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Comparison of the effect of shock-wave therapy and ultrasonic therapy application in the treatment of lateral epicondylitis

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Abstract
Background: Shock-wave therapy (SWT) and Ultrasonic Therapy (UST) are two commonly used methods in the treatment of lateral epicondylitis. In this study, the efficacy of these two methods was compared.
Methods: The study was planned as a pre-post experimental study design. A total of 67 patients were enrolled. The patients were divided into two groups: group 1 received SWT (32 patients) and group 2 received UST (35 patients). Patients in group 1 underwent four sessions of ESWT twice every week. In each session, an SWT device at 10 Hz, 1500 pulses, and 1.8 bar pressure was used. Patients in group 2 used an Ultrasonic Therapy, Pulsed mode 50%, time 10 minutes, frequency 3MHz for 2 weeks. Patients were assessed for handgrip strength, pain at rest, pain while working, and quality of life. Data were collected before and after treatment (at weeks 2). A visual analog scale was used to evaluate pain at rest and while working, subscales of the SF36 Health Survey to evaluate quality of life.
Results: In both SWT and UST groups, although there were considerably significant improvements (P<0.001) in the parameters evaluated (pain at rest and while working, handgrip strength, Patient-Rated Tennis Elbow Evaluation, Nirschl score, and SF36 subscales) were observed at 2 weeks compared to pretreatment values, there was no statistically significant difference between the two groups in terms of our evaluation parameters at the three time points (P<0.05).
Conclusion: Both SWT and UST applications were found to yield significantly superior results when compared to pretreatment values. In comparison of the two groups, on the other hand, there was no statistically significant difference.

Keywords: Lateral epicondylitis, elbow pain, shockwave therapy, ultrasonic therapy, quality of life Abbreviations: UST-Ultrasonic therapy, SWT- Shock Wave Therapy, LE-Lateral Epicondylitis

Introduction

Lateral epicondylitis (LE) is a common disease characterized by decreased grip and upper-extremity strength, along with pain on the outside of the elbow. It is pathology of the musculoskeletal system, secondary to recurrent micro trauma because of over- use of the upper extremity, causing pain and tenderness in the elbow area [1–3]. It is also known as “tennis elbow”, and is observed in 5%–10% of tennis players.4 The annual incidence in the population is 1%–3%,5 with people aged 35–50 years and older being most commonly affected.6,7 Clinically, it is characterized by pain radiating from the lateral aspect of the elbow to the forearm and loss of function because of decrease in grip strength secondary to tenderness and pain at compression in the lateral epicondyle, and it is more frequently seen in the dominant hand [5, 8].

Conservative approaches or surgical therapy can be used in the treatment of LE. The purpose of conservative treatment is to decrease pain, control inflammation, accelerate healing, and ensure that the patient performs daily life activities smoothly. While progressive strengthening is the most commonly used method among conservative treatment methods, other methods include watchful waiting, local injection, ultrasound, manipulation, manual therapy, Cyrax, lateral glide technique, shock-wave therapy (SWT), laser, splinting, resting, hot–cold application, electrotherapy, massage, and oral or topical nonsteroidal anti-inflammatory drugs [9, 10]. Recently, SWT has been used more commonly than other treatment methods, because it is noninvasive, well tolerated by patients, and has fewer side effects [11, 12]. However, the efficacy of SWT in LE is controversial. Some studies have reported that SWT is barely effective or as effective as placebo in LE [13, 14]. However, some other studies have reported that it is quite effective and could even be an alternative to surgery.15,16 Splinting, another conservative treatment method, is one of the most commonly used methods in LE, because it is noninvasive, painless, and easy to apply. Although splints are usually prescribed in LE, their efficacy remains controversial. Ultrasonic Therapy is a pro-inflammatory Therapy which not only reduces the pain but also improves the healing of the inflamed structure. In this study, we planned to evaluate clinical and demographic characteristics, pain, and quality of life in patients with LE receiving SWT and UST and compare the data of two groups.

