No long-term change found in caries prevalence in early South-East Asians

Archaeological findings question relationship between rise of agriculture and oral health

While caries prevalence in the samples differed from site to site, there was no chronological relationship between them, the researchers reported, suggesting that agriculture and change in diet did not have a long-term impact on the oral health of South-East Asians as previously believed. However, caries prevalence in deciduous teeth was consistently found to be higher than in permanent teeth, which the researchers believe could be due to the more cariogenic food, such as fruit and root grubs, that children were given at a very early age before switching to less-cariogenic food like rice.

Children seemed to have increasingly relied on rice as the main source of food later in life, as caries levels in permanent teeth were found to be relatively low throughout all samples.

Among other sites, the researchers from universities in New Zealand and the US examined samples from Khok Phanom Di, Thailand, and Cambodia, however, clinicians and anthropologists have recently found no evidence to support the theory that oral health in this region declined over time owing to the intensification of agriculture.

Researchers from Germany have discovered that fluoride decreases the adhesive forces of oral bacteria and cariogenic pathogens in particular. Testing the adhesion of caries-inducing Streptococcus mutans, Streptococcus oralis and Staphylococcus carnosus to smooth, high-density hydroxyapatite surfaces, which were produced especially for the experiments and resembled tooth enamel in their composition, they observed lower adhesive forces after fluoride treatment of the surfaces in all bacteria species. Compared with untreated surfaces, the adhesion was only half as strong.

In contrast to prior studies that traced the cavity-preventive effect of fluoride back to effects on demineralisation, the findings suggest that the decrease in adhesive forces is a key factor of the cariostatic effect of fluoride. This could help improve dental fillings, dentures and implants in the future, the researchers concluded.
Clinicians use YouTube to explore origins of dental fear

HONG KONG/PERTH, Australia/SHAH ALAM, Malaysia: With 800 million users per month currently, YouTube has become one of the most frequented websites on the Internet. Owing to its popularity, the video-sharing platform is increasingly used by scientists to research social patterns and behaviour. The latest study, conducted by paediatricians and public health experts across the Asia Pacific region, sought to investigate dental anxiety triggers in children and adolescents.

By analysing 182 videos with people expressing their views and experiences on the condition, they found that fear of the dentist not only has different manifestations and impacts but is also caused by yet under-estimated factors like improper behaviour or work ethic of the clinician. Another major cause was reported to be the influence of parents and peers who shared unpleasant dental experiences with their children or used their fear of a dental visit for making them more compliant.

Commenting on their findings, the researchers stated that results do not only allow better insight of how the condition emerges and manifests over time but also that social media like YouTube can offer some value for understanding health issues better. However, they recommended to confirm their findings through more examinations incorporating in-depth interviews with patients and parents.

“Dental fear and anxiety in children is known to cause un-cooperative behaviour during dental visits, delays in treatment, sleep disorders and psychological issues that can affect daily life,” said co-author Professor Nigel King from the University of Western Australia’s Faculty of Medicine. “The personal narratives and original sharing techniques for dental anxiety include the use of sedatives like nitrous oxide/oxygen or distraction methods.”

Common treatment techniques for dental anxiety include
National University of Singapore to expand dental faculty and services

The National University of Singapore’s Faculty of Dentistry is on the brink of a major expansion, Dental Tribune Asia Pacific has learned. Officials recently unveiled plans to transform the current facilities into an oral health-care centre, which will include the construction of a new, state-of-the-art building and extend the university’s clinical offering.

In addition, the centre will facilitate research on regenerative biology and tissue engineering, among other fields.

The opening of the new centre is anticipated for 2017, according to reports by the Singapore newspaper The Straits Times. It will allow the faculty to increase its annual intake of undergraduates to 80, the number needed to address the growing demand for dental services in the city-state, based on Ministry of Health projections. While the estimated development expenses for the new facility were not disclosed, the university told the newspaper that it aims to raise US$50 million for the project. The remaining development expenses will likely be borne by the government.

Speaking to Dental Tribune, the faculty would not divulge any further details on the matter, saying that the expansion is still in predevelopment.

Teaching, research and clinical services at the faculty are currently hosted in different facilities at the university itself and the National University Hospital, established in 1929 by the British. The faculty offers a number of dental programmes, including a Bachelor of Dental Surgery and Master of Dental Surgery.

According to university figures, over 200 dental students were enrolled at the faculty last term.

