The Short-term Efficacy of Laser, Brace, and Ultrasound Treatment in Lateral Epicondylitis: A Prospective, Randomized, Controlled Trial

Öznur Öken, MD
Yaşar Kahraman, MD
Figen Ayhan, MD
Sabahat Canpolat, MD
Z. Rezan Yorgancioglu, MD
Ankara Education and Research Hospital, Department of Physical Medicine and Rehabilitation, Division of Hand Rehabilitation, Ankara, Turkey

Ö. Fuad Öken, MD
Ankara Numune Education and Research Hospital, 1st Clinic of Orthopaedics and Traumatology Clinic, Ankara, Turkey

ABSTRACT: The aims of this study were to evaluate the effects of low-level laser therapy (LLLT) and to compare these with the effects of brace or ultrasound (US) treatment in tennis elbow. The study design used was a prospective and randomized, controlled, single-blind trial. Fifty-eight outpatients with lateral epicondylitis (9 men, 49 women) were included in the trial. The patients were divided into three groups: 1) brace group—brace plus exercise, 2) ultrasound group—US plus exercise, and 3) laser group—LLLT plus exercise. Patients in the brace group used a lateral counterforce brace for three weeks, US plus hot pack in the ultrasound group, and laser plus hot pack in the LLLT group. In addition, all patients were given progressive stretching and strengthening exercise programs. Grip strength and pain severity were evaluated with visual analog scale (VAS) at baseline, at the second week of treatment, and at the sixth week of treatment. VAS improved significantly in all groups after the treatment and in the ultrasound and laser groups at the sixth week (p < 0.05). Grip strength of the affected hand increased only in the laser group after treatment, but was not changed at the sixth week. There were no significant differences between the groups on VAS and grip strength at baseline and at follow-up assessments. The results show that, in patients with lateral epicondylitis, a brace has a shorter beneficial effect than US and laser therapy in reducing pain, and that laser therapy is more effective than the brace and US treatment in improving grip strength.


Tennis elbow, or lateral epicondylitis, is an injury related to overuse, which can cause serious long-term disability in both working and nonworking adults. The disorder is characterized by pain and tenderness over the lateral epicondyle of the humerus at its origin of the wrist extensor tendons.1

There are many treatments for lateral epicondylitis including non-steroid anti-inflammatory drugs, splinting, exercises, massage, manual therapy, physiotherapy, local injection therapy, and surgery; the condition has been known to resolve spontaneously within eight to 12 months.2 Recent studies have both supported and found low-level laser therapy (LLLT) to be ineffective in the treatment of lateral epicondylitis.3,4

Therefore, this randomized controlled assessor-blinded trial investigated the effects of LLLT in patients with lateral epicondylitis and compared these results with those of a brace or ultrasound (US) treatment.

METHODS

Participants

The trial included 65 patients (50 women, 15 men; mean age 45.4 ± 8.5 years, range 29–69 years) who attended the Hand Rehabilitation Unit of our hospital (between April and September 2006) due to elbow pain. Patients were diagnosed based on the Southampton examination criteria for lateral epicondylitis5,6; these are 1) pain lasting one day or longer in the last seven days in the lateral elbow region, 2)
tenderness over the lateral elbow region, and 3) pain occurring over the lateral elbow region during resisted active extension of the wrist. In patients who fulfilled the above criteria, X-rays were made of the elbow joint and cervical vertebra to rule out other pathologies of the elbow region or cervical disc pathologies; subsequently, they underwent diagnostic US to make a definite diagnosis of epicondylitis.

Exclusion criteria for our study were bilateral lateral epicondylitis, pregnancy, an implanted pacemaker, systemic metabolic disease (diabetes mellitus, thyroid disease, etc.), chronic inflammatory and neoplastic disease, cervical and shoulder lesions, and treatment with corticosteroid or local anesthetic injection in the previous six months. The trial procedure was explained and written informed consent was obtained from all patients. This study was approved by the local Ethics Committee and was not sponsored by any company or organization.

