

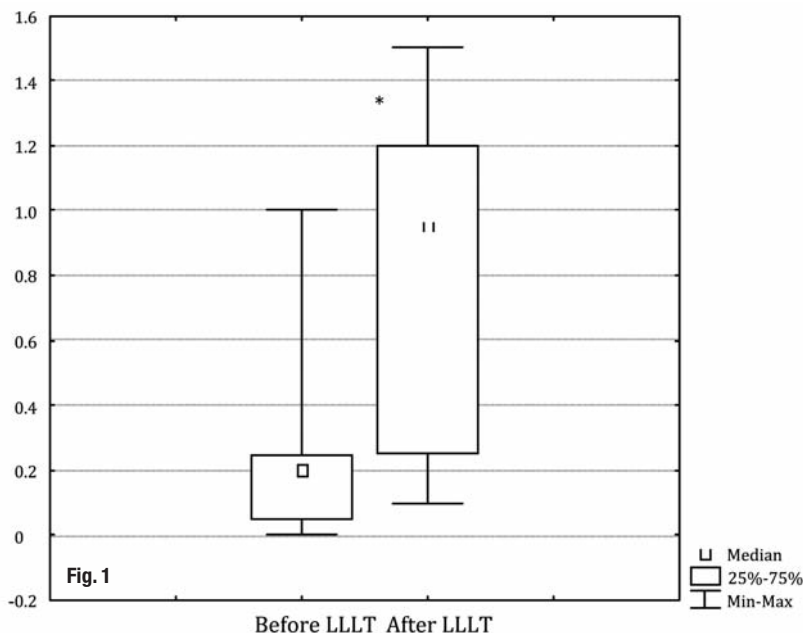
Salivary flow rate before and after low level laser therapy

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_Introduction

The therapy performed with lasers is often called low level laser therapy (LLLT) or just laser therapy. Several other names have been given to these lasers, such as soft laser and low intensity level laser whereas the therapy has been referred to as bio-stimulation. Low level laser therapy is a non-invasive, painless and athermal therapy, based on biological stimulative-regenerative, anti-inflammatory and analgesic effects. LLLT also appears to have a virustatic and bacteriostatic effect. Some explanation of analgesic effect of LLLT are: it increases ATP production, improves local microcirculation, increases lymphatic flow, increased serotonin and endorphins, increased anti-inflammatory effects through reduced prostaglandin synthesis.¹

Fig. 1 Salivary flow rate before and after LLLT. * Denotes significant difference between groups $P < 0.001$. LLLT—low level laser therapy.



In vitro data suggest that LLLT facilitates collagen synthesis, keratinocyte cell motility, and growth factor release and transforms fibroblasts to myofibroblasts.¹⁻⁴

Low level laser light is compressed light of a wavelength from the cold, red part of the spectrum of electromagnetic radiation. It is different from natural light in that it is one precise color; it is coherent, monochromatic and polarized. These properties allow laser light to penetrate the surface of the skin or mucosa with no heating effect and no damage. The most commercially available lasers are the helium-neon (He-Ne), emitting wavelengths of 632.8 nm, and the semiconductor diodes, such as gallium-arsenide (GaAs) and gallium-aluminum-arsenide (GaAlAs), emitting wavelengths of 650 and 830 nm, respectively.⁵

LLLT has also been used to stimulate bone formation by increasing osteoblastic activity, vascularization, organization of collagenous fibers and ATP levels.⁵

In recent studies, many authors have reported significant pain reduction with LLLT in acute and chronic musculoskeletal pain and also many authors have reported significant pain and symptoms of inflammation reduction with LLLT in radiotherapy-induced oral mucositis and xerostomia in oral cancer patients, and severe pain in patients submitted to hematopoietic stem cell transplantation.^{6,7}

In our previous research we investigated therapeutic response by determining the level of proinflammatory cytokines TNF-alpha and IL-6 in whole unstimulated saliva in patients with denture stomatitis before and after LLLT.⁷