Fossil teeth like this found in Thailand were examined by the researchers. (DTI/Photo courtesy of Sian Halcrow, University of Otago, New Zealand)

“Teeth show heterogeneity in caries prevalence that does not correlate with the chronology of the site, supporting the hypothesis that there was no decline in dental health with the intensification of agriculture in this region of the world,” the researchers commented in the report. The relationship between oral health and agricultural intensification may therefore be considered to be more complex, they said.

Rice is believed to have first been domesticated in the Pearl River valley in China, and the earliest archaeological evidence of rice intensification in mainland South-East Asia dates back to approximately 4,000 yr. Until now, the crop remains one of the major sources of food and income for the majority of people living there. Thailand is the world’s largest exporter of rice after India, producing over ten million tons a year.

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Dear reader,

Have you visited Tokyo lately? In a few week or days, depending on where you get this edition, the next congress of the International Federation of Endodontic Associations (IFEA) is going to take place in the capital of Japan and for the first time, the Dental Tribune International Publishing Group will be represented not only by our Japanese licence partners Medical Tribune but also by Modern Dentistry Media from South Africa, who recently joined our network and will be organising IFEA’s next congress in 2016. If you happen to be there, I encourage you to pay them a visit.

For all those readers missing out on the event, our newest endodontic supplement on pages 19 to 31 will give you an extensive overview about endodontic irrigants and retreatment are discussed by renowned experts in the field. In addition, Dr Gary Glassman by intention will introduce you to concepts like intentional replantation and development of image-based simulation which could be worth a look, as promising results have already been published.

A threat to the dental professional

The main purpose of the use of robots is to increase the precision, quality and safety of surgical procedures. Following the developments in industrial robot technology, robotics has found its way into the medical field and is used in a range of surgical disciplines. Robotics is not yet used in dentistry even though all the necessary technologies have already been developed and could easily be adapted. Some of the technologies are already used in dentistry, such as image-based simulation of implant surgery followed by the use of surgical guides, and creating digital impressions of preparations using an intra-oral scanner, after which a milling device produces the restoration, but we have not yet seen any robot able to prepare teeth for crowns, inlays or bridges.

Such a robot would fundamentally be a dental drilling device coupled with a navigation device to determine the correct position of the device in relation to the patient. The robot would either be operated directly by a dentist or be preprogrammed to perform its functions based on imaging data (CT scan). Finally, an intra-oral scanner would be used to make digital impressions. This data would then be transferred to the lab to produce temporary crowns or bridges in a very short time using a milling machine and to manufacture the final restorations in much shorter time than with conventional procedures.

Robotic systems to regenerate apical tissue.

Robotic technology could offer dentistry improved accuracy, predictability, safety, quality of care and speed of treatment. One might wonder why robots have not yet been introduced to dentistry, as the functions needed are relatively simple. An explanation could be that it is an example of a disruptive technology, meaning that the current manufacturers of dental equipment might fear a negative effect on their current business and the alienation of dentists, as robots might be seen as a threat to dental professionals.

Regenerative endodontics

In the first part of this century, there has been an increase in understanding and experimentation with stem cells as a primary tool in the expanding regenerative medicine and tissue-engineering revolution. Regenerative endodontics is one of the most significant developments among these biochemical approaches that will possibly involve a combination of disinfection and debridement of infected root-canal systems to regenerate apical tissue. Although the challenges of introducing these methods in the endodontic field are substantial, the potential benefits to patients and the profession are equally ground-breaking.

Regenerative endodontics can be defined as biologically based procedures designed to create or deliver tissue to replace diseased, missing or traumatised pulp–dentin complex. Two concepts currently exist in regenerative endodontics, the first is the active pursuit of pulp–dentine regeneration to implant or regrow pulp, and the other is the formation of new living tissue from the stem cells present in the root, allowing root development.

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The gingival biotype has important implications for increased susceptibility to recession.

While clinical periodontal measurements of probing depth and recession are used to work out the clinical attachment level, in many instances, the residual attachment is an important prognostic indicator for teeth with periodontitis. Indeed, one of the reasons for using periapical or panoramic radiographs rather than bitewing assessments of attachment status is the simple fact that one can see how much of a root is attached.

Clearly, 7 mm of attachment loss on a root that is 10 mm long will have completely different implications than such loss on a root that is 15 mm long. Therefore, patients with short roots are more likely to experience tooth loss following attachment loss last patients with long roots would.

The gingival biotype has important implications for increased susceptibility to recession. Gengival biotype frequency.

