FOR DENTAL PROFESSIONALS

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The 28th Saudi Dental Society International Dental Conference

Board members of the Saudi Dental Society. From left to right: Dr. Aws Arrejaie, Dr. Mohammed Al Shehri, Dr. Abdullah Al Amri, Dr. Fahad Al Shehri, Prof. Badran Al Omar, Dr. Meshari Al Otaibi, Prof. Khalil Al Eisa, Dr. Fawaz Al Qahtani

By Dental Tribune MEA

Riyadh, KSA: The Saudi Dental Society recently held its most important and the largest scientific gathering in the Kingdom. The 28th Saudi Dental Society International Dental Conference was held last 10-12 January 2017 (12-14 Rabi'II 1438H) at the Riyadh International Convention and Exhibition Center in Riyadh, Saudi Arabia. The conference was attended by over 6,000 participants (dental specialist, dental technicians and assistants) from various governments and private sectors, universities, hospitals and institutions.

The 12 scientific sessions featured lecture presentations given by 25 international keynote speakers from USA, Canada, Germany, France, Italy, Brazil, Greece, Netherlands, Portugal, Norway and Ukraine including local speakers on various dental specialties, in addition to the 26 Continuing Education Courses and Workshops conducted during the three-day conference.

The highlight of the conference was the Research Award's Competition for Young Dentists, Graduates and Poster Presentation Competition including 148 posters offering the opportunity for other participants to present their research through poster sessions.

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The scientific program was also complemented by 70 well-organized exhibitions of numerous leading medical and dental companies featuring the latest equipment, materials and devices in the medical and dental world.

CAPPmea – Dental Tribune MEA once again attended as close partner to the Saudi Dental Society for a 12th consecutive year. The event continues to prove year on year to be the leading scientific conference and exhibition in the Kingdom attracting world-class keynote speakers discussing the latest hot topics in dentistry. DT

CARE was amongst the leading sponsors


Three days of exhibition & conference


The opening ceremony


Dr. Fahad Al Shehri, President of SDS during the opening speech


Over 6,000 participants attended

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Diastema closure using the 3M Esthetic Restorative Solution: Time-tested materials with a modern spin on polishing

By Dr Marcos Vargas, USA

Introduction

Given my primary research interest in the area of dental materials—bonding, composite resins and esthetic dentistry—I'm always examining products with an eye toward simple techniques and patient-pleasing esthetic results. Recently, I was greatly impressed to discover a high-gloss finishing and polishing system that is effective for both anterior and posterior, direct and indirect restorations. The Sof-Lex™ Diamond Polishing System from 3M introduces a two-step approach that achieves a paste-like gloss with the convenience of a rubberized system. The flexible shape adapts to all tooth surfaces, producing a lifelike, high-gloss finish for the dental restoration. Used with Filtek Z350XT Universal Restorative, the polishing system delivered excellent results while maintaining the integrity and anatomy of the restoration. When a young patient presented with a small anterior diastema, I used Filtek Z350XT restorative to close the diastema, then completed the case using the Sof-Lex Diamond Polishing system, delivering beautiful esthetic results with a high gloss shine that greatly impressed the patient.

As a complete system, the Esthetic Restorative Solution from 3M combines the time-tested Filtek Z350XT restorative with the new Sof-Lex Diamond Polishing system to impart a very natural-looking gloss in a technique that is kinder to gingival tissues when compared with conventional discs. It brings together the diamond paste-like polish in the convenience of a rubberized system, which I can appreciate in my practice.

Case Presentation

A young female patient presented, after orthodontic treatment, with a small anterior diastema, mesial to the right lateral incisor (Fig. 1). The patient's main esthetic concern was to eliminate the space and increase the size of the lateral incisor. Additionally, to ensure optimal stability of the orthodontic treatment, proximal contact among all anterior teeth is desirable. Isolation with a rubber dam pushed the gingiva apically to provide accessibility to the cervical area and allowed me to create proper anatomical contour and emergence profile (Fig. 2). The patient presented with a small anterior diastema. (Fig 1.) DT

Pre-operative

Fig. 1. The patient presented with a small anterior diastema.

Step 1

Fig. 2. Isolation with a rubber dam pushed the gingival apically to provide accessibility to the cervical area and allowed me to create proper anatomical contour and emergence profile.

Step 2

Fig. 3. A mylar strip was used to protect the adjacent tooth from etching. The mesial proximal, facial and lingual areas were etched. I prefer to use a selective etch enamel technique with Single Bond Universal Adhesive from 3M to increase the bond strength.

Step 3

Fig. 4. To prevent contact of the adhesive with the adjacent tooth, another mylar strip was placed and adhesive was applied. The manufacturer's instructions for use states that you should rub in for 20 seconds, use a gentle stream of air for about 5 seconds, and light cure 10 seconds. My preference is to rub for 30 seconds, dry for 30 seconds and light cure for 10 seconds.

