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Dear laser friends and colleagues,

We all believe in a bright future for laser dentistry, a specialist field that is guided by experience and driven by innovation. It can be argued that advancements in laser dentistry should be made not only in terms of hardware, but also in terms of software.

Against this background, I would like to cordially invite you to join us for the upcoming annual meeting of the German Association for Laser Dentistry (Deutsche Gesellschaft für Laserzahnheilkunde—DGL), which will be held on 6 and 7 November 2020 in Bremen in Germany. Packed with scientific lectures from highly esteemed colleagues and technological innovations from the industry, the conference is considered a definite highlight by many who regularly seek out renowned dental training events. This 2020 annual meeting will be held as joint event together with the 3rd Future Congress of the German Association of Dental Implantology (Deutsche Gesellschaft für Zahnärztliche Implantologie—DGZI). In this way there will be ample opportunity for extensive interdisciplinary exchange with colleagues through shared lectures, poster presentations and industry exhibits.

With so-called “table clinics” the programme will feature yet another novelty on the first congress day on Friday: during round table presentations led by experienced trainers, small groups of participants will have the opportunity to discuss various topics revolving around laser dentistry and oral implantology with a view to synergetic effects between these two specialist fields. The participants will also be allowed to switch between tables, allowing them to get a glimpse into many of the topics discussed. The conference will put particular focus on practice-oriented aspects, which laser enthusiasts can implement effortlessly and rapidly into their daily clinical work.

With this in mind, I welcome you to Bremen this autumn and I wish you a great and interesting read with this first 2020 issue of *laser—international magazine of laser dentistry*!

Dr Stefan Grümer

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Effects of 10,600 nm carbon dioxide lasers on preventing caries

A literature review

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Introduction

Although dentistry has benefitted from technological advancements in recent years, dental caries remains a major oral health problem in most industrialised and non-industrialised countries affecting more than half of schoolchildren and a large majority of adults.[1] Dental caries is a localised chemical dissolution of dental hard tissues caused by the action of acidic by-products of the metabolic processes of cariogenic biofilm.[2] Conventional non-invasive strategies for caries prevention include oral health education, reduction of sugar consumption, use of fluoride, and application of pit and fissure sealants. Fluoride principally works by hindering the process of demineralisation of enamel and dentine and promoting remineralisation of tooth surfaces with early signs of mineral loss. Pit and fissure sealants generate a physical barrier to prevent the access of dental plaque and its acid products from damaging the enamel surface. However, dental sealants are only effective on the pit and fissures and not the smooth surfaces of teeth. New strategies, such as casein phosphopeptide amorphous calcium phosphate[3] and micro- or nanohydroxyapatite compounds, have been proposed to control the balance between demineralisation and remineralisation. It is essential to develop new caries preventive methods to control the disease. A novel, non-invasive approach is the use of laser irradiation on enamel or dentine in preventing caries development. A number of studies reported the potential of laser irradiation on tooth roots or enamel in inhibiting formation of caries lesions.[4–9]

Several types of laser were studied for caries prevention. The wavelengths of neodymium-doped yttrium aluminium garnet (Nd:YAG) lasers (λ = 1,064 nm) and argon lasers (λ = 488–514 nm) make them difficult to be absorbed by enamel. On the other hand, carbon dioxide (CO_2) lasers (λ = 9,000–11,000 nm) are highly absorbed by dental hard tissues and thus have good potential for use in caries prevention.[7,9] The first CO_2 laser adopted a mixture of nitrogen, helium, and CO_2, and CO_2 acted as the active laser medium.[10] Subsequent CO_2 lasers produced various emission laser lines with wavelengths ranging from 9,000 to 11,000 nm. The most common laser lines of CO_2 lasers are centred at 9,300; 9,600; 10,300; and 10,600 nm, respectively. CO_2 laser wavelengths have a higher absorption coefficient to hydroxyapatite than water. A conventional CO_2 laser-emitting light at 10,600 nm is well-absorbed by minerals, while 9,600 nm has the best absorption coefficient to hydroxyapatite followed by 9,300 nm.[1] However, the 10,600 nm CO_2 laser has been commonly used in medicine and dentistry, and most of the commercially available CO_2 lasers operate only at this wavelength. The effect of CO_2 lasers in caries prevention has been studied since the 1960s,[1] when CO_2 lasers (10,600 nm) were discovered to significantly inhibit enamel caries progression.[7] Significantly less demineralisation was also found in CO_2 laser-treated (λ = 10,600 nm) dentine than non-lased dentine.[9] Furthermore, promising effects of combined CO_2 laser irradiation and fluoride treatment in preventing enamel and dentine caries were reported.[11–13] However, the mechanism of caries prevention of CO_2 lasers remains to be elucidated. A literature search using the databases PubMed, Scopus and Web of Science revealed no comprehensive review to evaluate studies investigating the effects of actions of CO_2 lasers in caries prevention. Therefore, the objective of this paper was to systematically review the evidence regarding the effects of CO_2 lasers (λ = 10,600 nm) on preventing dental caries.

Methods

Search strategy

Two investigators (KL and ISZ) performed a systematic search of articles archived in three databases, PubMed, Scopus and Web of Science. The following keywords were used to identify relevant articles: [(CO_2 laser) OR (carbon dioxide laser)] AND [(dental caries) OR (tooth remineralisation)]. There was no publication year limit, and the last search was made on 31 January 2019. Studies published in English through 2018 and archived in the

PubMed, Scopus, and Web of Science databases were chosen. A list of potentially eligible articles was compiled of publications featuring the keywords (Fig. 1).

Study selection and data extraction

Records identified from database searches were checked for duplication. The titles and abstracts from the potentially eligible list were screened after removing duplicate publications. Articles that did not focus on the effects of CO_2 lasers on preventing dental caries were excluded after screening of titles and abstracts. The remaining articles were retrieved with full texts. The reference lists of all the included articles were screened to identify all possibly eligible studies. The inclusion criterion for selecting studies for this review was that studies investigated the effects of CO_2 lasers on preventing enamel and dentine caries, including their combined effect with topical fluorides on caries progression. For the included papers, the following information was recorded: publication details (authors and years), methods, outcome assessments (various criteria for studying the prevention of caries: reduction of carbonate content, lesion depth, microhardness, mineral loss, surface morphology, and bacterial counts), and the main findings. Any disagreements on study inclusion or data extraction were discussed by the two authors with a third author (OYY) until consensus was reached.

Results

The initial literature search identified 543 potentially relevant articles (143 articles in PubMed, 221 in Scopus, and 179 in Web of Science). A total of 285 duplicate records were removed. After screening the titles and abstracts, 236 articles that were classified as literature reviews, case reports, non-English articles, or irrelevant studies were excluded. No additional relevant publications were found from the references of the selected papers. Finally, 22 articles were found to meet the inclusion criteria and were included in this review. Among these articles, nine studies examined the action of CO_2 lasers on preventing enamel caries (Tab. 1), three studies investigated the effect of CO_2 lasers on preventing dentine caries (Tab. 2), eight studies investigated the effect of CO_2 lasers combined with topical fluorides on enamel (Tab. 3), and three studies examined the effect of CO_2 lasers combined with topical fluorides on dentine (Tab. 4).

Effects of CO_2 lasers on preventing caries of enamel and dentine

Nine studies investigated effects of 10,600 nm CO_2 lasers on morphological and chemical changes of enamel as well as on the reduction of enamel demineralisation. Concerning the microhardness analyses, CO_2 laser-treated enamel surfaces showed significantly higher values than those of negative control.[14,15] Polarised light microscopy evaluation revealed that laser-treated enamel groups showed significantly lower lesion depth compared with the non-lased controls,[16,17] and the decreased lesions represented up to 87 % inhibition of the caries progression.[8] The values of mineral loss of enamel calculated from cross-sectional microhardness analyses were statistically lower in laser-irradiated groups than

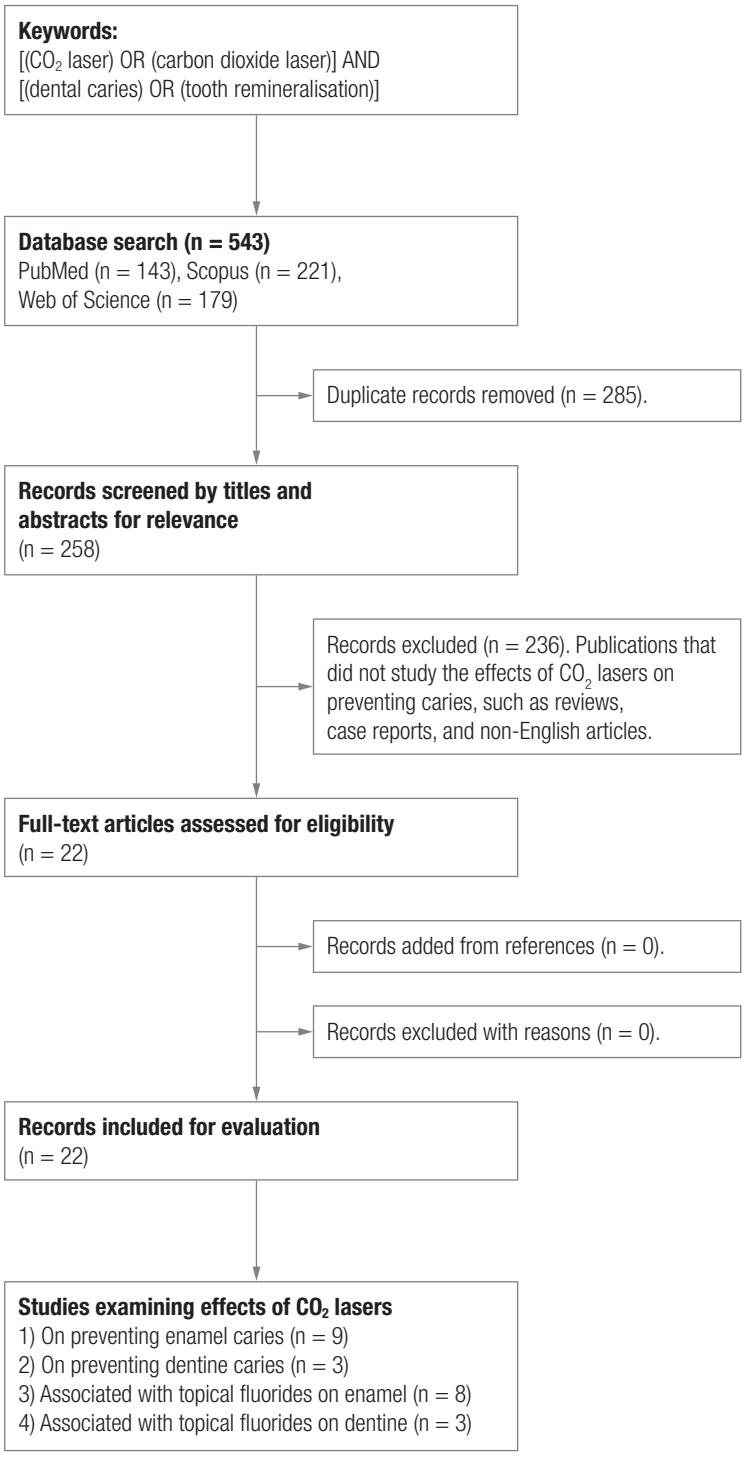


Fig. 1: Flowchart of the literature search.

Authors, year	Methods	Main findings
Vieira et al. 2015[14]	Human enamel was irradiated with CO_2 laser before FTRS and EDX. They were subjected to pH cycling before MHT and SEM.	Irradiated enamel increased microhardness and reduced carbonate content more than negative control. Melting and recrystallisation of enamel occurred after irradiation.
Correa-Afonso et al. 2012[15]	Human enamel irradiated with CO_2 laser was subjected to pH cycling before MHT, PLM, and SEM.	Enamel increased microhardness and reduced demineralisation after irradiation. No fusion, melting, or exposure of enamel prisms was found on the irradiated enamel.
Souza-Gabriel et al. 2010[18]	Human and bovine enamel were irradiated with CO_2 laser before SEM. They were subjected to pH cycling before MHT.	Enamel showed melting and recrystallisation after irradiation. It was more resistant to demineralisation than the negative control.
Esteves-Oliveira et al. 2009[17]	Bovine enamel was irradiated with CO_2 laser before SEM. It was subjected to pH cycling before PLM.	Irradiated enamel showed no ablation, melting, or cracks. It was more resistant to demineralisation than the negative control.
Steiner-Oliveira et al. 2006[20]	Human enamel was irradiated with CO_2 laser before FTRS and SEM. It was subjected to pH cycling before MHT.	Irradiated enamel had less carbonate content and mineral loss than the negative control. Enamel showed melting and fusion after irradiation.
Klein et al. 2005[19]	Human enamel was irradiated with CO_2 laser before SEM. It was subjected to pH cycling before MHT.	Enamel surfaces showed melting and fusion after laser irradiation. They had less demineralisation than the negative control.
Hsu et al. 2000[16]	Human sound enamel with organic matrix removal or not was treated with CO_2 laser and subjected to pH cycling before PLM, microradiography, and SEM.	Irradiated enamel had no surface melting or crater after irradiation. It had less mineral loss and lesion depth than other groups. An interaction effect was found between laser irradiation and enamel organic matrix content.
Featherstone et al. 1998[7]	Human enamel was irradiated with CO_2 laser and then subjected to pH cycling before MHT.	Irradiated enamel showed less mineral loss than the negative control.
Kantorowitz et al. 1998[8]	Human enamel irradiated with CO_2 laser was examined by SEM and subjected to pH cycling before MHT.	Irradiated enamel surfaces showed little or no morphological changes. They had less mineral loss than the negative control.

