

## Brief Report

# The Use of Polarized Polychromatic Non-coherent Light as Therapy for Acute Tennis Elbow/ Lateral Epicondylalgia: A Pilot Study

DIMITRIOS STASINOPOULOS, P.T., M.S.

### ABSTRACT

**Objective:** The aim of this study was to assess the efficacy of polarized, polychromatic, non-coherent, low-energy light (Bioptron 2, Bioptron AG, Switzerland) in the treatment of acute tennis elbow. **Background:** Tennis elbow, or lateral epicondylitis, is one of the most common lesions affecting the arm. A plethora of treatment regimes have been described for this condition, but no specific therapy has emerged as a gold standard. **Methods:** A pilot study was carried out with 25 patients who had acute tennis elbow. Bioptron 2 device was applied over lateral epicondyle three times per week for 4 weeks. Pain on VAS, function on VAS, and pain-free grip strength were measured at the beginning (week 0) and at the end of the study (week 4). **Results:** The pain on VAS was reduced at the end of treatment ( $t_{24} = 3.84, p = 0.001$ ). Function on VAS was increased at the end of treatment ( $t_{24} = 4.23, p < 0.001$ ). Pain-free grip strength was increased at the end of treatment ( $t_{24} = 4.23, p < 0.004$ ). **Conclusion:** Although the results suggested that the Bioptron 2 could reduce patients' symptoms with acute tennis elbow, future controlled studies are needed to establish the relative and absolute effectiveness of Bioptron 2.

### INTRODUCTION

TENNIS ELBOW (TE), or lateral epicondylitis or lateral epicondylalgia, is one of the most frequent lesions of the arm. TE was defined as pain on the lateral epicondyle, reproduced by digital palpation on the above site, resisted wrist extension and resisted middle finger extension with the elbow in extension, and gripping.<sup>1</sup> It is generally a work-related or sport-related pain disorder of the common extensor origin of the arm, usually caused by excessive quick, repetitive movements of the arm.<sup>2</sup> The etiology of this condition is mechanical, with macroscopic and microscopic tears in the proximal musculotendinous structures of the extensor tendons of the wrist with or without inflammatory changes in these structures.<sup>3</sup> The extensor carpi radialis brevis (ECRB) is the most common affected structure in TE.<sup>4</sup>

A myriad of conservative therapies have been employed by the medical staff to treat TE. Over 40 different methods for treating lateral epicondylitis have been reported in the literature.<sup>5</sup>

Although these treatments had different theoretical mechanism of action, all had the same effects, to reduce pain and improve function. Therefore, such a variety of treatment options suggest that the optimal treatment strategy is not known, and more research is needed to find out the most effective treatment in patients with TE.

Laser light has been promoted for more than two decades as a treatment modality for a variety of conditions, including tennis elbow. It has been suggested that laser beams cause bio-stimulation, a photochemical response to laser light, inducing biochemical alterations in cells.<sup>6</sup> The biostimulating effect of laser treatment conveys anti-inflammatory, analgesic, and anti-edematous effects on tissues and could be the basis for wound healing.<sup>7</sup> Although laser is often used for the treatment of tennis elbow, the majority of published studies have shown that this is an ineffective intervention in the therapy of tennis elbow.<sup>3,8-10,12-14</sup> Only two studies found positive effects of laser,<sup>11,15</sup> but the authors of studies concluded that as a sole treatment for tennis elbow lasers are of limited value. However, laser light cannot be excluded from

TABLE 1. MANUFACTURER'S EXPLANATION OF HOW BIOPTRON'S LIGHT WORKS

**Polarized**

Its waves move on parallel planes. In this device, polarization reaches a degree of approximately 95%.

**Polychromy**

Polychromatic light contains not just one wavelength (like laser light), but also a wide range, including visible light and a part of infrared range. The wavelength of this device's light ranges from 480 to 3400 nm. This electromagnetic spectrum does not contain ultraviolet radiation.

**Incoherency**

In contrast to laser light, this device's light is incoherent or out-of-phase light. This means the light waves are not synchronized.

**Low energy**

This device light has a low-energy density (Fluence), which has biostimulative effects. This means the light can simulate various biological processes in the body in a positive way.

