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Extracorporeal Shock Wave versus Ultrasound Guided Local Corticosteroid Injection in Treatment of Lateral Epicondylitis

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ABSTRACT

Background: Shock waves are high energy sound waves that showed high efficacy in diminishing the high levels of the inflammatory mediators. An ultrasound-guided corticosteroid injection is a highly effective method that significantly reduces pain and inflammation and has been demonstrated to offer superior temporary results in regaining grip strength.
Aim: This study aimed to evaluate the efficacy of extracorporeal shock wave therapy in relation to ultrasound-guided corticosteroid (CS) injections for managing lateral epicondylitis (LE).
Patients and methods: The investigation consisted of 60 cases encompassing both male and female participants with LE who were divided into two equal. Group I received a single US-guided corticosteroid injection and group B underwent extracorporeal shock wave therapy (ESWT) treatment.
Results: At both follow-ups, the visual analogue scale, Likert scale, patient-rated tennis elbow evaluation, and tendon thickness were notably higher in groups I and II compared to their pre-treatment levels, with an even greater increase observed at the 2nd follow-up compared to the 1st ($P < 0.05$). Furthermore, the Maudsley, Cosens, and Mills tests yielded significantly higher scores in groups I and II at both follow-ups than pre-treatment ($P < 0.05$). At the second follow-up, group I had substantially greater Power Doppler readings than before treatment, reflecting a statistically significant change ($p < 0.05$). **Conclusions:** Results showed that corticosteroid injections and ESWT were effective in treating LE, but ESWT demonstrated superior improvement in clinical and ultrasonographic follow-ups after 12 weeks compared to corticosteroid injections.
Keywords: Ultrasound, Extracorporeal shock wave, Local corticosteroid, Lateral epicondylitis injection.

INTRODUCTION

A degenerative condition known as lateral epicondylitis or tennis elbow affects the common point where the forearm extensors originate at the lateral humeral epicondyle. The frequency range lies between one and three percent, with the highest rate of occurrence typically observed in the fifth decade [1, 2]. Injuries caused by repetitive trauma and overexertion are frequently seen in jobs involving the use of vibrating tools [3]. At the site of the common extensor origin, a structural defect arises due to an initial inflammatory response, resulting in degenerative changes and the production of abnormal collagen [4].

The primary clinical symptoms are tenderness and outer part of the elbow pain, which worsen with activity in the affected arm, especially when extending the wrist against resistance, and improve with periods of rest [5].

The associated possible partial tearing, tendinosis or calcifications can be detected by the administration of musculoskeletal ultrasound (US) [6]. Treatment of such a case depends on three strategies; the first strategy is conservative, which mainly rely on physiotherapy and activity modification, the second strategy depends on the drug administration involving non-steroidal anti-inflammatory drugs, and local injections, the last strategy is surgical intervention and recommended only for the refractory cases [7]. Cortisone is a steroid and strong anti-inflammatory used for a variety of conditions, historically corticosteroid injection has been the most frequent intervention for LE. US corticosteroid injection is an effective method in alleviating pain, inflammation, and showed temporary superior efficacy in restoring grip strength [8].

The extracorporeal shockwave therapy (ESWT) is an effective non-invasive technique, which was first introduced into medical field back in 1980 [9]. High-energy shock waves are found to be highly effective in reducing inflammation by diminishing high levels of inflammatory mediators. This treatment also stimulates small nerve fibres, which in turn activates the serotonin system that is responsible for transmitting pain signals. Moreover, it has a regenerative and tissue repairing effect by promoting the release of proliferating cell nuclear antigen, vascular endothelial growth factor, and growth factors such as endothelial nitric oxide synthase [10]. Therefore, the 1ry goal of this investigation was to assess the efficacy of extracorporeal shockwave therapy relative to US guided corticosteroid injection in the management of lateral epicondylitis (LE).

PATIENTS AND METHODS

The current investigation involved 60 individuals, aged 28 to 76 years, comprising both sexes, who displayed symptoms and clinical manifestations of LE, characterised by pain and tenderness at the common extensor origin, which is intensified when the wrist was extended against resistance as confirmed by Cozen's test.

Exclusion criteria: Patients with conditions affecting the elbow joint, including rheumatoid arthritis, gout,

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certain types of spondyloarthritis, and inflammation caused by the cervical spine. Previous surgery at the elbow, skin infections, sepsis, fractures, severe joint damage, bleeding disorders, pregnancy, a recent steroid injection within six weeks, known allergies to steroid injections, a pacemaker, and cancer.