EDX = energy-dispersive X-ray, FTRS = Fourier-transform Raman spectroscopy, MHT = microhardness testing, PLM = polarised light microscopy, SEM = scanning electron microscopy

Table 1: Summary of studies of effects of CO_2 (10,600 nm) lasers on enamel.

those in non-lased groups.[7,8,16,18–20] There was an interaction effect between the CO_2 laser irradiation and the organic matrix content of enamel on lesion depth and mineral loss of enamel ($p < 0.05$).[16] The enamel with the removal of organic content (non-organic enamel) had a 38 % reduction in lesion depth and a 74 % reduction in mineral loss after laser irradiation when compared to the non-organic enamel without laser irradiation. Both reductions were significantly lower than the results for the lased normal enamel but greater than those for the non-lased enamel.[16] CO_2 laser irradiation could induce chemical changes in enamel. Fourier-transform Raman spectroscopy showed a reduced carbonate content for laser-treated enamel when compared with non-treated ones,[14,20] while there were no statistical differences for calcium and phosphorus components between irradiated groups and the control by energy-dispersive X-ray fluorescence spectrometry measurements.[14]

Observations under scanning electron microscopy revealed evidence of melting and fusion in the enamel samples treated with CO_2 lasers,[14,19,20] and melting and fusion were more frequent in the treated groups that underwent more than one laser application.[14] Enamel surfaces exhibiting melted structures were several times bigger than the prismatic structures and fusion across the prism boundaries.[14] It was verified that a laser-modified layer with a coalescence of crystals was presented in human enamel surfaces, forming an irregular solid mass.[18] A homogeneous and smooth recrystallisation was also observed on the fused enamel surfaces.[14,18] However, some studies found that the treated enamel areas showed little or even no morphological changes.[8,16] The irradiated enamel surfaces exhibited a similar appearance to the non-lased controls,[17] and no signs of surface melting, ablation, crater formation, cracks, or fissures could be observed using the parameters showing caries inhibition effects.[16,17] Three studies investigated the effects of a 10,600 nm CO_2 laser on morphological features of dentine as well as on the reduction of dentine demineralisation.[9,21,22] Root dentine surfaces irradiated with a CO_2 laser with fluences from

Authors, year	Methods	Main findings
de Melo et al. 2014[21]	Human root surfaces irradiated with CO_2 laser were subjected to pH cycling before MHT.	Irradiated root surfaces were more resistant to demineralisation than the negative control.
de Souza-Zaroni et al. 2010[22]	Human root surfaces were irradiated with CO_2 laser before SEM. They were subjected to pH cycling before MHT.	Irradiated root surfaces showed melting and resolidification. They showed less mineral loss than negative control.
Nammour et al. 1992[9]	Human root surfaces irradiated with CO_2 laser were subjected to cariogenic challenge before SEM, microdensitometry measurements, and microradiography.	Root surfaces appeared smooth after irradiation. Root surfaces showed melting with no dentinal openings, and they showed more resistant demineralisation than the negative control.

MHT = microhardness testing, SEM = scanning electron microscopy

Table 2: Summary of studies of effects of CO_2 (10,600 nm) lasers on dentine.

4.0 to 6.0 Jcm^{-2} showed evidence of melting and resolidification under scanning electron microscopy, and a cracking appearance was more evident on those samples treated with 5.0 and 6.0 Jcm^{-2}.[22] Longitudinally fractured samples had a layer of dentine with no tubular structure (20–70 µm thick), whereas the dentinal tubules retained the normal structure below the sealed layer.[9] The values of mineral loss were significantly lower in the laser-irradiated dentine groups than the non-irradiated controls.[21,22] Additionally, laser-induced inhibitory effects on dentine demineralisation were observed when fluences reached or exceeded 4.0 Jcm^{-2}.

Effects of CO_2 lasers combined with topical fluorides on enamel and dentine

Eight studies investigated the combined effects of 10,600 nm CO_2 laser irradiation and the application of topical fluoride on enamel. The results of these studies varied. Four studies found that there was a synergistic

effect between laser irradiation and fluoride application in reducing enamel demineralisation,[12,23–25] whereas the other four studies found that the combination of laser and fluoride had no additional impact on decreasing lesion progression when compared with the laser alone.[26–29] Enamel samples treated with laser irradiation in conjunction with the application of titanium tetrafluoride solution showed less calcium loss and increased microhardness than those treated with laser only.[24] Combined sodium fluoride treatment and laser irradiation showed overwhelming effectiveness in preventing enamel demineralisation based on the data analysis of mineral loss and lesion depth.[12] When enamel surfaces were treated with amine fluoride solution immediately followed by laser irradiation, they had markedly reduced cracking and fused and melted areas compared to counterparts treated with the laser alone.[25] Moreover, laser irradiation through the amine fluoride solution significantly increased fluoride uptake to the enamel surface layer compared to fluoride treatment alone.[25] Three studies investigated the combined effects of 10,600 nm CO_2 laser irradiation and application of topical fluorides on dentine, and the results of these studies were consistent, showing a significant synergistic effect of laser irradiation combined with fluoride treatment on the prevention of dentine demineralisation.[11,13,26] The laser combined with fluoride treatment resulted in an 84.5 % decrease in lesion depth,[11] significantly less mineral loss,[26] and lower calcium and phosphorous losses.[13] In addition, the combination of laser and fluoride yielded significantly lower bacterial numbers on dentine surfaces than laser only.

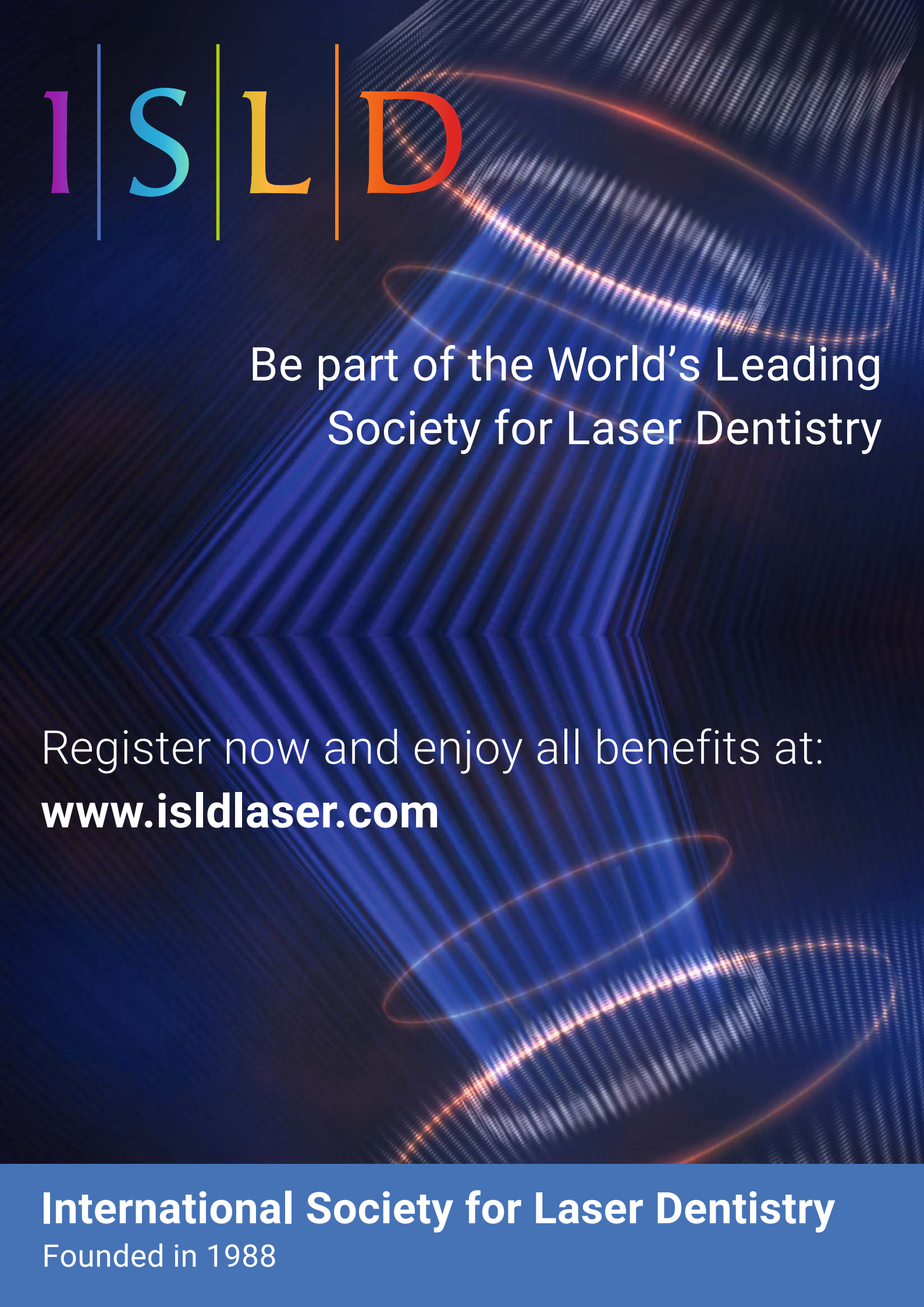
Discussion

The publication search in this review used three databases, PubMed, Scopus, and Web of Science. They are three of the most commonly used and readily available databases. PubMed, which focuses on medicine and biomedical science, provides open access to the public and includes articles published after 1950. One advantage of PubMed is that it provides printed literature as well as early versions before printing publica-

Authors, year	Methods	Main findings
Mahmoudzadeh et al. 2018[29]	Human enamel was irradiated with CO_2 laser associated or not with NaF in different order before SEM. It was subjected to cariogenic biofilm challenge before MHT.	No difference in microhardness was found among enamel treated with laser plus NaF, laser alone, or NaF alone. Irradiated enamel showed melting, cracks, and craters with discontinuities.
Esteves-Oliveira et al. 2017[26]	Bovine enamel was irradiated with CO_2 laser associated or not with NaF. It was subjected to cariogenic biofilm challenge before TMR, CFU, and SEM.	No difference in mineral loss was found between irradiated enamel treated with or without fluoride. The bacterial numbers on enamel were not affected by laser or fluoride.
Mirhashemi et al. 2016[24]	Bovine enamel irradiated with CO_2 laser was treated with TiF4 and subjected to pH cycling before AAS and MHT.	Irradiated enamel treated with TiF4 was more resistant to demineralisation and had an increased microhardness compared to those without TiF4 treatment.
Seino et al. 2015[27]	Human enamel was irradiated with CO_2 laser associated or not with APF before SEM. It was subjected to pH cycling before QLF.	Enamel surface showed no melting after laser irradiation. Irradiated enamel treated with fluoride showed similar resistance to demineralisation compared to those treated with laser only.
Tagliaferro et al. 2007[28]	Human enamel was irradiated with CO_2 laser associated or not with APF. It was subjected to pH cycling before MHT.	Irradiated enamel treated with fluoride showed similar resistance to demineralisation compared to those treated with laser alone.
Tepper et al. 2004[25]	Human enamel was irradiated with CO_2 laser associated or not with amine fluoride before SEM. It was subjected to acid challenge before AAS.	Irradiated enamel had higher fluoride uptake. Irradiated enamel treated with fluoride had less morphological change and similar demineralisation compared to those treated with laser alone.
Hsu et al. 2001[12]	Human enamel treated with sodium fluoride was irradiated with CO_2 laser before pH cycling. It was studied by microradiography and SEM.	Irradiated enamel treated with NaF was more resistant to demineralisation than the control group. Irradiated enamel showed no evidence of surface melting.
Hsu et al. 1998[23]	Enamel irradiated with CO_2 laser associated or not with fluoride was exposed to a demineralising solution before light microscopy and microradiography.	The irradiated and non-irradiated enamel was more resistant to demineralisation in the presence of fluoride. There was a synergism between laser irradiation and fluoride in reduction of enamel solubility.

AAS = atomic absorption spectrometry, APF = acidulated phosphate fluoride, CFU = colony-forming unit, MHT = microhardness testing, NaF = sodium fluoride, QLF = quantitative light-induced fluorescence, SEM = scanning electron microscopy, TiF4 = titanium tetrafluoride, TMR = transverse microradiography

Table 3: Summary of studies of CO_2 (10,600 nm) lasers with fluoride on preventing enamel demineralisation.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Authors, year	Methods	Main findings
Esteves-Oliveira et al. 2017[26]	Bovine dentine irradiated with CO_2 laser was treated with NaF and subjected to cariogenic biofilm challenge before TMR, CFU, and SEM.	Irradiated dentine treated with NaF was more resistant to demineralisation and yielded lower CFUs than those without NaF treatment.
Esteves-Oliveira et al. 2011[13]	Bovine dentine was irradiated with CO_2 laser associated or not with APF and then subjected to pH cycling before ICP-OES.	Irradiated dentine treated with fluoride had lower calcium and phosphorus concentration in the demineralisation solution than those without fluoride treatment.
Gao et al. 2006[11]	Human root dentine was irradiated with CO_2 laser associated or not with NaF. They were subjected to pH cycling before PLM. Fluoride uptake was characterised by the ToF-SIMS analysis.	Irradiated dentine treated with NaF was more resistant to demineralisation than the control group. Irradiated dentine had a significantly higher fluoride uptake than non-irradiated groups.

APF = acidulated phosphate fluoride, CFU = colony-forming unit, ICP-OES = inductively coupled plasma optical emission spectrometer, NaF = sodium fluoride, PLM = polarized light microscopy, SEM = scanning electron microscopy, TMR = transverse microradiography, ToF-SIMS = time-of-flight secondary ion mass spectrometry

Table 4: Summary of studies of CO_2 (10,600 nm) lasers with fluoride on preventing dentine demineralisation.

tion. Scopus and Web of Science belong to commercial companies, and subscription fees are required to use these two databases, which cover most scientific fields. Scopus includes a wider range of journals than PubMed and Web of Science,[30] and it includes articles published since 1966. Web of Science is the first comprehensive scientific citation indexing database covering the oldest publications. The earliest records date back to 1900.[30] The articles in Web of Science are published in journals with an impact factor. With the use of these three commonly used databases, the results of the retrieval were exhaustive, and they provided comprehensive information on the effects of CO_2 lasers on caries prevention in previous publications. This literature review only included 10,600 nm CO_2 wavelengths, while studies with 9,300 and 9,600 nm wavelengths were excluded. The 10,600 nm wavelength was selected because it has been extensively studied and marketed in the dental field.[31] Moreover, the absorption coefficient of 10,600 nm of enamel and dentine is lower than that of 9,300 and 9,600 nm wavelengths. This allows lasers of 10,600 nm wavelength to be six times and ten times deeper in penetration depth in dental hard tissue than those of 9,300 and 9,600 nm, respectively. Further, 10,600 nm might be the preferred wavelength for caries prevention studies because of its optical property.[24,26]

Enamel and dentine surface irradiated by CO_2 laser either showed little to no surface morphological change[7,8,15–17] or melting, fusion, and recrystallisation.[14,18–20,22] Regardless of surface change, irradiated surfaces showed reductions in carbonate content and increases in microhardness and demineralisation resistance. Surface changes were thought to be related to demineralisation inhibition.[14] Sealing of enamel surface was also suggested to reduce the permeability of enamel surfaces during ion exchange.[32,33] Studies showed that fluence between 5 and 16 Jcm^{-2} produced melting, fusion, resolidification, and recrystallisation on enamel surface.[14,18–20] Lower fluence is required on dentine than on enamel, as higher surface temperature is achieved due to the lower reflectance loss and lower thermal diffusivity of dentine.[21] Morphological variations on melted surfaces, such as droplets, holes,[14] and smooth recrystallined surfaces,[18] might foster resistance to demineralisation. However, undesirable cracks were also observed.[8,22,24] Although surface melting and fusion reduced permeability, surface morphological change was not necessary for enhancing resistance of enamel to demineralisation.[8,15–17] The effect of temperature rise induced by laser in an organic matrix was suggested by Sato.[34] He suggested that the melting and swelling of the organic matrix under heat (300 to 400 °C) blocked the diffusion pathway of calcium, which resulted in calcium loss reduction. Hsu suggested that there may be partial blockage of inter- and intraprismatic spaces.[16] This affected the ion diffusion in enamel and restricted enamel demineralisation. Dentine contains organic and inorganic components similar to enamel, but it is higher in water and organic content by volume. A laser-induced thermal effect at 600 to 900 °C was suggested as a mechanism to reduce or eliminate carbonate content and increase crystallinity to reduce tooth solubility.[21,22]