Source: [www.bioptron.com/characteristics/index.php](http://www.bioptron.com/characteristics/index.php).

research, as a close-response modality, and the optimal treatment dosages for the management of LE and for other musculoskeletal conditions have not yet been discovered.<sup>16</sup>

This pilot study aimed to assess the effects of polarized, polychromatic, non-coherent, low-energy light (Biopteron 2, Biopteron AG, Switzerland) in the treatment of acute (duration less than 6 weeks) tennis elbow. The polarized polychromatic non-coherent light will be referred to as Biopteron light. The manufacturer's explanation of how Biopteron's light works is given in Table 1.

## MATERIALS AND METHODS

### Subjects/participants

Twenty-five patients (men and women) suffering from lateral elbow pain were examined and evaluated by a doctor in our clinic (Rheumatology and Rehabilitation Centre) between June and December 2002 (a period of 6 months). The patients were either self-referred or referred by their physician or physiotherapist. Patients with clinically diagnosed acute (duration of symptoms less than 6 weeks) unilateral epicondylitis or tennis elbow (TE) with pathology at the origin of the extensor carpi radialis brevis (ECRB), the most common site of pain in patients with TE, took part in this study. The inclusion criteria were as follows:

1. Pain with palpation on the anterolateral aspect (facet) of the lateral epicondyle of the elbow.
2. Pain with resisted wrist extension, with the elbow in full extension and the fingers flexed.
3. Pain with resisted middle finger extension with the elbow in extension and the wrist in neutral position.
4. Pain with passive flexion of the wrist with the elbow in extended position.
5. Pain with gripping activities.
6. The age of the patients will be between 30 and 50, because TE is a common condition in this range of age.

The exclusion criteria were cubital osteoarthritis, carpal or radial-tunnel syndrome, rheumatoid arthritis, severe cervical spondylosis or cervical radicular syndrome, painful shoulder or rotator cuff tendinitis, previous fractures of arm causing limitations in arm functions, neurological abnormality, bi-lateral

lateral epicondylitis, and whether the patients had received other treatment regimes before entering the study.

### Apparatus

The Biopteron light is a non-invasive optical device, with patented technology based on the biostimulative effects of polarized, non-coherent light in the visible and infrared spectrum. It is a product from Harrier Inc., USA, created in Switzerland. The Biopteron 2 is dividable into minutes-steps and controlled by an integrated soft-start/soft-stop electronic switch. When the treatment is over, there is a characteristic sound (beep tone). The technical data of Biopteron 2 according to Biopteron light therapy booklet are as follows:

- Power supply: 100–240 V, 50/60 Hz
- Power consumption: 1.4–1.0 A
- Fuse: 12A/250V
- Rated power of halogen: 90 W
- Wavelength: 480–3400 nm
- Degree of polarization: 95%
- Specific power density: 40 mW/cm<sup>2</sup>
- Energy density: 2.4 J/cm<sup>2</sup>

The Biopteron light therapy booklet says that the effects of the Biopteron light will be reduced if the following occurs:

1. It is not applied to bare skin.
2. It is held at an operating distance more than 10 cm. The appropriate distance is 5–10 cm.
3. It is not held at 90° from the skin. For the greater penetration depth, the device should be perpendicular to the area.
4. The light and skin should not be steady.
5. The irradiation time is less than 6 min. The appropriate irradiation time is 6 min. Irradiation time more than 6 min is a waste of time without better results.
6. The period of treatment is less than three times per week in acute conditions.

### Procedure/protocol

All patients received Biopteron light three times per week for 4 weeks. The lateral condyle was bare, steady, and exposed to the light at an operating distance of 5–10 cm. Two positions were used:

- a. Vertically from the upper surface (anterior) with the elbow in extension and the forearm in supination
- b. Vertically from the lateral surface with the elbow in 90° of flexion and the forearm in pronation

The application time in each of the above positions was 6 min (12 min in all).

The study was approved by the manager of the clinic. The subjects gave signed informed consent. Patients were able to drop out from the study at any stage and without reason. Moreover, subjects could not participate in the study if they felt that this was dangerous.

In addition to the intervention described above, all patients were asked to avoid activities that irritate the elbow and to refrain from taking anti-inflammatory medication during the course of study.

The patients participating in the study were not allowed to receive any other treatment with respect to TE during the course of study. If the treatment was unsuccessful, patients were offered an alternative form of treatment for their condition after week 4, and the rate of patient dropout at week 4 would be used as an outcome measure. Treatment was considered unsuccessful if the patient still had moderate or severe symptoms and was unsatisfied with the outcome.