Dr. Marcos Vargas

Vargas attended Cayetano Heredia University School of Dentistry in Lima, Peru and graduated in 1985. He spent two years, 1990 to 1992, in the AEGD program at the Eastman Dental Center in Rochester, New York. Dr. Vargas received his Certificate and Master Degree in Operative Dentistry in 1994 at the University of Iowa where he is currently a Professor in the Department of Family Dentistry. His primary research interests are in the area of dental materials including glassionomers, dentin bonding, composite resins and esthetic dentistry. Dr. Vargas is also recognized for his expertise of Direct Restorative Treatment Procedures and conducts numerous lecture and hands-on seminars in the US and internationally.

Step 4

Fig. 5. Filtek Z350XT Universal Restorative shade XWE was placed in two increments and each increment light cured for 20 seconds. The first increment was placed over the facial aspect of tooth #7

Fig. 6. This increment was then spread and feathered towards the middle of the tooth to improve blending. After this, I started contouring and polishing. The second increment was placed to fill the palatal aspect of the diastema with the help of a mylar strip. This completely closed the diastema.

Step 5

Fig. 7. To begin the contouring and polishing process, the proper length was first established with a Sof-Lex™ XT Contouring Disc. Second, an incisal-facial line angle was formed. Third, the mesio-facial line angle, as well as the incisal, facial and palatal embrasures were defined. Once contoured, the surface characterization of the adjacent teeth was copied onto the restoration using a fine diamond. In my experience, a speed of about 5,000 RPM using the diamond is ideal to create microanatomy.

Step 6

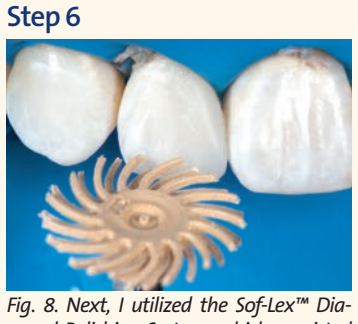

Fig. 8. Next, I utilized the Sof-Lex™ Diamond Polishing System, which consisted of two steps. First, a beige pre-polishing spiral smoothed and removed scratches in the restoration to prepare the surface for high-gloss polishing.

Fig. 9. Second, a pink diamond polishing spiral then imparted a smooth, high-gloss polish (Fig. 9). These spirals easily adapted to all surfaces. Finally, the proximal surface was polished with finishing strips.

Step 7

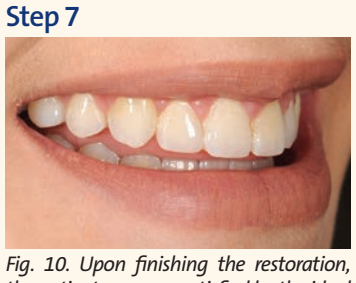

Fig. 10. Upon finishing the restoration, the patient was very satisfied by the ideal contour, surface smoothness and life-like luster.

Post-operative Restoration

Fig. 11. The patient returned one week later for a final post-operative appointment. She was still very satisfied with the final restoration.

3M Oral Care at Saudi Dental Society Exhibition

By 3M

On 10-12 January 2017, 3M Company traditionally participated in one of the largest annual events devoted to oral care in Saudi Arabia - The 28th Saudi Dental Society Exhibition, which took place in Riyadh and attracted professionals of various specializations from all across the region.

This year 3M Oral Care was presenting innovative procedure solutions and techniques for dentists and orthodontists that help oral care professionals achieve greater clinical, professional and personal success.

Esthetic Restorative Procedure solution with Filtek™ Z350XT Universal Restorative, Single Bond Universal adhesive, Elipar DeepCure curing lights and newly introduced Sof-Lex™ Diamond Polishing System is allowing to make it simple to create natural-looking restorations with a gorgeous paste-like gloss. Thanks to 3M's unique, patented nanotechnology, Filtek™ Z350XT Universal Restorative is easy to polish and also offers unsurpassed polish retention. The same nanotechnology that makes Filtek™ Z350XT Universal Restorative beautiful makes it strong, too, giving you the option of using it in any place and for any Class.

And with the Efficient Restorative Procedure solution 3M helps to simplify posterior restorations, one of the most common and complicated procedures. By using four 3M innovative technologies together (Filrek™ Bulk Fill Posterior restorative, Single Bond Universal adhesive, Elipar DeepCure curing light and Sof-Lex™ Diamond Polishing System) dentists can now move through a posterior restoration with speed and simplicity. Essential to this simplified procedure is Filtek™ Bulk Fill Posterior Restorative, designed to improve productivity by enabling fast and easy posterior restorations placing it in one convenient increment up to 5 mm!