Calcium fluoride crystals were present on fluoridated surfaces after topical fluoride application.[35,36] The concentration of fluoride on enamel surfaces was shown to increase with application of acidic fluoride agents.[37] Fluoride agents from neutral to strong acidity (low pH value) were studied in this review.[12] Enamel treated with 4 % titanium tetrafluoride (pH 1.2) alone had better resistance to demineralisation than those treated with laser and titanium tetrafluoride.[24] Laser irradiation before or after fluoride application of 1.23 % acidulated fluoride phosphate and 1.23 and 5 % sodium fluoride (NaF) at pH between 3.5 and 4.5 improved demineralisation resistance and

microhardness similar to fluoride alone or laser alone.[26–28] There was a synergistic effect in mineral loss reduction using a laser with 2 % NaF neutral solution.[12] It was suggested that laser irradiation in the presence of fluoride resulted in fluorapatite formation as organic matrix was removed.[12] Concentrations of NaF did not seem to be a factor in synergism with lasers.[12,26,28] It might be deducted from the above-mentioned studies that acidic fluoride affected the synergism of laser and fluoride, but it appears that neutral fluoride is related to synergism. Amine fluoride has been demonstrated to superior to sodium fluoride.[38] The amino group binds readily onto enamel enabling fast, even distribution of fluoride over the surface. It was reported that there was a synergistic effect in fluoride uptake and a reduction in enamel solubility using 1 % amine fluoride solution (pH not reported), but there was no significant difference in acid resistance between fluoride alone and laser with a fluoride group.[25] However, the same article concluded that laser with fluoride showed beneficial effect in acid resistance. Synergistic effects of laser and fluoride on dentine did not seem to depend on the sequence of laser and fluoride application.[11,13,26] The use of acidulated phosphate fluoride (pH 3.5 and 1.25 % fluoride) and NaF (pH 4.5 and 2.26 % fluoride) on dentine gave synergistic effect in reduction in calcium loss and mineral loss.[13,26] However, laser with the same fluoride concentration and acidity did not show synergistic effect on enamel. The use of 2 % neutral NaF solution with laser showed synergistic effect on dentine as well as enamel, as discussed earlier. The combination of NaF and laser irradiation resulted in significantly higher uptake of fluoride and lesion depth reduction than fluoride or laser alone.[11] Fluoride interacts with teeth by incorporating into hydroxyapatite crystals. The formation of calcium fluoride-like material on the surface was thought to be the main factor in caries reduction.

There were a few postulated mechanisms of combined laser and fluoride. Laser-induced temperature increase resulted in loss of carbonate in the crystalline structure, which was substituted by fluoride ions, enhancing fluoride uptake.[11] The use of laser to modify dentine surface energy might cause more stable absorption of calcium fluoride.[13,26] The fluoride ions released by calcium fluoride could reduce demineralisation and enhance remineralisation. The main reason for reduction in lesion depth might be the result of fluoride that firmly bound to root surfaces, acting as a fluoride reservoir against demineralisation.[11] Therefore, the effect of CO_2 laser irradiation on the lesion depth of dentine needs further investigation. The combined effect of laser and fluoride was also likely to be related to effect on enamel and dentine surfaces. Synergistic effects were achieved with different sets of laser parameters on enamel and dentine with 2 % neutral NaF solution.[11,12] There were many variables in laser parameters that could influence the temperature increase and changes on enamel and dentine surfaces.[13] Parameters such as pulse durations, energy densities, irradiation methods, and total pulses irradiated per spot area are not discussed in this review.

Conclusion

In this review, studies found that CO_2 (10,600 nm) lasers could prevent demineralisation of enamel and dentine. Although the exact mechanism is not well-elucidated, current evidence suggests that CO_2 lasers have a synergistic effect with fluoride in preventing the demineralisation of dentine.

Compliance with ethical standards: the authors declare that they have no conflict of interest.

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Literature

about the author

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Treatment of midline diastema

Dr Nataša Prebil, Slovenia

Introduction and background

Physiological transitory maxillary midline diastema is observed in children during the eruption of the maxillary anterior canines, but is unrelated to the eruption of teeth. In most cases, it self-corrects after the eruption of the maxillary canines (in 96 % it closes spontaneously). Midline diastema of teeth has been observed owing to various aetiological factors, such as supernumerary teeth, congenital absence of permanent teeth, deleterious oral habits, high frenal attachment and others, such as peg-shaped laterals and microdontia. The correct diagnosis should be established. If a high frenal attachment is the reason for a midline diastema, then a frenectomy is indicated as surgical procedure. Midline diastema persists when a maxillary labial frenum has papillary insertion (type III) or is penetrating at the palatal papilla (type IV).

The optimal time for frenectomy is after the maxillary canine teeth have erupted and diastema cannot self-correct. This advisable intervention should be performed in early childhood, between 7 and 9 years of age. At this time the postoperative recovery period is very short and requires minimal patient compliance. The surgical correction of a diastema can be successfully accomplished without orthodontic treatment. At a later stage, when active tooth eruption has finished, closure of the maxillary midline diastema with a prominent frenum is a more predictable approach with frenectomy and concomitant orthodontic treatment than with frenectomy alone. Some recommendations exist to perform frenectomy prior to orthodontic therapy, while some suggest between or after.

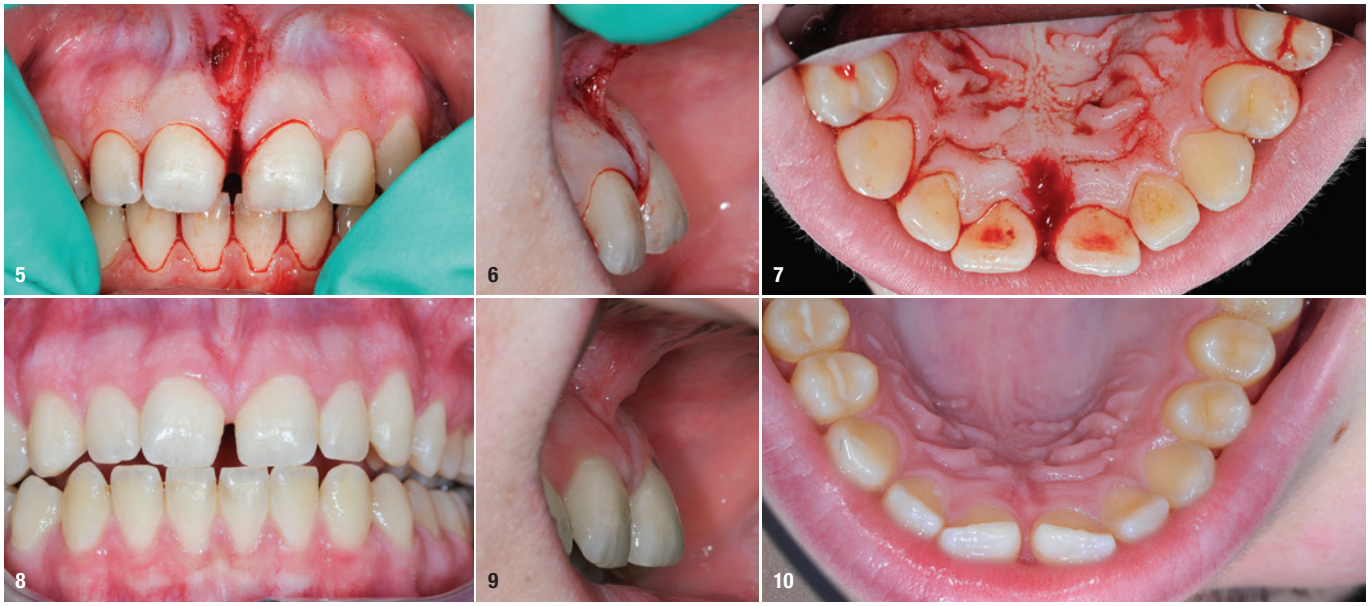
One of the explanations of the ideal time for this procedure says that it should be during an orthodontic therapy; if the procedure is done prior to closure (or near closure) of the diastema, the size of the scar will be larger; closing the space will involve an exaggerated amount of dense collagen (scar tissue) to bunch up, making space closure more difficult. The optimal time for the frenectomy is when there is still enough space to perform the surgical procedure and when the space is very nearly closed. Also, the appliances should be in place so that immediate force application will close the space and hold it closed while healing takes place. In this way the “scarring” will help to sustain the space closure, not prevent it. Finally, the procedure should be done with sufficient creativity so that the incisive papilla is enhanced, not destroyed.

In this case, the patient came to our dental surgery with a labial frenulum type IV. Such a frenum prevented closure of the diastema and affected the anterior aesthetics of the mouth. Er:YAG laser (2,940 nm) was used to vaporise the mucous and collagen components of the frenum through its photothermal effect on water molecules. Er:YAG is completely absorbed in the superficial tissue layer, thereby preventing damage to the underlying and surrounding structures. This is especially important when removing deeper layers around nerves and vessels (incisive papilla).

Figs. 1–4: Initial clinical situation showing the midline diastema.

Anamnesis and treatment plan

A 16-year-old female patient came to our office with labial frenulum type IV, anomalous frenum with fibrotic attachment penetrating at the palatal papilla, preventing the closure of the midline diastema (Figs. 1–4). She had been generally healthy, with no serious illnesses,



Figs. 5–7: Situation post-op immediately after labial frenectomy. **Figs. 8–10:** Clinical situation at the follow-up after 3 months, showing complete healing.

no observed allergies or use of medication. The patient had good oral health. Teeth 16, 24, 25, 34, 35, 36 and 44, 45, 46 had fissure sealant restorations. Tooth 26 had a composite filling. The third molars hadn't erupted yet. Gingival tissue was healthy. Plaque control and oral hygiene was good. Palpation of both temporomandibular joints (TMJ) showed no evidence of pathology, with normal jaw movements. The occlusal relationship was Angle's Class I. A local anaesthetic was infiltrated into the soft tissue surrounding the frenum and incisive papilla after topical anaesthesia (0.5 ml of 3 % Scandonest, mepivacaine HCl injection, Xylocaine Spray 50 ml topical). An Er:YAG laser system (LightWalker AT, Fotona) was used with a H14 handpiece and a chisel fibre tip 12/0.5 x 1.5 mm. The laser was set at 155 mJ energy, 15 Hz frequency, 2.3 W power, water level 3, air level 2, in SP mode.

The laser handpiece was positioned in contact with the frenum. First, a vertical incision of the upper frenum was made, followed by a horizontal incision to create the mucogingival line. When the collagen fibres were vaporised, a light incision of the periosteum was made along the mucogingival junction using a higher percentage

Figs. 11–14: Clinical situation at the follow-up after 7 months, showing small spontaneous closing of the diastema.


15


16

Figs. 15 & 16: Clinical situation 2.5 years after the operation.

of air–water spray to better control thermal damage (water 5, air 3). For the final interdental vaporisation of the collagen fibres in the papilla and palate, slightly higher energy was employed: 165 mJ energy, 15 Hz frequency, 2.47 W power, water level 5, air level 3, in SP mode. Subsequently, Nd:YAG was used (LightWalker AT) to control the bleeding due to its coagulating properties, with a R21-C3 handpiece with non-initiated 300 µm fibre, 30 Hz frequency, 4 W power, in VLP mode. The procedure was finished with biomodulation using Nd:YAG with a Genova handpiece in MSP mode with 0.5 W power, 10 Hz frequency, at one spot on the buccal side and one on the palatal side, for 60 seconds per spot to achieve pain reduction and faster healing. Biomodulation was performed twice, every second day. The total time of the procedure was approximately 14 minutes.

Discussion and results

Mild bleeding persisted at the start of the treatment, followed by moderate bleeding with no pain, which then ceased completely after using Nd:YAG and applying pressure with a gauze for 10 minutes (Figs. 5–7). No complications (such as pain, swelling, or bleeding) were encountered immediately after the laser procedure. It is important to use a shorter pulse duration with Er:YAG (SP–MSP mode) for removal of the collagen fibres from the bone and incision on the periosteum; a longer pulse (VLP mode) can present a higher risk of thermal damage, but can be a suitable alternative for Nd:YAG with coagulation at the end. The patient was instructed to use chlorhexidine gel 0.5 % (Curasept, Curaden) and to avoid eating hot, acidic or hard food during the first few days after the surgery. There were no complications resulting from the procedure.

At the 3-month recall, a completely healed wound was observed (Figs. 8–10). Seven months after the surgical procedure a slight spontaneous closure of the diastema seemed to be observed (Figs. 11–14). The patient was referred to a specialist for orthodontic therapy but did not want to undertake it. She was still satisfied with the result at 2.5-year follow-up (Figs. 15 & 16).

Conclusion

The Er:YAG laser with a wavelength of 2,940 nm has been successfully used for carrying out the here described labial frenectomy, with complication-free subsequent healing. For complete closure of the diastema, it is important that—when a frenectomy is indicated—the timing should be agreed between the orthodontist and surgeon.

about the author

In 1996 **Dr Nataša Prebil** graduated in Stomatology from the University of Ljubljana, Slovenia, and subsequently started her career as a paediatric dentist. In 2003 she started focusing on patients with special needs. She later opened a private clinic for children and adults in 2006 and another clinic for adult patients in 2013. She began working with dental lasers in 2009 and completed the LA&HA Dental Master's Program in Laser Dentistry in 2018. She mainly uses lasers in oral surgery, periodontics and endodontics, as well as in facial aesthetics.