Methods

The study was a planned pre-post experimental study, and conducted in accordance with the World Medical Association, Declaration of Helsinki, and the International Council for

Harmonisation guidelines for good clinical practice. In addition, participants were informed about the study. Written and verbal consent was received from all participants.In the scope of the study,a total of 67 patients (33 females and 34 males) who had been treated based on a diagnosis of unilateral LE between September 2018 and July 2019 were evaluated. The mean age was 38.84±6.77 years in the SWT group and 37.94±6.45 years in the UST group, and the mean body mass index was 27.21±1.38 in the SWT group and 26.340±2.29 in the UST group.The clinical diagnosis of LE was made with physical examination. In addition, standard anteroposterior and lateral elbow radiographs were obtained. Patients with pain in the lateral elbow, local tenderness to palpation on the lateral epicondyle, pain in the lateral elbow with resisted wrist extension, and patients with positive Mill's test19 results were included in the study. Patients with bilateral LE, carpal tunnel syndrome, cubital tunnel syndrome, previous elbow surgery, previous conservative and surgical treatment for LE, neurological deficits in the upper extremity, systemic disease, other diseases in the neck and shoulder region, lat- eral epicondylar tendon ruptures, tumors in the forearm and elbow, osteoporosis, and hemophilia were excluded from the study. All patients were instructed to avoid taking painkillers during the treatment period. All patients were provided information on the procedures of the study.

Study groups

Patients receiving SWT were designated as group 1 (32 patients) and those receiving UST as group 2 (35 patients). In the SWT group (group 1 – 32 LE), four sessions of SWT were delivered twice per week. In each session, an SWT device (Enraf Nonius Endo-Puls 811; The Netherlands) at Frequency 10 Hz, Power 60 mJ, 1500 pulses, and 1.8 bar pressure was used. Shock waves were radial. Radial shock waves have lower penetration (3 cm), lower effect (0.02–0.06 mJ/mm2), and limited biological effect.20 Radial SWT has been shown to be effective in more superficial musculoskeletal disorders, because of the limited amount of energy, simplicity of use, no need for sedation, and no need for monitoring with radiographic or echographic devices.21 Radial SWT is commonly used in musculoskeletal diseases. The application was performed while the patient was in a sitting position with the shoulder at 45° abduction, elbow flexed, and forearm supported in a supine position. SWT was applied to the most tender spot on the lateral epicondyle and surrounding area. No local anesthetic or analgesic medication was administered before or during application. In the Ultrasound Therapy group (group 2– 35 LE), was given by UST Unit (Medison 2 1/3; Medical Technology, Enraf Nonius, The Netherlands) Power 1 W/cm^2, Pulse 50%, Frequency 3 MHz, for 10 Minutes was applied 5 days/week for 2 weeks. Both groups were given wrist and forearm stretching exercises.

Measurement parameters

Patients were evaluated for pain at rest, pain while working, and quality of life. Evaluation data were collected before and after treatment at 2 weeks. A 10 cm visual analog scale (VAS) was used to evaluate pain at rest and while working (0 indicated no pain and 10 the worst pain). The SF36 Health Survey form was used to evaluate patients' quality of life. The SF36 is composed of 36 items, and the scale contains eight subscales: physical functioning, physical role functioning, bodily pain, general health, vitality, social functioning, emotional role functioning, and mental health. Scores in each subscale range from 0 to 100. Higher scores indicate better quality of life [23]. We used Nirschl scores to assess pain in the affected arm during exercise. Patients were then instructed to mark the most appropriate option indicating the severity of pain during exercise on a Nirschl scale of 1–7 to evaluate pain in the affected arm during exercise. Low scores indicated lower intensity of pain during exercise in the affected arm [26]. Three males and one female in the SWT group and one male in the UST group failed to complete the treatment. These patients were excluded from the study.

