Low level lasers in dentistry

Jan Tunér DDS, Grängesberg, Sweden

Per Hugo Christensen, DDS, Copenhagen, Denmark

A wide range of different lasers are used in modern dentistry. The Erbium:YAG laser has a potential c in selected situations; the carbon dioxide laser is a valuable tool in oral surgery; the Argon laser is use and composite curing; the Nd:YAG is used in pocket debridement, tissue retraction and more. This is few of the possibilities of the dental laser.

The major drawback so far has been the high cost compared to the conventional therapies and th in the field. The high cost of the investment may not have paid off until the next generation of lasers i far the majority of the dentists using lasers are mainly the entrepreneurs and the enthusiasts.

All the above listed lasers are using, or have the possibility of using high powers, ranging from to 25 watts or more.

Interest from media and patients has been considerable during the last decade, party because of "high-tech" and partly because of the eternal dream about an escape from the discomfort experienced

This article will summarize the physics, science and clinic of a quite different type of dental la laser.

Low level lasers

While the lasers already mentioned can be labeled "High level lasers", there is a less known type of level lasers". These lasers are generally smaller, less expensive and operate in the milliwatt range, 1- therapy performed with such lasers is often called "Low Level Laser Therapy" (LLLT) or just “las lasers are called "therapeutic lasers". Several other names have been given to these lasers, such as "s intensity level laser" whereas the therapy has been referred to as "biostimulation" and "biomodulation more appropriate, since the therapy can not only stimulate, but also suppress biological processes [1].

Therapeutic lasers generally operate in the visible and the infrared spectrum, 600-900 nm wa other wavelengths such as the Nd:YAG at 1064 nm and even the carbon dioxide laser at 106 successfully used in laser therapy.

The **energy** used is indicated in Joule (J), which is the number of milliwatts x the number of sec Thus, 50 mW x 60 seconds produces an energy of 3000 millijoules, equals 3 J. Suitable therapeutic 1-10 J per point. The **dose** is expressed in J/cm2. To calculate the dose, the irradiated area must be area of 1 cm2 = 1 J/cm2. 1 J over an area of 0.1 cm2 = 10 J/cm2. There is generally no heat sensati involved in this therapy.

The history

The first laser was demonstrated in 1960. It was a ruby laser, 694 nm wavelength. Interest in the med laser light was high and already in 1967 [2] some of the first reports appeared on the effects of very light on biological tissues. In animal studies it was observed that experimental wounds healed better i even the shaved fur of the experimental animals reappeared faster in the irradiated areas. There biological window for the dose. If too low, there was no effect, if too high there was a suppressive eff

the Helium-Neon laser was introduced in research and the results were similar. Later on diode lasers w
they provided the same results, although some wavelengths appeared to be better for certain indicatio
introduction of infrared lasers improved the optical penetration of the light, reaching deeper lying tissu

The first commercially available lasers in the early 80ies were extremely low powered, below 1
fact that the first scientific reports used 25 mW. This partly explains the initial controversy about LI
development of laser diodes, the powers of therapeutic lasers have changed dramatically and dio
typically in the range of 50-500 mW. Increased power has not only shortened the treatment time bu
therapeutic results.

Risks and side effects

The only physical risk in laser therapy is the risk of an eye damage. While never reported to have occ
eye damage must be considered, especially when using an invisible and collimated (parallel) beam.
goggles should be worn by the patient for extra oral therapy in the face.

Since the therapeutic lasers are well above the ionizing spectrum there is no risk of cancerous
malignancies should of course not be treated by anyone but the specialist.

Among the side effects (rarely) observed are:

- temporary increase of pain in chronic pain conditions. It has been suggested that this is a sign
chronic condition into an acute situation.

- tiredness after the treatment. This is probably a result of the pain relief where the pain previous
normal relaxation pattern

- redness and a feeling of warmness in the area which is irradiated a result of a increases micro circula

The science

There are more than 2500 scientific studies in the field of laser therapy, among them more than 100 p
studies [3]. In dentistry alone, the number of studies are some 325, from 82 institutions in 37 countrie
these studies vary but it is interesting to note that more than 90% of the studies report on positive effe

In total, 30 different dental indications have been reported in the literature. The very variety
been used as an argument against the probability of laser therapy. However, it rather shows th
biological systems, such as the immune system, SOD activity, ATP production, cell membrane perm
transmitter substances etc.

Laser therapy science is a complicated matter where a combined knowledge about laser
clinical procedures and scientific rules is essential [5]. Many studies, positive and negative, lack
parameters and make a proper evaluation difficult. The existing literature is a sufficient foundation fo
therapy but more research is still needed to find out the optimal parameters.

In two recent US meta analyses [6], [7] there was a high overall significance for wo
regeneration and pain.