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Complex management of drug-induced gingival hyperplasia

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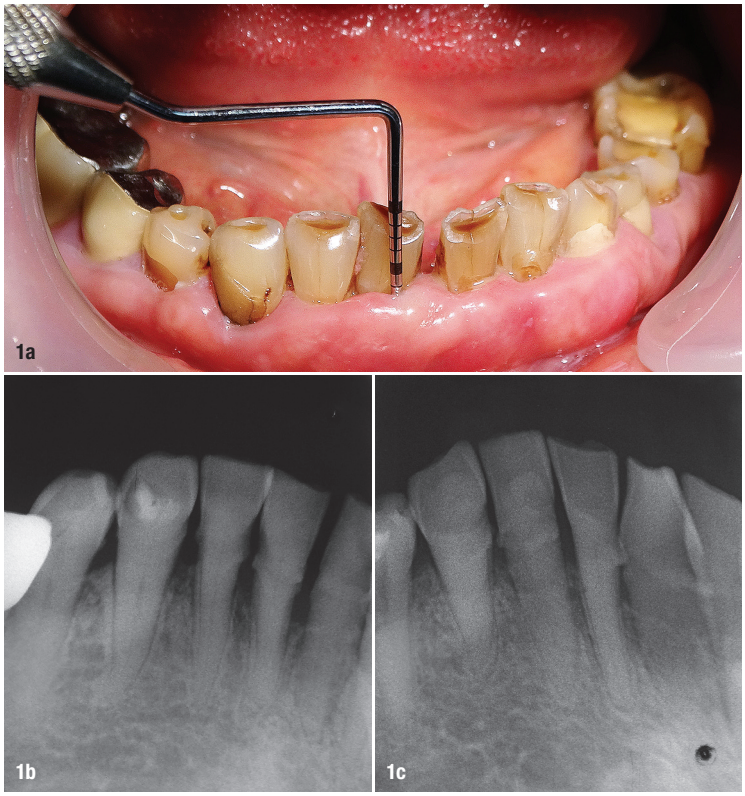

Fig. 1a: Preoperative view of soft tissues and estimation of periodontal probing depth with a CP-15 probe. **Figs. 1b & c:** Radiographic evaluation of the mandibular anterior region, showing approximately 2 mm of attachment loss, subgingival calculus and carious lesions.

Introduction

Drug-induced gingival overgrowth or enlargement occurs as a part of the systemic therapy of some non-dental conditions.[1] It occurs as an adverse effect following administration of drugs such as calcium channel blockers, anticonvulsants, specific immunosuppressants, among others.[1] The existence of specific oral and extra-oral factors (age, genetic predisposition, presence of pre-existing plaque and gingival inflammation) determine the interaction between the drugs and gingival tissue. However, the gingival response in patients can vary in severity and scope. Drug-induced gingival overgrowth impairs proper hygiene habits, lowers the aesthetic profile of the dentition and creates a suitable environment for further plaque formation and aggravation of pre-existing periodontal conditions. As of yet, there has been not enough data and research findings which could consolidate the challenging management of affected patients. There is a clear need for developing new and reproducible clinical treatment protocols, committed to recent advancements made in dental technology. The aim of this case report is to demonstrate a comprehensive treatment protocol of drug-induced gingival overgrowth, employing different treatment modalities.

Case presentation

A 57-year-old female patient was referred to the Laser Center in the Faculty of Dental Medicine of the Medical University of Plovdiv in Bulgaria, with the complaint of the unaesthetic appearance of gums in the mandibular anterior region, along with occasional bleeding when brushing and overall difficult oral hygiene in the region (Fig. 1a). After obtaining written consent for diagnostics and treatment, a thorough dental history was taken. The patient revealed she suffers from hypertonia (high blood pressure) which has been treated by means of a calcium channel blocker (Amlodipine) for more than five years. The rest of the medical history was non-contributory.

Periodontal assessment of the patient revealed firm and nodular attached gingiva in the anterior mandibular region covering over one-half of the clinical crowns with clinical signs of inflammation: redness as well as bleeding upon gentle probing was noted and loss of stippling and rolling of the free gingival margin was visible. Its position was estimated coronally from the CEJ (cemento-enamel junction). Consecutively, periodontal charting was performed, presenting pocket probing depths around 6 mm in the anterior mandibular region and 4–5 mm in the rest of the dentition. The radiographic examination of the dentition revealed initial periodontal involvement with clinical attachment loss of around 2 mm throughout (Figs. 1b & c). Based on the collected diagnostic data, the observed pocketing in the anterior mandibular

region was deemed pseudo-pocketing, classified as grade 2 in the modified index system of Angelopoulos & Goaz (1972); see Table 1.

The active treatment protocol continued with devising a treatment plan consisting of two distinct phases: initial periodontal therapy and corrective periodontal therapy. Initial treatment consisted of thorough scaling and root planing by means of ultrasonic devices and manual instrumentation. The patient's oral hygiene habits were discussed and a 0.12 % chlorhexidine solution was prescribed. After two weeks, the patient was recalled for corrective treatment. The corrective protocol involved three procedures, each scheduled one week apart.

Procedure 1

Er:YAG laser-assisted gingivectomy and gingivoplasty (2,940 nm)

The gingivectomy was performed according to a standard surgical protocol. Local anaesthesia was infiltrated, before the bleeding points were marked with Crane-Kaplan forceps. The gingivectomy was performed 1.5 mm apically from the bleeding points with a continuous excision bevelled at 45°. The excision was done with Er:YAG laser system (LiteTouch, Syneron Dental) at a wavelength of 2,940 nm (Figs. 2a & b). A chisel-type tip was used with high water cooling at an energy level of 300 mJ/18 Hz in contact mode. The consequent gingivoplasty consisted of bevelling and smoothening of the excised margin, until a festooned knife-edge gingival contour is achieved (Fig. 2c). The gingivoplasty was performed using a 1.3 x 19 mm laser tip and the laser set at 200 mJ/15 Hz in non-contact mode with high water cooling. Upon finishing the procedure, a periodontal dressing (Peripac, Dentsply DeTrey) was placed inside the patient's mouth and she was given thorough instructions for post-op care (Fig. 2d).

Grade	Hyperplasia	Size	Tooth coverage
0	No	Normal	No
1	Minimal	< 2 mm	Cervical third or less
2	Moderate	2–4 mm	Middle third
3	Severe	> 4 mm	More than 2/3rd

Table 1: Degree of gingival hyperplasia according to modified index by Angelopoulos & Goaz (1972).

Procedure 2

Antibacterial photodynamic therapy with an 810 nm diode laser

After two weeks, the epithelisation process finalised uneventfully (Fig. 3). However, signs of inflammation were

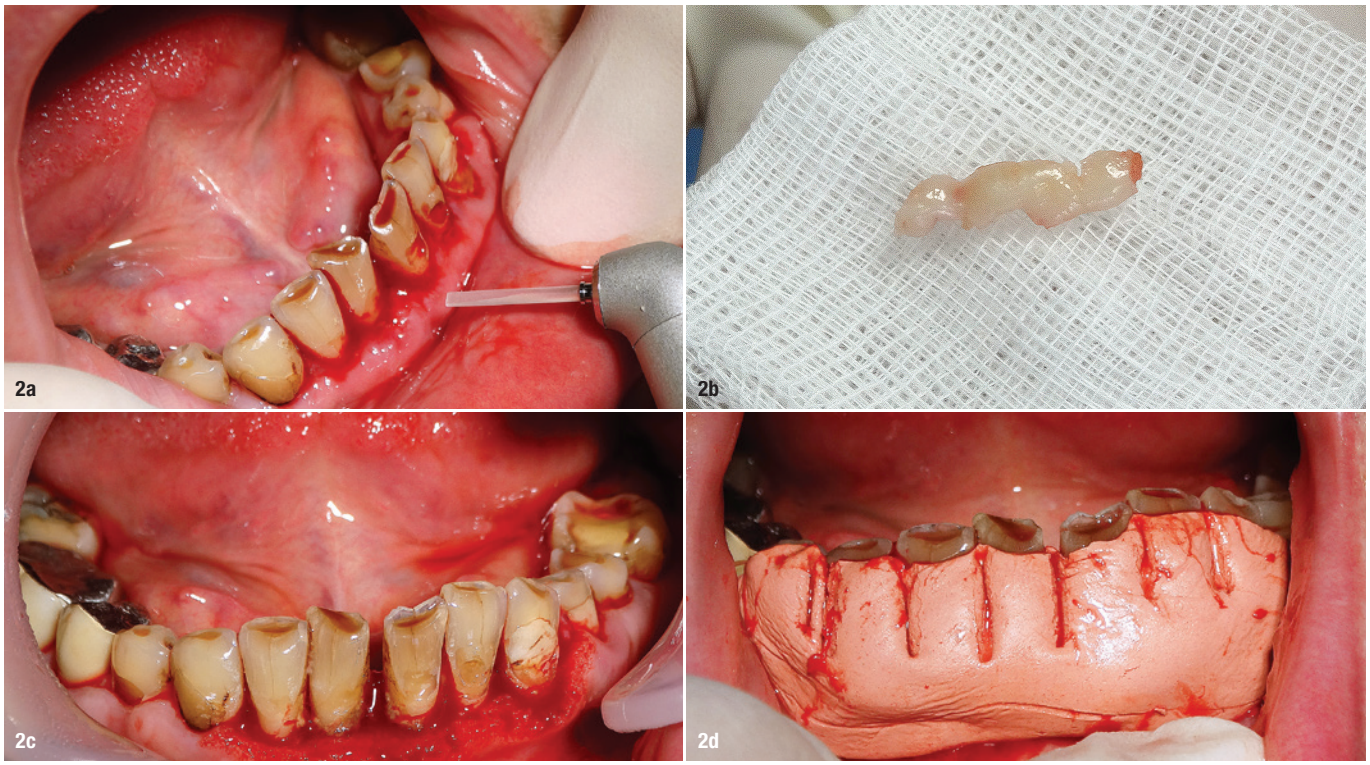

Fig. 2: Performance of gingivectomy with Er:YAG laser **(a)**; view of the excised soft tissue **(b)**; immediate postoperative view of the treated area **(c)**; placement of periodontal dressing **(d)**.

Fig. 3: Postoperative view of the soft tissues after 14 days. **Fig. 4a:** Application of indocyanine green dye. **Fig. 4b:** Light activation of the dye with 810 nm diode laser. **Fig. 5a:** Er:YAG laser-assisted tooth structure preparation for adhesive obturation. **Fig. 5b:** Postoperative result after three weeks. **Fig. 6:** Periodontal status after six months.

still visible, thus indicating the need for antibacterial photodynamic therapy (aPDT). This is a novel approach in supplementary periodontal treatment. It involves the application of a specific dye into the periodontal pockets, which—when activated with a specific light wavelength—dissipates into reactive oxygen species (ROS). In the periodontal pockets, ROS have high cytotoxic properties against most of the periodontal flora. aPDT is a non-thermal and non-invasive local therapy, bearing numerous beneficial effects. For this case, aPDT was performed using indocyanine green dye (EmunDo; Fig. 4a), mixed ex tempore and activated with an 810 nm diode laser (Syneron Dental; Fig. 4b). Indocyanine green is a fluorescent dye with an absorption spectrum of between 750 and 850 nm wavelength. Hence, a diode laser system operating at a wavelength of 810 nm is deemed its optimal light activation. When activated, indocyanine green is highly toxic to most anaerobic periodontal flora. Photodynamic activation was performed three times for a duration of 20 seconds per tooth.

Procedure 3

Er:YAG laser-assisted cavity preparation and composite obturation

However, after soft-tissue contouring, many carious and non-carious lesions were evident, acting as plaque-retentive factors. The teeth were prepared for obturation with the Er:YAG laser (LiteTouch) with a 1.0 x 17 mm tip, set to non-contact mode, 200 mJ/20 Hz, and water cooling. Laser preparation of tooth structures is vastly more conservative and effective due to the water absorption

peak of the Er:YAG wavelength. After preparation, the cavities were obturated according to a standard adhesive protocol with a nano-filled composite (G-ænial Anterior, GC Europe; Figs. 5 & 6).

Discussion

Drug-induced gingival hyperplasia is a soft-tissue condition that often requires a complex treatment approach.[2] In most cases, the enlarged gingival tissue presents a suitable environment for the growth of a pathogenic periodontal flora and impairs oral hygiene efficacy, thus aggravating a pre-existing periodontal condition. In some cases, the drug–tissue interaction cannot be avoided or substituted with another medicament, which ultimately creates a therapeutic challenge. Surgical excision of the hyperplastic tissue in the form of a gingivectomy is the procedure of choice in this context.[2] Implementation of laser-assisted protocols in both surgical and supplementary treatment provides a vast number of advantages over standard procedures.[3]

In the soft-tissue surgical phase Er:YAG lasers provide high cutting efficacy with minimal to no thermal damage to the tissue, improved healing and better post-op comfort for the patient.[3] Erbium-doped lasers can be used in non-contact mode along with water cooling, thus improving the field of view of the operator. Er:YAG laser systems have the highest absorption peak in water molecules, thus rendering them as one of the most sophisticated surgical systems for soft-tissue interventions. This is well presented in a secondary surgical procedure—the gingivoplasty. Gingivoplasty is the surgical recreation of the thin, scalloped, knife-edge contour of the gingival tissue. Traditionally, this is performed with a diamond bur, which causes thermal (frictional) and mechanical trauma to the soft tissue.[4] With Er:YAG laser systems, a gingivoplasty is performed in a non-contact minimally invasive fashion without thermal or mechanical trauma to the soft tissue.[4] The achieved contour is much more delicate and provides faster healing. Er:YAG laser systems are the only ones suitable for hard-tissue preparation, owing to their water molecule absorption peak. Er:YAG laser-assisted tooth preparation is a minimally invasive, non-contact process which does not create a smear layer on the hard tooth structure, improving the adhesive protocol of obturation as a result.

Antibacterial photodynamic therapy is a novel approach in supplementary periodontal treatment.[5] It relies on the photoactive properties of some dyes, which when activated (through a specific light wavelength) release an array of ROS. ROS, in turn, have highly specific cytotoxic effects on the bacterial cells. The photochemical reaction in its essence is purely oxidative, thus creating oxidative stress on bacterial membranes. Antibacterial photodynamic therapy is a local, non-thermal and non-invasive supplement to the standard protocols of non-surgical periodontal treatment.[5] The high selectivity of this method depends on two main factors: photoactive dye and light source. Lasers are especially suitable for photodynamic therapy, since they provide a monochromatic, coherent light beam with a fixed wavelength. In this case, indocyanine green was selected for its proven efficacy against Gram-negative anaerobic flora (predominantly found in periodontal pockets). As the dye's highest absorption peak ranges between 750 and 850 nm, a diode laser with a wavelength of 810 nm was selected as a light source for the photodynamic reaction.

Conclusion

A treatment plan that includes complex laser-assisted modalities for treating drug-induced gingival hyperplasia offers a plethora of benefits outcome-wise. However, insufficient knowledge of light-tissue interaction and the optical properties of some structures and substances in the oral cavity can limit the clinician's scope of treatment with laser light.

