DENTAL TRIBUNE

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HYGIENE TRIBUNE

Over 100 countries celebrate World Oral Health Day

>Insertion

LAB TRIBUNE

2nd Dental Technician Forum 2016 Singapore (Part of IDEM 2016)

Organized by Koelnmesse & CAPPmea

>Insertion

10th CAD/CAM INT'L CONFERENCE

Happy 10th Birthday CAPPmea

CAD/CAM Digital Dentistry in a milestone year

>Insertion

Dental Tribune MEA/CAPPmea - IDS Cologne success story

By Dental Tribune MEA / CAPPmea

DUBAI, UAE: The Dental Tribune MEA license owner – Centre for Advanced Professional Practices (CAPPmea) - were amongst the "movers and shakers" in the dental market during the 36th International Dental Show (IDS), which took place in Cologne, Germany, on 10-14 March 2015. The event has become the biggest and most successful "dental show" for all major players in the field, including its organizer - Koelnmesse, dental industry representatives and other dental professionals tasted the "newest spices" of the dental development cuisine at IDS Cologne.

In the year of its 10th Anniversary, and prior to the 10th CAD/CAM & Digital Dentistry International Conference, CAPPmea travelled to Cologne, for a 10-day mission, to represent globally the Middle East dental society, at the 36th International Dental Show and the 11th DTI Annual Publishers Meeting. CAPPmea provided information on its latest Continuing Dental Education events in the Middle East & Asia and distributed 2,500 up to date publications of Dental Tribune MEA at the 100m2 DTI Media Lounge stand (D66/F65) situated in hall 4.1.

The Cologne cathedral

11th DTI Publishers Meeting 2015

As an IDS tradition, the DTI Annual Publishers meeting was held for the 11th time. All 96 publishers from the DTI family came together at Hilton Dom Hotel for the two days meeting. The 11th Annual Publishers Meeting welcomed attendees from Australia, the U.S.A., the Middle East and many other countries. DTI's CEO, Torsten Oemus opened the meeting with a motivational speech presenting the achievements of the last year of all the partners. Together the group evaluated, planned and strategized approaches. Amongst new projects of the partners Dental Tribune MEA / CAPPmea introduced two new innovative items: 'Referral Clinic section' and 'Digital e-newspaper' incorporating the print publication as a digital copy into the e-newsletters. The 2015 Publishers Meeting helped strengthen the global DTI platform and announced plans for the coming years to work in cooperation with the entire publishing group. Amongst the main subjects discussed were the globalization process, the digitalization of dental practices and laboratories and the relevance of on-line education and e-commerce for dentistry. Dental Tribune International and its partners will continue to follow this path. On its part, Dental Tribune MEA / CAPPmea will join forces in asserting the same trends for the MEA region in the coming years.

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Henry Schein at IDS: Everything for digital dentistry

By Dental Tribune International

Stanley M. Bergman, Chairman of the Board and CEO of Henry Schein, provided information on Henry Schein's history and future development. (Photograph: Claudia Duschek, DTI)

COLOGNE, Germany: In 2013 the Henry Schein launched an umbrella brand, ConnectDental, bringing together the range of digital products and services needed to connect dental practices and laboratories while integrating open CAD/CAM systems and materials. Tuesday's IDS press conference confirmed once more that this is the only way to establish a future-proof practice and laboratory structure. It also provided an overview of present market developments, including a strategic outlook on current and future trends in dentistry.

According to Stanley M. Bergman, Chairman of the Board and CEO, Henry Schein, the truly relevant question to ask in this context is, why not? After all, this is what was in the minds of Esther and Henry Schein when they founded their company to occupy a key position between the current health market and the idealised vision they sought to create. Now, the time has come for practices and laboratories to demonstrate similar courage and to view digitalization as a real opportunity.

In this context, Henry Schein offers two concepts for complete digitalization of practice work flows: ConnectDental and CEREC+. Both concepts are entirely structured to deliver efficiency and profitability, and are therefore trendsetting tools in the hands of practices and laboratories. The ConnectDental workflow brings together the various digital system components to produce an open solution, covering 3-D diagnosis, digital impressions, implant planning and model production using 3-D printers, while also incorporating design and manufacture for restorative surgery using grinding and milling machines.

Andreas Meldau, President, European Dental Group, Henry Schein, and Managing Director, Henry Schein Dental Deutschland, emphasised the absolute prioritisation of continuous development for the efficient treatment of patients. "360°— digitale Zahntechnik gestalten [shaping digital dental technology]"— this theme describes a first-of-a-kind event scheduled for June that is intended to offer laboratory owners and management, as well as their customers, a 360° view of the systems, components and materials that are part of the digital workflow. The event will place particular importance on providing a variety of perspectives: digital solutions according to practices, the dental laboratory perspective and the academic viewpoint. The two-day event presented by Henry Schein will feature speakers from the world of science, practices, laboratories and industry, who will share information on the opportunities and limits of digital manufacturing technologies.

Attendees of the IDS are invited to pencil in the 360° congress scheduled for June.

Henry Schein, one of the world's leading providers of products and services for doctors, dentists and veterinarians is at the vanguard of progress in the establishment of new concepts in the health care sector. DT

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Bulk fill restorations in the posterior area

By Dr. Abubakar Sheikh, Pakistan

Introduction

Traditionally cavities in posterior teeth were generally filled with amalgam. With the advent of direct composites this approach gradually changed, but there were quite a few challenges that had to be overcome. These challenges included reducing polymerization shrinkage and postoperative sensitivity, achieving tight contacts in posterior teeth and sufficient strength in load bearing areas.