Studies to obtain the Caucasian son and data from European standard root lengths for comparison to obtain standardized data from standard dental analysis textbooks to obtain standardized gingival tissue compared with these 49 Asians had shorter root is still attached. Can estimate how much of the root length we can evaluate the root length. By combining the clinical and panoramic radiographs, which were measured from dental panoramic radiographs, which were calibrated using 5 mm ball bearings. Gingival biotype was determined according to standard clinical protocols.

The results suggested that these 49 Asians had shorter roots and generally thinner gingival tissue compared with Caucasians. The authors used data from standard dental anatomy textbooks to obtain standard root lengths for comparison and data from European studies to obtain the Caucasian gingival biotype frequency.

“...the residual attachment is an important prognostic indicator for teeth with periodontitis.”

While clinical periodontal measurements of probing depth and recession are used to work out the clinical attachment level, in many instances, the residual attachment is an important prognostic indicator for teeth with periodontitis. Indeed, one of the reasons for using periapical or panoramic radiographs rather than bitewings to assess periodontal status is the simple fact that one can evaluate how much of a root is attached.

Clearly, 7 mm of attachment loss on a root that is 10 mm long as increased susceptibility to recession. Jami's studies showed that thin tissue is more likely to recede when subjected to micro-trauma such as that from overzealous toothbrushing, but it is important to remember that classic studies like those of Miyasato and coworkers in 1977 showed us that thin areas of keratinised gingiva are not necessarily more susceptible to inflammatory periodontal disease. Therefore, we must separate the susceptibility to recession from the susceptibility to periodontitis.

We must bear in mind the limitations of this study, some of which were pointed out by the authors in their discussion. Firstly, this paper looks at a fairly small number of patients relative to the beam and the focal trough and leading to typical foreshortening in patients with proximal teeth. Orthodontists are well aware of the racial differences in facial shape and tooth position and so such differences could contribute to differences of root length projection on panoramic films.

The root lengths measured from the radiographs were then compared to standard tooth lengths from well-known textbooks, which obtained their data in turn from absolute measurements of extracted teeth. Therefore, the comparison made between the study population and the reference population is technically invalid because different methods were used to obtain the measurement.

Overall, the take-home messages from this study are that Asian patients may have thinner periodontal biotypes and may consequently be more likely to experience gingival recession than the Caucasian, Koreans, Vietnamese and Japanese. These results suggested that these 49 Asians had shorter roots and generally thinner gingival tissue compared with Caucasians. The authors used data from standard dental anatomy textbooks to obtain standard root lengths for comparison and data from European studies to obtain the Caucasian gingival biotype frequency.

“Correct preventative advice and treatment must be a cornerstone of managing all patients…”
Extracting a tooth should be the last resort in space

An interview with former NASA dentist Dr Michael H. Hodapp, USA

A toothbrush of Buzz Aldrin, a crew member of Apollo 11 and one of the first humans to ever walk on the moon, was recently auctioned for $822,705. Fifty years later, astronauts are still using everyday oral care products on their missions. DT Group Editor Daniel Zimmermann sits down with former NASA dentist Dr Michael H. Hodapp, USA, about his work, the possibility of dental emergencies in space and how to maintain good oral health on future long-term missions to Mars.

Daniel Zimmermann: Do you know how many dentists are currently employed by the agency?

Dr Michael Hodapp: Owing to the recent cutbacks to NASA’s budget, they have closed the NASA dental clinic, so there are no dentists contracted by the agency at this point. Astronauts seek dental care from private practitioners, and are followed closely by NASA-employed flight physicians.

Dr Hodapp, how did you become involved with NASA?

In 1994, another dentist working for NASA informed me that a position had become available to care for the astronauts and their families at NASA, and asked me if I would be interested. After a series of interviews, I was appointed to the position. I served NASA as a contractor for over a decade before I went back into private practice in 2004. However, I am still called on occasionally as a consultant for dental issues aboard the International Space Station (ISS) and future exploration-class missions.

Dr Hodapp served as constructor for NASA between 1994 and 2004. Source: Asia Pacific Edition

How important is oral health for astronauts in general?

Oral health is a primary concern for astronauts and goes hand in hand with general health. All astronaut candidates are initially screened for dental issues prior to selection, and all those selected are expected to adhere to a meticulous oral hygiene routine and maintain good oral health. The primary goal is prevention. Yet, even with the highest standards in prevention, the potential for a dental emergency in space still exists.

A recent analysis of all medical conditions determined that the one condition most likely to result in departure from the ISS is a dental abscess.