Design

This was a prospective and assessor-blinded study with a randomized controlled design.

Intervention

Six of the 65 patients were excluded from the study; 2 had bilateral epicondylitis, 1 had received steroid injection(s) during the previous six months, and 3 patients were diabetic. The remaining 59 patients were randomized to receive a brace, US therapy, or LLLT using random-number list.

Patients in the brace group (n = 20) used a bandage for lateral epicondylitis (Orthocare 3125, Turkey) during the daytime for two weeks (Fig. 1).

Patients in the ultrasound group (n = 19) received continuous mode US (Pagani, Italia) at a frequency of 1 MHz and intensity of 1.5 W/cm² for 5 minutes in five days per week for two weeks plus a hot pack on the lateral elbow region, for ten sessions.

Patients in the LLLT group (n = 20) received treatment with low-level laser for 10 minutes in five days per week for two weeks plus a hot pack, for ten sessions. In this study, we used a He-Ne laser with wavelength 632.8 nm and output of 10 mV. Laser was applied to the entire lateral epicondyle using a scanner technique.

One assistant physiatrist preformed the treatment and two physiatrists completed the evaluations. In addition, all patients in the three groups participated in a progressive four-step exercise program aimed at stretching and strengthening. In this program, when a patient was able to perform the exercises without pain, he or she advanced to the next step. The exercises were supervised by the same assistant physiatrist during the first two weeks, then the patients did them at home performing each exercise ten times, three times a day.

Objectives

In the current study, we tested the hypothesis that laser therapy could 1) reduce the elbow pain, 2)

**TABLE 1. The Four-Step Progressive Stretching and Strengthening Exercise Program**

<table>
<thead>
<tr>
<th>Step</th>
<th>Exercise</th>
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| 1    | Clenching fist strongly  
Resisted wrist extension  
Resisted wrist flexion  
Wrist rotation with a stick  
Toward the little finger  
Toward the thumb  
End: stretching at least 30 sec to flexion and extension |
| 2    | Exercises against an elastic band for:  
Wrist extension  
Wrist flexion  
Wrist radial deviation  
Wrist unlar deviation  
End: stretching as in step 1, 10 × 3 repetitions daily |
| 3    | Combined wrist rotatory movements using, for example, a table top as a support  
Upward resisted from below  
Toward the little finger  
Toward the thumb  
Pressing hand against a wall  
End: stretching as in step 2 |
| 4    | An occupational training program including:  
Soft ball compressing exercises  
Transferring buttons from one cup into another  
Twisting a towel into a roll  
Rotating hand on a table in both directions  
End: stretching as in step 2 |
increase grip strength, and 3) prove superior to a brace and US therapy in patients with lateral epicondylitis.

**Outcome Measures**

Hand grip strength, pain severity, and a global assessment of improvement were used as outcome measures. Outcome measures were tested at pretreatment (baseline), at the end of the treatment (second week), and at one month after the treatment (sixth week). The evaluators were blinded to the intervention and worked independently from the clinicians providing the intervention.

**Grip Strength**

We measured grip strength at 90° elbow flexion with a hand dynamometer at level 3 (Jamar, J.A. Preston Co., MI) and used the mean of three measurements.8

**Pain Severity**

Elbow pain lasting at least 24 hours was evaluated using a 10-cm visual analog scale (VAS) (0 = no pain, 10 = the most severe pain).9

**Global Assessment of Improvement**

A six-point scale was used to measure the patient’s global assessment of improvement. The patient was asked to rank the degree of improvement as 1) completely recovered; 2) much improved; 3) slightly improved; 4) not changed; 5) slightly worse; and 6) much worse.7

**Statistical Analysis**

Data were analyzed using SPSS (SPSS Inc., Chicago, IL) version 11.5 for Windows. Differences among groups for age, symptom duration, and grip strength of affected hand were evaluated using one-way analysis of variance (ANOVA). Differences between the three groups in terms of grip strength were analyzed using ANOVAs with repeated measures with a between-subject factor at three levels (the groups: brace, US, LLLT) and a within-subject factor at three levels (the time: pretreatment, second week, and sixth week). Kruskal-Wallis test was used to determine the difference regarding for each visit VAS among groups. The changes within treatment in terms of VAS were evaluated by Friedman test. When the p-value from the Friedman test statistics is statistically significant, Wilcoxon test was used to know which measurement time differ from which others. Chi-square test was applied for categorical comparisons. A p-value less than 0.05 was considered statistically significant.