3M Oral Care at SDS

Prosthodontics could learn more about the Indirect Procedure solution which is allowing to simplify and improve every step of the crown and bridge clinical procedure, including such sub-procedures as post & core with the newly introduced RelyX™ Fiber Posts 3D, impressioning with Impregum™ and Express ™ Penta™ materials, temporization with Proremp™ 4 composite material, cementation with very widely RelyX™ U200 self-adhesive cement etc.

Orthodontic Esthetic procedure with Clarity™ Advanced ceramic brackets, Efficient procedure with Metal brackets complemented with APC™ Flash-Free adhesive coated appliance system are providing various solutions and allowing to grow orthodontic practice with esthetics and efficiency.

This year 3M was honored to host many local and international guests on the booth. Alongside with representatives from Saudi Arabia dental community: Dr .Saud Orfali, Dental Director for MOH, Dr. Abdullah Shemary from Riyadh Dental College, Dr. Ali Habib, President of Saudi Orthodontic Society, Dr. Saeed Zahran, Vice Dental Director for MOH, Dr. Abdulrahman Hedan, Head of Dental at Military Hospital, the well-known international speakers Dr. Paulo Monteiro, Dr. Walter Devito, Dr. Angelo Putignano were welcomed at 3M Booth.

To learn more about 3M products and technologies please visit: www.3m.com.sa DT

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Filtek™ Z350 XT Universal Restorative polished with Sof-Lex™ Diamond Polishing System (left) vs. TPH Spectra® Universal Composite polished with Enhance® Finishing System and PoGo® Polishing System (right).

New universal adhesive with active moisture control

By Dentsply Sirona

Dentsply Sirona is proud to introduce Prime&Bond universal™ universal adhesive. Designed for all etching methods and indications, Prime&Bond universal features patented Active-Guard™ Technology – a significant advancement in adhesive chemistry that actively controls moisture on the prepared surface. Even if dentin is overly wet or dry, Prime&Bond universal is simple to use and provides consistent results for a strong, reliable bond.

Most dental adhesives are rather hydrophobic: they separate from water. With too much water on the prepared surface, these rather hydrophobic adhesives fail to cover the prepared surface uniformly. During air-drying, adhesive gaps can form as embedded pockets of water evaporate, increasing the risks of post-operative sensitivity and bond failure.

Partner glass ceramics can now also be processed in the CEREC SpeedFire with IPS e.max CAD (Ivoclar Vivadent) and Suprinity PC (VITA Zahnfabrik).

Active-Guard Technology with active moisture control is exclusively designed to protect against these risks.

The patented Active-Guard Technology balances hydrophobic and hydrophilic features and helps to achieve an optimized surface tension. Thus, Prime&Bond universal can overcome the surface tension of water, allowing the adhesive to spread evenly across the dentin and into the dentinal tubules to form a uniform, homogeneous layer. When the adhesive is air-dried, solvent and excess water evaporate uniformly to leave a thin, consistent coating of adhesive across the entire surface. The result is a strong, reliable bond, with virtually no post-operative sensitivity.

In addition to active moisture control, Prime&Bond universal provides several benefits over competing universal adhesives, including:

- **Active spreading** across the prepared surface to minimize the risk of dry spots that can lead to post-operative sensitivity and micro-leakage.
- **Low film thickness**, minimizing the risks of changing the preparation geometry and compromising crown fit, or leaving adhesive pools that may show up on radiographs and can be misdiagnosed a voids, gaps or secondary decay.
- **No need to apply an activator** when used with Calibra® Ceram cement.
- **Convenience and control,** with one-handed opening of Flip Top Cap bottle, precise dispensing and up to 30 minutes of working time in a closed CliXdish™.
- **Innovative formulation** without any HEMA, TGDMA and Bisphenol

Prime&Bond universal with patented Active-Guard technology is simple to use, delivers consistent results and helps ensure a strong bond even when dentin is overly wet or dry. To learn more and try a sample, contact your Dentsply Sirona representative or visit www.dentsply.eu. DT

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Planmeca – 45 years of better care through innovation

Planmeca Founder and President Mr. Heikki Kyöstilä

By Planmeca

2016 marks the 45th anniversary of Planmeca. Founder and President Heikki Kyöstilä attributes the company's success to a strong commitment to R&D, as well as a clear vision for the future. Planmeca's steady ascent to the top of the dental industry has been a shining example of the power of innovation and Nordic fortitude.

The story of Planmeca began in 1971 in a garage in Finland's capital city Helsinki.

"Starting the company was like skydiving without parachute", Heikki Kyöstilä illuminates. "The jump paid off – today Planmeca is a global leader in health care technology."