The cases were divided into two groups of equal size. Group I received one US-guided local injection of corticosteroids, comprising 1 ml of betamethasone in combination with one millilitre of one percent lidocaine for local anaesthesia. Group B received ESWT consisting of three weekly sessions, with each session employing the radial head and the following settings: 1.8 millijoules of energy, 3000 pulses, and a frequency of 15 Hertz.

A comprehensive evaluation was performed for all patients, which included a thorough medical history, physical examination, and a range of diagnostic tests [complete blood count (CBC), serum uric acid levels, erythrocyte sedimentation rate (ESR), and radiological assessments such as musculoskeletal ultrasound (US) and color Doppler imaging].

The examiner applies Maudsley's test by holding back the 3rd digit of the case's hand, focusing on the extensor digitorum muscle and tendon, and simultaneously feeling the patient's lateral epicondyle. Pain experienced on the elbow's outer part, specifically over the lateral epicondyle of the humerus, indicates a positive test result [11]. During the Cozen's test, the case is requested to bend their wrist backwards, with the therapist providing resistance to this movement in the specified position. Pain elicited on the lateral epicondyle signifies a positive test result [12]. During the Mills test, the examiner employs one hand to palpate the case's lateral epicondyle, simultaneously using the other hand to rotate the patient's forearm in a pronated position, with the wrist fully flexed and the elbow fully extended. Pain experienced in the area near the lateral epicondyle at the point where the tendon inserts is indicative of a positive result of the test [13].

A tenderness assessment tool employs a Likert scale, which rates tenderness from 0 to 3, with a score of 0 signifying no tenderness, 1 mild tenderness, 2 moderate tenderness, and 3 severe tenderness [14].

The Patient-Rated Tennis Elbow Evaluation (PRTEE) is a functional assessment instrument that permits cases to rate their level of tennis elbow pain and disability on a scale from 0 to 10, comprising two subscales: pain assessment and functional ability [15].

Imaging assessment by musculoskeletal ultrasound: The equipment used in the US was a SAMSUNG MEDISON (UGEO H60). The patient should be positioned either seated or supine, with their elbow placed on an examination table. A linear transducer operating at a frequency of 12–17 MHz is applied to the common extensor tendon, specifically the superficial part, using sufficient ultrasound gel. The elbow is examined from the side with the elbow bent at ninety degrees in flexion. A linear transducer is positioned at the proximal forearm. The CEO is positioned along the body's longitudinal axis, with the probe's upper edge placed near the lateral epicondyle from the front. The evaluation of the elbow involves rotating the transducer ninety degrees counterclockwise for both transverse and longitudinal imaging of the joint's lateral aspects. Assessments were made of tendon thickness, focal tendon echogenicity, power Doppler, and bony irregularity. The "plateau measure" technique was employed to ascertain the thickness of the common extensor tendon by taking a measurement of the tendon thickness at a precise anatomical point situated on the lateral epicondyle's bony surface, which is also commonly referred to as "the plateau." The plateau is located on a flat section of the capitulum of the lateral epicondyle, situated between where the tendon attaches and the humeroradial joint. Measurements of tendon thickness were taken from the plateau area to the tendon surface, perpendicular to the direction of the tendon's length. A colour Doppler ultrasound scan was conducted in the longitudinal plane by incrementally moving the transducer laterally to locate the region with the most pronounced Doppler signal. A low probe pressure was successfully attained, resulting in the application of a considerable gel layer. Colour Doppler activity was scored from 0 to 4 on a scale. The grading was assessed within a 0.5-centimeter longitudinal section of the tendon, focusing on the area with the highest Doppler activity, which was designated as the region of interest (ROI). Grading was as follows: Grade 0, no activity. One ship operating at grade 1 within the Republic of Ireland. Doppler activity was seen in fewer than twenty-five percent of the region of interest in grade 2. Grade 3 showed Doppler activity in a range of twenty-five percent to fifty percent of the region of interest. Significant Doppler activity was noted in more than fifty percent of the region of interest at Grade 4 levels. Doppler activity with a rating of zero to one was designated as Doppler negative, whereas ratings of two to four were classified as Doppler positive. An examination of bone irregularities, tears, calcifications, and focal tendon echoes with ultrasound was conducted, taking note of bony spurs at the point of insertion of the calcaneal enthesal tendon [16].