Russian cosmonaut Yuri Viktorovitch Romanenko had to go through two weeks of incapacitating tooth pain during the Salyut 6 mission in 1975. When were dental emergencies first included in mission protocols?

Unfortunately for Romanenko, according to reports, the Soviets did not have a dental contingency protocol at that time. The Russian space programme has since made provision for such emergencies, however.

During the US Mercury programme, the flights were so short that there was no need for an in-flight dental emergency protocol, and prevention was the primary focus. Owing to the extended time spent in space during the Gemini programme, a toothbrush was added to flight kits as a preventative measure.

How frequently are astronauts given pre-flight check-ups?

No in-flight dental emergency has ever been reported by NASA. What kind of problems do you think are most likely to occur?

While the chances of a dental emergency occurring in space are low, the potential is always there. For instance, when astronauts move large objects, the inertia of mass and velocity can potentially cause facial injuries and result in either a medical or dental emergency or both. Besides breaking a tooth, other considerations include laceration, crushing, grinding, split teeth or the fracturing of a cusp while chewing. Even with most meticulous dental exam and hygiene programme, there is always a possibility that a tooth abscess could form due to trauma, hidden caries or a failing root canal.

Which dental emergencies are astronauts trained to handle by themselves?

There are two crew medical officers (CMOs) aboard every mission and they are trained to perform a number of dental and medical emergency procedures. On board, CMOs have the capability to treat with antibiotics and analgesics, administer anesthetics, place temporary dental fillings, replace a crown with temporary cement, treat exposed pulp, and as a last resort, extract teeth. Any emergency treatment would include communication with ground support flight physicians, as the CMOs are non-registered physicians or dentists themselves. However, since the ISS is in low earth orbit, any oral emergency situation would likely result in a return to earth for proper treatment.

Future missions will take astronauts to other planets in the solar system, like Mars. What are the main challenges that these long-term flights pose regarding oral health?

While we still do not know the long-term effects of space flight on the teeth, alveolar bone and periodontal health, it is well documented that during space flight bone mineral density decreases in weight-bearing bony. It still not clear how this affects the teeth and alveolar bone and whether crew members are more susceptible to tooth decay or periodontal disease.

Skylab oral health studies determined that there were increased counts of caries-producing bacteria such as Streptococcus mutans among crew members. It was concluded that this was due to the dehydrated diet that astronauts consume. This could be a potential contributor to oral health issues during extended missions, especially if a crew member begins to lapse in proper oral hygiene.

Dental emergencies in space would be challenging to handle as well. A mission to Mars would require a flight duration of six to nine months. Owing to the alignment of earth and Mars, the nominal mission would spend either 50 days or a year and a half on the Martian surface. Were an oral emergency to occur during the outbound flight, there would not be a safe-return-to-earth capability. Not enough fuel could be carried to counteract the forces of launch that propel the crew on their voyage. In essence, all emergencies would have to be handled by the CMOs either in flight or on a planet with a little more than one-third of the gravity of earth.
In space, “for every action, there is an opposite and equal reaction” has special meaning to the treating CMO and the crew member receiving treatment. Just the act of giving an injection would send the crew member and CMO darting away from each other if proper techniques were not followed. The luxury of gravity does not exist, and simple procedures can become major challenges without it.

Working in the oral cavity poses special concerns, since the very act of breathing not counteracted by gravity would have a tendency to draw anything loosely held within the oral cavity back into the lungs.

There is also the concern of the limited medical skills of CMOs, and the one-way communication delay with ground support of 20 to 25 minutes. In other words, it could take 45 minutes for a flight physician to deliver instruction to the treating CMO. Prayers would be in order for the afflicted crew member.

What measures are being considered to overcome these problems?

Recent discussions in relation to exploration-class missions have proposed instrumentation for semi-annual dental exams and cleaning for each crew member, as well as additional equipment for the diagnosis and treatment of dental emergencies. Some of the equipment considerations include a high-definition intra-oral camera system, a method for detecting interproximal decay and osseous infections while limiting radiation, as well as a battery-operated dental handpiece and headlight.

Material considerations include an intermediate restorative material that is easy to use, does not require special equipment for mixing or curing, releases fluoride, and could last for the duration of an exploration-class mission. The US Navy is currently conducting research on a restorative material for field use that fits this description. A glass ionomer restorative material is also under consideration, although this would require special packaging to allow for controlled mixture by hand in a microgravity environment.