#### Outcome measures

Each patient was evaluated at the beginning of the treatment (i.e., baseline pre-treatment recording at week zero), and again at the end of the 4-week course of treatments (week 4). Patients' evaluations were measured independently by another physiotherapist, who was blind to the patients' therapy group and who did not treat patients at all.

Pain and function are commonly measured in patients with TE. The researcher in this trial assessed these two. Function was measured by visual analogue scale (VAS) and pain-free grip strength (PFGS). Pain was measured by visual analogue scale (VAS).

A visual analogue scale (VAS) for function was used to ascertain the patients overall level of elbow function in the past 24 h. This function VAS consisted of an 11-point numerical rating scale, in which 0 means no function and 10 means full function. This measure has demonstrated validity and reliability in patients with lateral epicondylitis.<sup>17,18</sup>

Pain-free grip strength (PFGS) is a valid and sensitive measurement to detect changes exhibited in subjects with lateral epicondylitis. This was measured by the JAMAR hand dynamometer, with the upper limb placed by the subject's side in a standardized position of elbow extension and internal rotation of the upper limb such that the palmar aspect of the hand faced posteriorly. The subject was informed to stop squeezing the adjustable dynamometer handles when the pain was first provoked. Three measures of pain-free grip strength were recorded with a 30-sec rest interval between each measurement. This measure of function has been shown to be the most valid measure of improvement in patients with TE.<sup>17,18</sup>

A visual analogue scale (VAS) for pain was also used to measure the patient's worst level of pain over the previous 24 h. This pain VAS consisted of an 11-point numerical rating scale, in which 0 means no pain and 10 means very severe pain. This

measure has demonstrated validity and reliability in patients with lateral epicondylitis.<sup>17,18</sup>

#### Analysis

Paired *t* test was used to analyze the results. A two-tailed test with alpha at 0.05 was conducted.

## RESULTS

All 25 patients completed the study, and there were no adverse effects or complications reported during or after the experimental sessions.

The group consisted of 19 women and six men with an average age of 43.1 years (range, 30–50 years) and an average duration of symptoms of 16 days (range, 1–42 days). The cause of tennis elbow was manual work or housework. None of the patients had received any treatment previously.

Statistically significant decrease in pain as measured by the VAS was present in the group from the beginning to the end of treatment ( $t_{24} = 3.84$ ,  $p = 0.001$ ). Significant improvements in grip strength on the affected side were seen in the group from the beginning to the end of treatment ( $t_{24} = 4.23$ ,  $p < 0.001$ ). A decrease on function VAS was noticed throughout the study in the group and this was statistically significant ( $t_{24} = 4.23$ ,  $p < 0.004$ ).

## DISCUSSION

Tennis elbow, or lateral epicondylitis, is one of the most common lesions affecting the arm. A plethora of treatment regimes have been described for this condition. One of these treatments is the laser, but the results showed that laser is an ineffective treatment in the management of tennis elbow. This pilot study assessed the effectiveness of Biopton light in the treatment of acute tennis elbow, showing that this could reduce patients' symptoms with acute lateral epicondylitis.

Like laser therapy, Biopton is also a low-power light sources, but differ from it in that it is polychromatic and incoherent rather than monochromatic and coherent. Moreover, Biopton combines visible light at a wavelength of 480–700 nm and infrared light at a wavelength of 700–3400 nm. In contrast, low power laser contains either visible or infrared light at one specific wavelength.

The mechanism of action of Biopton light is unknown. Probably, Biopton light accelerates the cellular mechanisms and improves the blood supply, but research is needed to investigate how biopton light works.

The researcher did not perform a power analysis in order to determine an adequate sample size, but research has showed that a sample size of twenty-five subjects was sufficient to demonstrate statistical significance of all outcome measures.<sup>19</sup> The results of this pilot study cannot be generalised due to the fact that the one group pretest-post test design is an uncontrolled, quasi-experimental design and therefore susceptible to threats to internal validity.<sup>20</sup> Research is needed to establish the absolute and relative effectiveness of Biopton

light with long term follow up for patients with acute tennis elbow. In addition, the efficacy of Bioptron can be investigated in chronic tennis elbow.