With the improvement in adhesive bonding systems and composite materials most of these challenges were addressed but still it has always been recommended to place composite in increments due to a variety of reasons. These include penetration of curing light to a limited depth and placing composite in increments will help reduce the effect of polymerization shrinkage to a certain degree. From a clinician's point of view this approach is certainly time consuming and there has always been a desire to fill the cavity in a single increment and get the job done as fast as possible.

Considering the demand of the dental practitioners, manufacturers such as 3M, have now introduced bulkfill composites which can be placed in cavities in a single increment and yet can be cured effectively and have good adaptability and reduced shrinkage. We tried bulkfill material in a clinical case in which 3 posterior cavities were filled with Filtek™ Bulk Fill Posterior composite.

Clinical Case

A female patient presented with multiple cavities in her teeth. There was a moderate sized cavity in the first molar, the first premolar had a large distal carious lesion and the second premolar had caries mesially. We decided to manage the 3 adjacent large cavities in her posterior teeth in 4th quadrant with bulkfill composite in a single appointment. Fig. 1 to Fig 13.

Conclusion

Previously with composites being placed in multiple increments, it would have been quite time consuming and tedious to do a number of such restorations in a single appointment. Certainly bulkfill composites made the job easier. Their handling and manipulation with instruments are also quite user friendly. With the composites being applied in a single increment, an ideal shade match might not be possible in all situations but in posterior restorations the effect can be masked to a certain degree. Overall I would say that bulkfill composites will definitely speed up the work and make things easy for the clinician. DT

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Practice owner and Specialist in Restorative Dentistry at Dr. Abubakar's Specialist Dental Practice.
Specialist in Restorative Dentistry at Fatima Jinnah Consulting Clinics.

Fig. 1. Initial case 1: 44 large carious lesion distally, 45 large carious lesion mesially, 46 moderate size lesion occlusally.

Fig. 2. Isolation of the affected teeth with rubberdam.

Fig. 3. Caries has been removed and cavities prepared. Premolars have been separated by sectional matrices and wedge.

Fig. 4. Selective etching done on enamel margins.

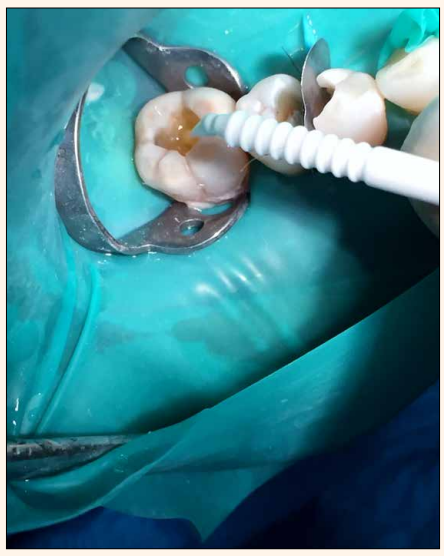

Fig. 5. Single Bond Universal adhesive being applied in the molar cavity.

Fig. 6. Single Bond Universal application in all cavities.

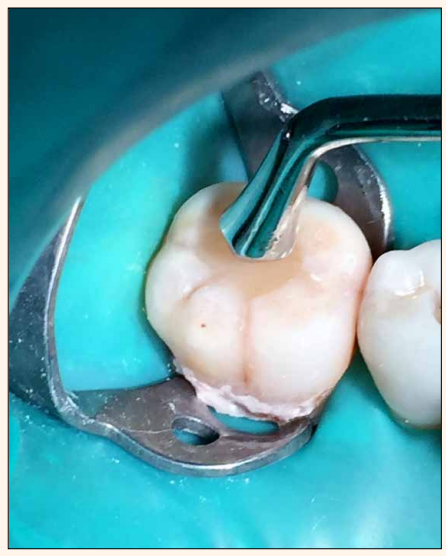

Fig. 7. Adaptation of Filtek™ Bulk Fill Posterior composite after completely placing in molar cavity.

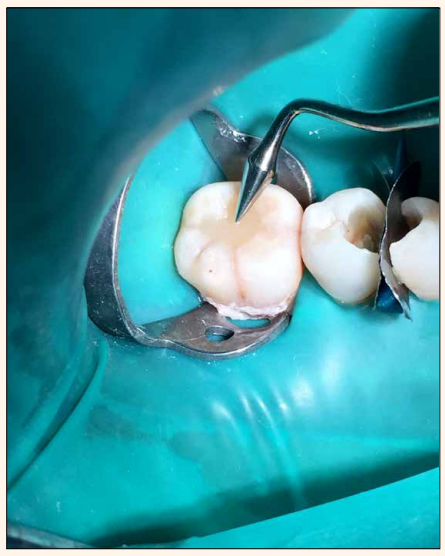

Fig. 8. Occlusal anatomy being carved on the molar surface.