Discussion about medications indicated that all drugs would need to be freshly manufactured and would require special packaging to maximise shelf life, especially those medications that are sensitive to moisture and radiation.

Software considerations include training videos for the crew members to review and train to keep abreast during their travel.

President Obama speaks of sending humans to Mars as early as 2018. Do you believe that these plans are realistic? It is my understanding that there are no definitive plans for a manned mission to Mars in the near future. Recent cuts to NASA’s budget have slowed progress for a manned mission to the red planet. Our closest neighbour is explored using robotics, and there is much to learn about Mars prior to risking the lives of humans on such a distant journey.

However, planning and research for manned exploration-class missions is still being conducted, and the Orion project is still in progress. There are so many hurdles to overcome before such a journey could be undertaken.

Currently, NASA is formulating plans for a three-month mission to rendezvous with a near-earth asteroid. This would be a scientific mission requiring a one-month flight to rendezvous with the asteroid, conduct research and fly back to earth.

If NASA offered you the opportunity to go to space, would you accept it?

Since I was a young boy I have looked to the heavens and been fascinated by its beauty and have always dreamt of going into space. Given the opportunity, I would go in a heartbeat.

Thank you very much for this interview.
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company aims to increase the Vora said in a statement that with its main investor, Seedfund, in Mumbai.

million (US$1.8 million) from AHF, mydentist is also re-

tern Indian-based Total Dental Care, which runs dental clinics in Mumbai and Pune under the

vanguard of treatments

According to KaVo, 3D eXam has an average exposure time of only 8.5 seconds, which reduces exposure to radiation and the quality loss caused by patient movement. Owing to its high definition, 3D eXam provides excellent resolution even for small voxel sizes of 0.125 mm.

According to KaVo, 3D eXam can also capture 3-D images of the condyles as part of the surrounding structures. Furthermore, it replaces panoramic, cephalometric and individual-tooth images with a single volumetric image.

Indian dental business receives large-scale investment

NEW DELHI, India: Indian pri-

vate equity firm Asian Health-
care Fund (AHF) has confirmed that it will be investing signifi-
cantly in one of the country’s largest dental chains. According to the German dental equipment manufacturer, the volumetric diagnostic imaging system of KaVo 3D eXam pro-

vides clinicians with a detailed view of all oral and maxillofacial structures for sound diagnostic data that allows a thorough analysis of bone structures, as well as orientation of the teeth. Optimum implant placement can be assessed as well, the company said.

For the analysis of the bone morphometry of the temporomandibular joint (TMJ), the TMJ cleft and joint function, 3D eXam can also capture 3-D images of the condyles as part of the surrounding structures. Furthermore, it replaces panoramic, cephalometric and individual-tooth images with a single volumetric image.

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Japanese corp close to market entry in the Philippines

Lion starts joint venture with Peerless Products Manufacturing

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“Progress is not realised until technology is available to the masses”
An interview with Ultradent CEO, Dr Dan Fischer

Daniel Zimmermann

At the International Dental Show in Cologne, Germany, US company Ultradent launched a new restorative option with the Edelweiss composite veneer system. Company president Dr Dan Fischer sat down with Dental Tribune International to speak briefly about the concept behind the unique system and its advantages compared with commonly used ceramics.

DT International: Dr Fischer, you seem to be very excited about this IDS.
Dr Dan Fischer: The activity here is extraordinary and we have never been busier than we are at this show. Our people always try to raise the bar and offer better products for the whole dental team. It has also been nice to rub shoulders with old friends again.

Your company has become a household name in dental offices worldwide. How would you describe your business philosophy?
We are known as an innovative company that aims to go to places where others have not been before. That means that we also tread a different path to many manufacturers, driven by our passion to reach a larger segment of humanity. For instance, we have zero interest in developing ceramics for dentistry that only five per cent of the world’s population can afford.

As a company, we want to be able to offer lower socio-economic groups preventative measures and affordable materials like the new Edelweiss veneers that are being presented here. I think Henry Ford said it best when he said that progress is not realised until technology is available to the masses. Our first goal is to reach the masses.

Dental veneers have been very popular indeed. What are the shortcomings of the current market offerings, and how does the company plan to position itself?
Dental veneers have been used extensively for many decades now and ceramics have been by far the most common materials used. It is important for clinicians to remember, however, that a ceramic must be supported chiefly by enamel not dentine—even when quality adhesives are used. Direct-placed dentine—supported chiefly by enamel not dentine—would be a good result, but for the majority of clinicians it can be time-consuming and produce results that are not ideal.