Indeed, the company that Kyöstilä started from nothing now boasts an extensive product portfolio that covers everything needed at a modern dental clinic – from high-tech dental care units to world-class 2D and 3D imaging devices, comprehensive CAD/CAM equipment and powerful software solutions.

Planmeca's products are still designed and manufactured in Helsinki, at the company's headquarters. Using the latest technology and best materials, they are tailored to meet the unique needs of dental professionals in different markets. Planmeca is the largest family business in its field today, with over 98% of its products exported abroad to over 120 countries worldwide.

According to Kyöstilä, the secret behind his company's success and never-ending innovation is a strong and unwavering commitment to Research and Development. Up to 10% of the Planmeca's annual turnover is invested in R&D. The company also works closely with renowned dental universities and leading experts in forming its product portfolio.

"At Planmeca, we always operate with the future in mind. I strongly believe that we will guide dentistry into the future like no one else can." DT

Guy Leaver, Neoss Chief Financial Officer, talked to Dental Tribune about the company's history, products and future plans

By DTI

Neoss was founded in 2000 by CTO, Fredrik Engman and Professor Neil Meredith and is head quartered in Harrogate, North Yorkshire, in the United Kingdom. The business has operations in Australia, Austria, Germany, Italy, New Zealand Sweden and the USA. In recent years the expansion has been via appointed distributors in Europe, Asia and now the Middle East. This continued expansion has propelled the business forward with sales in constant currency increasing year on year since it was founded.

Guy Leaver stated "We are very proud of our business, our European heritage, Neoss products are all manufactured in Europe, Switzerland and the UK and are manufactured to the highest quality". Neoss products are developed by its Product Development and Research team and they always aim to develop products which are innovative and market leading. Neoss ProActive® Implants are manufactured in Sweden and are protected by 3 patents, the macro geometry, thread forming and cutting, abutment connection and ProActive Surface. The Neoss ProActive surface was introduced in 2009 and creates a surface with dual roughness yet it is also superhydrophilic. This surface enhances protein aggregation and can accelerate fibrin network formation. Studies show the etched and blasted ProActive surface stimulates bone to form more rapidly and with a greater strength at the implant interface. Neoss launched its Neoss ProActive® Tapered Implant in 2012, to add to the Neoss ProActive® Straight Implant.

Guy Leaver, Neoss Chief Financial Officer and Ahmed El Ghandour, Area Sales Manager

Neoss states its objective is to "Advance the Science of Dental Implant Treatment" and that the "Neoss Dental Implant System is the most efficient dental implant system in the market. It combines market-leading functionality for the patient with the lowest level of complexity available for the Surgeon."

Neoss aims to continue its expansion in the Middle East and has built a strong team in a short time, which should enable the business to support more Distributors and Clinicians in the region. DT

If you are interested in finding out more about Neoss and its products please contact:

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Ahmed.Ghandour@neoss.com

Visit EMS at AEEDC 2017, 7-9 Feb. – booth 8E06

By E.M.S

This year the visit of the EMS stand at the AEEDC is particularly worthwhile: At EMS booth 8E06 we present the Guided Biofilm Therapy (GBT). This clinical protocol ensures a high standard in dental maintenance and facilitates the complete removal of subgingival as well as supragingival biofilm. GBT was developed in close cooperation with universities, dentists, dental hygienists and EMS specialists. It is safer, more comfortable and more efficient than conventional methods.

Furthermore, as part of the trade fair promotions, EMS grants special conditions. These offers are supported by all retailers in the Middle East.

Don't miss this outstanding occasion!

In addition, you have the opportunity to win an AIR-FLOW® HANDY 3.0 PERIO at EMS booth raffle. The AIR-FLOW® HANDY 3.0 offers you extreme flexibility and an ergonomic design for maximum comfort. The spray handpiece AIR-FLOW® Perio is suitable for treatment in periodontal pockets of up to 9 mm. The replaceable and flexible PERIO-FLOW® nozzles have a step-by-step Millimeter scale – 3mm, 5mm, 7mm and 10mm. Come to EMS booth to experience the remarkable advantages of all EMS devices and to find out how they can support and facilitate your daily business.

Another highlight of this year's AEEDC: At Al-Hayat booth, patients will be treated with the state of the art technologies AIR-FLOW® and PIEZON®. Don't miss this unique possibility to learn more about these forward-looking treatments of EMS. DT

New Technologies— to improve root canal disinfection

By Drs Gianluca Plotino, Nicola M. Grande & Prof. Gianluca Gambarini, Italy

Introduction

The major causative role of micro-organisms in the pathogenesis of pulp and periapical diseases has clearly been demonstrated.[1] The main aim of endodontic therapy is to disinfect the entire root canal system, which requires the elimination of micro-organisms and microbial components and the prevention of its reinfection during and after treatment.
This goal is pursued through chemo-mechanical debridement, for which mechanical systems are used with irrigating solutions.

