce pain. **Reduction of Inflammation: Pulsed ultrasound may lessen swelling and soreness in the area of the ECU tendon and assist regulate inflammatory reactions. **Enhanced Collagen Extensibility: Heating tissues high in collagen makes them more flexible, which can enhance tendon movement and lessen stiffness.

Component	**LLLT + Exercise + K-Taping**	**T-US + Exercise + K-Taping**
Primary Mechanism	Photobiomodulation (cellular stimulation)	Thermal and mechanical effects
Pain Reduction	Strong anti-inflammatory and analgesic effects	Analgesic effect through thermal and non-thermal mechanisms
Tissue Healing	Increases ATP production, fibroblast proliferation, collagen synthesis	Enhances fibroblast activity and collagen remodeling
Inflammation Control	Direct modulation of inflammatory mediators	More indirect effect, especially with pulsed ultrasound
Circulation	Improves microcirculation through photobiomodulation	Increases blood flow via thermal effects
Tendon Repair	Stimulates cellular repair processes	Promotes tissue healing through mechanical and thermal effects
Exercise Benefits	Improved tolerance to strengthening due to reduced pain	Improved tissue extensibility may facilitate exercise
K-Taping Benefits	Pain relief, proprioception, support	Pain relief, proprioception, support

V. CONCLUSION

Both LLLT and therapeutic ultrasound (T-US) can be beneficial in the therapy of Extensor Carpi Ulnaris Tendinopathy by lowering pain and increasing wrist function. Similarly the conventional therapy plays a comprehensive growth in pain and functioning condition. When comparing all the necessary actions for managing ECU tendinitis, LLLT may be more beneficial since it may improve cellular metabolism by increasing ATP generation, regulate inflammatory processes, encourage collagen synthesis and tendon repair, and also Relieve pain effectively without using tissue heating. On the other hand, T-US mainly improves circulation, tissue extensibility, and pain through mechanical and heat actions. As a result, Group-A's treatments outperformed the other two groups in terms of pain relief and functional results.

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