In group I, the elbow is bent to ninety degrees with the hand in a pronated position. The probe of the US device is positioned at the elbow until the starting point of the common extensor is fully visible; a needle measuring 18-gauge is then inserted into line with the probe located just ahead and below the lateral epicondyle at the spot of maximum tenderness. During an injection, the sensation of crepitation or cracking is experienced as the needle is inserted, slightly moved, and repositioned without breaking the skin's surface. This procedure is repeated until the sensation subsides. Care should be taken to handle the needle delicately and insert it softly to prevent damage when the bone is encountered, which is often the situation. Patients were

allowed to resume their daily routines right away, nevertheless they were advised to avoid repeating any activities that triggered elbow pain for a period of four weeks. Patients were permitted to resume recreational or sporting activities once they were pain-free during daily tasks and showed no symptoms during strength-testing exercises.

For group II in this study, radial shock wave therapy has been administered utilizing the DUOLITH SD1 >>Ultra<< device, which is manufactured by STORZ MEDICAL AG. The treatment head was placed on the affected elbow, which was slightly bent with the forearm turned downwards, in order to apply the radial shock waves tangentially to the common extensor origin. Local anesthesia was not administered. A conductive gel has been utilized as the medium between the skin and the management head. We applied radial shock waves initially at lowest energy level at 15 Hz. Depending upon patient tolerance, the energy levels were increased to the highest level that could be maximally tolerated. We were certain that the patient did not become too uncomfortable. The radial head was moved at the most painful area, lateral epicondyle and along the muscles near the origin. After delivering a total of 3000 shocks to the affected side, removal of the S.W head from the treated area and the site of application were observed. Applying of the V-ACTOR (3000 shocks/session, with energy level 1.8) to round off a successful therapy by relaxing the muscles and connective tissue and to improve metabolic activity. Wiping away the gel. Total number of shocks was 3000 shocks, (3 sessions, week a part, of 15 Hz, the pressure was 1.8-3.0 bar for each session).

The patients received post-treatment instructions including Avoiding excessive wrist extension, pronation and supination movements. Wrist extensors stretch exercises was done 2-3 times daily. All participants were advised to avoid NSAIDS and to limit overuse of the elbow during the study period. Acetaminophen is only available if pain is severe. All patients were evaluated by previous clinical, functional and ultrasonographic parameters before management, four weeks following the end of management and after twelve weeks as monitoring.

Ethical considerations: The participants' confidentiality was guaranteed. The research participants weren't identified by name in any publication or report that addressed this research. The nature and goal of the research, as well as the risk-benefit evaluation have been explained to the participants prior to their admission to this study. Informed consent has been obtained from each participant. Approval of Ethics committees of Rheumatology, Rehabilitation and Physical Medicine Department, Tanta University faculty of Medicine, was obtained (Approval code of 33349/09/19). The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

Statistical analysis has been carried out utilizing the SPSS version 26 programme (IBM Inc., based in Chicago, Illinois, USA). The parameters have been reported as means and standard deviations (SD), and a comparison was made among both groups utilizing the unpaired Student's t-test. Quantitative data has been presented as percentage and frequency for categorical variables, while statistical assessment was conducted with the Chi-square or Fisher's exact test when applicable. A $P \leq 0.05$ was deemed statistically significant in a two-tailed test.

RESULTS

Patients' characteristics were insignificantly different among both groups (Table 1**).**

Table (1): Comparison among both investigated groups based on patients' characteristics

		Group I (number=30)	Group II (number=30)	P
Age (years)		41.30±8.19	44.1±6.86	0.157
Sex	**Male**	24(80.0%)	17(56.7%)	0.052
	Female	6(20.0%)	13(43.3%)	
Occupation	**Housewife**	18(60.0%)	10(33.3%)	0.219
	Plumper	1(3.3%)	1(3.3%)	
	Driver	2(6.7%)	1(3.3%)	
	Police officer	1(3.3%)	0(0.0%)	
	Employee	5(16.7%)	6(20.0%)	
	Nurse	3(10.0%)	6(20.0%)	
	Electrician	0(0.0%)	1(3.3%)	
	Worker	0(0.0%)	4(13.3%)	
	Technician	0(0.0%)	1(3.3%)	
Affected hand	**Right**	27(90.0%)	29(96.7%)	0.301
	Left	3(10.0%)	1(3.3%)	

Data are presented as frequency (%) or mean ± SD Group I: Corticosteroid, Group II: Shockwave.