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Literature

about the author

In 2004 **Dr Georgi T. Tomov** graduated from the Medical University of Plovdiv, Bulgaria, with Summa cum laude for his Master's degree in Dental Medicine. In 2009, after the defense of a doctoral thesis, he obtained a PhD degree. He has two specialties – endodontics (2008) and periodontology (2019). Currently, Georgi Tomov is Head of the Oral Pathology Division and the Director of the Laser Center at the Faculty of Dental Medicine, Plovdiv. The scientific interests and clinical practice of Dr Tomov are focused on endodontics, periodontology, oral pathology and laser applications in dentistry.

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Marsupialisation of an oral mucocele with a diode laser

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Introduction

A mucocele is a prevailing disorder of the oral cavity. This lesion is caused by the accumulation of seromucous fluids in response to trauma, such as biting on the lip, and/or changes to minor salivary glands. Histopathologically, there are two kinds of mucoceles: extravasation (mostly due to trauma) and retention (mostly due to obstruction of the salivary glands). Clinically speaking, the lesion has the form of a bulla and/or a vesicle. Patients do not feel pain when biting on it. It is pink or blue in colour and has a tendency to recur. Its size varies from 1 mm to several centimetres, and it may occur at any age and in any sex. It most commonly occurs on the lower lip, but it can occur in any other part of the oral cavity as well.[1] It is diagnosed clinically in order to assess whether the lesion is pathogenic or not.[2] Trauma scarring, location of the lesion, blue colour, rapid onset, fluctuation and persistence are the main factors for diagnosis. Aspiration of the lesion reveals the presence of mucus.[3] Moreover, radiographic imaging is used to check for obstruction of the salivary gland ducts. Cone beam computed tomography scans and magnetic resonance imaging are also important ways to determine its origin and range.[4] For differential diagnosis, salivary gland and lipoma tumours should be considered. In this regard, the lesion is touched to determine fluctuation. Fluctuation is observed in cysts, abscesses, mucoceles and haemangiomas, whereas the symptom of fluctuation of the lesion is not observed in salivary gland and lipoma tumours.[5] If the lesion does not heal automatically after a duration of two weeks, it should be treated.[6]

Various methods have been proposed for the treatment of mucoceles, including scalpel incision, complete surgical excision, marsupialisation, micro-marsupialisation, intralesional injections of corticosteroids, cryosurgery, laser ablation, intra-lesional injections of sclerosing agent, and electrocautery methods.[7] The removal of a mucocele with a scalpel as done conventionally is associated with problems such as intra-oral bleeding, compromised wound healing and sterility. All these problems can be avoided by treating mucoceles with a laser.[8] Given the introduction of lasers in dentistry and their potential applications in dental treatments, there are excellent treatment opportunities for diode laser.[9] Laser treatment of mucoceles has been reported to provide excellent results.[10]

Medical and dental history

The systemic evaluation of a 36-year-old patient showed no systemic medical problems, no allergies, no medication and no history of surgical procedures, so there was no need for the patient to be referred to a medical consultant. The oral and maxillofacial examination of the patient showed that there were no temporomandibular joint disorders, myofascial disturbances, or functional or parafunctional habits, nor was there Class I malocclusion. However, we found multiple sites of dental caries and calculus accumulation. Apparently, the patient's oral hygiene was poor.

Clinical findings and diagnosis

The patients' chief complaint was that there had been painless swelling on the inner surface of the lower lip for six months. Swelling had been minor initially and then had increased gradually until it had reached the present size. Upon intra-oral examination, a round, solitary, fluctuant swelling was seen on the inner surface of the lower lip at the region of the right central incisor and canine. The swelling extended to the vermilion border of the lower lip and downward towards the lingual vestibule, measuring approximately 10 mm in size (Figs. 1 & 2). The swelling was of the same colour as the adjacent mucosa. The patient revealed that he had a habit of lip biting. There was no difficulty in speaking or chewing. His main complaint was rather of an aesthetic nature. The lesion was diagnosed as a mucocele based on the clinical features and the history of the lip biting habit.

Treatment plan

Pre-procedural preparation

The controlled area was defined and laser warning signs were properly placed to secure the operating room. The laser was then set up and tested for proper function: a laser test fire was carried out, directed towards articulating paper, according to the appropriate safety measures

Figs. 1 & 2: Initial clinical situation showing the mucocele on the lower lip. **Fig. 3:** Clinical situation immediately after the laser surgery.

and using minimum power and settings to ensure correct laser function. Subsequently, the patency of the delivery and the aiming beam was secured. The fibre tip was inspected to ensure that proper cleaving had been carried out and the spot size was uniform. The equipment was checked for cleanliness and the instruments were checked to ensure that they had been properly sterilised. Patient information, including the examination sheet, preoperative radiographs and the consent form were evaluated. Thereafter, the patient and the assistant were equipped with appropriate laser protection goggles for their eyes.

Treatment sequence

Topical anaesthesia was administered using a 10% lidocaine spray. Laser safety googles were put on. Conservative marsupialisation commenced with gently uncovering the lesion roof. Low-level laser therapy of the lesion with different laser settings was then carried out. Afterwards, the patient was instructed on post-surgical care. He was advised to keep the area clean and free from plaque by means of gentle brushing. He was also told to avoid food and liquids that may cause pain or irritation to the sensitive tissue. If needed, he was told to use over-the-counter analgesics.

Aim of laser application and its setting

Laser surgery was chosen because of its many advantages in that it reduces pain for patients, prevents oedema, controls bleeding and, owing to its minimally invasive nature, reduces stress for patients. In general, it can be argued that laser marsupialisation helps us to offer patients the best treatment services possible. The unique physics of the laser and the properties of the targeted tissue should be taken in account when choosing the most suitable laser settings. The 980 nm wavelength is better absorbed in water, and this helps us to carry out marsupialisation as satisfactorily as possible. In the case presented in this article, a diode laser with a wavelength of 980 nm (GIGAA LASER) was chosen. Because such thin tissue had to be removed, it was better to employ continuous wave mode, an initiated fibre and a 0.8 W power output, as these settings make for the best laser–tissue interaction. The high-speed movement of the fibre and high-volume suction can prevent thermal damage to the surrounding tissue. Low-level laser therapy was also performed with a 980 nm diode laser (GIGAA LASER) set to 0.1 W, non-contact mode at a distance of about 1 mm from the tissue, an irradiation duration of 10 seconds, a handpiece diameter

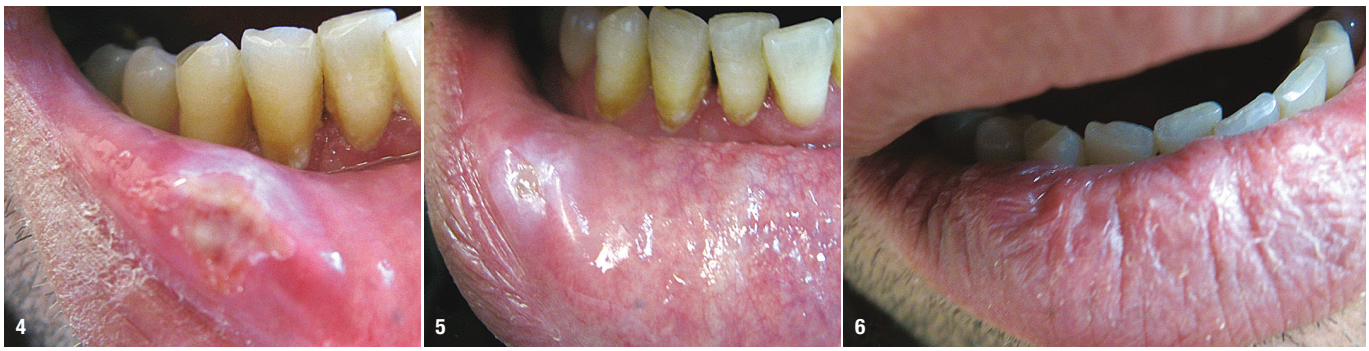

Fig. 4: Low-level laser therapy was performed again three days post-op. **Fig. 5:** Low-level laser therapy was performed again five days post-op. **Fig. 6:** A satisfactory result was seen at the follow-up after one month.

of 3 mm, a spot size of 0.07065 cm^2, scanning mode, a power density of 1.4 W/cm^2 and a dose of 14 J/cm^2. Postoperatively, low-level laser therapy was performed again at the follow-up after one, three and five days.

Surgical technique

The optic fibre was precisely cleaved and lightly initiated. With the fibre held perpendicular to the surface of the tissue, an initial vaporisation was performed via contact of the hot tip with the tissue. During treatment, high-volume aspiration was used to evacuate vapour plume and objectionable odours at the site of vaporisation.

Final result and follow-up

The outcome of the marsupialisation was excellent and no signs of bleeding, carbonisation, or char were observed. The patient did not experience any discomfort. He was calm throughout the procedure and satisfied with the outcome (Fig. 3). Postoperative low-level laser therapy was performed at the follow-up appointments on the first, third (Fig. 4) and fifth days (Fig. 5) postoperatively. The healing process went well and progressed as expected in that there were no signs of swelling and the patient did not experience any pain during the period. A good result with no sign of recurrence was observed one month after the procedure (Fig. 6).

Discussion

Our present study showed that the diode laser can be an excellent aid for achieving successful treatment results when treating oral mucoceles. Good results with laser treatment of mucoceles has been reported in the relevant literature.[10] Kato and Wijeyeweera used a carbon dioxide laser at a wavelength of 10.6 µm and a power of 3 and 4 W in continuous wave mode to remove mucoceles.[11] Pedro et al. used a diode laser at a wavelength of 810 nm and a power of 2 W in continuous wave mode to treat mucoceles.[12] A pulsed laser application is reported by Chinta et al., in which a diode laser was applied at a wavelength of 810 nm and a power of 2 W at 50 ms pulses to treat mucoceles.[13] Another instance of the pulsed mode is described by Agarwal et al., who used a diode laser at a wavelength of 940 nm and a power of 1.3 W at 10 ms pulses.[14] Moreover, Ahad et al. successfully used a pulsed diode laser at a wavelength of 810 nm and a power of 2 W at 30 ms pulses for the removal of mucoceles.[15] Another example is Ramkumar et al., who treated mucoceles with a diode laser at a wavelength of 940 nm and a power of 1.5 W in continuous wave mode with a 400 µm fibre.[16]

Conclusion

A combination treatment with a diode laser (its high power setting for removing the roof of the lesion and its low power setting for acceleration of the healing process) can be a safe and viable treatment modality for management of oral mucoceles.

Literature

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Dr Masoud Shabani is an Iran-based dentist specialised in laser dentistry. He is a lecturer at the Department of Community Dentistry at the School of Dentistry of the Ardabil University of Medical Sciences in Ardabil in Iran. In addition, he is an internationally published author.

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- access to two dedicated journals: *laser—international magazine of laser dentistry* (OEMUS MEDIA) and *Lasers in Dental Science* (Springer Nature);
- exclusive newsletters that bring you the latest news from the world of laser dentistry;
- one voting right.

You can also register your own expert association and become part of our affiliated societies worldwide network. Moreover, if you are an undergraduate student, you can benefit from a discount when registering (proof is required).

Academic Map

A new and innovative feature of our website is our unique Academic Map. For the first time ever, the members of a dental laser society can pin themselves online on a digital map of the world. There, they can upload short versions of their CVs, their work addresses (private dental clinics or academic institutions) and the wavelengths that they prefer to use. In this way, laser dentists worldwide are connected with each other and laser dentists can be found not only by their country or region but also by the wavelengths that they use. Thus, the ISLD gives its members the opportunity to expand their networks and motivates them to work together to further scientific clinical research on dental lasers.

The ISLD currently has more than 750 members worldwide, making it the world's leading laser organisation. You are hereby encouraged to register online on our website (www.isldlaser.com) and become an active member of our society.

contact

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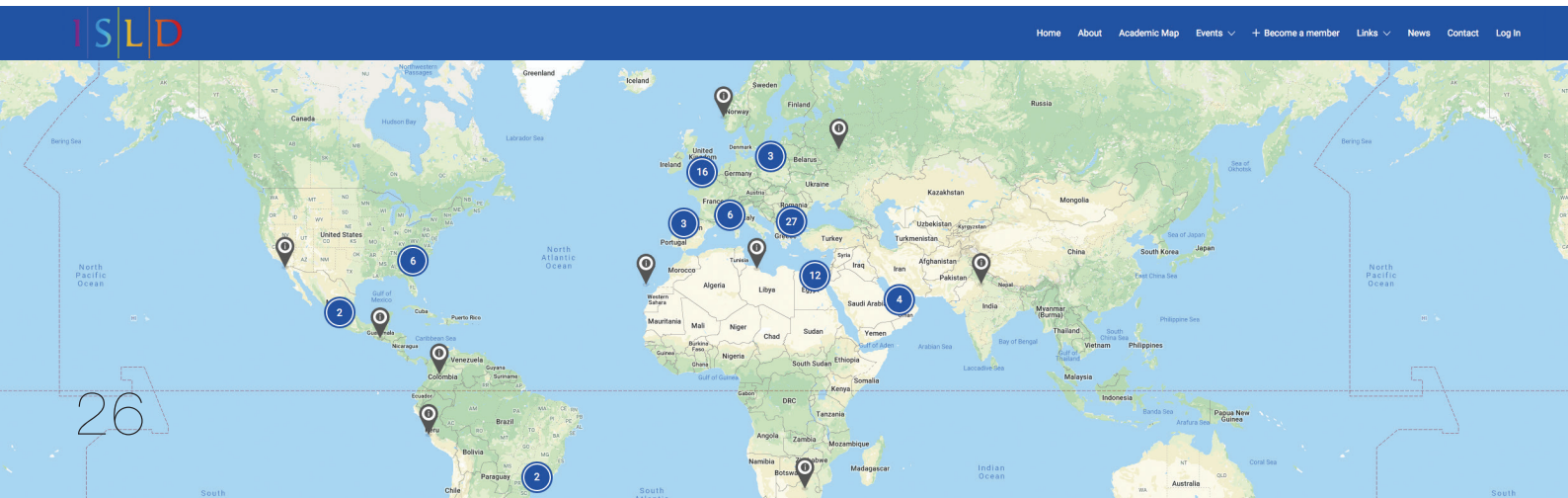
RWTH Aachen University
Pauwelsstraße 30
52074 Aachen, Germany
www.isldlaser.com