Xerostomia is frequently associated with decrease in the flow rate of saliva. The measurement of salivary flow is basic to understanding of the process of secretion and to our assesment of conditions and disease which lead to salivary hypofunction.⁸ Xerostomia is not a disease, but it may be a symptom of various medical conditions, a side effect of a radiation to the head and neck, or a side effect of a wide variety of medications. It may or may not be associated with decreased salivary gland function. Xerostomia is often a contributing factor for both minor and serious health problems. It can affect nutrition and dental, as well as psychological, health. Some common problems associated with xerostomia include a constant sore throat, burning sensation, difficulty speaking and swallowing, hoarseness and/or dry nasal passages.⁹ The management of xerostomia will include the identification of the underlying cause. For many patients little can be done to alter the underlying cause. For those whose xerostomia is related to medication use, effective symptomatic treatment may be important to maintain compliance with their medication regime. Symptomatic treatment typically includes four areas: increasing existing saliva flow, replacing lost secretions, control of dental caries and specific measures such as treatment of infections.¹⁰

Some investigators had effect of LLLT on mucositis and temporomandibular joint dysfunction.^{11,12} LLLT may also have an effect on salivary glands so it is important to know the effects of this therapy on parotid and submandibular gland tissues.

The aim of this study was to investigate is it LLLT able to increase salivary flow rate.

_Materials and methods

A sample consisting of 20 consecutive subjects were selected on a voluntary basis from patients who presented for diagnosis and treatment of xerostomia at the Oral Medicine Unit of the Medical Faculty University of Rijeka. All subjects were in-

formed of the aims and procedures of the research, as well as of the fact that their medical data would be later used in the analysis. The Ethics Committee of Medical Faculty of Rijeka (University of Rijeka) approved this study protocol. Only those subjects who have given a written permission in form of an informed consent were included. Each subject completed a questionnaire for demographic and health information.

The clinical examination was performed according to the standard clinical criteria. We mesured the whole saliva.

After initial evaluation and diagnosis, the patients were divided in two groups:

Group 1: before receiving LLLT

Group 2: after receiving LLLT

Xerostomia may be diagnosed with the aid of salivary collection tests (sialometry). Salivary flow rate should be measured by standardized techniques. As salivary secretion fluctuates between minimal and maximal rates during the day, it is important to assess the salivary secretion consistently at an established time of the day, in order to properly examine the evolution of the condition and its treatment in every patient. Whole saliva can be collected by spitting, blotting, suctioning or draining the oral fluid. The normal flow rate for unstimulated, "resting" whole saliva is 0.3 to 0.5 ml/min.; for stimulated saliva, 1 to 2 ml/min. Values less than 0.1 ml/min. are typically considered xerostomic, although reduced flow may not always be associated with complaints of dryness.⁹ We measured the whole saliva.

The whole unstimulated saliva was collected between 9:00 and 11:00 am using standard techniques described by Navazesh.¹³ Participants were refrained from eating, drinking, using chewing gum, etc, for at least 1,5 hours prior to evaluation. Saliva specimens were collected from each participant in sitting position, before and after LLLT. Samples were obtained by requesting subjects to swallow first, tilt their head forward, and expectorate all

Tab. 1 _Descriptive statistics of salivary flow rate before and after LLLT. (S.D.—standard deviation; LLLT—low level laser therapy)