Statistical analysis

In the statistical evaluation of our data, SPSS 15.0 for Windows program was used. Quantitative variables are presented as mean ± SD and categorical variables as number and percent- age. Data were tested for normal distribution. The independent *t*-test was used for paired comparisons of normally distributed variables of the SWT and UST groups at week 2. Variables of the SWT and UST groups without normal distribution at 2 week were compared using the Mann–Whitney *U* test. In comparison to the variables of the SWT and UST groups at week 2, analysis of variance was used in repeated measurements. The *X*2-test was used to compare qualitative variables of the groups. Hypoth eses were two-tailed, and $P<0.05$ was considered statistically significant. While the power analysis of the number of subjects we set for randomization was 0.82 for each group (n=41), the power analysis of the number of subjects remaining after exclusion criteria was 0.76 for each group (n=36). In addition, the power analysis of the total number of all subjects taken into the study (n=67) was calculated to be 0.92.

Results

Throughout the study period, no unfavorable condition was observed in the SWT or UST groups. There was no statistically significant difference between the two groups in terms of demographic characteristics or evaluation parameters before treatment (Table 1). In terms of the occupation of the patients in the SWT group, two were unemployed, nine were workers, 12 were office employees, two were retired, and seven were housewives. In the UST group, there were three unemployed, 10 workers, 13 office employees, one retired, and eight housewives. There was no significant difference between the two groups according to the occupational distribution of the patients ($P<0.05$). There was no statistically significant difference in terms of disease duration either (SWT 27.69±7.92, UST 27.49±8.15; $P<0.05$; Table 1).Mean VAS scores for pain at rest and pain while working before treatment in the SWT group were 4.8±1.4 and 7.2±2.6, respectively, whereas mean VAS scores after treatment were 2.2±1.0 and 3.2±1.7 after 2 weeks (54.17% and 55.6% reduction in pain). There were significant increases in PRTEE-T and Nirschl scores, which evaluated function and pain in the affected arm in various daily life activities after week 2 compared to pretreatment values ($P<0.001$). In addition, there were considerably significant improvements in all subscales of the SF36 (general health, physical functioning, physical role functioning, emotional role functioning, social functioning, bodily pain, mental health, and vitality) after week 2 compared to pretreatment values ($P<0.001$; Table 2).

Table 1: Comparison of demographic characteristics between SWT and UST groups

Demographic features	SWT (n□32), mean □ SD/n	UST (n□35), mean □ SD/n	*P*
Age, years	38.84□6.77 (26/56)	37.94□6.45 (27/54)	0.809
Sex, male/female	15/17 (46.87%/53.13%)	19/16 (54.28%/45.72%)	0.544
BMI, kg/m2	27.21□1.38 (24.5/30.1)	26.34□2.29 (22.1/31.5)	0.398
Dominant hand right/left	28/4 (87.5%/12.5%)	30/5 (85.71%/14.29%)	0.830
Disease duration (days)	27.69□7.92 (15–44)	27.49□8.15 (14–44)	0.778
Side of involvement, right/left	24/8 (75%/25%)	27/8 (77.14%/22.86%)	0.837
Occupation			
Unemployed	2 (6.25%)	3 (8.57%)	0.436
Working	9 (28.12%)	10 (28.57%)	0.886
Officer	12 (37.50%)	13 (37.14%)	0.812
Retired	2 (6.25%)	1 (2.85%)	0.312
Housewife	7 (21.87%)	8 (22.85%)	0.737

Abbreviations: SWT, Shock-wave therapy; UST ultrasound therapy; BMI, body-mass index.