Standard endodontic irrigation protocol

Sodium hypochlorite

Sodium hypochlorite (NaOCl) is the main endodontic irrigant used, owing to its antibacterial properties and its ability to dissolve organic tissue.[2]
NaOCl is used during the instrumentation phase to increase its time of action within the canal as much as possible without it being chemically altered by the presence of other substances.[3] The effectiveness of this irrigant has been shown to depend on its concentration, temperature, pH solution and storage conditions.[3] Heated solutions (45–60 °C) and higher concentrations (5–6 %) have greater tissue-dissolving properties.[2] However, the greater the concentration, the more severe the potential reaction if some of the irrigant is inadvertently forced into the periapical tissue.[4] In order to reduce this risk, the use of specially designed endodontic needles and an injection technique without pressure is recommended.[5]

EDTA

The main disadvantage of NaOCl is its inability to remove the smear layer. For this reason, combination of NaOCl with EDTA (ethylenediaminetetraacetic) is recommended.[2] EDTA has the ability to decompose the inorganic component of intracanal debris and is generally used in a percentage equal to 17 %.
EDTA appears to reduce the antibacterial and solvent activity of NaOCl; thus, these two liquids should not be present in the canal at same time.[6] For this reason, during mechanical preparation, abundant and frequent rinsing with NaOCl is performed, while the EDTA is used for 2 min at the end of the preparation phase to remove the inorganic debris and the smear layer from the canal walls completely.

Ultrasonic activation of NaOCl

The use of ultrasound during and at the end of the root canal preparation phase is an indispensable step in improving endodontic disinfection. The range of frequencies used in the ultrasonic unit is between 25 and 40 kHz.[7] The effectiveness of ultrasound in irrigation is determined by its ability to produce cavitation and acoustic streaming. Cavitation is minimized and limited to the tip of the instrument used, while the effect of acoustic streaming is more significant.[7]
Ultrasound creates bubbles of positive and negative pressure in the molecules of the liquid with which it comes into contact. The bubbles become unstable, collapse and cause an implosion similar to a vacuum decompression. Exploding and imploding they release impact energy that is responsible for the detergent effect. It has been demonstrated that ultrasonic activation of NaOCl dramatically enhances its effectiveness in cleaning the root canal space, as ultrasonic activation greatly increases the flow of liquid and improves both the solvent and antibacterial capacities and the removal effect of organic and inorganic debris from the root canal walls.[7]

Ultrasonic activation of NaOCl of 30–60 s for each canal, with three cycles of 10–20 s (always using new irrigant), appears to be sufficient time to obtain clean canals at the end of the preparation phase (Figs. 1 & 2).[7] Ultrasound appears to be less effective in enhancing the activity of EDTA, although it may contribute to better removal of the smear layer.[7] The accumulation of debris produced by mechanical instrumentation in inaccessible areas is preventable by using ultrasonic activation of NaOCl even during the preparation phase.[8] The use of a system of ultrasonic continuous irrigation might therefore be advantageous.
It involves the use of a needle activated by ultrasound. With this method, the irrigant is released into the canal and is activated by the action of the ultrasonic needle simultaneously.[9]

Chlorhexidine

A final flush with 2 % chlorhexidine (CHX) after the use of NaOCl (to dissolve the organic component) and EDTA (to eliminate the smear layer) has been proposed to ensure good results in cases of persistent infection, owing to its broad spectrum of action and its property of substantivity.[5, 10] However, the use of CHX is hindered by the interaction between NaOCl and CHX, which tends to create products that may discolor the tooth and precipitates that may be potentially mutagenic. For this reason, CHX should not be used in conjunction with or immediately after NaOCl.[11] This interaction can be prevented or minimized by an intermediate wash with absolute alcohol, saline or distilled water.[12]

Activation systems

Mechanical instrumentation alone can reduce the number of micro-organisms present within the root canal system even without the use of irrigants and intracanal dressings,[13] but it is not able to ensure an effective and complete cleaning.[14] Irrigating solutions without the aid of mechanical preparation are not able to reduce the intracanal bacterial infection significantly.[15] For these reasons, today research is oriented toward the study of systems that can improve root canal disinfection through mechanical activation of endodontic irrigants, and in particular NaOCl. Multiple agitation techniques and systems for irrigants have been used over time,[16] demonstrating more or less positive results.[17]

Figs. 1 & 2: Ultrasonic activation with a passive file (Fig. 1) and an active file (Fig. 2).