For these reasons, we developed a laser-sintered, pressure- and heat-formed composite veneer system with Edelweiss. The laser sintering offers a predictable, quality, aesthetic finish that is extremely wear resistant. The heat-formed (300 °C) composite bonds at very high values, but it can also flex, allowing it to perform well and with greater resistance to cracking, even when bonded to dentine. Since Edelweiss composite veneers are preformed, their laser-sintered enamel shells provide a more cost-effective alternative to laboratory veneers.

In addition, Edelweiss allows for ideal shade selection via the composite used to customise the veneers to the preparation. This can be done for a direct modality or an indirect modality.

Edelweiss veneers offer a great solution not only for the patient on a budget, but also for teenagers and people who play contact sports. They are also great when used for lower anterior veneers because the wear against opposing dentition is superior to that of ceramic. Edelweiss is an incredibly versatile veneer option.

It looks like the product has already generated much interest here.
That is right and our office in Cologne was very keen on having Edelweiss veneers here for the first time. We already have many Edelweiss veneers that are being preformed, laser sintered and heat-formed everywhere. For example, in Seattle, Washington, for example, the inventor of Edelweiss Dr Stephan Lamm just completed a multi-city, multi-country trip through South-East Asia. The response there was very good.

Thank you very much for the interview.

As a ceramic must be supported chiefly by enamel not dentine...

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A minimally invasive approach to correcting diastemas

Metal-free restorations have become well established in aesthetic restorative dentistry. New clinical applications and possibilities provide users with a vast array of treatment options. Minimally invasive and in some cases even preparation-free restorations have become feasible owing to new materials and recent advances in adhesive techniques. It is recommended, however, that the indication at hand be carefully assessed to achieve a restoration that meets the given aesthetic and functional requirements optimally.

A 31-year-old male patient presented to us with a request for the aesthetic improvement of the anterior region (Fig. 1). A clinical examination showed us a large anterior diastema. His medical history did not reveal any symptoms or complaints related to the occlusion or temporomandibular joint dysfunction.

A few years ago, metal-ceramic restorations would have been the treatment of choice for a case like this. Nowadays, clinicians are increasingly rejecting this option, as it requires not only numerous treatment steps but also the removal of large parts of healthy tooth structure. Metal-free crowns however may present an alternative treatment option. This option may not always sufficiently prevent the loss of healthy tooth structure because closing the gap with conventional ceramic veneers necessitates an invasive preparation method.

If this treatment option is selected, the tooth is provided with a small cervical shoulder on the basis of a diagnostic wax-up. Additionally, approximately 2 mm of tooth structure is removed in the incisal region and the vestibular area is slightly reduced.

Whilst, without doubt, this presents a suitable treatment option, some dentists feel that this preparation method is not adequately conservative. The issues concerning the removal of healthy tooth structure can be avoided by using non-preparation ceramic veneers, which do not require any reduction of tooth structure.

Conservative though it may be, it entails some limitations mainly related to aesthetics and the working procedure in the dental laboratory.

Although correcting a diastema seems to be a straightforward procedure initially, a deeper look makes it clear that several treatment possibilities are available. It also raises questions concerning whether it will be possible to close the gap between the teeth completely and whether an appropriate emergence profile will be achieved in the interproximal region. Other issues include whether “black holes” will remain visible in the interdental space or whether the interdental papillae will be present at the end of the treatment.

When selecting a treatment option, we should always aim for the best possible aesthetic outcome that requires the removal
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of the least possible amount of tooth structure. In other words, we aim to achieve the best possible solution. With this in mind, we decided to use ceramic veneers and apply a preparation technique that, from our point of view, was suited to achieve that goal by not preparing a cervical shoulder and by reducing the incisal, vestibular and proximal surfaces only minimally. It served to provide appropriate guide surfaces for the veneers and to achieve ideal conditions for the dental technician to create true-to-nature restorations.

Taking an initial impression using an addition-reaction silicone (Virtual, Ivoclar Vivadent) is indispensable for accurate treatment planning, the fabrication of a diagnostic wax-up and the implementation of preliminary treatment steps. A diagnostic wax-up was made by the dental laboratory and then used as the basis for the mock-up (Systemc.ck II) with the help of a silicone key. The result and the proportions of the teeth, contoured in wax, in the oral cavity could thus be accurately visualised. It was found that the size and shape created a harmonious and natural-looking overall impression (Fig. 2).

