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Prof. Dr Norbert Gutknecht
Editor-in-Chief

Wavelengths

Dear readers,

As sunlight consists of different wavelengths and can only in this composition of wavelengths serve the vital biological requirements, future-oriented laser users have to learn that, although the application of a wavelength is important and good, the same wavelength cannot fulfil all biological and therapeutic demands. Based on this insight, the future of laser dentistry will be associated with the combination of specific wavelengths.

Success or failure of a laser treatment is inseparable from the selection of the correct wavelength. The better the biophysical knowledge of the laser user, the better he or she would be able to select the wavelength to target the intended tissue, triggering the desired interaction. Since there are different tissue types in the oral cavity—in areas of little space, such as in periodontal pockets—it may be necessary to involve two different wavelengths in the treatment planning. This knowledge is increasingly used by manufacturers of laser devices not only to extend the indication spectrum of their devices, but also to optimise specific treatment procedures by combining two or more wavelengths. The combination and application of different wavelengths will thus be one of the main themes at this year's international annual congress of the Deutsche Gesellschaft für Laserzahnheilkunde (German Society for Laser Dentistry) and will be reflected in lectures and workshops, as well as in the dental exhibition.

For the summer months ahead, I wish you much pleasure in enjoying the different wavelengths of sunlight.

Kind regards,

Prof. Norbert Gutknecht
Editor-in-Chief


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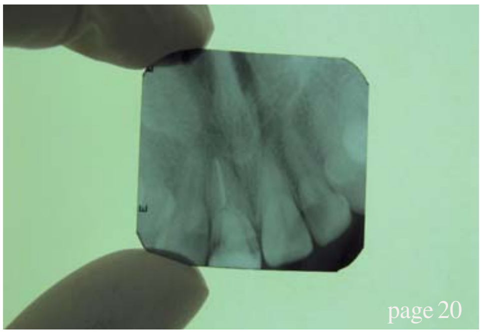
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Preventive approach in paediatric dentistry using Er:YAG laser

Author_Ani Belcheva, Maria Shindova & Georgi Tomov, Bulgaria

_Modern dentistry has focused on preventive methods and conservative techniques to apply less-invasive procedures to tooth structure.[1] Awareness towards the importance of preserving tooth tissue combined with a patient-friendly approach is becoming self-evident. It has been shown that operative dental treatment often leads to an increasing scale of more surgical and invasive treatments. Whenever possible, tissue should be preserved, and invasive treatment should be kept to a minimum. The best way to ensure maximum life for the natural tooth is to respect the healthy tissue and protect it from being damaged by using minimally-invasive techniques in restorative dentistry.[2]

_Preventive dentistry

Preventive dentistry is a branch of dentistry that deals with the preservation of healthy teeth and gingiva and the prevention of dental and oral disease. The field involves dental procedures, materials and programmes that prevent the occurrence of oral diseases or retard their further progression. There are three levels of preventions:

Level 1: Primary prevention

The pre-pathogenic stage employs measures that forestall the onset of the disease to reverse the progress of the initial stage, or to arrest the disease process before treatments becomes necessary.

Level 2: Secondary prevention

The pathogenic stage employs treatments methods, to terminate a disease process and to restore tissues as near normal as possible.

Level 3: Tertiary prevention

At this level, prevention employs measures that are necessary to replace much tissue and to rehabilitate patients to the point that functionality resembles its natural condition, as much as possible, after the failure of the secondary preventions.