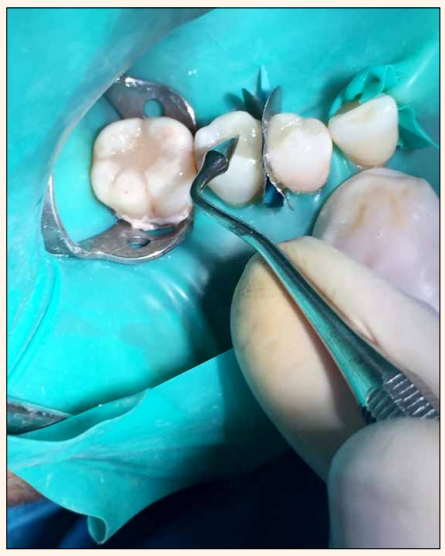

Fig. 9. Anatomy being carved after complete filling of Filtek™ Bulk Fill Posterior composite in both premolars.

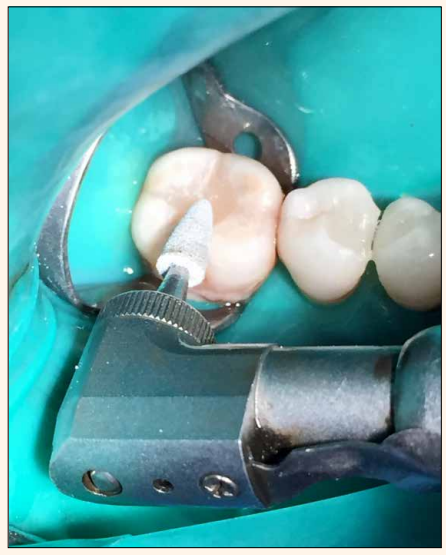

Fig. 10. Finishing of the restorations.

Fig. 11. Polishing with 3M Spiral Polishing disc and diamond polishing paste.

Fig. 12. Restorations after finishing and polishing.

Fig. 13. Completed restorations.

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By Dr. Sebastian Ercus, Belgium

Introduction

In today's dentistry, for rendering the best comprehensive dental services to our aesthetically driven patients, the paradigm has shifted to an interdisciplinary team of specialists that work together steered by a clinical co-ordinator. This person should be either a multicompetence general dentist or a specialist with additional training outside his or her specialty area. This gives him or her the ability to bring the surgical, orthodontic, restorative and technical teams together as a whole, following treatment sequences customised especially for the patients' best interests and expectations.

The challenge is making the correct diagnosis and selecting the appropriate treatment regimen. In order to achieve that, the clinician has to follow certain guidelines and understand the relations between teeth and the adjacent structures. Establishing the correct position of the incisal edge of a maxillary central incisor in relation to the lower lip, the correct ratios between the tooth's width and length, and the level of gingival margin when smiling are very powerful diagnostic tools.

In order to aid memory, one may remember it as the 42.2 rule:
(a) a maximum of 4 mm of maxillary central incisor display when the lips are at rest (a minimum of 2 mm; Fig. 1);
(b) a maximum of 2 mm of gingival display during smiling;
(c) a maximum of 2 mm from the incisal edge of the maxillary central incisor to the lower lip during smiling (Figs. 2 & 3); and
(d) the middle third of the maxillary central incisor should be perpendicular to the occlusal plane and the incisal edge should touch the plane (± 0.5 mm; Fig. 4).

The correct ratio between the width and length of a maxillary central incisor is 78 to 80 per cent. With the incisal edge position already determined, we can identify the position of the gingival margin (Figs. 5 & 6).

Gingival margin positioning should be in accordance with the understanding of six conditions present in the oral cavity with different aetiologies and treatment regimens:

1. Altered passive eruption when the gingival margin does not recede to a level near the cemento enamel junction (CEJ) during tooth eruption. Diagnostically, the gingival margin is located incisal to the CEJ. Treatment options depend on the amount of attached gingiva and the position of the bone relative to the CEJ (as a general rule, the biologic width should be a minimum of 2 mm):
(a) gingivectomy;
(b) osseous resection (ostectomy) with or without flap surgery (without a flap, it is difficult to control the osseous contour driven by the new gingival margin);
(c) apically repositioned flap.

2. Altered active eruption when the osseous crest does not resorb to a level 2 mm apical to the CEJ. The gingival margin is still located incisal to the CEJ. This is treated with periodontal surgery with osseous resection.

3. Compensatory eruption when the tooth surface is lost, with the reduction in facial height or vertical dimension of occlusion unaffected (short tooth syndrome). Treatment is either restorative or, in the case of hypermobility of the lip, combined with a coronally positioned mucosal flap.
4. Delayed eruption followed by early loss of primary maxillary incisors, delayed eruption of maxillary permanent incisors or overeruption of mandibular incisors. Diagnostic features are short maxillary incisors, overerupted mandi bular incisors or a Class III maxillomandibular relation. Bearing the 42.2 rule in mind, treatment should follow incisal reduction done selectively with crown lengthening only or crown lengthening combined with orthodontic intrusion of mandibular incisors and possible minimally invasive restoration of maxillary teeth.

5. Vertical maxillary excess described as a hyperplastic growth of the maxillary skeletal base where teeth are positioned farther from the skeletal base, an increased facial lower third and excessive gingival display, which is classified according to three categories:
(a) Category 1: 2–4 mm of gingival display, treated with only orthodontic intrusion, orthodontics and periodontics, or periodontics with restorative therapy;
(b) Category 2: 4–8 mm of gingival display, treated with periodontics and restorative or orthognathic surgery (Le Fort type I);
(c) Category 3: more than 8 mm of gingival display, treated with orthognathic surgery with or without periodontal and restorative treatment.