In groups I and II, the VAS score, Likert scale, and patient-rated tennis elbow evaluation were significantly better following management compared to before management, with further improvement at the second follow-up than at the first follow-up (P<0.05). The Maudsley, Cosin and Mills test scores were substantially higher in both groups following treatment, achieving statistical significance (P<0.05). Nonetheless, these scores demonstrated no notable disparity between the initial and subsequent follow-ups. Furthermore, the Maudsley, Cosin and Mills test scores exhibited statistically insignificant difference between both groups at any point in time, encompassing the pre-treatment period and both follow-up assessments (Table 2**).**

Table (2): Comparison among VAS, Likert scale, patient rated tennis elbow evaluation, Maudsley, Cosen and Mills test at the base line, after first and second follow up in groups I and II

	Group I (number=30)	**Group II (number=30)**
VAS		
At 0 weeks	7.767±1.995	7.667±1.668
At 4 weeks	3.800±1.710	3.200±1.769
At 12 weeks	2.233±1.135	0.633±0.850
P	**P1 less than 0.001*, P2 less than 0.001*, P3 less than 0.001***	**P1 less than 0.001*, P2 less than 0.001*, P3 less than 0.001***
Likert scale		
At 0 weeks	2.533±0.571	2.567±0.504
At 4 weeks	0.733±0.521	0.900±0.548
At 12 weeks	0.500±0.509	0.100±0.403
P v	**P1 less than 0.001*, P2 less than 0.001*, P3 equals 0.006***	**P1 less than 0.001*, P2 less than 0.001*, P3 less than 0.001***
Patient rated tennis elbow evaluation		
At 0 weeks	73.283±14.316	69.350±11.594
At 4 weeks	57.567±12.907	43.963±14.582
At 12 weeks	50.183±12.101	20.867±13.301
	P1 less than 0.001*, P2 less than 0.001*, P3 less than 0.001*	**P1 less than 0.001*, P2 less than 0.001*, P3 less than 0.001***
Maudsley test		
At 0 weeks	29(96.7%)	30(100.0%)
At 4 weeks	3(10.0%)	1(3.3%)
At 12 weeks	1(3.3%)	1(3.3%)
P	**P1 less than 0.001*, P2 less than 0.001*,** P3 equals 0.301	**P1 less than 0.001*, P2 less than 0.001*,** P3 equals 1.000
Cosen test		
At 0 weeks	30(100.0%)	30(100.0%)
At 4 weeks	3(10.0%)	1(3.3%)
At 12 weeks	1(3.3%)	0(0.0%)
P	**P1 less than 0.001*, P2 less than 0.001*,** P3 equals 0.301	**P1 less than 0.001*, P2 less than 0.001*,** P3 equals 0.313
Mills test		
At 0 weeks	30(100.0%)	30(100.0%)
At 4 weeks	5(16.7%)	1(3.3%)
At 12 weeks	2(6.7%)	0(0.0%)
	P1 less than 0.001*, P2 less than 0.001*, P3 equals 0.228	**P1 less than 0.001*, P2 less than 0.001*,** P3 equals 0.313

*Significant P value <0.05. P1: between 0 weeks and 4Weeks, P2: between 0weeks and 12weeks, P3: between 4weeks and 12weeks. VAS: visual analogue scale.

Significant differences have been found in the VAS and Likert scale among both groups at the second monitoring ($p < 0.05$). The patient's evaluation of tennis elbow was significantly different between both groups at both the first and second monitoring sessions ($P < 0.05$). In contrast, the Maudsley, Cosen, and Mills test results weren't significantly different among both groups both before treatment and at the first and second follow-up assessments (Table 3).