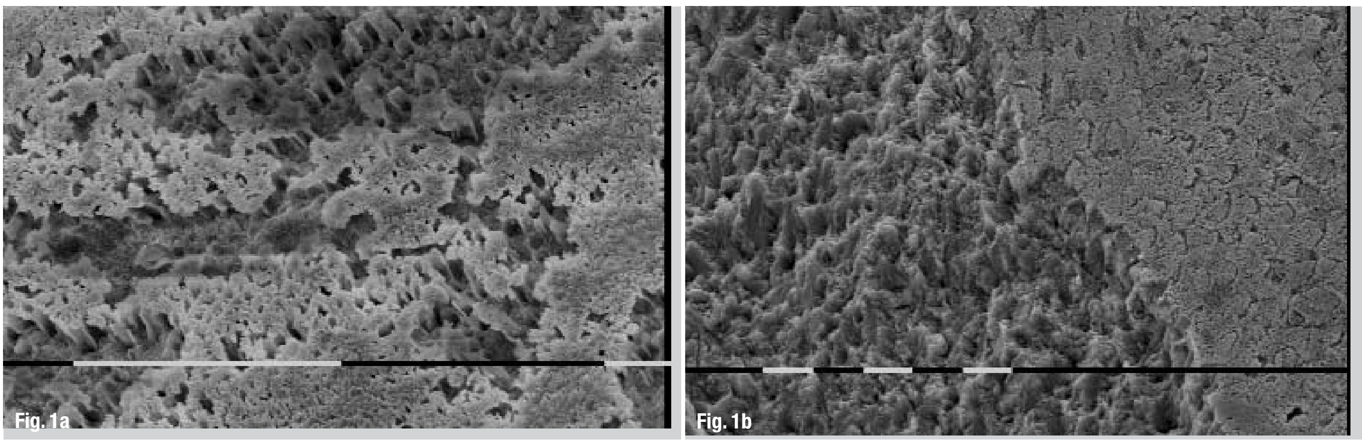


Fig. 1a
Fig. 1b

Figs. 1a & b_Acid etching of hypoplastic enamel showed patchy loss of surface tooth structure without evidence of uniform etching patterns (a). The laser treated surfaces showed that Er:YAG radiation caused an uniform roughness of the enamel for HE (b) teeth (magnification x 3,000).

In recent years, the development of new technologies made it possible to prevent complications and to conduct treatments with minimal intervention. Laser treatment with its considerable variety of biological actions and high therapeutic effectiveness is used widely both in medicine and dentistry. Erbium lasers could be used in large array of both hard and soft tissue procedures performed in paediatric dentistry.[3] Many of these procedures may be treatments that require a specialist. However, when Er:YAG lasers are being used their efficacy and special characteristics allow general practitioners to perform and complete a wide range of these procedures. The advantages of Er:YAG laser are associated with a process of ablation, decontamination, minimal invasion and analgesia, thus providing clinical solutions to what once was attribute solely to experts. The purpose of this study is to describe the scientific approaches to prevention by using Er:YAG lasers.

_Er:YAG laser characteristics and advantages

Ablation

Er:YAG laser has a wavelength of 2.94 µm, which matches exactly the absorption peak of water and which is also absorbed by hydroxyapatite. Erbium laser radiation is very efficient in removing both dentin and enamel, limiting the laser effect on these tissues to a superficial layer of a few micrometres. The overheated water abruptly vaporises and the so released vapour carries away surrounding broken tissue fragments in a thermo-mechanical ablation process.[4, 5]

In general, there is a linear relationship between crater depth or removed volume and applied energy density.[15] Water mist is needed to avoid thermal side effects and for pain control.[6] The way to remove hard tissues with Er:YAG without overheating prevents the pulp. Er:YAG laser ablation works in a minimally-invasive way, removing only the damaged tissues. It prevents destruction of sound structures and gives opportunity for a fast healing process.

Decontamination

The bactericidal effect of laser light was advanced to be one of its beneficial effects. The wavelengths well-absorbed in water have a good bactericidal effect even at low-energy density output levels, starting at 0.3 J/cm^2, without excessive temperature elevation.[7] Due to its bactericidal effect combined with the reduced pain sensation during its application, the Er:YAG laser was a very promising tool for cavity preparation in Paediatric Dentistry and in Dentistry in general. Antimicrobial resistance or drug resistance is a problem spread and discussed worldwide. It is a major concern of the WHO. The ability of Er:YAG laser to establish decontamination is a solution for effective treatment and prevention of future complications.