Table 2: Results and statistical comparisons of pretreatment (week 0) and posttreatment (after week 2) parameters in SWT group (n□32)

Elbow pain and QOL	Baseline (week 0)	After week 2	*P* (week 0–week 2)
Pain at rest (VAS)	4.8□1.4	2.2□1.0	□0.001
Pain under strain (VAS)	7.2□2.6	3.2□1.7	□0.001
PRTEE-T	60.5□22.3	41.5□18.2	□0.001
Nirschl SF36	5.7□0.9	3.1□0.7	□0.001
GH	60.2□17.1	74.8□21.0	□0.001
PF	54.3□11.5	70.9□13.8	□0.001
RLPR	60.7□25.7	71.0□27.2	□0.001
RLER	59.3□19.7	68.7□22.1	□0.001
SF	59.7□16.6	70.1□23.1	□0.001
BP	54.7□13.4	66.6□16.4	□0.001
MH	55.0□18.1	65.0□22.1	□0.001
V	51.8□14.3	67.6□18.2	□0.001

Abbreviations: SWT, shock-wave therapy; VAS, visual analog scale; PRTEE-T, Patient-Rated Tennis Elbow Evaluation; GH, general health; PF, physical functioning; RLPR, role limitation – physical reasons; RLER, role limitation – emotional reasons; SF, social function, BP, bodily pain; MH, mental health; V, vitality; QOL, quality of life.

Table 3: Results and statistical comparisons of pretreatment (week 0) and posttreatment (after 2 weeks) evaluation parameters in UST group (n□35)

Elbow pain and QOL	Baseline (week 0)	After Week 2	*P* (week 0–week 2)
Pain at rest (VAS)	4.7□1.5	2.1□1.1	□0.001
Pain under strain (VAS)	7.3□2.5	3.3□1.9	□0.001
PRTEE-T	61.3□19.7	43.3□13.1	□0.001
Nirschl SF36	5.8□1.3	3.1□0.8	□0.001
GH	61.5□19.5	76.4□26.4	□0.001
PF	53.3□13.6	69.2□18.1	□0.001
RLPR	58.6□22.6	71.4□27.2	□0.001
RLER	60.9□22.4	69.4□24.4	□0.001
SF	58.9□27.7	70.7□34.1	□0.001
BP	53.7□14.2	67.3□19.6	□0.001
MH	53.6□14.9	68.2□22.1	□0.001

Abbreviations: UST, ultrasound therapy; VAS, visual analog scale; PRTEE-T, Patient-Rated Tennis Elbow Evaluation ; GH, general health; PF, physical functioning; RLPR, role limitation – physical reasons; RLER, role limitation – emotional reasons; SF, social function, BP, bodily pain; MH, mental health; QOL, quality of life.

Elbow pain and QOL	Week 0, SWT (pretreatment)	Week 0, UST (pretreatment)	P	Week 2 UST	Week 2 SWT	P
Pain at rest (VAS)	4.84±1.4	4.74±1.5	0.790	2.1±1.1	2.2□1.0	0.833
Pain under strain (VAS)	7.21±2.6	7.31±2.5	0.496	3.3±1.9	3.2□1.7	0.638
PRTEE-T	60.50±22.3	61.31±19.7	0.855	43.3±13.1	41.5□18.2	0.919
Nirschl	5.75±0.96	5.8±1.3	0.641	3.1±0.8	3.1□0.7	0.907
SF36						
GH	60.28±17.1	61.54±19.5	0.443	76.4±26.4	74.8□21.0	0.178
PF	54.37±11.5	53.28±13.6	0.913	69.2±18.1	70.9□13.8	0.853
RLPR	60.75±25.7	58.57±22.6	0.816	71.4±27.2	71.0□27.2	0.971
RLER	59.32±19.7	60.95±22.4	0.920	69.4±24.4	68.7□22.1	0.866
SF	59.76±16.6	58.92±27.7	0.824	70.7±34.1	70.1□23.1	0.793
BP	54.75±13.4	53.71±14.2	0.643	67.3±19.6	66.6□16.4	0.464
MH	55.06±18.1	53.60±14.9	0.239	68.2±22.1	65.0□22.1	0.173
V	51.87±14.3	48.28±9.6	0.099	69.8±16.2	67.6□18.2	0.201

Abbreviations: SWT, shock-wave therapy; UST; ultrasound therapy; VAS, visual analog scale; PRTEE-T, Patient-Rated Tennis Elbow Evaluation; GH, general health; PF, physical functioning; RLPR, role limitation – physical reasons; RLER, role limitation – emotional reasons; SF, social function, BP, bodily pain; MH, mental health; V, vitality; QOL, quality of life.