Table (3): Comparison among VAS, Likert scale, patient rated tennis elbow evaluation, Maudsley, Cosen and Mills test at the base line, after first and second follow up in both groups

		Group I (number=30)	Group II (number=30)	P
VAS	**At 0 weeks**	7.767±1.995	7.667±1.668	0.834
	At 4 weeks	3.800±1.710	3.200±1.769	0.187
	At 12 weeks	2.233±1.135	0.633±0.850	**<0.001***
Likert scale	**At 0 weeks**	2.533±0.571	2.567±0.504	0.811
	At 4 weeks	0.733±0.521	0.900±0.548	0.232
	At 12 weeks	0.500±0.509	0.100±0.403	**<0.001***
Patient rated tennis elbow evaluation	**At 0 weeks**	73.283±14.316	69.350±11.594	0.247
	At 4 weeks	57.567±12.907	43.963±14.582	**<0.001***
	At 12 weeks	50.183±12.101	20.867±13.301	**<0.001***
Maudsley test	**At 0 weeks**	29(96.7%)	30(100.0%)	0.313
	At 4 weeks	3(10.0%)	1(3.3%)	0.301
	At 12 weeks	1(3.3%)	1(3.3%)	1.000
Cosen test	**At 0 weeks**	30(100.0%)	30(100.0%)	**1.000**
	At 4 weeks	3(10.0%)	1(3.3%)	0.301
	At 12 weeks	1(3.3%)	0(0.0%)	0.313
Mills test	**At 0 weeks**	30(100.0%)	30(100.0%)	1.000
	At 4 weeks	5(16.7%)	1(3.3%)	0.085
	At 12 weeks	2(6.7%)	0(0.0%)	0.150

Tendon thickness was significantly higher in groups I and II in the first and second follow up than before treatment and at second follow-up than at first follow-up ($P < 0.05$). Tendon thickness was significantly different in group II at second follow-up ($P < 0.05$). Bone irregularity or bony spurs and power Doppler were insignificantly different between both groups (Table 4).

Table (4): Comparison among tendon thickness by US, focal echogenicity, bone irregularity or bony spurs and power Doppler at the base line, after first and second follow up in groups I and II

		Group I (number=30)	Group II (number=30)
Tendon thickness by US			
At 0 weeks		0.608±0.111	0.625±0.104
At 4 weeks		0.548±0.086	0.521±0.098
At 12 weeks		0.512±0.081	0.448±0.087
P		**P1 less than 0.001*, P2 less than 0.001*, P3 less than 0.001***	**P1 less than 0.001*, P2 less than 0.001*, P3 less than 0.001***
Focal echogenicity			
At 0 weeks	**Normal**	2(6.7%)	4(13.3%)
	Focal hypoechoic	28(93.3%)	26(86.7%)
At 4 weeks	**Normal**	2(6.7%)	5(16.7%)
	Focal hypoechoic	28(93.3%)	25(83.3%)
At 12 weeks	**Normal**	2(6.7%)	6(20.0%)
	Focal hypoechoic	28(93.3%)	24(80.0%)
P		P1=1.000, P2=1.000, P3=1.000	P1=0.718, P2=0.488, P3=0.739
Bone irregularity or bony spurs			
At 0 weeks		15(50.0%)	13(43.3%)
At 4 weeks		15(50.0%)	13(43.3%)
At 12 weeks		13(43.3%)	13(43.3%)
P		P1=1.000, P2=0.605, P3=0.605	P1=1.000, P2=1.000, P3=1.000
Power Doppler			
At 0 weeks	**Grade 0**	19(63.3%)	24(80.0%)
	Grade 1	9(30.0%)	4(13.3%)
	Grade 2	2(6.7%)	2(6.7%)
At 4 weeks	**Grade 0**	26(86.7%)	26(86.7%)
	Grade 1	4(13.3%)	4(13.3%)
	Grade 2	0(0.0%)	0(0.0%)
At 12 weeks	**Grade 0**	27(90.0%)	28(93.3%)
	Grade 1	3(10.0%)	2(6.7%)
	Grade 2	0(0.0%)	0(0.0%)
P		P1=0.082, **P2=0.041*,** P3=0.688	P1=0.353, P2=0.226, P3=0.389

US: ultrasound.

There was a significant improvement of tendon thickness in the 2nd group at 2nd follow-up. Focal echogenicity, bone irregularity or bonny spurs and power Doppler were insignificantly different among both groups before treatment and at first and second follow-up (Table 5).