The silicone key for the diagnostic wax-up was also useful as a reference in the preparation. First, the incisal surface was reduced by approximately 1 mm. The silicone key demonstrated that some portions of the incisal areas only needed to be smoothed out, as they already offered enough space (Fig. 3). Next, the proximal areas were slightly reduced in order to create a guide surface for the veneers. This reduction should cause the proximal margins to be positioned slightly towards the vestibular. The vestibular preparation involved only the reduction of the ridge between the proximal and vestibular surfaces (Fig. 4) and the reduction of the vestibular area to allow for the contouring of the veneer (Fig. 5).

Finally, the preparation was finished with grinding discs at reduced rotational speed. The result was then checked with the silicone key to ensure that a sufficient amount of tooth structure had been removed for the design of the veneers (Fig. 5b). For the working procedure in the laboratory, an impression was taken using (virtual) and the double-cord technique (Fig. 6).

Thin ceramic veneers were fabricated with the IPS e.max System (Ivoclar Vivadent) using the press technique and carefully individualised with the layering technique. The technician’s extensive technical expertise and skills were very important in achieving this task, particularly considering the limited amount of space available (Figs. 7 & 8).

During the try-in, the accuracy of fit, shape and shade were checked and the design was evaluated to ensure that it adapted well. Try-in and shade determination were performed using the Variolink N Try-In pastes (Ivoclar Vivadent) in various shades. We opted for the Transparent shade from the Variolink N range of adhesive luting composites.

Prior to cementation, the tooth surface was conditioned with 37% phosphoric acid for 30 seconds. A silicone key demonstrated in wax, in the oral cavity that some portions of the incisal area to allow for the contouring of the veneer (Fig. 5a).

The diastema has been closed successfully. The photograph demonstrates the natural-looking result (Fig. 9). The finish line was checked and the design was evaluated to ensure that it adapted well. Try-in and shade determination were performed using the Variolink N Try-In paste (Ivoclar Vivadent) in various shades. We opted for the Transparent shade from the Variolink N range of adhesive luting composites.
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A novel solution for anterior implant aesthetics
Implant placement combined with hard- and soft-tissue augmentation via the VISTA technique

For achieving an appearance similar to natural teeth, adequate hard- and soft-tissue support is a prerequisite to implant placement in the ideal position. From a prosthetic point of view, the ideal position for an implant usually requires the establishment of a significant amount of bone and soft-tissue volume using grafts in order to maintain aesthetics during the healing process and tissue remodelling. An aesthetic outcome therefore still remains challenging, even for an experienced clinician.

Since 2002, many articles focusing on immediate or early implant placement in extraction sockets have been published. Studies have shown that immediate placement can reduce treatment time. However, this involves different classifications and treatment recommendations. In 2005, for example, Dr Joseph Kan introduced a novel classification for immediate implant placement, in which buccal bone and histotype are carefully measured (Table 1). For Class 1 and 2, immediate implant placement is possible and predictable.

Soft-tissue contour is a concern in aesthetic restoration. Therefore, Dr Homayoun Zadeh, it is easy to regenerate damaged alveolar bone and close the jumping gap of extraction sockets. Moreover, it can improve blood supply and soft-tissue stability.

Table 1: The extraction defect sounding classification.

<table>
<thead>
<tr>
<th>Defect type</th>
<th>General assessment of affected tissue</th>
<th>Biotype of hard tissue</th>
<th>Distance to the ideal position</th>
<th>Treatment recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Pulpitis</td>
<td>0–1 Thick</td>
<td>0 mm</td>
<td>Immediate implant placement (one stage)</td>
<td></td>
</tr>
<tr>
<td>2 Minor damage</td>
<td>1–2 Thicker</td>
<td>0–5 mm</td>
<td>Slightly compromised</td>
<td>Immediate implant placement (two stages)</td>
</tr>
<tr>
<td>3 Moderate damage</td>
<td>2–3 Thicker</td>
<td>5–10 mm</td>
<td>Compromised</td>
<td>Immediate implant placement (three stages)</td>
</tr>
<tr>
<td>4 Severe damage</td>
<td>3–4 Thicker</td>
<td>10–15 mm</td>
<td>Compromised</td>
<td>Immediate implant placement (two stages)</td>
</tr>
</tbody>
</table>

The VISTA technique is a new concept in aesthetic implant dentistry. Instead of making a horizontal incision in the sulcus or in the vestibular area without involving the mucosal flap and the connective tissue bed underneath, the CT vestibular area (aesthetic flap), a vertical incision is made at the mucosal area (aesthetic flap) and the gingival margin contour. In this way, more blood supply is preserved and keratinised tissue remains intact. Overall, the VISTA technique reduces tissue remodelling and retains soft-tissue appearance, which results in a better clinical aesthetic outcome.