Manual agitation techniques

The simplest technique of mechanical activation of irrigants is manual agitation, which can be performed with different systems. The easiest way to achieve this effect is to move vertically an endodontic file that is passive in the canal. The use of the file facilitates the penetration of the irrigant, leads to a more effective delivery of irrigant to the untouched canal surfaces and reduces the presence of air bubbles in the canal space,[18] but does not improve the final cleaning.[17] Another similar technique moves vertically a gutta-percha cone to working length with the canal filled with irrigant. Even this method, however, has not been found to improve the intracanal cleaning.[9, 17] For this purpose, in each case, well fitting gutta-percha cones (increased taper) were more effective than cones with the standard taper (0.02).[9] The use of endodontic brushes and of particular needles for endodontic irrigation with bristles on their surface is another technique suggested in order to move the irrigant more effectively within the canals. These systems have been shown to be valid in the removal of the smear layer from root canal walls and thus they can be recommended during irrigation with EDTA to improve their efficacy at the end of the preparation.

Machine-assisted agitation systems

The evolution of manual systems led to the introduction of instruments that can be rotated in handpieces at low speed inside the canal filled with irrigant.
They are rotary brushes too large to be brought close to the working length; thus, they can be used effectively only in the coronal and middle thirds of the canal. Other similar instruments are files in plastic with a smooth surface and increased taper or with a surface with lateral plastic extensions, that have dimensions appropriate to achieve the working length if used after the canal preparation. Studies on these systems have shown conflicting results.
In general, the results are better than with hand irrigation with a syringe, but lower than that of other more effective systems.[16]

Continuous irrigation during instrumentation

Recently, a new system for root canal preparation has been introduced to the market. This system uses a particular instrument with an abrasive surface that enlarges the canal via friction in a vibrating motion and allows irrigant to flow through the file itself. This system has shown excellent results in terms of respecting the anatomy and cleaning of difficult root canal anatomies, such as difficult isthmuses, oval canals or C-shaped canals.[19] The low cutting efficiency of this system in some cases may limit its use in root canal preparation, but makes it an excellent additional technique to enhance the cleaning and disinfection of the root canal system at the end of the preparation.[20] The concept of continuous irrigation was developed in the past with the use of mechanical instruments for sonic and ultrasonic preparation that could concurrently clean through the continuous release of irrigant. These techniques were then abandoned for various reasons related to the poor quality of the preparation itself.

Sonic activation

Sonic activation has been shown to be an effective method for disinfecting the root canals. The recent systems use smooth plastic tips of different sizes activated at a sonic frequency by a handpiece.
The system seems to be able to clean the main canal effectively, to remove the smear layer and to promote the filling of a greater number of lateral canals.[17] Another recently introduced technique uses a syringe with sonic vibration that allows the delivery and activation of the irrigant in the root canal simultaneously. Sonic activation differs from ultrasonic activation in that it operates at a lower frequency (1–6 kHz), and for this reason it is generally found to be less effective in removing debris than are ultrasonic systems.[17, 21, 22]

Apical negative-pressure irrigation

As the irrigant must be in direct contact with the micro-organisms and canal walls to be effective, the accessibility of the irrigant to the whole root canal system, in particular in the apical third, is essential.
In order to deliver the irrigant into the root canal for the entire length and to obtain a good flow of fluid, apical negative-pressure systems have been introduced that release and remove the irrigant simultaneously.

These systems consist of a macrocannula for the coronal and middle portions and a microcannula for the apical portion, and the cannulas are connected to a syringe for irrigation and the aspiration system integrated with the dental unit (Fig. 3). During irrigation, a tip connected with a syringe delivers the irrigant to the pulp chamber without the risk of overflow, while the cannula placed in the canal pulls irrigant into the canal, through the aspiration system to which it is connected, and evacuates it through the suction holes. This system is intended to ensure a constant and continuous flow of new irrigant into the apical third safely and with a lower risk of extrusion.[23] Most of the studies on this technique have shown that it is very effective at ensuring a greater volume of irrigant in the apical third[24] and excellent removal of debris from this area[25] and inaccessible areas,[26] with results in the majority of cases similar to those of ultrasonic activation techniques.[27–29] From a clinical perspective, apical negative-pressure systems can be effectively integrated with ultrasonic irrigation techniques because they act by different mechanisms. They can operate in synergy with the objective to obtain cleaner canals, especially in the apical third and the most inaccessible areas.