Table (5): Comparison among both investigated groups based on tendon thickness by US focal echogenicity, bone irregularity or bony spurs and power Doppler at the base line and after first and second follow up

		Group I (number=30)	Group II (number=30)	P
Tendon thickness by US				
At 0 weeks		0.608±0.111	0.625±0.104	0.543
At 4 weeks		0.548±0.086	0.521±0.098	0.269
At 12 weeks		0.512±0.081	0.448±0.087	**0.005***
Focal echogenicity				
At 0 weeks	**Normal**	2(6.7%)	4(13.3%)	0.389
	Focal hypoechoic	28(93.3%)	26(86.7%)	
At 4 weeks	**Normal**	2(6.7%)	5(16.7%)	0.228
	Focal hypoechoic	28(93.3%)	25(83.3%)	
At 12 weeks	**Normal**	2(6.7%)	6(20.0%)	0.129
	Focal hypoechoic	28(93.3%)	24(80.0%)	
Bone irregularity or bony spurs				
At 0 weeks		15(50.0%)	13(43.3%)	0.605
At 4 weeks		15(50.0%)	13(43.3%)	0.605
At 12 weeks		13(43.3%)	13(43.3%)	1.000
Power doppler				
At 0 weeks	**Grade 0**	19(63.3%)	24(80.0%)	0.286
	Grade 1	9(30.0%)	4(13.3%)	
	Grade 2	2(6.7%)	2(6.7%)	
At 4 weeks	**Grade 0**	26(86.7%)	26(86.7%)	1.000
	Grade 1	4(13.3%)	4(13.3%)	
	Grade 2	0(0.0%)	0(0.0%)	
At 12 weeks	**Grade 0**	27(90.0%)	28(93.3%)	0.640
	Grade 1	3(10.0%)	2(6.7%)	
	Grade 2	0(0.0%)	0(0.0%)	

The visual analogue scale, Likert scale and patient-rated tennis elbow evaluation showed a statistically significant difference among both groups at the second follow-up assessment ($P < 0.05$) (Table 6).

Table (6): Comparison among both investigated groups based on percentage of improvement at the second follow up

	Group I (number=30)	Group II (number=30)	P
Percentage of improvement at 12 weeks			
VAS	71.3%	91.7%	**0.020***
Likert scale	80.3%	96.1%	**0.044***
Patient rated tennis Elbow evaluation	31.5%	69.9%	**0.002***
Maudsley' test	93.4%	96.7%	0.554
Cosen' test	96.7%	100%	0.313
Mills' test	93.3%	100%	0.150
Tendon thickness	15.8%	28.3%	0.347
Echogenicity	0.0%	6.7%	0.150
Bone irregularity	6.7%	0.0%	0.150
Power Doppler	26.7%	13.3%	0.197

DISCUSSION

Tennis elbow, also referred to as lateral epicondylitis, is a common musculoskeletal condition impacting approximately one to three percent of adults. The tenderness is located on the lateral epicondyle of the humerus and is accompanied by pain when the wrist is forcibly flexed upwards against resistance [17].

Our results for the VAS, Likert scale, and patient-rated tennis elbow assessment in initial measurements and also at the first and second follow-up evaluations are consistent with **Ismael *et al.*** [18] who also observed a highly significant efficacy of extracorporeal shockwave therapy in addressing pain and functional impairment. Studies conducted by **Maffulli *et al.*** [19] revealed a significant enhancement in visual analogue scale score, PRTEE score, and HGS at three, six, twelve, and twenty-four months during the monitoring periods. Investigations have been carried out to assess the effectiveness of shock wave therapy in managing LE, and documented success rates ranged from 68% to 91% according to **Wang** [10]**.** A systematic review conducted by **Buchbinder *et al.*** [20] discovered clear evidence that ESWT had either a minimal or no influence on pain and functional enhancement in cases experiencing LE.

The varying outcomes of Extracorporeal Shock Wave Therapy on Local Edema may be attributed to alterations in pulse quantity, duration of application, frequency, treatment session timing, and the diverse devices utilised, all of which are dependent on the distinct treatment protocols employed. This is due to a lack of a standardised protocol for ESWT treatment of LE, which becomes apparent upon reviewing the revised literature. **Rompe *et al.*** [21] found statistically insignificant differences among both groups after treatment.