Group	Mean (ml /5 min.)	S.D. (ml /5 min.)	Median (ml /5 min.)	Minimum (ml /5 min.)	Maximum (ml /5 min.)	Lower Quartile (ml /5 min.)	Upper Quartile (ml /5 min.)
Before LLLT	0.235	0.272	0.20	0.0	1.0	0.05	0.25
After LLLT	0.825	0.504	0.95	0.1	1.5	0.25	1.2

saliva into 50 ml tubes for 5 min. without swallowing. The final volume and flow rate of saliva were determined gravimetrically (Analytical Balance, Model WTS-6001, Sartorius Corp., Long Island, NY, USA). Entire procedure was repeated after the final treatment, after four weeks. 20 subjects were treated five days in week for four consecutive weeks with a 685 nm GaAlAs (gallium-aluminium-arsenide) diode laser (Medio LASER Combi Dental, Iskra Medical, Ljubljana, Slovenia). The output of the laser was measured in 7 minutes and found to be practically constant. The laser outputs were controlled weekly using analogue power meters provided by the manufacturers. During each session, the laser treatment was delivered to the tissue by a straight optical fiber with a 1.2 mm spot size. The treatment areas, each one being a 1 cm² surface. Laser applied on parotid glands with 10 minutes (685 nm, continuous wave, 30 mW output power, 3.0 J/cm²). The treatment time (t) for each application point was given by the equation: $t(\text{sec}) = \text{energy (J/cm}^2) \times \text{surface/cm}^2 / \text{Power (W)}$. The average energy density delivered to the treatment areas was 3.0 J/cm². The effect of laser light was evaluated after the final treatment.

Results

The sample included 20 patients (15 women and 5 men), mean age 60.25±6.27.

Salivary flow rate were measured before and after LLLT and the results are presented in table 1. Salivary flow rate after LLLT were significantly greater than salivary flow before LLLT ($P < 0.001$) (Fig. 1).

Statistical analysis

Statistical analysis of data was performed using Statistica for Windows, release 6.1 (StatSoft, Inc., Tulsa, OK). The Kolmogorov-Smirnov normality test was applied to our data. The results were compared using nonparametric Wilcoxon signed-rank test. Statistically significant difference was defined at $P < 0.05$.

Discussion

LLLT is a non-invasive light source treatment that generates a single wavelength of light. It emits no heat, sound or vibration. Lasers with different wavelengths, varying from 632 to 904 nm, are used in the treatment of musculoskeletal disorders. This non-invasive nature of laser biostimulation has made lasers a choice of therapy. In our previous investigation we investigated the effect of LLLT on patients with denture stomatitis.⁷ We found a statistically significant reduction in the salivary levels of proinflammatory cytokines, TNF- α and IL-6

in patients with DS following treatment for 4 weeks with LLLT. This results may suggest that LLLT may be an efficacious choice of therapy in patients with DS. Simoes A et al.¹⁴ made a clinical case study report on dry mouth symptoms in a patient with Sjogren's syndrome. The patient was treated with LLLT. A diode laser (780 nm, 3.8 J/cm², 15 mW) was used to irradiate the parotid, submandibular, and sublingual glands. The salivary flow rate and xerostomia symptoms were measured before, during, and after LLLT. Dry mouth symptoms improved during LLLT. In this study we found that the incidence in xerostomia is significantly reduced in patients treated with LLLT.

Xerostomia is not a disease but can be a symptom of certain diseases. It can produce serious negative effects on the patients quality of life. Saliva is necessary for carrying out the normal functions of the oral cavity, such as taste, speech, and swallowing. Depending on duration and extent of salivary deficiency, severe changes of the oral mucosa and teeth will develop. Treatment of xerostomia may be performed causally (withdrawal or exchange of drugs inhibiting salivary secretion) but will often only be possible as a symptomatic therapy. For this purpose there are available today saliva surrogate solutions ('artificial saliva') and substances that stimulate the secretion of the still intact salivary gland parenchyma. In this preliminary study, with a small sample size, we found a statistically significant improvement in the salivary flow rate after the therapy with low level laser.

Conclusion

Treatment with LLLT was an effective method to improve the quality of life of patient with xerostomia as an noninvasive, quick, safe, non-pharmaceutical intervention.