6. Hypermobile upper lip—the average mobility of the upper lip is from 6 to 8 mm from the rest position. More than 8 mm represents hypermobility. Considering that the average distance from the lower margin of the upper lip and the base of the nose (subnasion) is 21 mm, one could take two superimposed photographs with the patient at rest and the patient smiling fully to calculate the lip mobility very easily using the 42.2 rule. Generally normal tooth length is present and dental labial aesthetics is good to ideal. The treatment regimen could entail a coronally po - sitioned mucosal flap, crown lengthening with osseous resection or a combination of both (Figs. 8 & 9). Example: Photographs captured at the same magnification opened in Adobe Photoshop:
Picture 10: Full smile—length of the central exposed – measure digitally in pixels distance from incisal edge to the lower margin of the upper lip in full smile.
Picture 11: Lips at rest – 2 mm central incisor reveal + 21 mm distance lower lip to base of the nose. Incisal edge to base of the nose 23 mm (incisal edge at the correct position).

x = distance from the incisal edge to the lower margin of the upper lip in full smile
y = the amount of central incisor exposed at rest 23 mm = 1,725 px; x = 900 px; mobility = x – y; = [(23 × 900) / 1,725] – 2 mm; = 12 mm – 2 mm; = 10 mm (Figs. 10–12)

Since the aetiology is generally multifactorial, by combining all the clinical data gathered during the initial examination, including facial, periodontal, orthodontic, endodontic and restorative data, as well as radiographs and diagnostic photographs, the clinician has the ability to compose a very detailed and comprehensive treatment plan especially for a patient with high aesthetic demands.

Following the digitally designed smile concept, balancing the relations between the teeth and adjacent structures will help the clinical co-ordinator and the specialty team propose treatment planning to the patient. Presenting the plan in Keynote

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Fig. 1. The level of the maxillary central incisors in the relaxed position (2–4 mm in women and 1–2 mm in men).


Fig. 2. A maximum of 2 mm from the incisal edge to the lower lip during smiling, example 1.


Fig. 3. A maximum of 2 mm from the incisal edge to the lower lip during smiling, example 2.

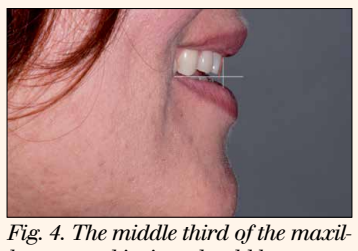
Fig. 4. The middle third of the maxillary central incisor should be perpendicular to the occlusal plane.

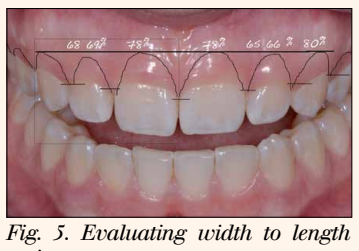
Fig. 5. Evaluating width to length ratios.

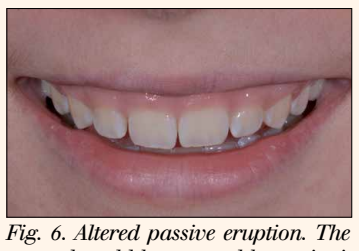
Fig. 6. Altered passive eruption. The enamel could be exposed by a gingivectomy in one appointment.


Fig. 7. Lower third smile showing altered passive eruption.


Fig. 8. Delayed eruption.


Fig. 9. A hypermobile lip and a slight vertical maxillary excess.


Fig. 10. Lower third full smile design.


Fig. 11. Relaxed position (/m/ sound – ahhh).

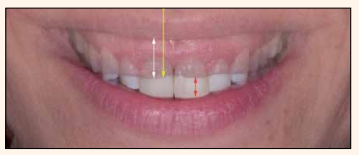
Fig. 12. Superimposed photographs 10 & 11. The red arrow indicates the distance from the incisal edge to the upper lip in the relaxed position. The yellow arrow indicates the height of the upper lip in the relaxed position (~ 21 mm). The white arrow indicates mobility of the upper lip from the relaxed to smile position.


Fig. 13. Initial lower third when smiling.


Fig. 14. Findings in order of importance after establishing the incisal edge position on the full smile photograph.


Fig. 15. The wax-up duplicated in a stone model.

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(Apple) or Microsoft PowerPoint is a very powerful communication tool in obtaining treatment acceptance.

Case presentation

A 32-year-old female patient came to the dental office with her chief complaints being short teeth, an uncomfortable bite, too much gingiva showing when smiling, brown-coloured areas of her teeth and insufficient contact points. The patient was in good general health with a good periodontal status and probing depths of 2 to 3 mm. The aetiology of the excessive gingival display was multifactorial, a combination of delayed eruption, altered passive eruption and hypermobility of the upper lip. From an evaluation of the teeth, both clinically and from the diagnostic photographs, we made the findings given in Table 1 in order of importance (Figs. 13 & 14). We placed incisal edge position first in order of importance because, in the majority of cases, without proper placement whatever follows could result in a tooth that tries to mimic nature but is not properly exposed in a full smile.

Based on the data gathered, the treatment plan was then presented to the patient in 3-D on models mounted in the articulator and in 2-D with a Keynote presentation, allowing her to understand the present situation, treatment proposed and simulated final outcome.

Following the treatment proposal and acceptance, the case was sent to the dental laboratory, where the dental ceramist fabricated a wax-up and a stone model based on the clinician's diagnostic findings (Figs. 15–17).

