The application of diode laser (970 nm) in the treatment of aphthous ulcers

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ABSTRACT
Aphthae are very painful lesions on the mucous membrane of the oral cavity, which heal spontaneously after 7–10 days. This condition affects around 10–15% of the population, however most people usually do not consult a doctor or dentist. Many studies show that laser treatment offers relief from the pain associated with aphthous changes. Aphthous ulcers can be treated in the dental practice with a diode laser, which is mainly used for periodontics, endodontics and minimally invasive surgery.
In this field study, ten patients with acute aphthous stomatitis were treated with the SIROLaser Advance, a 970 nm diode laser. The aphthous ulcerations were irradiated with the laser fiber in non-contact mode at a distance of 1–3 mm (2.0 W, 10 Hz, duty cycle 50%, 320 µm optical fiber).
Several patients felt the symptoms subside during the treatment. For the majority of patients, the symptoms did not occur again after treatment. None of the patients experienced complications or discomfort as a result of the treatment. All of the patients were satisfied with the treatment.
The treatment of aphthous ulcers with a laser presents a good opportunity to help patients quickly and easily. The results of this field study are consistent with the results in the literature.

KEYWORDS
Diode laser, 970 nm, aphthous ulcers

Introduction

Benign recurrent aphthous stomatitis (RAS) usually refers to painful lesions on the mucous membrane of the oral cavity. They are surrounded by a reddened, inflamed border and have a white fibrin coating on the inner surface.

Recurrent aphthous ulcers can be classified into three different types—the herpetiform and major types, which rarely occur and the minor type. The key characteristics of the minor type are summarized below:

– Common; 90 % of all RAS (10–15 % of the population)
– Episodic 3–6 times per year
– Short duration, lesions < 10 mm, heals without scarring
– Few lesions, largely isolated
– Spontaneous healing within 7–10 days
– Pain subsides after 3–5 days
– Does not usually interfere with daily activities
– Limited to the oral cavity.

The etiology and formation mechanism of RAS are largely unknown. It is believed that genetic factors, among others, may play a role. Enabling triggers, such as trauma, stress, food intolerances, hormonal imbalances, zinc and iron deficiencies and cigarette smoking are discussed.[2] Therefore, treatment of RAS is also not specific and usually symptomatic aimed at reducing the symptoms (especially the pain), decreasing the number and size of the lesions as well as prolonging the time to the next episode. The symptomatic and, in particular, local application of gels and ointments (such as chlorhexidine or corticosteroids) should be critically evaluated due to the possible side effects.[1]

The treatment of aphthous ulcers with a diode laser gives the dentist an interesting opportunity to expand the range of services offered in the practice and to alleviate the discomfort of patients quickly and easily.

Case studies using different approaches confirm the success of laser treatments. However, controlled studies are still missing:

a) In their five-year study, Bladowski et al.[3] compared drug therapy, laser treatment and a combination of both and highly recommend the use of laser.
b) Repeat laser irradiation with the Nd:YAG laser in two studies by Brader et al.[4,5] resulted in pain relief as well as shorter healing times.
c) Early on, the Nd:YAG laser was used for the direct removal of aphthous ulcers. The treatment is described by Convissar and Massoumi-Sourey[6] as painless; the patients reported an immediate decrease in symptoms.

d) The biostimulating effect of low-level laser treatment with diverse diode lasers was positively assessed for the treatment of children.[7,8]
e) Caputo et al.[9] see laser treatment as an important alternative to improve the quality of life of marginalized groups (HIV patients). Al Mulla et al.[10] also come to a similar conclusion with regard to disabled patients.

Materials and methods

After introduction of the patients, differential diagnoses such as virus infections (herpes simplex labialis or oralis, stomatitis, cytomegalovirus, chicken pox, coxsackievirus, HIV), bacterial infections (ulcerative gingivitis, syphilis), fungal infections, neoplasms, hematological illnesses and autoimmune diseases, were ruled out.

Afterwards, treatment with the diode laser was carried out. In this study, the SIROLaser Advance diode laser from Sirona Dental Systems GmbH, Bensheim, Germany, was used. It works with a wavelength of 970 nm with a maximum output of 7 W in continuous wave operating mode. The laser irradiation can also be emitted in "pulsed mode" with a pulse rate of 1 to 10,000 Hz and a duty cycle of between 1 % and 99 %. The laser is easy to handle and the parameters for frequently occurring indications are stored in the instrument and can be easily called up via a menu. The laser parameters recommended for aphthous ulcers were used. They are as follows:

– Output power: 2 W,
– Pulse mode with a rate of 10 Hz,
– Duty cycle 50 %
– Use of a 320 µm fiber optic at a distance of 1–3 mm, with no tissue contact.

Each of the aphthous ulcers were irradiated three times for 30 seconds at a distance of 1–3 mm. In absolute terms, the resulting irradiance was between 222 W/cm^2 and 48 W/cm^2; this value is between the one for surgery (approx. 10,000 W/cm) and that for low-level laser treatment (a few milliwatts to a few 100 mW/cm^2). In addition, the patients had to indicate any sensation of pain, at which point the distance was increased up to 8 mm (irradiance approx. 8.2 W/cm^2, close to the LLLT).

Afterwards, the patients received an anonymous questionnaire to fill out and return once the symptoms had subsided completely. The questions referred to their age and gender, frequency of occurrence of the aphthous ulcers, the typical severity of the symptoms, the usual treatment methods performed, the general progression, and the status before laser treatment. Additional questions focused on the subjective experience of the patients during the procedure (reduction of pain, sensation of warmth, relief of other symptoms) and their progression after the laser treatment (complications, satisfaction). Patients who felt the laser treatment was not effective enough were allowed to repeat the treatment.