Laser activation

The interaction between the laser and the irrigant in the root canal is a new area of interest in the field of endodontic disinfection. This concept is the base of laser-activated irrigation (LAI) and photon-initiated photoacoustic streaming (PIPS) technology.[30]
The mechanism of this interaction has been attributed to the effective absorption of the laser light by NaOCl. This leads to the vaporization of the irrigant and to the formation of vapor bubbles, which expand and implode with secondary cavitation effects.
The PIPS technique is based on the power of the Er:YAG laser to create photoacoustic shock waves within the irrigant introduced into the canal.
When it is activated in a limited volume of liquid, the high absorption

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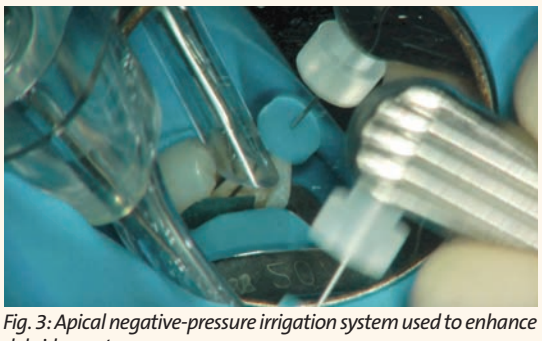

Fig. 3: Apical negative-pressure irrigation system used to enhance debridement.

Fig. 4: Disinfection activated by light to enhance root canal cleaning.

of the laser in NaOCl combined with the high peak power derived from the short pulse duration employed (50 µs) determines a photomechanical phenomenon.[30] A study showed that there was no difference in bacterial reduction achieved by NaOCl activated by laser compared with only NaOCl.[31] Another study investigated the capability of LAI to remove a bacterial biofilm created in vitro on the canal walls.[32] This study found that it did not completely remove the biofilm from the apical third of the root canal and infected dentinal tubules.
However, the finding that laser activation generated a higher number of samples with negative bacterial cultures and a lower number of bacteria in the apical third was a promising result regarding the effectiveness of the technique, and has been confirmed by a more recent study.[33]

Additional disinfection systems

In addition to the above-mentioned systems that were able to activate the endodontic irrigants and to improve their cleaning capability, endodontic research is oriented toward the identification of alternative solutions that could further refine disinfection and assist in the destruction of biofilms and the elimination of micro-organisms.
For this purpose, different substances and technologies have been investigated over time with different results.

Photoactivated disinfection

A new method recently introduced in endodontics is photoactivated disinfection. This technique is based on the principle that the photosensitizing molecules (photosensitizer, PS) have the ability to bind to the membranes of the bacteria.
The PS is activated with a specific wavelength and produces free oxygen, which causes the rupture of the bacterial cell wall on which the PS is associated, determining a bactericidal action.
34 Extensive laboratory studies have shown that the two components do not produce any effect on bacteria or on normal tissue when used independently of each other; it is only the combination of PS and light that exert the effect on the bacteria.[34]
An endodontic system called light-activated disinfection (LAD) has been developed based on a combination of a PS and a special light source.
The PS attacks the membranes of micro-organisms and binds to their surface, absorbs energy from light and then releases this energy in the form of oxygen, which is transformed into highly reactive forms that effectively destroy microorganisms LAD is effective not only against bacteria, but also against other micro-organisms, including viruses, fungi and protozoa. The PSs have far less affinity for the cells of the body; therefore, toxicity tests carried out did not report adverse effects of this treatment. Clinically, after root canal preparation, the PS is introduced into the canal to working length with an endodontic needle and is left in situ for 60 s to allow the solution to come into contact with the bacteria and spread through any structures, such as biofilms.
The specific endodontic tip is then inserted into the root canal up to the depth that can be reached and irradiation is performed for 30 s in each canal (Fig. 4). This technique has proven to be effective in laboratory studies at eliminating high concentrations of bacteria present in artificially infected root canals.[35] Care should be taken to ensure maximum penetration of the PS, since it is important that it come into direct contact with the bacteria, otherwise the effect of photosensitivity will not occur. In addition, LAD appears to be effective not only against the bacteria in suspension, but also against biofilm.[5] Research is now directed toward evaluating the possibility of increasing the antibiofilm effectiveness of LAD, combining the benefits of photodynamic therapy with those of bioactive glasses and nanoparticles, which will be described later. Currently LAD is not considered as an alternative, but rather as a possible supplement to standard protocols of root canal disinfection already in use.[5]

Laser

One of the main disadvantages of the current endodontic irrigants is that their bactericidal effect is limited primarily to the main root canal.