A crown-lengthening surgical guide (a vacuum-formed Essix appliance) was manufactured on a duplicate model of the wax-up for ideal osseous contouring during the surgical procedure (Fig. 18). The gingivectomy was performed following exactly the gingival margin of the wax-up and then used for guiding the osseous contouring, through which a biologic width of a minimum of 2 mm was maintained (Figs. 19–24).

The mock-up should be placed before the surgical appointment for an initial evaluation and then ideally six to eight weeks post-crown lengthening. If done earlier, a very well-adapted indirect acrylic prototype would be advised or the utmost care in adaptation of the bisacrylic resin (Figs. 25–27).

For the ultimate control and when time management in a private office is not an issue, the osseous contouring is performed and the flap is closed, followed by guided gingivectomy and mock-up placement at the next appointment in two to three months' time. With this approach, the risk of recession or invasion of biologic width is reduced to the minimum.

Controlled tooth preparation was performed through the mock-up using 0.6 mm depth-gauge burs (Figs. 28 & 29). In designing restorations, the diagnosis of the initial situation and underlying tooth structure, the new design proposal and the patient's expectations play a very important role. The material of choice in this case was feldspathic porcelain (VITA Zahnfabrik) on a refractory die in the anterior zone combined with pressed lithium disilicate (IPS e.max, Ivoclar Vivadent) in the posterior zone (Figs. 30–33). As a rule of thumb, when a material like feldspathic porcelain is used, which filters the light through to the underlying structure, a space of 0.2–0.3 mm is needed per shade change.

The restorations were adhesively cemented using a total-etch technique and initially tried in with a translucent try-in paste (CHOICE 2, BISCO, Inc.).

The occlusion was checked after cementation and a processed acrylic night guard was delivered two weeks post-operatively.

The final result is shown in Figures 34, 36 & 37).

Fig. 16. The new design proposal in wax.

Fig. 17. Very good communication with the dental laboratory.

Fig. 18. The crown-lengthening surgical guide.

Figs. 19–24. Crown lengthening with osseous contouring. (Surgery performed by Dr Muriel Krischek, Belgium.)

Figs. 25–27. The bis-acrylic prototype.

Fig. 28. Controlled tooth reduction.

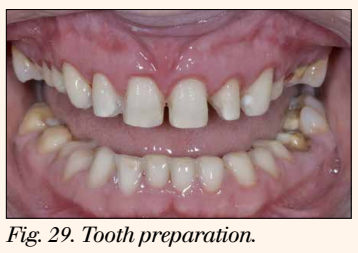

Fig. 29. Tooth preparation.

Fig. 30. Porcelain restorations on alveolar models.

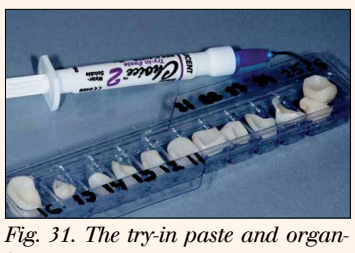

Fig. 31. The try-in paste and organiser.

Fig. 32. Cementation.

Fig. 33. Situation before.

Fig. 34. Situation after. (Ceramics performed by Edwing Chung, Canada.)

Incisal edge position	Missing
Form	Missing
Value	Missing
Surface texture	Missing
Translucency	Missing
Chroma	Missing
Hue	Present
Gummy smile evaluation	Missing
Teeth ratios	Missing
Contact points	Missing
Occlusal interferences	Present

Table 1. Findings.

Fig. 35. Initial situation.

Fig. 36. Situation five months post-op.

Fig. 37. Final result.

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From everyday dentistry to advanced photoacoustic endodontic applications (PIPS): Er:YAG & Nd:YAG dual wavelength laser

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By Lawrence Kotlow DDS, Enrico DiVito DDS and Giovanni Olivi MD

Introduction

Lasers provide an exciting new technology that allows the dentist the ability to give patients optimal care without many of the "fear factors" found in conventional dental techniques. Used with proper understanding of laser physics, lasers are extremely safe and effective. Using lasers for caries removal, perio treatment, endodontic treatment, bone management, cutting and shaping, and soft-tissue procedures can reduce postoperative discomfort and infection, and provide safe, simple in-office treatment. As a result, we can improve our efficiency, expand what we can do, achieve better results and increase production.

Lasers represent a real quantum leap forward in the treatment of our patients, including the pediatric patient. The U.S. Food and Drug Administration (FDA) gave approval for the use of the Er:YAG laser in 1997 for both hard- and soft-tissue procedures. The erbium doped (erbium particles placed within the YAG crystal) crystal of Yttrium-Aluminum-Garnet's (Er:YAG) development and success has made the treatment of children safer and quicker.

Plainly stated, a laser is a piece of equipment that creates a concentrated monochromatic beam of visible or infrared light that can be absorbed by a specific target. Since then, laser-assisted dental care has changed forever the way dentists can prepare diseased teeth, ablate bone and treat soft-tissue abnormalities and disease. An entire new standard of care is becoming a reality.

Lasers and pediatric dentistry are a perfect fit. There are a wide range of hard and soft dental procedures that may be completed using lasers as an alternative to conventional dental care on adults and, especially, children. Many of these procedures may be treatments dentists historically refer out to other specialists; however, if you understand and use your laser efficiently, you will discover that many of these are procedures that every dentist can easily complete.

The question that is often the major concern and barrier to investing in lasers is the how this investment will pay for itself, more recently described as return on investment (ROI). Will it pay for itself? We prefer to speak of this as the secondary effect. If you understand your laser, it will easily pay premiums on your investment, and the cost factor becomes a non-issue.