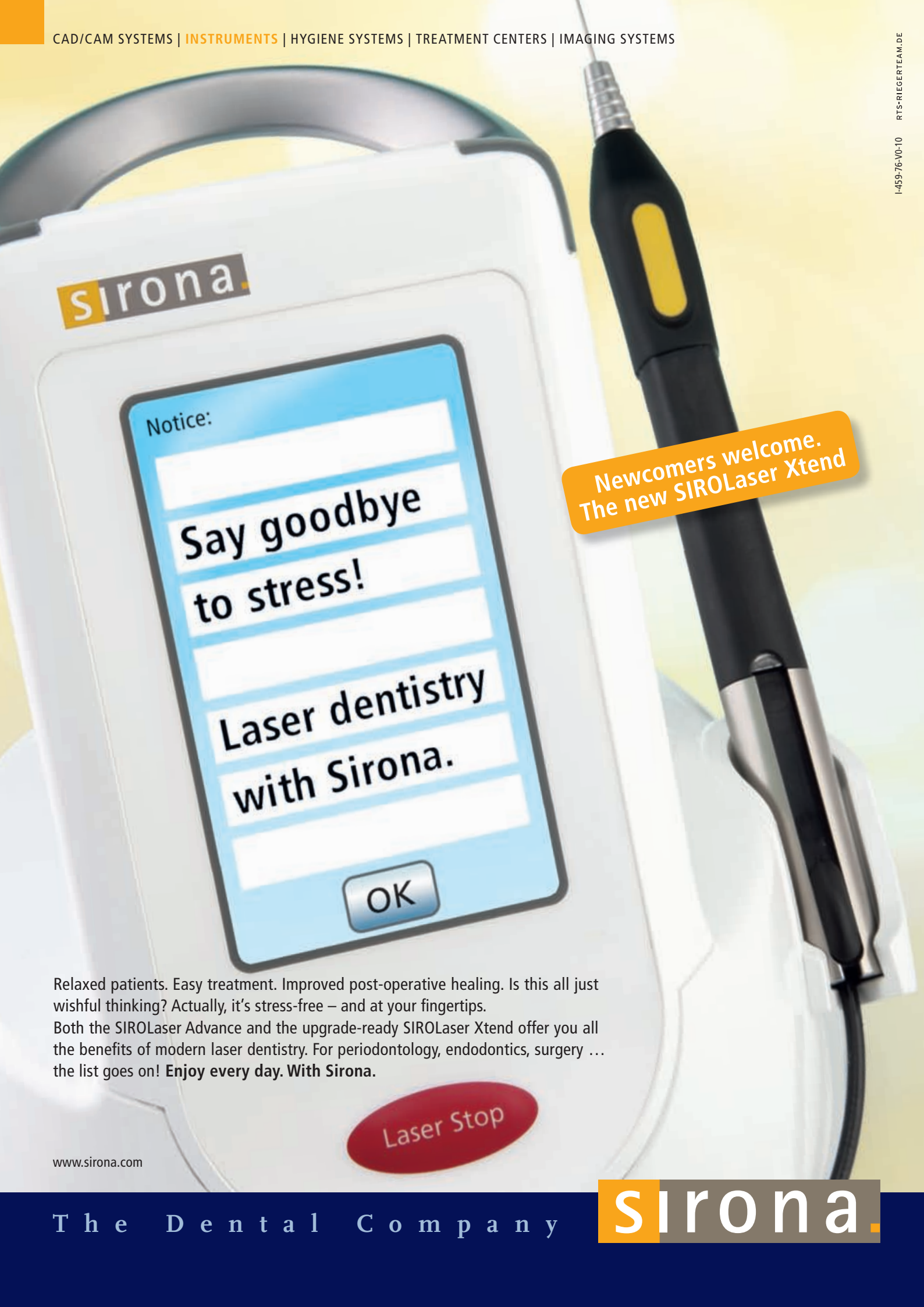
Editorial note: The literature list can be requested from the author.

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