Treatment

Treatment is often carried out through local irradiation of the site of injury/pain, but it can also be perf
points such as regional lymph nodes, ganglia and cervical nerve roots corresponding to the dermatome

release can often be achieved in one or two sessions (especially if the reason for the pain still is in a ac
many conditions have to be treated during several sessions. When calculating the dosage, parameters s
pigmentation of the skin, condition of the tissue, acute/chronic stage, depth beneath skin/mucosa, trans
overlying tissue must be considered.

New possibilities

The therapeutic lasers offer improved possibilities in the treatment of pain, wound healing, inflamm
However, they also offer the dentist a possibility to treat indications previously not within the capal
dentist. In the following some examples will be given, each with a selected reference

Dentinal hypersensitivity

With the advent of desensitizing agents, the prevalence of treatment-resistant dentinal hypersensitiv
considerably. On the other hand, the placement of composites and inlays has brought a new reason
Gershman [8] has shown that dentinal hypersensitivity can be successfully treated with LLLT. Mi
higher doses than the common dentinal hypersensitivity, and repeated treatments. Frequently a sens
be treated with only one treatment.

Herpes simplex

Oral herpes (HSV1) is a common feature in the dental operatory. Instead of being a contraindication
during the acute period, an onset of HSV1 can be a good reason for a visit to the dentist. As with any
a treatment in the early prodromal stage is most successful. The pain will be reduced immediately a
disappear within a few days. Repeated treatment, whenever a blister appears will lower the incid
Unlike Acyclovir tablets, there are no side effects [9]. It has been shown [10] that laser therapy can
latent period between the attacks to lower the incidence of recurrence.

Mucositis

Patients undergoing radiotherapy [11] and/or chemoradiotherapy [12] suffer gravely from the muco
therapy. Nutrition is troublesome and therapy regimen may have to be suboptimal for this reason. LL
only to treat the mucositis but even to reduce it by mucosal irradiation prior to radiotherapy/chemothe

Pain

The most frequent complaint among patients is of course pain. LLLT can reduce or eliminate pain of
Postoperative discomfort after surgery can be substantially reduced by irradiating the operated ar
before the anesthesia wears off.

Paresthesia

After oral surgery paresthesias may occur as a result of the surgery, in particular in the mandibula
been used to eliminate or reduce such complications [13].

Sinuitis

While many cases of sinuitis are "dental", a great number of patients arrive in the dental office with s
bacterial background. LLLT will in most cases lead to a fast reduction of the symptoms [14], ma
treatment easier.

TMD

Problems in the temporo-mandibular joint region are quite suitable for LLLT. For arthritic cas
concentrated to the joint area, in myogenic cases the muscular insertions and trigger points are tre
should always be used in combination with conventional treatment but will improve the outcome of th

Tinnitus/vertigo

It has been shown [16] that patients suffering from Ménière's disease (tinnitus/vertigo) have a sig
prevalence of problems in the masticatory, neck and trapezius muscles plus problems in the cervica
in the transverse processes of the atlas and the axis. Relaxation of the tension in these muscles plus o
procedures (occlusal adjustment, bite splint) will reduce or eliminate the symptoms of tinnitus and v
of patients. Laser therapy can successfully be used to promote muscular relaxation and pain relief in th

Trigeminal neuralgia

Apart from being extremely debilitating, trigeminal neuralgia can sometimes make dental treatment in
miracle cure, dentists can offer a great deal of comfort to these patients, and with a non-invasive meth

Zoster

Zoster in the trigeminal nerve should be treated in its early phase. The zoster attack in itself is bad
infrequently a postherpetic neuralgia will persist for years or even lifelasting. Laser therapy is a
invasive method without side effects [18].

Other indications

29 different dental indications are described in the literature, some of them being aphtae, bone re
dificilis and decubitus.

Acupuncture

If a dentist is trained in acupuncture, the low level laser will be a very convenient way of replacing t
instances, for corporal or auricular acupuncture. Needles are not too popular with the patients, s
appreciated. Even for a dentist not practicing acupuncture, there are some well defined acupuncture p
used, for instance to reduce nausea [19].

No panacea

The clinical results described above may seem impressive, even to the degree of doubts. However,
panacea and should only be used within the limits of its own merits. Correct diagnosis, proper treat
treatment intervals plus sufficient dosage are all essential to obtain good results.

Non-biomodulating LLLT

A large number of in vitro studies have reported on the enhanced killing of bacteria using various d
with low level lasers. The most frequently used dye has been toluidine blue (TBO) and some of t
studied are streptococcus mutans (20) and staphylococcus aureus (21). The bactericidal effect of T
low level laser light and the clinical implications of this combination in cariology and periodo
promising. Low level laser has also been shown to enhance the release of fluoride from lacquers (22)
(23).

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