The purchasing of lasers is an investment, not an expense, for any dental practice.

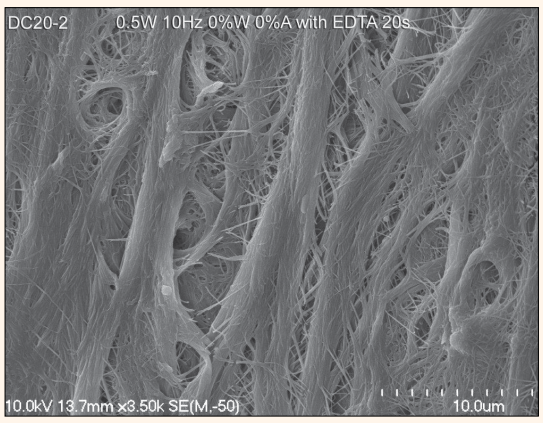
Lasers represent a fundamental change in the entire way dentistry has been taught. We can now rethink and often modify G.V. Black's principle of extension for prevention with the concept of minimally invasive micro-dentistry. We need to understand that laser dentistry is one portion of an entire new way of practicing conservative, pain-free dentistry.

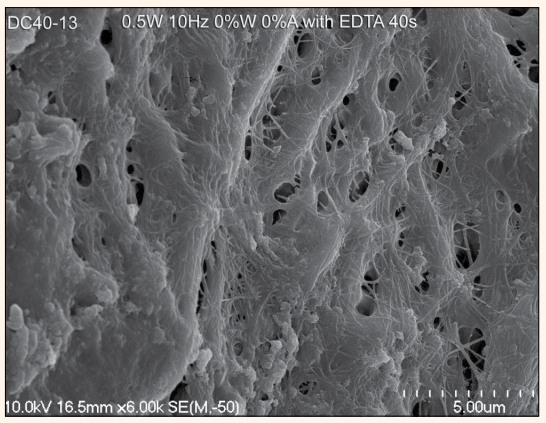
The laser that we call the "all-purpose" laser is the Lightwalker Er:YAG & Nd:YAG laser, manufactured by Fotona and distributed in the United States by Technology4Medicine. The Er:YAG produces its effect at 2940 nm and has as its primary tissue target water and hydroxyapatite. It is very safe, relatively quiet, eliminates the smells and vibrations associated with the dental handpiece and, most importantly, is much more comfortable for the patient, significantly reducing the need for local anesthesia.

The use of the new generation erbium lasers for repair of incipient hard-tissue disease allows the dentist to provide a stress-free means of restoring teeth in a minimally invasive manner, most often with no shot and no numb lip, without the need for any local anesthetics.

The erbium laser can be used for restoring primary and permanent teeth, eliminating or reducing the amount of local anesthetics. In most cases, the patient will not require numbing for Class 1, 2 (sometimes), 3, 4, 5, 6 restorative procedures using bonded restorative materials. Using the concept of minimally invasive restorative procedures, the Er:YAG laser allows the operator to remove only diseased tissue and thus preserves much more of the healthy, unaffected tooth.

In cases where alloy is preferred, the laser's analgesia effect may also allow the dentist to create a restorative preparation using a conventional handpiece that is not meant for bonding. The erbium laser is effective because of its effect on its target, water within the tooth structure. This effect occurs when the laser heats up water within the target tissue, causing it to create small microscopic explosions (photothermal followed by photoacoustical effects). When applied to soft tissue, bone or teeth and cavities, the explosions then cause the areas to be vaporized.





Figs. 1, 2. Representative sample images of root canal dentinal walls irrigated with 17 percent EDTA and PIPS for 20 seconds. (Photos/Provided by Technology4Medicine)

Er:YAG laser 2940 nm: Soft-tissue procedures

There is a wide array of soft-tissue procedures that can be completed using the all-purpose laser: maxillary and mandibular frenum revisions, lingual frenum revisions, treatment of pericoronal pain or infection, removal of hyperplasic tissue because of drugs or poor oral care in orthodontic patients, biopsies, treatment of aphthous ulcers and herpes labialis, pulpotomies, removal of impacted teeth and, in adults, apicoectomies and bone recontouring.

Pulpotomies

Parents often express concern about the need to take radiographs because of the nature of X-rays and their possible side effects on a child's overall health. They question the use of alloys because of the chemical makeup of the alloy. Whether these should be a real concern in today's dental care is open to debate, depending on your individual beliefs. There are also concerns by many, although not as loudly, about the effect of various pulpotomy procedure medicaments used in pulpotomy procedures, such as formocreosol.

Lasers provide a safe, non-chemical, effective and alternative treatment for pulpotomies. During the span of eight years, post-treatment results on more than 4,000 pulpotomies using the erbium (2940 nm) laser provide ample evidence that this method is both effective and safe for children without the need for introducing chemicals or using electrosurgery methods.

When the final result of orthodontic positioning of the front teeth results in gingival hypertrophy, the laser can be a useful tool to increase crown length and give the patient a more esthetic smile. This may often be accomplished without the need for local anesthesia. Patients who have medically induced hyperplastic tissue, such as patients requiring dilantin, can also have their tissue reduced and reshaped with the erbium.