In the endodontic field, several types of lasers have been used to improve root canal disinfection: the diode laser, carbon dioxide laser, Er:YAG laser and Nd:YAG laser. The bactericidal action of the laser depends on the characteristics of its wavelength and energy, and in many cases is due to thermal effects. The thermal effect induced by the laser produces an alteration of the bacterial cell wall that leads to changes in osmotic gradients up to cell death. Some studies have concluded that laser irradiation is not an alternative, but rather a possible supplement to existing protocols to disinfect root canals.[36] The laser energy emitted from the tip of the optical fiber is directed along the canal and not necessarily laterally toward the walls. In order to overcome this limitation, a new delivery system of the laser was developed. The system consists of a tube that allows the emission of the radiation laterally instead, directed through a single opening at its terminal end. The objective of this modification was to improve the antimicrobial effect of the laser in order to penetrate and destroy microbes in the root canal walls and in the dentinal tubules.
However, complete elimination of the biofilm and bacteria has not yet been possible, and the effect of the laser has been found to be less relevant than that of the classical solutions of NaOCl.[37] In conclusion, strong evidence is not currently available to support the application of high-power lasers for direct disinfection of root canals.[38]

Ozone

Ozone is an unstable and energetic form of oxygen that rapidly dissociates in water and releases a reactive form of oxygen that can oxidize cells. It has been suggested that ozone may have antimicrobial efficacy without inducing the development of drug resistance and for this reason it was also used in endodontics. However, the results of the available studies on its effectiveness against endodontic patho gens are inconsistent,39 especially against biofilms.
The antibacterial effectiveness of ozone was found not comparable and less than that of NaOCl.[39]

Alternative antibacterial systems

Nanoparticles

Nanoparticles are microscopic particles between 1 and 100 nm in size that have antibacterial properties and a tendency to induce much lower drug resistance compared with traditional antibiotics. For example, nanoparticles of magnesium oxide, calcium oxide or zinc oxide are bacteriostatic and bactericidal. They generate active oxygen species that are responsible for their antibacterial effect through electrostatic interaction between positively charged nanoparticles and negatively charged bacterial cells, resulting in accumulation of a large number of nanoparticles on a bacterial cell membrane and a subsequent increase in its permeability associated with the loss of its functions.
Nanoparticles synthesized from powders of silver, copper oxide or zinc oxide are currently used for their antimicrobial activity. In addition, nanoparticles can alter the chemical and physical properties of dentin and reduce the strength of adhesion of bacteria to the dentin itself, thus limiting recolonization and bacterial biofilm formation. In any case, the possible success of the application of nanoparticles in endodontics will depend essentially on the manner in which they can be delivered in the most complex root canal anatomy.

Bioactive glass

Recently, bioactive glass or bioactive glass-ceramics have been a subject of considerable interest for endodontic disinfection owing to their antibacterial properties, but conflicting results have been obtained.[5]

Natural plant extracts

A current trend is the use of natural plant extracts, taking advantage of the antibacterial activity of polyphenolic molecules generally used for storing food. These compounds have been found to have poor antibacterial efficacy, but several demonstrate significant ability to reduce the formation of biofilms, although the mechanism by which this occurs is not clear.[5]

Noninstrumentation techniques

The first trial of a method of cleaning without canal preparation was the noninstrumentation technique conceived by Lussi et al.[40] This technique did not provide for the enlargement of the root canals because there was no mechanical instrumentation of the root canal walls. In fact, root canal cleaning was exclusively obtained with the use of NaOCl at low concentration, introduced and removed from the canal using a vacuum pump and an electric piston that created fields of alternating pressure inside the canal.
These caused the implosion of the produced bubbles and hydrodynamic turbulence that facilitated the penetration of NaOCl into the root canal ramifications. At the end of this procedure, the canals were filled with a cement conveyed by the same vacuum pump. This system did not prove to be of substantial effectiveness and was never marketed.
Recently, a method has been developed for cleaning the entire root canal system through the use of a broad spectrum of sound waves transmitted within an irrigating solution to remove pulp tissue, debris and micro-organisms quickly.
One study showed that this technique was able to dissolve the tissue tested at a rate significantly higher than that of conventional irrigation.[4] More research is needed to determine whether this approach is effective in the root canal system with minimally invasive or no canal preparation.

Conclusion

According to current knowledge, endodontic pathology is an infection mediated by bacteria and in particular by biofilm. From a biological perspective, endodontic therapy must then be directed toward the elimination of micro-organisms and the prevention of possible reinfection.
Unfortunately, the root canal system, with its anatomical complexity, represents a challenging environment for the effective removal of bacteria and biofilm adherent to the canal walls. Chemomechanical preparation involves mechanical instrumentation and antibacterial irrigation, and it is the most important phase of the disinfection of the endodontic space. The technological advances of instruments have brought significant improvements in the ability to shape the root canals, with fewer procedural complications. In the management of the infected root canal system, various antimicrobial agents have been employed. Furthermore, some clinical measures, such as an increase in apical preparation and a more effective system of irrigant delivery and activation of irrigant, can promote and make more predictable the reduction of intracanal bacteria, especially in complex anatomical and noninstrumented portions of the root canal system. DT

Editorial note: A list of references is available from the publisher.

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