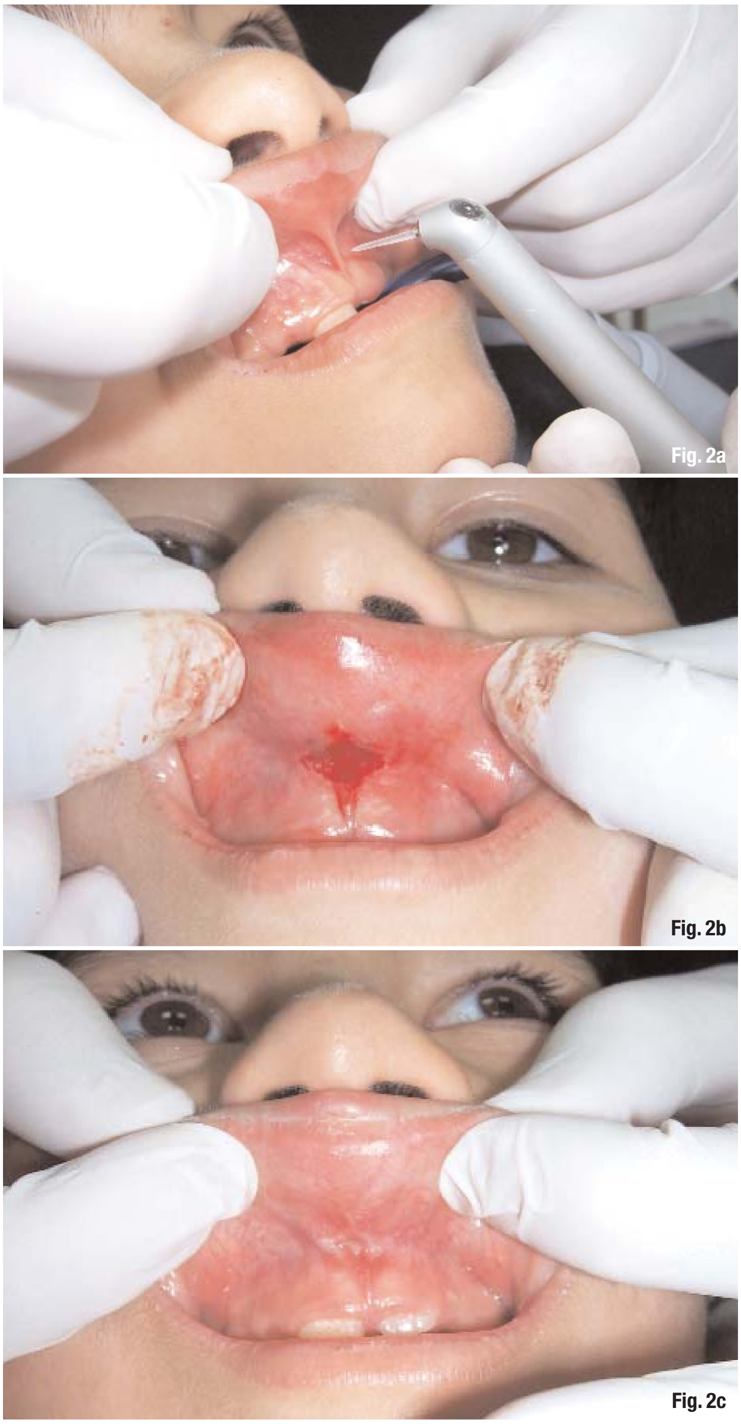


Fig. 2a

Fig. 2b

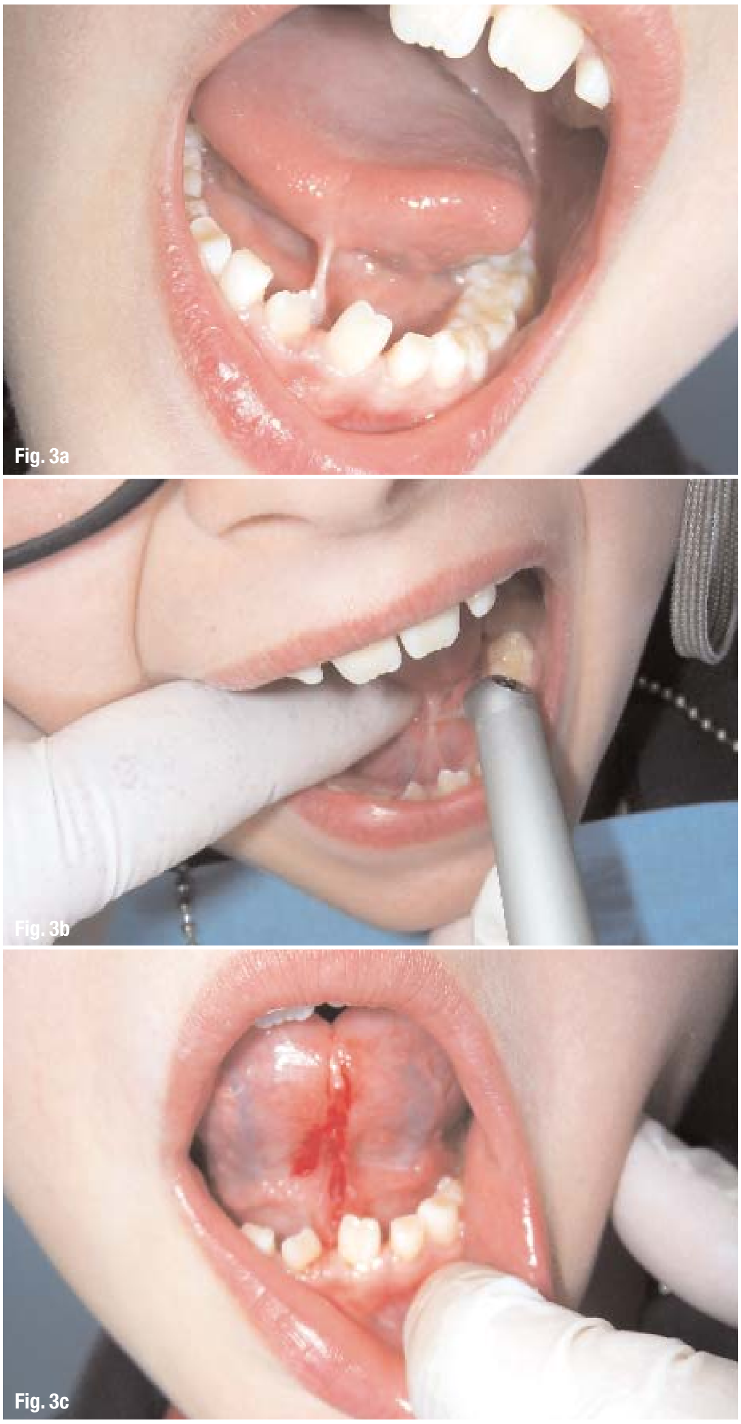
Fig. 2c

Figs. 2a–c_Maxillary frenectomy with LiteTouch, Er:YAG laser.

Analgetic effect and pain perception

As Er:YAG lasers can be used to prepare cavities without thermal damage and the systems availability on the market offers a high ablation efficiency, it was of interest to investigate the patients' subjective perception of this treatment method: Cavity preparation with the help of Er:YAG laser was found to be more comfortable in the patients perception than mechanical treatment in at least 80 per cent of the cases.[10, 11]

One of the parameters partly explaining the absence of pain perception is the difference in tooth vibration



Figs. 3a–c_Lingual frenectomy of 7-year-old boy with Lite Touch, Er:YAG laser.

speed caused by Er:YAG laser versus high-speed drill. Mean vibration speed during laser cavity preparation reaches 166 +/- 28 µm/second, at a characteristic frequency of 230 Hz, whereas the high-speed drill induces a 100 times higher vibration speed of 65 +/- 48 mm/second, at 5 kHz. In addition, this much higher frequency has its spectrum near the peak sensitivity of hearing, as a potential factor of discomfort and pain provocation.[12]

A patient may suffer progression of oral disease if treatment is not provided on time because of age, behaviour, inability to co-operate, disability, or medical status. Postponement of dental care can result in unnecessary pain, discomfort, increased treatment needs and costs, unfavourable treatment experiences, and diminished oral health outcomes. Using Er:YAG laser in patients with fear or phobia of dental treatment is a real opportunity to treat them and show an alternative well-accepted method to overcome the barrier of dental care. With the help of Er:YAG laser, patients realise that there is a way to preserve their teeth without pain, which will encourage them to take care of their oral health more frequently and at the end only for prevention.

_Application of Er:YAG laser in hard tissues

Primary Caries Prevention