In addition to the many examples described in this article, lasers can be used for additional procedures not usually required in pediatric dentistry, such as revisions of the abnormal mandibular frenum, often avoiding the need for soft-tissue grafts, crown-lengthening procedures where bone requires recontouring, apicoectomies, removal of bony exostoses, removal of third molar impactions, removal of root remnants, incising and draining soft-tissue infections, advanced periodontal treatments and the latest in advanced endodontic treatment via photo-ninduced photoacoustic streaming.

Photoacoustic endodontics using PIPS

The goal of endodontic treatment is to obtain effective cleaning and decontamination of the smear layer, bacteria and their byproducts in the root canal system. Clinically, traditional endodontic techniques use mechanical instruments, as well as ultrasonic and chemical irrigation, in an attempt to shape, clean and completely decontaminate the endodontic system but still fall short of successfully removing all of the infective microorganisms and debris. This is because of the complex root canal anatomy and the inability for common irrigants to penetrate into the lateral canals and the apical ramifications. It seems, therefore, appropriate to search for new materials, techniques and technologies that can improve the cleaning and the decontamination of these anatomical areas.

Among the new technologies, the laser has been studied in endodontics since the early 1970s[1-3] and has become more widely used since the '90s.[4-6]

Different wavelengths have been shown to be effective in significantly reducing the bacteria in the infected canals, and important studies have confirmed these results in vitro.[7] Studies reported that near infrared laser are highly efficient in disinfecting the root canal surfaces and the dentinal walls (up to 750 microns for the diode 810 nm and up to 1 mm for the Nd:YAG 1064 nm). On the other hand, these wavelengths did not show effective results in debriding and cleansing the root canal surfaces and caused characteristic morphological alterations of the dentinal wall. The smear layer was only partially removed and the dentinal tubules primarily closed as a result of melting of the inorganic dentinal structures.[5,8]

Other studies reported the ability of the medium infrared laser in debriding and cleaning root canal walls.[9,10] The bacterial load reduction after erbium laser irradiation demonstrated high on the dentin surfaces but low in depth of penetration because of the high absorption of laser energy on the dentin surface.[7] Also the laser activation of commonly

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used irrigants (LAI) resulted in statistically more effective removal of debris and smear layer in root canals compared with traditional techniques (CI) and ultrasound (PUI).[11,12] Additionally, the laser activation method resulted in a strong modulation in reaction rate of NaOCl, significantly increasing production and consumption of available chlorine in comparison to ultrasound activation.[13]

A recent study has reported how the use of an Er:YAG laser, equipped with a newly designed radial and stripped tip, in combination with 17 percent EDTA solution, using very low pulse duration (50 microseconds) and low energy (20 mJ) resulted in effective debris and smear layer removal with minimal or no thermal damage to the organic dentinal structure through a photoacoustic technique called photon induced photoacoustic streaming or "PIPS."[14,15] Also the same photoacustic protocol in combination with 5.25 percent sodium hypochlorite solution has been investigated and shown to reduce the bacterial load and its associated biofilm in the root canal system three dimensionally.[16]

Other similar studies are in progress for publication and the results are promising and suggest a three-dimensional positive effect of this laseractivated decontamination (LAD) method.

The purpose of this article is to present briefly the experimental background of this laser technique and to introduce the clinical protocol.

Scientific background

The microphotographic recording of the LAI studies suggested that the erbium lasers used in irrigant-filled root canals generate a streaming of fluids at high speed through a cavitation effect.[17] The laser thermal effect generates the expansion implosion of the water molecules of the irrigant solution, generating a secondary cavitation effect on the intracanal fluids. To accomplish this streaming, it is suggested the fiber be placed in the middle third of the canal, 5 mm from the apex and stationary.[18] This concept greatly simplifies the laser technique, without the need to reach the apex and to negotiate radicular curves.

Also, the recorded video of the new technique, PIPS, showed a strong agitation of the liquids inside the canals. It differs from the already cited LAI technique by activating the irrigant solutions in the endodontic system through a profound photoacoustic and photomechanical phenomena. The use of low energy (50 microsecond pulse, 20 mJ at 15 Hz, 0.3 W average power, or less) generates only a minimal thermal effect. The study with thermocouples applied to the radicular apical third revealed only 1.2 degrees C of thermal rise after 20 seconds and 1.5 degrees C after 40 seconds of continuous radiation.[14]

When the erbium laser energy is delivered at only 50 microsecond pulse duration through a special designed tapered and stripped 400 microns tip (Fotona LightWalker, Technology-4Medicine), it produces a large peak power of 400 watts when compared to a longer pulse duration. Each impulse, absorbed by the water molecules, creates a strong "shock wave" that leads to the formation of an effective streaming of fluids inside the canal while also limiting the undesirable thermal effects seen with other methodologies. The placement of the tip in the coronal portion only of the treated tooth allows for a more minimally enlarged canal preparation with less thermal damage as seen with those techniques placed into the canal system.

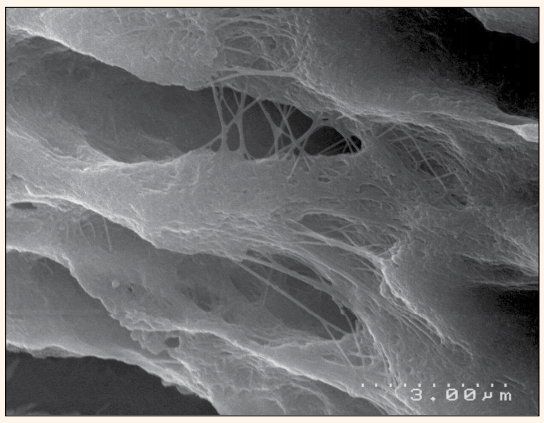

Fig. 3. Representative sample image of root canal dentinal walls irrigated with 17 percent EDTA and PIPS for 20 seconds.