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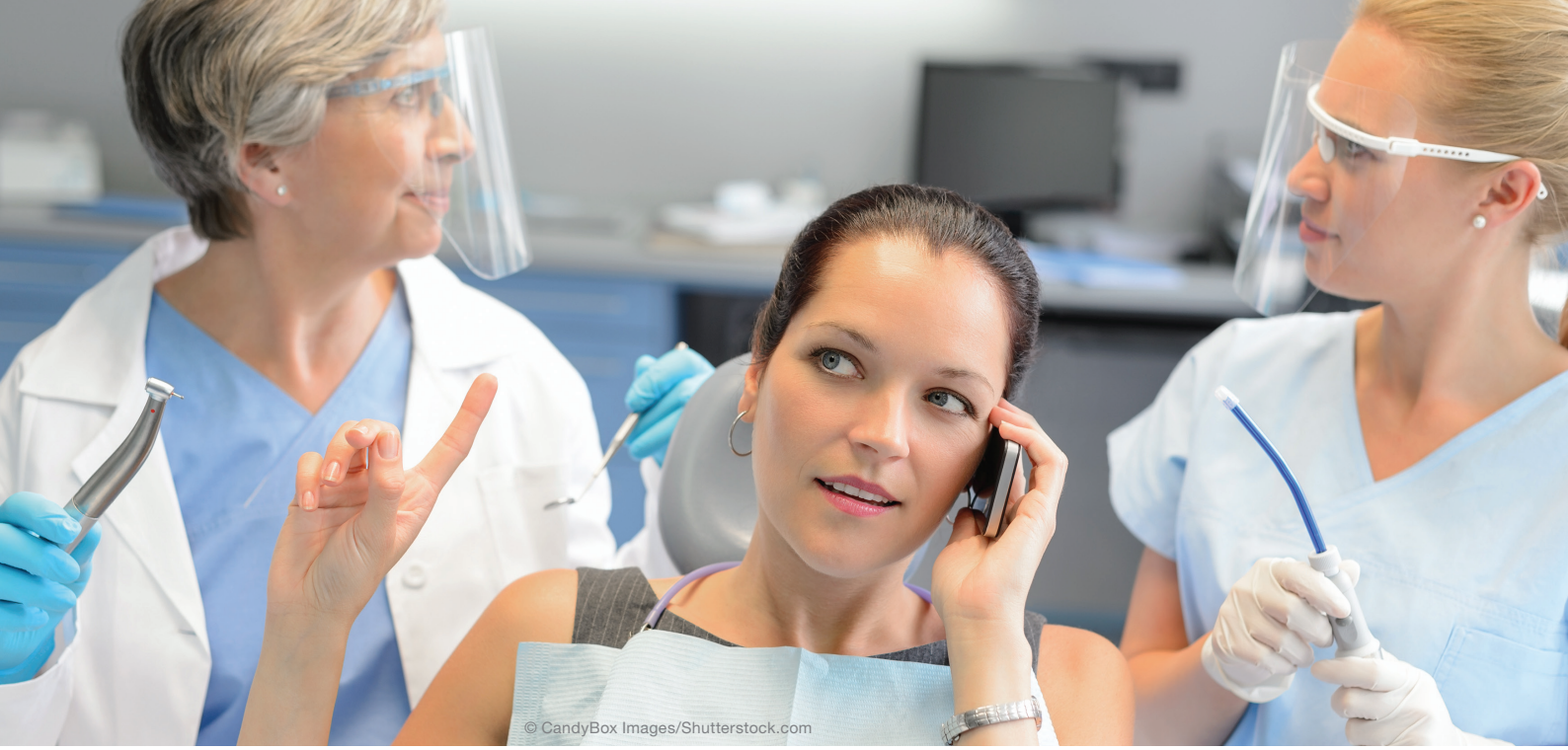

Successful communication in your daily practice

Part XIII: How to deal with rude patients

Dr Anna Maria Yiannikos, Germany & Cyprus

Hi! My name is Dr Anna Maria Yiannikos. Today, I present you the thirteenth part of this popular series, packed with communication protocols for your clinic or practice. This series covers the most common and challenging scenarios that might arise in your dental practice and presents successful ways to manage them in order for you to enjoy greater peace of mind and to reach another level regarding your experiences with patients. Each article of this series teaches you a new, easy-to-use protocol which can easily be applied and implemented into your own dental clinic's workflows and procedures right from the outset.

Have you ever wondered what the essential ingredients are for solving problems that you might encounter in the day-to-day interaction with patients? I'm here to teach you. There are plenty of issues—many of which we have already thoroughly discussed in previous parts of this series—which might put you in a difficult position, possibly even make you lose sleep, or lead to your self-confidence being seriously shaken. Imagine the feeling that you are able to overcome every problem that you could possibly face and that you can properly serve your patients by offering them the best solutions for their medical or aesthetic problem. How amazing would that be? Because let's face it: we are not only dentists, but also entrepreneurs, and we have to look at our clinics and dental practices as businesses that we have to run. Are you ready to find solutions for all of these problems?

Today's challenging topic is: how to deal with difficult and rude patients. Do you feel anxious and stressed out every time they visit your practice, or do you grow increasingly nervous with each day an appointment with a rude patient is drawing nearer in your calendar? Do not despair—in the following I will teach you five crucial and practical steps that will help you to stay calm and focused when faced with a difficult situation involving a rude and/or impolite patient.

5 essential steps

1. Think before you speak

Being the leader of a dental clinic, engaging in conflict with your patients is never a good idea. You should therefore always give yourself a moment to reflect and think

about the situation you're in before you start to speak. Allow yourself time to consciously breathe in order to balance yourself and take control of the interaction. Envision yourself as the conductor of an orchestra who is responsible for making the individual players follow your desired path. It is vital that you never ever engage in a discussion or start treatment on a patient if you are angry about him or her, or about the situation involving this particular patient.

2. Don't take anything personally

Rude or impolite patients are mostly angry with themselves, rather than with you—their dentist. Remember that it is only human to project one's self-discontent onto others. Whatever these patients say to you, it is most likely something that only has more to do with themselves, rather than with you or with something you might have done wrong. Here's a trick: try to imagine these patients as being physically very small before and during your encounter with them. In this way you will be able to take control of situations like these more efficiently.

3. Be proactive

Be sure to send out the treatment protocols of rude patients immediately after having finished their treatment sessions. Here's why: usually, these types of patients have issues with trust. Being rude or impolite is often only a protective shield protecting them from being hurt or disappointed. It is therefore vital to do everything you can in order to make them feel safe, and to show them that they have no reason to be suspicious.

4. Be brave, be vocal!

If patients are being rude to you—be brave and call them out on it! Figure out what could be the worst possible scenario while assessing the situation. With this risk management tip, you will immediately be able to acknowledge the fact that you could master any arising circumstance. Express your feelings verbally and tell your patient that he or she is being rude to you. You might be surprised about how ignorant the other person is towards the entire situation. Listen to what they have to say in defence. Show empathy and react with phrases like 'I understand you', instead of saying 'you are right'. It would be a pity to not see the forest for the trees!

5. Be calm and humane

Good interpersonal skills are essential for building lasting relationships. Therefore, always speak the truth without letting hurt feelings get in your way. Try to get to the bottom of a concrete issue by asking your patient questions, sit down with him or her and work out a solution that works for the both of you. A true win-win situation. At the end—make a gesture. For instance, offer your patient a warm handshake to show your positive attitude towards resolving the problem and departing with him or her on good terms.

How easy was that, right?

Use the above-mentioned steps as a protocol in your daily practice and you will soon notice that you are in control again and have greater peace of mind. With these five steps at your disposal, you will know exactly how to resolve a difficult problem and how to establish a customer-oriented service culture. In addition, I am confident that—if implemented correctly—these tips will help you achieve a significant increase in income. Just try it and feel free to share your thoughts with me!

I am sure that you are looking forward to the next issue of laser magazine with great anticipation, where in the fourteenth part of this series I will take a deep dive into yet another fascinating topic, namely: how to reject a patient (politely) without putting the reputation of your practice in jeopardy as a consequence. I will present you with the five most important steps that will help you remain calm and balance your stress levels. Until then, remember that you are not only the dentist at your clinic but also its manager and leader.

In case you have any questions or requests, if you would like to have further information on this topic, or if you simply need guidance in solving certain situations, don't hesitate to get in touch by e-mailing me at dba@yiannikosdental.com or visit our website, www.dbamastership.com. I am looking forward to our next step towards business growth and educational development. Let's keep in touch!

about the author

Dr Anna Maria Yiannikos (DDS, LSO, M.Sc., MBA) is one of the first two women worldwide to have obtained a master's degree in laser dentistry. She has owned a dental clinic for 30 years now and leads the innovative Dental Business Administration Mastership Course at RWTH Aachen University in Germany. She is an adjunct faculty member of the Aachen Center for Laser Dentistry.

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In order to avoid stress and disharmony in the daily work routine and to appear professionally as a team to the outside world, clear communication with one another is important. Reciprocal feedback is therefore of vital importance in order for communication in the dental practice to be as simple, appreciative and smooth as possible. What needs to be taken into account in this regard will be highlighted in this article.

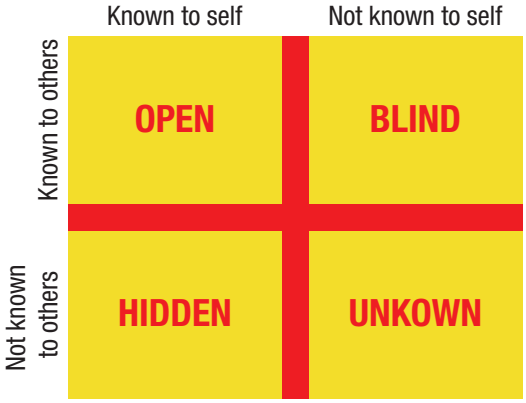
Feedback is important

Why we need feedback is explained by American social psychologists Joseph Luft and Harry Ingham in a model that sets out conscious and unconscious personality and behavioural traits. Their Johari Window, a combination of the psychologists' first names, is divided into quadrants and shows the differences in self-perception and perception by others. The open quadrant relates to what one reveals about oneself and what is known or visible to others. This includes external characteristics such as appearance, manners or even physical reactions, as well as internal attitudes and behaviour. The hidden quadrant is what a person knows about himself or herself, that is, things that he or she is aware of, but either unknowingly does not make available to others or consciously hides from them. The blind quadrant is everything that a person conveys and is perceived by the recipient without the sender being aware of it. Others thus recognise behaviours and characteristics that one does not perceive in oneself. Only through constructive feedback can information be moved from the blind quadrant to the open quadrant. It also allows reflection on things that we unconsciously keep from others. Feedback is an effective instrument to support colleagues or employees in their personal development. Unfortunately, the potential of this powerful tool often remains unexploited in many companies.

What is feedback?

The term "feedback" refers to a response to or assessment of a person's behaviour. It is a central process by which a reaction is conveyed. With feedback, we inform someone about how we perceived and experienced his or her behaviour. In this way, we invite the other person to employ metacommunication, that is, to talk about his or her behaviour. The most common feedback error is criticism of personality traits—and that is exactly what turns feedback into ridicule. Discussion in this manner of one's personality—which cannot be changed—is insulting and abusive, and no good or fruitful outcome can come from it. Authentic feedback, however, always aims at a positive change in behaviour; it is constructive and supportive. Feedback complements self-perception through external assessment and external perception. Feedback can

Johari Window (Joseph Luft & Harry Ingham, 1995)
Conscious and unconscious personality and behavioural traits



make visible how one's own behaviour has an effect on or is received by the other person, how a situation or performance is assessed or what potential for improvement exists. Correctly used, feedback can therefore be extremely valuable. In everyday professional life, it is almost indispensable for the further development of one's behaviour.

Differentiation from praise

Praise is usually not very specific, such as "you did a good job", "I am very pleased with you" or "keep up the good work". Praise is therefore positive feedback which, owing to a lack of specificity, does not bring about any lasting change. Praise might be very important in daily interaction—but giving feedback is essential.

Giving feedback

Giving constructive feedback has to be learned because, if applied incorrectly, it can have the opposite effect to that intended. Ideally, feedback should follow a methodical framework—feedback rules. The feedback should help the recipient to reflect on his or her behaviour in order to better assess its effect on others and to modify his or her behaviour if necessary. Feedback must be conveyed in a particular form in order to be fully effective.

Feedback rules

In order for feedback to have a motivating effect and to encourage one to develop oneself further as a consequence, it is important to follow the ten golden rules of feedback. The context especially is of vital importance: feedback is particularly effective if it is given promptly. Feedback should never take place according to fixed times. It makes much more sense to give constructive feedback as relevant things—whether positive or negative—arise.

Receiving feedback

Receiving feedback is also something that has to be learned. Most people initially react defensively to feedback and this is just what must be avoided. Constructive feedback is valuable because it reduces our blind spot. Explaining or justifying oneself immediately after receiving feedback would be counter-productive. Furthermore, feedback is not debatable. Even if one perceives the situation differently to the feedback received, it shows in a very appreciative way how one's behaviour affects others. The giver of the feedback must always intend to trigger a positive outcome—regardless of whether it concerns something negative that needs to be improved or something positive that needs to be reinforced. If one is not receptive to feedback, one is unlikely to receive authentic feedback. Hence: LISTEN. TAKE IT IN. SAY THANK YOU.

Rules for constructive feedback:

1. Give feedback only in an emotionally relaxed state. This will help you to stay objective and avoid strong emotional reactions.
2. Is your counterpart receptive to feedback? Is feedback desired? Ask for feedback!
3. Separate statements about behaviour from statements about personality traits! In this way, you can avoid affronting the person and increase the probability that your feedback will be well received. IMPORTANT: Behaviour must be clearly separated from identity. There must be no moral judgement, generalisation or interpretation.
4. If you have negative things to communicate, also express your positive experiences, perceptions and feelings.
5. Give very specific feedback. Use concrete examples of the behaviour to which your feedback relates.
6. Observation: Describe only what is visible and objectifiable for all.
7. Perception/effect: Make sensory statements and name your own (emotional) reaction to the recipient of feedback. Say what and how something has affected you: "It affects me …".
8. Express yourself exclusively using "I": "I have seen …", "I have noticed …", "I feel …".
9. Recommendation/wish: Address specific criteria for desirable behaviour so that your feedback is useful for future situations. "I recommend …", "I would like …", "I would like it if …".
10. Be brief and only convey as much as your counterpart can take in.

In teams, feedback should always be given directly to the intended recipient.

about the author

Germany-based **Andrea Stix** is a consultant for communication strategies. She is a coach in practice marketing and is specialised in personality diagnostics. She currently works as strategic consultant for CAMLOG.

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A double-edged sword

From 1 to 3 October, the 2020 World Congress of the International Society for Laser Dentistry (ISLD) will be held in Cairo in Egypt. In the run-up to the congress this autumn, *laser* had a chance to talk to Dr Youssef Sedky, the Organising Chairman of the event, about why Egypt was chosen as host country of the 2020 conference, what differentiates the dental laser market in Egypt, and why he employs laser technology in his own dental practice.