Results

The ten patients in this field study consisted of five women and five men of different ages. The distribution is shown in Figure 1.

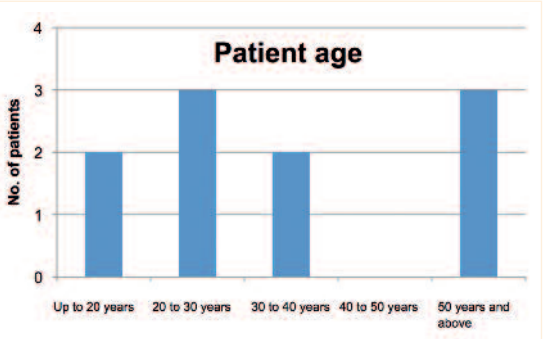

Fig. 1: Age distribution of field study participants.

The patients suffer from aphthous ulcers to different degrees with episodes 1 to 8 times a year (Tab. 1).

Frequency of occurrence	Number of patients
1–4x	7
5–8x	3
9–12x	0
> 12x	0

Tab. 1: How many times a year do you have episodes of ulceration?

Usually, the patients have single aphthous ulcers. The symptoms of the ulcers differ from patient to patient. Only the sensation of pain (e.g., when touched/pressed) as well as difficulty swallowing are regularly occurring accompanying symptoms (Tab. 2).

Symptoms	Number of patients
Single aphthous ulcer	8
Several aphthous ulcers (> 2)	3
Small blisters	1
Swollen lymph nodes on neck	1
Pain	7
Pain–when touched/pressed	6
Pain–difficulty swallowing liquids and food (e.g., sweet, sour, etc.)	4
Other	-

Tab. 2: What symptoms occur when you have aphthous ulcers (multiple answers possible)?

Topical medications are used by 70 % of patients for symptomatic relief of pain (Tab. 3).

Alternative treatment methods	Number of patients
None	3
Special ointments/gels/sprays	7

Tab. 3: What alternative treatment methods do you usually use?

Severity	Number of patients
Single aphthous ulcer	8
Several aphthous ulcers (> 2)	1
Small blisters	1
Swollen lymph nodes on neck	0
Pain	6
Pain–when touched/pressed	5
Pain–difficulty swallowing liquids and food (e.g., sweet, sour, etc.)	3

Tab. 4: In which stage are you with the laser treatment? (multiple answers possible).

Immediate reaction to treatment	Number of patients
Sensation of warmth	9
Reduction of pain	4
Reduction of small blisters	2

Tab. 5: What did you feel during and after the treatment?

Are you satisfied with the treatment?	Number of patients
Yes	10
No	0

Tab. 6: Are you satisfied with the laser treatment of the aphthous ulcers?

Were there complications ?	Number of patients
Yes	10
No	0

Tab. 7: Were there complaints/complications due to the laser treatment?

Was the treatment repeated?	Number of patients
Yes	9
No	1

Tab. 8: Was the treatment repeated?

The stage and severity of the aphthous ulcers at the time of participation in the field study varied (Tab. 4).

Almost all of the patients experienced a sensation of warmth during the treatment. In several cases, the pain subsided during or immediately after treatment and the skin symptoms were reduced (Tab. 5).

All of the patients were satisfied with the laser treatment of the aphthous ulcers (Tab. 6) this is with certainty in part due to the fact that effects were seen quickly and that none of the patients experienced complications or complaints (Tab. 7) afterwards.

In 90 % of the patients, the treatment was successful after only one session; the treatment was repeated for just one patient (Tab. 8).

Discussion

A reduction in the sensation of pain associated with aphthous ulcers using an Nd:YAG laser (2 W, 25 Hz, non-contact, 50–60 seconds) is described by Blandowski et al.[3]—the result here was an almost immediate analgesic effect (24 h). Similar results were obtained by Brader (2008) in the application of an Nd:YAG laser with comparable parameters. It can be assumed that the basic differences in the parameters of pulsed Nd:YAG and diode lasers with regard to wavelength, pulse output power and duration are not relevant for treatment success as long as the average values for irradiance, average output power and treatment duration concur (Tab. 9). Thus treatment with the infrared diode laser at 970 nm and similar average parameters produce similarly successful results.

The spontaneous reduction of symptoms during and after laser treatment results in a significant relief of the discomfort caused by RAS.

The field study confirms that laser treatment of an aphthous ulcer with the diode laser is a very good alternative to help my patients quickly and easily without side effects.

Actually, the only thing that speaks against laser treatment is that many patients are not familiar with it. This can partially be attributed to the fact that generally only few dentists have a laser in their practice.

	Nd:YAG from Brader	SIROLaser Advance
Wavelength	1,064 nm	970 nm
Pulse energy	80 mJ	100 mJ
Pulse rate	30 Hz	10 Hz
Pulse duration	100 µsec	50 msec
Pulse output power	800 W	2 W
Average output power	2.4 W	1 W
Type of treatment	Non-contact irradiation	
Duration of treatment	30 sec/cm^2	3 times every 30 sec.
Treatment distance	10–12 mm	1–3 mm
Irradiance	113 J/cm^2	48–222 W/cm^2

Tab. 9: Comparison of laser parameters of Nd:Yag and diode laser.

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