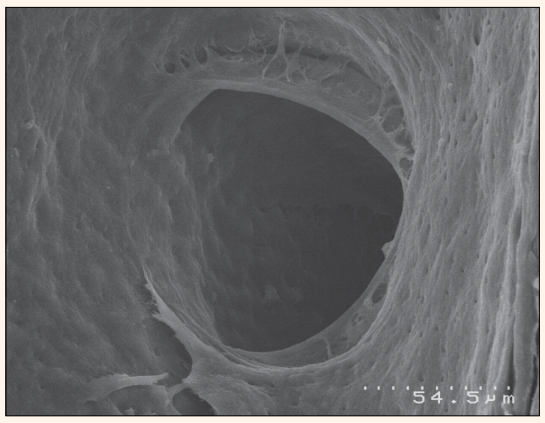

Fig. 4. SEM image of clean lateral canal.

The root canal surfaces irrigated with 17 percent EDTA and laser activated for 20 seconds showed exposed collagen matrix, opened tubules and the absence of smear layer and debris (Figs. 1-3). The rinsing with 5.25 percent sodium hypochlorite and laser irradiation for 20 seconds produced a strong activation of the solution, as reported by Macedo,[15] improving the disinfecting action of the sodium hypochlorite.[16] The disinfecting action of PIPS is very effective both on the root surface, the lateral canals and the dentinal tubules, as confirmed with SEM and confocal studies (Fig. 4).

The profound and distant effect of PIPS eliminates the need to introduce the tip into the root canal system. Unlike traditional laser techniques requiring placement of the tip 1 mm from the apex, or even 5 mm from the apex as proposed for LAI[18], the PIPS tip is placed in the coronal portion of the pulpal chamber only and left stationary, allowing the photoacoustic effect to spread into the openings of each canal. A new tip design consisting of a 400-micron diameter, 12 mm long, tapered end is used for this technique (Fig. 5). The final 3 mm of coating is stripped from the end to allow for greater lateral emission of energy compared to the frontal tip.

This mode of energy emission allows for improved lateral diffusion with low energy and enhanced photoacoustic effect.

Discussion

Laser irradiation is a common technique used in endodontics to improve the cleaning, the debriding and disinfection of the root canal system. Many wavelengths and protocols are used. Near infrared lasers are used for the three-dimensional decontamination of the endodontic system. Nd:YAG and diode lasers use thermal energy to destroy bacteria. Observations reveal a certain grade of thermal injury to the root canal surface and create a typical morphological damage. Moreover, they are not able to thoroughly remove the smear layer.

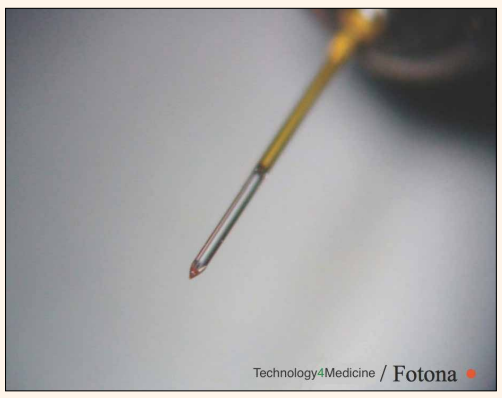

Fig. 5. New tapered tip design for this technique.

On the contrary, erbium lasers are used for their effective smear layer removal while their bactericidal activity is limited to the root surface. The placing of the tip close to the apex and its back movement during the activation process is related to the risk of apical perforation, ledging and surface thermal damage, because of the ablation ability of this wavelength. Also a combination of the near and medium infrared lasers has been proposed. A technique, called twinlight endodontic treatment (TET), uses the erbium laser energy first, to clean the root canal surface and remove the smear layer, and the Neodimium:YAG laser second, used in dry mode as the final disinfecting step. All these techniques utilize traditional tips and fibers placed into the canal, close to the apex (1 mm) with all the corresponding thermal disadvantages observed in long, narrow and curve canals.

The erbium lasers are also used as a medium of activation of commonly used irrigants (LAI), avoiding the risk of thermal damage, while increasing the cleaning and disinfecting activity of the fluids. PIPS, in particular, reduces all these risks and disadvantages, thanks to the position of the tip in the coronal orifice only and to the use of minimally ablative energy levels of 20 mJ or less.

The findings of our studies demonstrated that PIPS technique resulted in a safe and effective debriding and decontaminating of the root canal system. Our clinical trials showed that PIPS technique greatly simplifies root canal therapy while facilitating the search for the apical terminus, debriding and maintaining patency.

As a result of the efficacy of PIPS, the final size required for canal shaping can be significantly reduced, often to a size 25/04, allowing for a more minimally invasive and biomimetic preparation that can then be obturated three dimensionally.

Conclusion

Lasers are an extremely versatile addition to the dental practice and can be used in many instances instead of the conventional methods employed by the vast majority of dentists. Incorporating a laser in the dental practice should be viewed as an investment rather than a cost. When used with a good knowledge of laser physics, training and safety, lasers provide our patients a new standard of dental care.

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Full list of references is available from the publisher.

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