**RESULTS**

All of the patients finished the study, with the exception of one patient in the ultrasound group; this patient had to leave treatment early because of her son’s illness. A total of 58 patients were completed in the study (9 men, 49 women; mean age 45.3 ± 8.3 years; range 29–69 years). The mean duration of their symptoms was 4.7 ± 5.1 months (range, 1 mo–2 yr). Of the 58 patients, 54 had right-hand dominance and 4 left-hand dominance; the dominant hand was affected in 40 patients.

Demographic and clinical characteristics of the three groups are presented in Table 2. Gender, mean age, symptom duration, baseline VAS, and grip strength of the affected hand did not differ between the groups.

The elbow pain assessed by VAS had improved significantly in all groups at the end of treatment and this improvement continued in the ultrasound and laser group up to the sixth week (p < 0.05). On the contrary, pain increased followed by discontinuing brace at sixth week.

The grip strength of the affected hand had increased only in the laser and ultrasound group at the sixth week.

According to the patient’s global assessment of improvement evaluated on a six-point scale post-treatment, the condition worsened in the brace group and unchanged in ultrasound group from week 2 to week 6, whereas it had improved in the laser group at

| TABLE 2. Characteristics of the Patients in the Three Treatment Groups |
|------------------------|------------------------|------------------------|------|
| **Variable**            | **Brace Group (n = 20)** | **Ultrasound Group (n = 18)** | **Laser Group (n = 20)** | **p** |
| Age (yr)                | 44.5 ± 8.9             | 46.5 ± 8.3             | 45.1 ± 8.2             | 0.767 |
| Gender (women/men)      | 18/2                   | 14/4                   | 17/3                   | 0.581 |
| Symptom duration (mo)   | 3.5 ± 3.4              | 4.3 ± 3.8              | 6.2 ± 7                | 0.240 |
| (minimum-maximum)       | (1-12)                 | (1-12)                 | (1-24)                 |      |
| Affected dominant/nondominant hand | 17/3                | 12/6                  | 11/9                   | 0.118 |
| Visual pain scale       | 8.1 ± 1.3              | 7.8 ± 1.5              | 7.1 ± 1.4              | 0.097 |
| (minimum-maximum)       | (6-10)                 | (5-10)                 | (5-10)                 |      |
| Grip strength of affected hand (kg) | 43.7 ± 16.9         | 48.8 ± 19.8           | 45.8 ± 18.6           | 0.694 |

Values are mean ± standard deviation.
week 6 compared to week 2; however, this difference was not significant.

No significant difference between the groups was observed in terms of mean VAS, grip strength, and global assessment at baseline or follow-up assessments (p > 0.05) (Table 3).

All treatments were well tolerated by all patients and no adverse effects were observed.

**DISCUSSION**

We investigated the effects of laser therapy on pain and grip strength in patients with lateral epicondylitis and compared these results with a brace or US treatment.

In the present study, all groups showed improvements in terms of elbow pain (VAS) scores at week 2. However, bracing only has an effect when used (i.e., the pain scores decreased from baseline to week 2). When the brace was discontinued, the pain returned. US and laser therapy continue to decrease subjective pain reports, even after the actual intervention is discontinued (week 2 to week 6). Lack of a statistical difference between groups at the sixth week was attributed to increasing pain in the brace group. This finding indicates that US and laser therapy have a longer beneficial effect on pain than the use of a brace in patients with lateral epicondylitis.

Although there are a few reviews and meta-analyses regarding conservative treatment of lateral epicondylitis, there is still insufficient evidence regarding the management of lateral epicondylitis. It is difficult to compare our results with earlier studies, because no trials have compared a brace, LLLT, and US therapy in a similar setup to ours. US alone or in combination with other treatments has been found effective in reducing pain.