Discussion

Several studies have evaluated the efficacy of SWT and UST. However, there has been no study evaluating the efficacy of these two methods comparatively. In our study, we compared the efficacy of these methods. There was no statistically significant difference between demographic and clinical characteristics of patient groups after randomization. The homogeneous distribution of the groups may indicate that results obtained after treatment were highly independent of pretreatment values.

In a systematic review, it was reported that LE was observed equally in males and females, but more frequently in male tennis players than female tennis players.27 In addition, according to the literature, LE is observed in the dominant hand more frequently.8 In our study, numbers of female and male patients were similar to each other (SWT male/female 15/17, UST 19/16). In addition, similarly to Dundar *et al*, [8] we found that LE was seen in the dominant hand more frequently (SWT 24/8, UST 27/8). In the majority of studies on LE, VAS has been used to evaluate pain, and it has been stated that a 1-point change in VAS score might be of clinical significance. In some studies, on the other hand, a 50% reduction in VAS score from baseline was considered significant [28, 29]. In our study, we obtained 2.4–2.9 points of change in VAS scores compared to baseline values and reduction <50% in both SWT and UST groups.

In many studies, the PRTEE scale was used to assess arm disability [31–33]. PRTEE was shown to be an appropriate test in evaluating LE. In our study, we used the PRTEE-T. We obtained statistically significant results in PRTEE scores at 2nd week compared to pretreatment values. Similarly, SF36 subscales have been used to evaluate quality of life in many studies. It has been emphasized that it is an important scale evaluating the quality of life [34–36]. We also used SF36 subscales in our study. We obtained improvements in both SWT and UST groups compared to pretreatment values. We planned a four-session treatment with a similar design to that of Pettrone *et al*. [37] with 1500 pulses per session. Although application interval varies, in our study we applied SWT with 3-day intervals, because generally accepted opinion for sufficient level of effectiveness is applying sessions with 3- to 5 day intervals.38

In the literature, there have been conflicting reports on the efficacy of SWT in the treatment of LE. According to some publications, there is a reduction in pain after SWT application [5, 39, 40] while according to some other studies, strong evidence was provided that SWT has little or no benefit for lateral elbow pain [13, 41–43]. On the other hand, there have been studies advocating that SWT is a treatment method yielding successful results, especially in persistent LE cases [44, 45]. The reason for these conflicting results might be differences in the number of pulses delivered, frequency, duration of application, treatment interval, and different devices used, depending on the different treatment protocols used. This is because when the literature is examined, it is seen that SWT does not have a standard treatment protocol for LE, and different numbers of pulses, frequencies, duration of application, treatment intervals, and device applications are available. in the early period [47]. In our study, we found that UST was as effective as SWT in decreasing pain and improving quality of life. Presently, there is no universally accepted and standardized LE-treatment program. For this reason, we examined the effectiveness of SWT and UST both in themselves and in comparison with each other. Both treatment methods were noninvasive, painless, and easy to apply. In conclusion, we found that SWT and UST were considerably effective in decreasing pain, increasing quality of life, and alleviating arm pain during daily life activities in the treatment of LE. It can be said that SWT and UST are effective conservative treatment options in the treatment of LE. As both methods are comparable in terms of efficacy, when we evaluate SWT and UST in terms of cost-effectiveness and efficacy, UST seems to be slightly more advantageous than SWT, because UST is easy to apply, and does not cause complications. Our study has some limitations. The SF36, PRTEE, and Nirschl questionnaires are patient-reported instruments, and the number of patients in the study was low.

Conclusion

In this study, both SWT & UST are beneficial and equally effective in reducing pain and improving Quality of Life in patients with Lateral Epicondylitis.

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Conflict Of Interest: The present study does not have any conflicts of interest and Author has no issues if data and materials of present study is shared.

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