Dr Sedky, this year the ISLD World Congress will take place in Cairo, Egypt and you have been appointed as its Organising Chairman. What can participants expect from the event?
It was a great honour for me when the ISLD board entrusted me with the task of organising their upcoming 18th World Congress. We are currently in the midst of preparing for and crafting a world-class event that rests on three main pillars; for one thing, there will be a very strong scientific programme that is enriched by numerous internationally renowned key opinion leaders in the field of laser dentistry, who will present and discuss the latest in dental laser innovations. Secondly, there will be an industry exhibition with 22 manufacturing companies showcasing their products. There, participants of the conference will have another great opportunity to learn more about the latest in state-of-the-art dental technologies. Thirdly, there will be plenty of social events where congress participants will have the chance to enjoy and unwind in their spare time, right on the banks of Cairo's magical river Nile.

> "The introduction of dental laser systems to the Egyptian market was relatively challenging."

What were the key reasons behind choosing Egypt as venue for the congress?
Egypt is a very old and ancient country with more than seven thousand years of civilisation. It has a great and incredibly rich history and culture. When we voted for the host country of the 2020 conference, we agreed that Egypt would be the best pick, as the country encapsulates the philosophy of laser technology perfectly through a mix of science and authenticity. Also, it is for this reason that the official congress theme "History Carved with Laser" was chosen.

What differentiates the Egyptian laser dentistry market from other markets?
The introduction of dental laser systems to the Egyptian market was relatively challenging. Dentists here in Egypt were motivated to go for this new technology, since they realised the opportunity to be able to provide the best possible treatment results yet with it. However, there were great challenges in terms of initially approaching dental laser technology, mainly owing to the fact that it is simply a vast field with numerous different wavelengths for different indications being available. I would say that educating dentists and providing them with in-depth knowledge was the first step towards success. Nowadays, dental lasers are an incredibly popular technology and laser systems are in high demand, both among dentists and patients.

How do dental lasers contribute to your own clinical practice? What are the main indications you use them for?
In my dental office, the dental laser is an essential tool within the day-to-day workflow, since I am able to optimise all of my treatment results with it. As for my specialisation as an orthodontist, I use the dental laser for numerous surgical procedures, including the exposure of impacted canines, or labial and lingual frenectomies. In addition, I often utilise low-level laser therapy for pain control and for accelerating the rate of orthodontic tooth movements.

What are the overriding challenges laser dentistry is facing today?
Actually, I would argue that laser dentistry is a double-edged sword. Of course, the clinical benefits of dental lasers are manifold and simply cannot be overlooked. The problem is that a lot of clinicians working in the dental field wrongly think that it's only about pressing a couple of buttons in order to successfully and effectively implement dental laser technologies into pre-existing workflows and treatment processes. However, one cannot deny that a great deal of in-depth professional knowledge is required first before dental lasers can be implemented successfully. And professional knowledge can only be obtained through first-rate education and a lot of further clinical training. Only when dentists put this kind of effort into such a sensitive and complex technology can they then begin to successfully capitalise on its benefits and provide their patients with the best treatment outcomes.

ISLD International Society for Laser Dentistry

> "In my dental office, the dental laser is an essential tool within the day-to-day workflow, since I am able to optimise all of my treatment results with it."

Where do you see dental laser technologies in five to ten years from now?
I personally see dental lasers as a smart technology that serves the dentist in a variety of different dental disciplines. They are able to solve treatment challenges that no other available dental tool is able to tackle successfully. In addition, given the steadily growing awareness and the increasing level of information among patients today, I guess that dental laser systems will soon become a mandatory tool in every dental clinic. However, as is the case with many medical disciplines, further research and technological advancements are needed in order to make lasers more feasible and accessible for dentists.

about the interviewee

Egypt-based **Dr Youssef Sedky** holds a PhD in Orthodontics and Dentofacial Orthopaedics. He completed the MSc programme "Lasers in Dentistry" at RWTH Aachen University, Germany. In addition, he lectures at the Aachen Dental Laser Center (AALZ) and at the Department of Orthodontics of the Misr International University (MIU) in Cairo. He is also a head of the Dental Laser Center at the Faculty of Dentistry of the MIU.

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Master of Science course “Lasers in Dentistry” offered again

The University of Excellence, RWTH Aachen University, has been offering the accredited postgraduate “Lasers in Dentistry” Master of Science programme in collaboration with the AALZ Aachen Dental Laser Center and RWTH International Academy since 2004. This year, the programme aimed at dentists who want keep pace with their patient’s wishes for innovative and gentle treatment methods will be offered again in Aachen, Germany.

In standard academic studies in dentistry, the use of dental laser technology and laser-assisted treatment concepts are usually not part of the curriculum. Building on a university degree in dentistry, the two-year extra-occupational M.Sc. course teaches the necessary professional knowledge for laser applications in the dental practice at the highest academic level in theoretical and practical modules. The most important theories and application options regarding the use of lasers in dentistry are taught. Participants obtain sound theoretical knowledge in lectures and seminars led by renowned and experienced international researchers and practitioners. Skill training sessions, exercises, practical applications, live surgeries and workshops with intensive assistance from scientific associates with doctorates guide participants towards the successful and professional use of dental lasers in their own surgeries.

During the ten modules, students remain in ongoing contact with the RWTH Aachen University and the lecturers between attendance days via an e-learning system. This allows established dentists to remain active in their surgeries while completing their Master’s degree. Participants receive a certificate for every module that they pass. Students complete the Master course by handing in a Master thesis in which ten clinical cases are presented and discussed. On graduation day, the RWTH Aachen University confers the Master of Science (M.Sc.) degree. In addition, graduates receive a Diploma Supplement from RWTH Aachen University upon completing the programme.

What you can expect:

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- Instructions for the correct handling of lasers and the subsequent practical use
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- Necessary organic materials and laser safety goggles are provided for students to practice independently
- Specialist literature is available for students to fully immerse into the subject
- Students are trained to become certified laser safety officers
- Certificates with ECTS credit points are given out upon successfully finished modules
- Comfortable learning environment thanks to state-of-the-art seminar rooms
- Master’s degree certificates are legitimised by apostillisation for applications abroad

This year’s instalment of the M.Sc. course “Lasers in Dentistry” will start on 17 September 2020. For more information, visit www.aalz.de or contact info@aalz.de.

contact

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Phone: +49 170 1070022
www.aalz.de

2020 annual congress of DGL to take place in Bremen

Prof. Andreas Braun, Germany

Dear colleagues,

This year, on 6 and 7 November 2020, the annual congress of the German Association for Laser Dentistry (Deutsche Gesellschaft für Laserzahnheilkunde–DGL) will be held in Bremen in Germany.

In modern-day dentistry laser-assisted applications can be found in every dental discipline including tooth preservation, periodontics, paediatric dentistry, prosthetics, orthodontics and oral surgery. The objective of the Bremen event will be to set new standards in laser dentistry and to anchor this particularly innovative dental field even more strongly in other specialist areas such as implant dentistry, periodontics or endodontics. The congress will also offer ample opportunity for interdisciplinary and intercollegial exchange. At the event, laser enthusiasts can get an in-depth view into the entire range of laser-assisted treatment modalities, with which conventional dental indications can be expanded.

The congress will take place within the context of the 3rd Future Congress for Dental Implantology of the German Association of Dental Implantology (Deutsche Gesellschaft für Zahnärztliche Implantologie–DGZI). DGL will adopt the same congress structure for its 2020 annual meeting in that there will be an industry-oriented first congress day on Friday involving table clinics and the live-streaming of surgeries. The second day on Saturday will then focus on science and feature lectures from renowned speakers. Both DGL and DGZI will share facilities for the table clinics and the industry exhibition.

On behalf of the entire DGL board, I look forward to welcoming you to Bremen this autumn to a dental event packed with scientific lectures and clinical trainings. More information can be found online at www.dgl-online.de. In addition, contact event@oemus-media.de to register for the event.

With best regards
Prof. Andreas Braun

contact

Prof. Andreas Braun
DGL board member
Director of the Clinic for Dental Conservation, Periodontology and Preventive Dentistry
RWTH Aachen University, Germany

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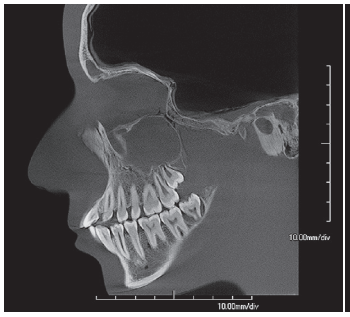
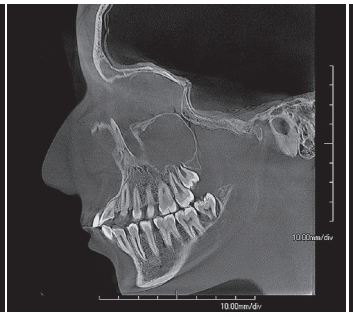


100 µm voxel size.



74 µm voxel size (PreXion3D EXPLORER).

3D image with a 150 x 160 mm field of view.

Curcumin helps fight

Oral and oropharyngeal cancers

According to Cancer.Net, head and neck cancers account for approximately 4 % of all cancers. Since current treatment options, such as surgery and chemotherapy, often cause adverse effects, there is a strong need for novel low-toxicity therapies for the effective treatment of cancer patients. In a recent study, researchers examined the effect that APG-157, a botanical plant-based drug that contains curcumin, has on neck and head cancer patients. The findings showed that the drug helps patients fight oral and oropharyngeal cancers by reducing the concentration of cytokines in the saliva and could serve as a therapeutic drug in combination with immunotherapy. Owing to its antioxidant properties and its ability to reduce swelling and inflammation, curcumin has been proved to help fight multiple cancers. The study found that, when APG-157 was administered by oral mucosal absorption, levels of curcumin circulating in the blood were high and it ended up being absorbed by cancer tissue. The researchers also found APG-157 therapy to be successful in reducing the relative abundance of *Bacteroides* species, a group of Gram-negative bacteria that is associated with oral cancer. Additionally, APG-157 helped attract immune system T cells to the tumour area. This suggests that, when used in combination with immunotherapy drugs, the therapy could help the immune system T cells both recognise and kill tumours. The study, titled "A randomized, phase 1, placebo-controlled trial of APG-157 in oral cancer demonstrates systemic absorption and an inhibitory effect on cytokines and tumour-associated microbes," was first published online in *Cancer* on 5 February 2020.

Source: Dental Tribune International

Dual-light photodynamic therapy

Helps kill oral bacteria

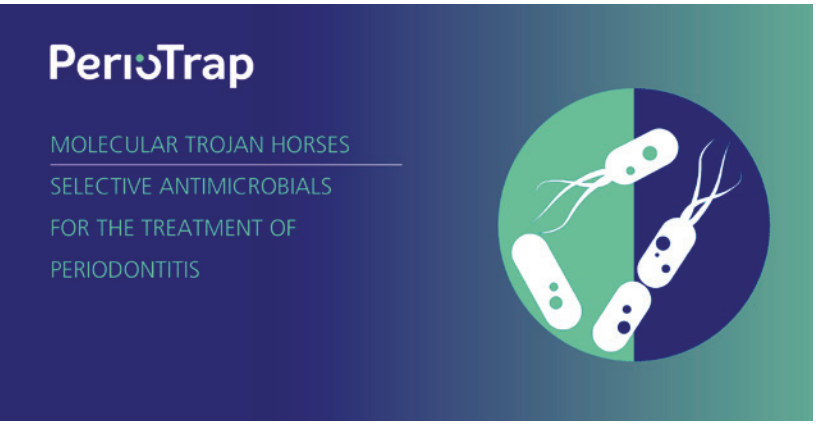
Regular toothbrushing helps maintain good oral health, but does not completely prevent the occurrence of oral disease. To help kill *Streptococcus mutans* bacteria and the harmful oral bacteria that cause gingivitis, researchers from Koite Health in Finland are launching a method intended for home use. The method involves using antibacterial photodynamic therapy and antibacterial blue light to reduce the markers indicating early gingivitis and plaque formation. "Dental diseases are caused by the combined effect of the bacterial community, and *Streptococcus mutans* plays a key role in dental caries. For plaque, *mutans* is a bit like the first violin that starts a concert. It adheres to the tooth first and opens the door for other bacteria," said co-founder of Koite Health Dr Tommi Pätilä, associate Professor in paediatric heart surgery and organ transplantation in the Hospital District of Helsinki and Uusimaa. According to the researchers, bacteria living in the mouth are resistant to the antibacterial blue light because they are protected by various sugars. However, the combination of a photosensitive solution and the wavelength of dual light affects the bacteria's internal structures. "The photosensitive substance in the effervescent tablet adheres to the surface structures of the bacteria. Red light activates the substance and initiates a chain reaction that kills the bacteria. Antibacterial blue light administered at the same time significantly enhances the effect," Pätilä explained. The researchers believe that dual-light therapy is particularly beneficial to people with aggressive strains of dental bacteria, chronic disease or diseases such as arthritis. Dual-light therapy designed for home use will be launched for consumers in early 2020. The study, titled "Dual-light photodynamic therapy administered daily provides a sustained antibacterial effect on biofilm and prevents *Streptococcus mutans* adaptation", was published online on 9 January 2020 in *bioRxiv*.

Source: Dental Tribune International

PerioTrap—a highly specific

Substance against periodontitis

Periodontitis is one of the most common infectious diseases in the world today. Under the leadership of Dr Mirko Buchholz, a team of researchers from the Fraunhofer Institute for Cell Therapy and Immunology in Halle (Saale) in Germany has now developed a highly specific antibiotic against the disease. According to Dr Buchholz, the active compound is effective in two ways: it can only be absorbed by the pathogens and it also only works on them. The active compound does not target the rest of the organism and thus fewer reserve antibiotics are needed. In this way, the new drug makes a major contribution to fighting the risk of multi-resistant germs. The effect of the substance is based on the blocking of an enzyme, which is required for the "nutrition" of the bacterium, and on a specific transport mechanism for iron. It has already been patented by the start-up company "PerioTrap Pharmaceuticals". They are currently looking for investors in order to lead the product from the preclinical phase to market entry.



Source: Univations GmbH/Investforum Startup-Service

Cairo as host city of the

2020 ISLD World Congress

Following the great success of the congresses in Aachen, Germany, in 2018, and Plovdiv, Bulgaria, in 2019, the board members and the general assembly of the International Society for Laser Dentistry (ISLD) have decided to make Cairo the destination for the 18th ISLD World Congress, to be held from 1 to 3 October 2020.

Application for the dental event in Egypt is now open. At the congress, attendees will have the chance to experience high-rate lectures and presentations from the most prominent names in the field of laser dentistry, participate in numerous workshops and engage in enlightening conversations with other laser enthusiasts from around the world. In addition, there will be an industry exhibition featuring the world's leading dental laser manufacturing companies. Compared with the 2019 congress in Plovdiv, the ISLD is expecting a significant increase in participants at the event in Egypt, which is why the number of tickets is restricted. Further information on the upcoming event hosted by the leading expert society worldwide for laser dentistry can be found online at www.isldcairo2020.com.