Strujs et al. compared the same type of brace we used with physical therapy consisting of US, friction massage and exercise, or combination therapy (brace plus physical therapy). They found that only physical therapy was superior for pain, disability, and satisfaction on the short term, whereas only brace treatment was superior for problems during activities of daily living. However, combination therapy had no superior effect compared to physical therapy alone, but was superior to the brace on the short term. At the end of their study, Strujs et al. concluded that a brace can be considered as initial and supportive treatment. The main difference between the trial of Strujs et al. and the present study is that we used continuous US.

Holdworth and Anderson reported that hydrocortisone phonophoresis and brace treatment significantly decreased resting pain compared to conventional US in patients with lateral epicondylitis.

A review by Trudel et al. inspected the short-term effects of US in reducing pain on lateral epicondyle. In another trial, continuous US therapy resulted in greater pain reduction compared with the placebo US and rest at three months, but offered no advantages over placebo US on pain, grip strength, and global improvement.

Progressive strengthening and stretching programs have been shown to significantly reduce pain. However, the effect on grip strength does remain controversial, with some studies reporting improvement and others documenting no change. Svendlov and Adolfssson reported progressive strengthening and stretching programs resulted in a significant reduction in pain and an increase in grip strength in their lateral epicondylitis patients. On the other hand, a trial comparing a six- to eight-week stretching exercise program with isometric and isotonic exercises combined with US showed that the exercises may improve pain in lateral epicondylitis but do not improve maximum grip strength. Although exercise was not an independent variable in our study, the inclusion of a stretching and strengthening program may have contributed to the lack of significant differences between our interventions.

Although, there is general agreement that LLLT is not effective in improving pain, grip strength, and global improvement on the short term in lateral epicondylitis, we found that laser and US significantly decreased pain from baseline to a period six weeks later. In addition, laser significantly increased grip strength, from baseline to reevaluation.
two and six weeks later. When the interventions were compared, however, there was no statistical difference in outcome measures for any of the treatment interventions.

However, none of these latter trials used a He-Ne laser with a wavelength of 632.8 nm as was used in our study.

Limitations of the Study

The limitations of the current study are the relatively small study population, the lack of long-term follow-up results, and the fact that we did not evaluate the activities of daily living. Another limitation of the study may be the addition of the exercise to interventions. Improvement in pain and grip strength may be due to the stretching and strengthening exercises alone.

Conclusions

There are conflicting results regarding the treatment of lateral epicondylitis. Our results show that bracing is less effective than US and laser therapy in reducing pain, and that LLLT increases grip strength but is not superior in terms of improving pain and grip strength compared with the other two methods used to treat lateral epicondylitis.

Additional studies are needed to determine the long-term effects of laser therapy in lateral epicondylitis.

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REFERENCES

Record your answers on the Return Answer Form found on the tear-out coupon at the back of this issue. There is only one best answer for each question.

#1. This study used a _____________ design
   a. randomized, retrospective
   b. linear, prospective
   c. randomized, prospective
   d. linear, retrospective

#2. Outcomes measures included
   a. pain and grip
   b. pain and function
   c. grip and function
   d. pain, grip, and ROM

#3. The results indicated that
   a. bracing had a greater effect in improving grip than laser
   b. bracing had a greater effect in improving grip than US
   c. bracing had a longer duration effect in reducing pain than US and laser
   d. bracing had a shorter duration effect in reducing pain than US and laser

#4. The type of brace studied was
   a. a static wrist extension splint
   b. an elbow flexion block splint
   c. a counter force brace
   d. a modified sugar long splint

#5. The authors cite prior studies that suggest that
   a. LLLT is effective in treating lateral epicondylitis
   b. LLLT is ineffective in treating lateral epicondylitis
   c. LLLT is contraindicated in treating lateral epicondylitis
   d. LLLT is approved for use in Turkey but not approved in the US

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