## CONCLUSION

This study showed that polychromatic polarized light therapy, applied as monotherapy, reduced patients' symptoms with acute tennis elbow. However, a well-designed randomized controlled study conducted by a multidisciplinary team is necessary to confirm the efficacy of this form of phototherapy in patients with acute tennis elbow and to objectively evaluate recommendations for its routine use in clinical practice.

## REFERENCES

- Haker, E. (1993). Lateral epicondylalgia: diagnosis, treatment and evaluation. *Crit. Rev. Phys. Rehabil. Med.* 5, 129-154.
- Pienimaki, T., Tarvainen, T., Siira, P., et al. (1996). Progressive strengthening and stretching exercises and ultrasound for chronic lateral epicondylitis. *Physiotherapy* 82, 522-530.
- Vasseljen, O. (1992). Low-level laser versus traditional physiotherapy in the treatment of tennis elbow. *Physiotherapy* 78, 329-334.
- Noteboom, T., Cruver, S., Keller, A., et al. (1994). Tennis elbow: a review. *JOSPT* 19, 357-366.
- Kamien, M. (1990). A rational management of tennis elbow. *Sports Med.* 9, 173-191.
- Mester, E., Spiry, T., Szende, G., et al. (1971). Effect of laser rays on wound healing. *Am. J. Surg.* 122, 532.
- Mester, E., Mester, F., and Mester A. (1985). The biomedical effects of laser application. *Laser Surg. Med.* 5, 31-39.
- Basford, J., Sheffield, C., and Cieslac, K. (2000). Laser therapy: a randomized controlled trial of the effects of low intensity Nd:YAG laser irradiation on lateral epicondylitis. *Arch. Phys. Med. Rehabil.* 81, 1504-1510.
- Haker, E., and Lundeberg, T. (1990). Laser treatment applied to acupuncture points in lateral humeral epicondylalgia. A double-blind study. *Pain* 43, 243-247.
- Haker, E., and Lundeberg, T. (1991). Lateral epicondylalgia: report of Noneffective Midlaser treatment. *Arch. Phys. Med. Rehabil.* 72, 984-988.
- Haker, E., and Lundeberg, T. (1991). Is low-energy laser treatment effective in lateral epicondylalgia? *J. Pain Symptom Manage.* 6, 241-246.
- Krashennikoff, M., Ellitsgaard, B., Rogvi-Hansen, B., et al. (1994). No effect of low-power laser in lateral epicondylitis. *Scand. J. Rheumatol.* 20, 260-263.
- Mulcahy, D., McCormack, D., McElwain, J., et al. (1995). Low-level laser therapy: a prospective double-blind trial of its use in an orthopaedic population. *Injury* 26, 315-317.
- Papadopoulos, E., Smith, R., Cawley, M., et al. (1996). Low-level laser therapy does not aid the management of tennis elbow. *Clin. Rehabil.* 10, 9-11.
- Vasseljen, O., Hoeg, N., Kjeldstad, B., et al. (1992). Low-level laser versus placebo in the treatment of tennis elbow. *Scand. J. Rehabil. Med.* 24, 37-42.
- Stasinopoulos, D., and Johnson, M. Effectiveness of laser in tennis elbow: a review. *Photomed Laser Surg* (submitted for publication).
- Stratford, P., Levy, D., Gaultie, S., et al. (1987). Extensor carpi radialis tendonitis: a validation of selected outcome measures. *Physiother. Can.* 39, 250-255.
- Stratford, P., Levy, D., and Gowland, C. (1993). Evaluative properties of measures used to assess patients with lateral epicondylitis at the elbow. *Physiother. Can.* 41, 93-99.
- Paugmali, A., Vicenzino, B., and Smith, M. (2003). Hypoalgesia induced by elbow manipulation in lateral epicondylalgia does not exhibit tolerance. *J. Pain* 4, 448-454.
- Abbott, J., Patla, C., and Jensen, R. (2001). The initial effects of an elbow mobilization with movement technique on grip strength in subjects with lateral epicondylalgia. *Manual Ther.* 6, 163-169.

Address reprint requests to:

*Stasinopoulos Dimitrios, P.T., M.S., PGCRM*

*Rheumatology and Rehabilitation Centre*

*Orfanidou 16, Patissia*

*Athens 11141, Greece*

*E-mail: d\_stasinopoulos@yahoo.gr*