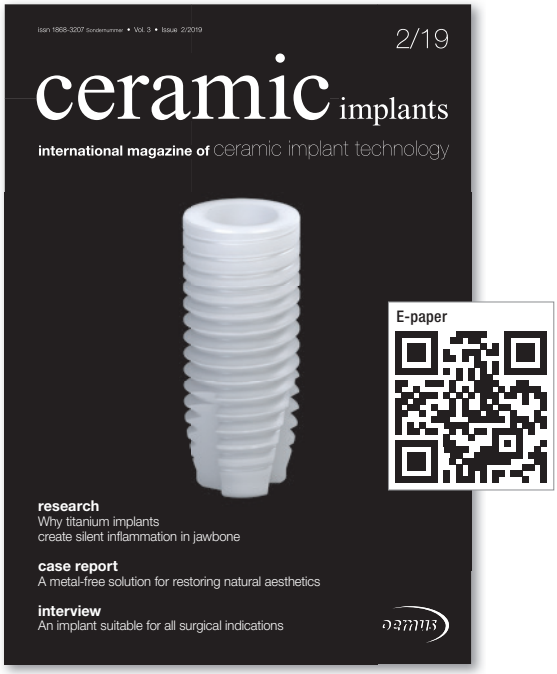
Source: ISLD

ceramic implants

The international medium for ceramic implant technology

Since 2017, the English-language magazine *ceramic implants—international magazine of ceramic implant technology* has been published with great success. The magazine, which is published twice a year, gives the extremely active international ceramic community a powerful and independent platform. The need for information on evidence-based research findings and the interest in clinical cases dealing with metal-free implants is growing on a constant basis. The magazine has become a must read for implantologists, as it provides orientation at a product and practitioner level on the one hand, and an international overview of thematically relevant further training events and industry cooperations on the other hand. The magazine is published by the German dental publishing house OEMUS MEDIA AG and the next instalment will be out in April 2020. For an annual subscription (€30 plus shipping) as well as a free hard copy, contact subscribe@oemus-media.de.

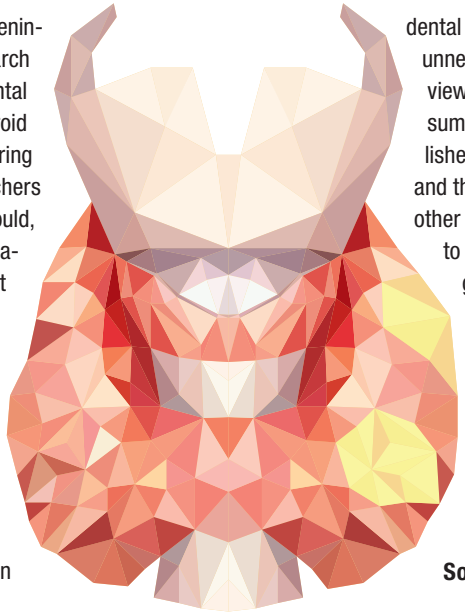
Source: OEMUS MEDIA AG



Dental radiographs might pose

Potential hazard to human health

The incidence of thyroid cancer and meningioma is increasing globally. New research has found that repeated exposure to dental radiographs may increase the risk of thyroid cancer and tumours in the tissue covering the brain and spinal cord. The researchers concluded that dental radiographs should, therefore, be prescribed only when the patient has a specific clinical need and not as a standard part of routine dental evaluation. Prof. Anjum Memon, Chair in Epidemiology and Public Health Medicine at Brighton and Sussex Medical School, believes that some of the factors that contribute to the increase in thyroid cancers are increased surveillance and dental screening, and over-diagnosis. Dental professionals should thus maintain dental radiographic records in order to avoid unnecessary screenings. In the systematic review and meta-analysis, Memon and his team summarised the findings of previously published studies on dental radiographic exposure and the risk of thyroid cancer, meningioma and other cancers of the head and neck. According to Memon, current UK, European and USA guidelines have already stressed the need for thyroid shielding during dental radiography. The study, titled "Dental X-rays and the risk of thyroid cancer and meningioma: A systematic review and meta-analysis of current epidemiological evidence", was published online on 14 October 2019 in *Thyroid*.



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Source: Dental Tribune International

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Ceramic implants—state of the art

Discussed in May in Berlin

ISMI | INT. SOCIETY OF METAL FREE IMPLANTOLOGY

On 8 and 9 May 2020, the sixth Annual Meeting of the International Society of Metal Free Implantology (ISMI) will be held in the Steigenberger Hotel Am Kanzleramt in Berlin, Germany. An internationally renowned team of speakers represents a versatile and high-rate scientific programme. Dr Dominik Nischwitz, president of the ISMI, comments: "[…] I believe that we can look optimistically to the future and that we will continue to define state-of-the-art ceramic implantology through international professional exchange." This is in keeping with the theme of the 2020 annual meeting ("Ceramic implants – State of the Art"). Dr Nischwitz continues by saying: "It's important to mention that the success of our international endeavours is underlined by the fact that the International Academy of Ceramic Implantology is the official partner of our conference; its president, Dr Sammy Noumbissi (USA), and other internationally renowned experts will be among the speakers." On both congress days the programme will cover practical experiences and current trends in the use of ceramic implants, as well as biological aspects of metal-free implantology. The two-day event will kick off on Friday with two pre-congress symposia, involving the live streaming of a surgery via the internet. The highlight of the first congress day will be the ISMI White Night, held in the Beletage of the renowned borchardt in the heart of Berlin. Saturday will then be dedicated to scientific lectures. Simultaneous translations (German/English) will be provided on both congress days. To register for the event, contact event@oemus-media.de. For more information, visit www.ismi.me/?lang=en.

Source: OEMUS MEDIA AG

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Chewing gum could help

Fight dental caries

Though the relative benefits of chewing gum are often subject to debate, a number of studies have shown that the sugar-free varieties can promote oral health. On this topic, researchers from King's College London identified and subsequently analysed 12 studies published over the last 50 years that explored the impact on oral health and the intervention outcomes of chewing sugar-free gum in a systematic review. It was found that chewing sugar-free gum reduces the incidence of dental caries by 28 per cent and that it could be used as a possible preventive agent in combination with oral health education and supervised toothbrushing initiatives. Previous studies have shown that chewing gum can increase the level of certain vitamins in blood plasma. According to the researchers, the specific relationship between the development of dental caries and chewing sugar-free gum had not previously been explored. The study, titled "A systematic review and meta-analysis of the role of sugar-free chewing gum in dental caries", was first published online in November 2019 in the *Journal of Dental Research: Clinical and Translational Research*.

Source: Dental Tribune International

Burnout causing half of dentists

To consider leaving dentistry

Half of dentists (50 %) have considered leaving dentistry for reasons of personal well-being, according to a Dental Protection survey. In its report, "Breaking the burnout cycle", the indemnity provider warned that burnout impacts dentists, the team and patients. Dental Protection is calling on dental organisations to establish a "well-being guardian" for exhausted dentists to talk to. Half of dentists surveyed (50 %) in "Breaking the burnout cycle" experience dissatisfaction with their work-life balance and 60 % of those surveyed say it is difficult for them to take a short break from work. Dental Protection therefore believes key performance indicators should now include dentists' well-being. "We encourage dentists to reduce their exposure to burnout by reviewing the working environment and workload and adopting a proactive approach to developing resilience to reduce the risk and its consequences," Raj Rattan, dental director at Dental Protection, said. Moreover, the fear of litigation causes stress and anxiety to 77 % of dental professionals, a previous Dental Protection survey showed. Dental Protection claims studies have shown healthcare professionals often don't seek help when they find themselves in such circumstances. An anonymous Dental Protection member said: "No other profession seems to have the same regulation and punishment as dentistry."

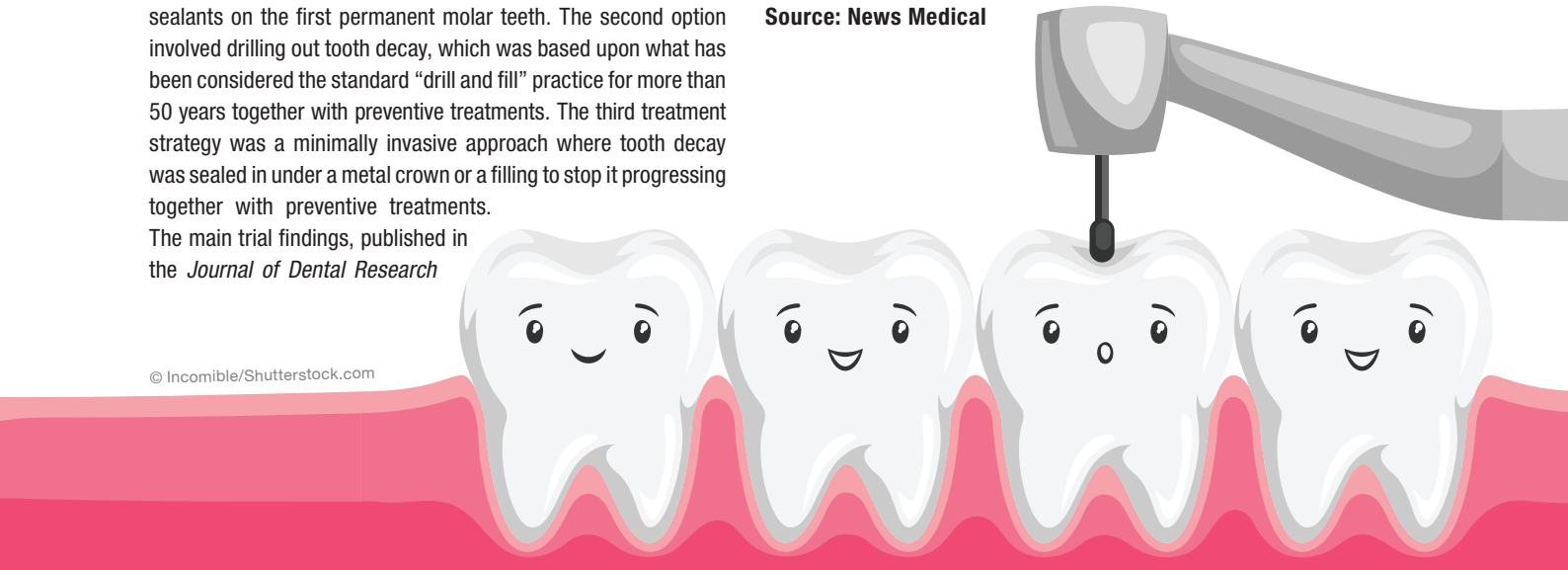
Source: Dentistry.co.uk

Drilling might not be the best way

To manage tooth decay in children

A three-year study, led by dentists from the Universities of Dundee, Newcastle, Sheffield, Cardiff, Queen Mary University of London and Leeds, has found no evidence to suggest that conventional fillings are more effective than sealing decay into teeth, or using prevention techniques alone, in stopping pain and infection from tooth decay in primary teeth. The scientists evaluated the results of 1,144 children aged between three and seven years. One of three treatment approaches was chosen randomly for each child's dental care for the duration of the trial: the first approach avoided placing any fillings and aimed to prevent new decay by reducing sugar intake, ensuring twice-daily brushing with fluoridated toothpaste, application of fluoride varnish and placing of fissure sealants on the first permanent molar teeth. The second option involved drilling out tooth decay, which was based upon what has been considered the standard "drill and fill" practice for more than 50 years together with preventive treatments. The third treatment strategy was a minimally invasive approach where tooth decay was sealed in under a metal crown or a filling to stop it progressing together with preventive treatments.
The main trial findings, published in the *Journal of Dental Research* found no evidence to suggest that any of the treatment strategies were better than another in terms of making a difference in children's experience of pain or infection, quality of life or dental anxiety between groups. All three different ways of treating decay were acceptable to children, parents and dental professionals. In conclusion, the researchers recommend preventive measures and programmes to be implemented early on in children to prevent caries from developing. The study (Innes, N.P., et al. 2019. Child Caries Management: A Randomized Controlled Trial in Dental Practice. *Journal of Dental Research*.) can be accessed online at doi.org/10.1177/0022034519888882.

Source: News Medical



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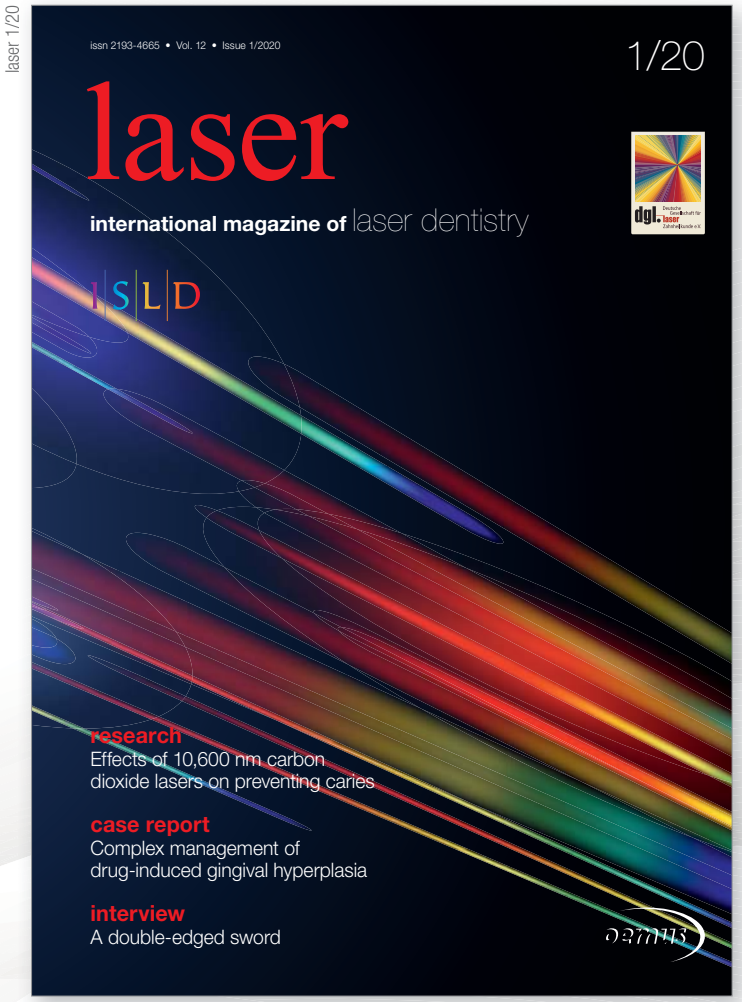

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