Upon impact of a shock wave on tissue, two distinct physical consequences are observed: The development of cavitation bubbles at the solid-fluid barrier and the short upsurge duration (about 5 nanoseconds) both influence the stress-related phenomena. The short-wave effect is the result of these two activities working together. During the first several hours, ESWT mainly speeds up soft tissue recovery by inhibiting afferent pain receptor activity. Following this initial phase, it facilitates healing over the subsequent days by reducing the production of inflammatory cytokines [22]. Additionally, ESWT stimulates angiogenesis and, by approximately the 28-30th day, it optimizes cellular proliferation and the formation of the extracellular matrix [23]. Haake and colleagues [24] discovered that the efficacy of ESWT was equivalent to a placebo treatment at 12 weeks, with 25.8% and 25.4% success rates respectively. A study by **Yang *et al.*** [25] suggested that ESWT could stimulate fibroblast reactions leading to the gradual healing of cracks in the extensor tendon.

Research has demonstrated that shock waves could decrease calcitonin-related peptide expression in dorsal root ganglia, subsequently alleviating pain [26]**.** Research by **Spacca *et al.*** [27] revealed considerable pain alleviation resulting from shock wave therapy within 12-week follow-up period relative to a placebo. **Collins and Jafarnia** [28] discovered a substantial reduction in pain exacerbation associated with activity following eight weeks of ESWT treatment.

Our study found a notable impact of CS injection to be consistent with **Smidt *et al.*** [29] who pointed out that thirteen research compared the effectiveness of CS injection to other conservative therapies for LE, such as local anaesthetic injections or placebo injections. Comparing CS injections to alternative therapy modalities revealed notable differences in short-term outcomes (six weeks or less) for pain alleviation, general improvement, and hand grip strength. After 2, 4, 8, and 12 weeks of therapy, **Ibrahim *et al.*** [30] discovered that the CS injection group had significantly improved in terms of pain and functional limitation markers such as visual analogue scale, Patient-Rated Tennis Elbow Evaluation, and the Quick DASH test.

Research has investigated the comparative effectiveness of ESWT versus injectable steroids in relation to both pain and functional outcomes. **Beyazal and Devrimsel** [31] found comparable enhancements in all patients from both groups after four weeks of management, and the extracorporeal shock wave therapy group showed superior outcomes at twelve weeks of monitoring, suggesting a superior long-term outcome for extracorporeal shock wave therapy**. Crowther *et al.*** [32] noted a significant decrease in VAS scores, with an 82% reduction in the CS group and a 49% reduction in the extracorporeal shock wave therapy group at 12 weeks post-treatment.

According to **Awori** [33], a preparation that is less soluble in water is more suitable for managing ongoing inflammatory conditions. Extracorporeal shock wave therapy and therapeutic ultrasound were compared by **Lizis** [34] in cases with chronic lupus erythematosus to assess their pain-relieving effects, showing a highly significant drop in VAS scores in the group receiving ESWT compared to those treated with US at both immediate and three-month post-treatment assessments**.** In a study, ESWT was delivered without local anesthesia by **Pettrone and McCall** [35] who discovered that local anesthesia can alter the impact of shockwaves on tissue and also hinder treatment of the most painful area because of its analgesic impact. **Ozturan *et al.*** [36] found that patients receiving corticosteroids showed improved VAS and grip strength scores at 4 weeks, but this improvement was not sustained in later follow-up assessments.

According to the Maudsley, Cozens, and Mills tests, the results showed a substantial improvement in the Maudsley test for both groups at the 1st and 2nd follow-up periods relative to before treatment. Furthermore, there was no notable difference between the 1st and 2nd follow-up measurements in both groups. The Maudsley test demonstrated no significant difference among both

groups prior to treatment and at both the first and second follow-ups**. Lee *et al.*** [37] found that ESWT was considered as effective as injections in management, with its benefits observed up to 8 weeks post-therapy.

Our results on tendon thickness are in line with those of **Clarke *et al.*** [38], who discovered no connection between tendon thickness and clinical outcomes. Similar to this, **Zeisig *et al.*** [39] assessed 25 LE patients who were treated with intertendinous injections, however they did not discover any connection between clinical observations and US results.

CONCLUSION

Lateral epicondylitis was successfully treated with both corticosteroid injections and extracorporeal shock wave therapy. However, after twelve weeks of monitoring extracorporeal shock wave therapy showed a higher improvement on both clinical and ultrasonographic monitoring than corticosteroid injections. Another safe and efficient treatment option for lateral epicondylitis of the elbow is extracorporeal shock wave therapy.

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