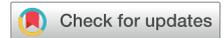




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Practice Forum

Design and construction of a tennis elbow brace with light-emitting diode in subjects with lateral epicondylitis



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Individuals with tennis elbow often experience pain and difficulty with functional activities. Thus, designing orthotics to improve function and decrease pain is common practice. These therapists designed an orthosis using a combination of a tennis elbow brace and light therapy. Therapists in the US need to take into consideration that this is not an FDA-approved device before applying the device to a patient. — KRISTIN VALDES OTD, OT, CHT, Practice Forum Editor, Journal of Hand Therapy

Introduction

Lateral epicondylalgia or tennis elbow (TE) is a common disorder that affects between 1% and 3% of the population.¹ This type of injury occurs most often between the third and sixth decades of life.² TE is associated with pain and tenderness on the lateral epicondyle, with a reduction in grip force.³ The pain is aggravated by resisted wrist extension⁴ and also by heavy-duty hand function during work-related, sporting, and daily activities.⁵

Overuse of the extensor tendon causes microtears in the origin of the common wrist extensor and extensor carpi radialis brevis and degeneration of the associated collagen.⁶ Excessive loading of the common extensor origin,⁴ the area where the maximum tensile forces occur during wrist movements, is considered an underlying cause.⁷ Decreasing forces on the origin of the extensor carpi radialis brevis is perceived to be the general principle of treatment for lateral epicondylitis.⁸ Rest, injection therapy, physical therapy, nonsteroidal anti-inflammatory drugs, shock wave therapy, orthotic treatment, ultrasound, and surgery⁹ are the treatment options for TE.

Orthoses prescribed for treatment of the TE include wrist-hand orthoses and forearm straps.^{10,11} The mechanism of action in this type of intervention is related to its effects on the restriction of forearm movement or relief of loads on the origin of the extensor muscles. Previous studies in this field have demonstrated that low-level laser therapy (LLLT) is safe and effective.¹² Mechanism of action in using

LLLT is based on the biological mechanisms which modulate both tendon inflammation and tendon repair processes.¹² Low-level laser has been used for the treatment of TE with contradictory results.^{13–18} Analysis of studies in this field that evaluated the effect of LLLT demonstrates that there is no evidence of superiority of this type of intervention over others. In addition, LLLT must not be used alone in the treatment of TE. The LLLT should be used in combination with other types of treatment approaches in improvement of TE symptoms.

The concept of the new device described in this study was based on the combination of the low-level laser and TE strap. The reason for the design and development of a new orthosis in this present study was therefore to identify the best orthotic treatment option in this field. The purpose of this study was to design and construct a new device to treat symptoms of TE and to improve grip strength, decrease pain, and improve function in subjects with TE.

Materials

- TE brace
- Light-emitting diode (LED) with a frequency of 940 nm (2 pairs)
- Charger
- Battery
- Switch

Fabrication steps

1. Four LEDs with 940-nm frequency and 0.5-W power are closed to each other in parallel, which together produce 2 W.
2. A circuit is closed with a switch and a battery.
3. The circuit (Fig. 1)

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	<p>materials:</p> <ol style="list-style-type: none"> 1- tennis elbow brace 2- multimeter 3- rechargeable battery 1.2 volt 4- male/female screw jack 5- infrared LED 0.5 watt power 6- solder wire 7- Soldering System 8- Lining
	<p>construction:</p> <ol style="list-style-type: none"> 1- create four holes in tennis elbow brace pad
	<ol style="list-style-type: none"> 2- close two LED series (positive pole of first LED close to negative pole of another LED)
	<ol style="list-style-type: none"> 3- close two other LED as stage 2
	<ol style="list-style-type: none"> 4- close LEDs in stage 2 and 3 parallelly (close homonymous pole)
	<ol style="list-style-type: none"> 5- close battery to circuit
	<ol style="list-style-type: none"> 6- evaluate potential difference of each LED (each LED shows 1.2 volt potential difference.)
	<ol style="list-style-type: none"> 7- evaluate potential difference of total circuit (battery create 2.5 volt propulsion)
	<ol style="list-style-type: none"> 8- adjust multimeter on electricity flow and measure total circuit flow (there is 161 milliampere here) 9- total circuit power is calculated by $161 * 2.5 = 4.2$ (there is 4.2 milliwatt power)
	<ol style="list-style-type: none"> 10- close circuit to brace

Fig. 1. Fabrication steps of a tennis elbow brace with light-emitting diode in subjects with lateral epicondylitis.

Use of the TE brace with LED for inflammation reduction

Laser therapy has been studied and recommended for use in rehabilitation because strong evidence suggests that this kind of energy facilitates tissue healing. Existing evidence suggests that light and LED can be effective at cellular and subcellular levels, including stimulating adenosine triphosphate and RNA production and altering the synthesis of cytokines involved in inflammation. This effect not only decreases inflammation and pain but also improves function. Therefore, using a TE brace with LED can increase the recovery manifold.

Clinical example

This orthotic design was first utilized on a 35-year-old woman referred to our orthotics clinic. She reported unilateral elbow pain over the lateral epicondyle for longer than 6 weeks and pain aggravated by at least 2 times by gripping and palpation. Clinical evaluation of the patient demonstrated resisted wrist or middle finger extension or stretching of forearm extensor muscles. The participant voluntarily signed the informed consent form. The study procedure was approved by the Ethics Committee of the University of University of Social Welfare and Rehabilitation Sciences.

The custom-made neoprene TE orthosis with compression pad was fabricated for the patient. She received the modified elbow brace wrapped around 5 cm below the lateral epicondyle, maintaining a pressure of 40 mm Hg. She wore the orthosis while performing her daily activities. She was advised to wear the orthotic device as much as possible (for 2 weeks) during most of the daily activities at home and work place.

A decrease in pain, from 7 to 3 based on measurement by visual analog scale, was observed after treatment with the orthosis. After 6 weeks of using the orthosis, improvement in grip strength (from 7.6 to 9.1 kgf), pinch strength (from 4.1 to 5.6 kgf), and function (from 47 to 65), measured by the Jamar Hydraulic Hand Dynamometer, Jamar Hydraulic Pinch Gauge, and the Michigan Hand Outcomes Questionnaire, respectively, was observed.

Summary

The purpose of this present study was to introduce a new-design TE orthosis equipped with light therapy to reduce disability due to lateral epicondylitis and improve function. Providing a comfortable orthosis is important in treatment and rehabilitation of patients with

TE. There is no evidence of use of this kind of orthosis in patients with lateral epicondylitis. A randomized clinical trial that uses this orthosis may be helpful in generating clinical evidence in this field.

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- # 1. The most commonly involved structure in elbow lateral epicondylitis is the
- FCR
 - EDC
 - ECRB
 - ECRL
- # 2. The LLLT circuitry is embedded into a
- conventional tennis elbow strap device
 - thermoplastic tennis elbow orthotic device
 - custom made soft tennis elbow strap device
 - lateral elbow stabilizing orthotic device
- # 3. To fabricate the circuitry requires
- a CHT
 - an electrician's license in all US states, except California and Washington D.C.
 - 36 hours of supervised training
 - at least rudimentary soldering skill
- # 4. The authors recommend using the device
- only at night
 - to the exclusion of other accepted interventions in managing LE
 - in conjunction with other accepted interventions in managing LE
 - under the direct supervision of a licensed orthotist
- # 5. It is important for therapists to understand that the method described is not FDA approved for clinical application in the US
- false
 - true

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