Laser is becoming common in clinical dental care and is one of the promising new modalities used for caries management. In many studies was investigated the possibility of sub-ablative energies to increase the acid resistance and the micro-hardness of enamel surface and to reduce enamel solubility by increasing caries resistance without severe alterations of the enamel.[13] Laser–fluoride effect on enamel found that low-energy Er:YAG laser irradiation coupled with fluoride treatment could inhibit enamel demineralisation through increased fluoride deposition on the surface and formation of fluoridated hydroxyapatite.[14] In one recent study, silver diamine fluoride (SDF) application followed by sub-ablative low-energy Er:YAG laser irradiation on dentine rendered the dentine surfaces more resistant to caries development, both chemically and mechanically.[15] Lasers have also been used to prevent the enamel demineralization caused by dental caries and have shown good results.[16,17] The Er:YAG laser has been shown to reduce or prevent the demineralization of tooth enamel.[18] In some studies, when associated with fluoride, it leads to a reduction in mineral surface loss.[19,20]

Sealants reduce the risk of caries in susceptible pits and fissures of primary and permanent teeth.[13] The enamel surface prior to the placement of the sealant can be pre-treated in different ways. Non-invasive techniques include only etching with 37 per cent orthophosphoric acid or air abrasion and acid etching. Invasive techniques use burs for opening the deep and narrow fissures and then acid etching. Preparing the enamel surface with Er:YAG laser with subsequent acid etching is considered as non-invasive technique for pre-treatment of pits and fissures. This laser wavelength has special uses in the domain of primary and secondary prevention which include sealing of pits and fissures and cavity preparation.[14] This technology makes the enamel more resistant to caries attack, and also the need to acid etching procedure is eliminated, or reduced.[14,15] The use of laser gives the dentist the ability to clean and sterilise enamel fissures. The bactericidal effect of Er:YAG laser irradiation could boost the inter-



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