Clinical case report

A 48-year-old female patient of Asian ethnicity presented for treatment of tooth 21, which had been extracted the week before owing to trauma. She did not smoke, nor did she have any systemic disease. She also showed no signs of recreational drug abuse. No known drug allergy was reported. Generally, she was a healthy middle-aged woman (Figs. 1–8).

The clinical examination revealed a relatively healthy periodontium, with localised bone destruction visible on tooth 27. Previously, tooth 11 had been treated endodontically. She had a Class I interdental occlusal relationship, but denied bruxism and therefore the use of night-guard protection. There was no temporomandibular joint disorder and the head and neck examination was within normal limits.

Table 1: The extraction defect sounding classification.
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Local anesthesia was administered (2 % lidocaine with 1:100,000 epinephrine). The flap was extended a full thickness flap from the periosteal elevator was used to raise preserve the papilla. A Buser apical from the papilla in order to first on the middle frenum, 2–3 mm formed.

The extraction socket was healing with granulation tissue after one week. The CT image showed about 10 mm (mesiodistally), 7 mm (buccolingually) and 22 mm (coronao-apically). According to Kam's sagittal root classification, the sagittal root position was Class III.

A vertical incision was made first on the middle frenum, 2–5 mm apical from the papilla in order to preserve the papilla. A Buser periosteal elevator was used to raise a full thickness flap from the vertical incision. The flap was extended to the bottom of the vestibule and coronal in the straight buccal surface of the sulcus at the extraction site (Figs. 14–17).

After the flap had been reflected, the loss of buccal plate could be observed at the extraction site. In order to obtain a good primary closure after grafting, connective-tissue grafting for coverage was recommended. After connective tissue had been harvested, platelet-rich fibrin was placed into the donor site, and suture sutures were used to achieve a good closure and haemostasis (Figs. 16–23).

Drilling was performed in accordance with the recommendations of the manufacturer of the implant system. The ideal implant position was determined to be 2.5 to 5 mm apical to the buccal gingival margin, with 1.5–2 mm between the implant and adjacent tooth and with 2–3 mm from the cervical height of contour to the buccal surface of the implant platform. After the osteotomy had been performed, a 4.2 x 14 mm platform-switching implant was placed, which achieved good initial stability (Figs. 24–28).

Two membranes were placed horizontally and vertically to augment the site via the vertical incision. Freeze-dried bone allograft mixed with bovine bone was used to maintain the volume. After that, the connective-tissue graft was anastomosed to the flap to cover the socket. The vertical incision was then closed and the graft was held in place (Figs. 29–32).

After four months of healing, a simple second-stage surgery was performed. Only a single incision was required to replace the healing abutment, which helped to push soft tissue buccally to improve appearance (Figs. 37–44). Two weeks later, after the soft tissue had healed, an open-tray impression technique was used to fabricate the final restorations on both teeth 11 and 21 (Figs. 43–45). Figures 33 to 36 show the seating of the crowns.

At the half-year follow-up appointment, a CT scan showed that the bone graft was stable. A harmonious result had been achieved (Figs. 57 & 58).

**Discussion**

Articles on immediate or early implant placement recommend preserving the labial bone and augmenting the soft tissue, changing the labial mucogingival position. In areas demanding high aesthetics, it rarely achieves satisfactory results. Fortunately, the VISTA technique with hard- and soft-tissue augmentation can help clinicians without preparing the blood supply and more easily maintain an intact gingival margin. In this case report, hard- and soft-tissue augmentation was performed simultaneously with implant placement. By utilizing the VISTA technique to regenerate damaged labial bone and to close the jumping gap of the extraction socket, blood supply is improved and soft-tissue stability is increased. The VISTA technique can offer great benefit to the clinician and operator, and it can shorten treatment time in the aesthetic zone.

In Asian populations, ideal candidates for anterior immediate implantation are rare unless the criteria stated above can be met by performing augmentation procedures. Combining immediate implantation with a lamina subepithelial connective-tissue graft can change soft tissue from a thin to a thick biotype and offer better resistance to long-term remodelling and physical trauma. However, hard-tissue augmentation remains almost impossible.

In order to perform a bone-grafting procedure, an open-flap and tension-free periosteal releasing incision is usually used in order to achieve adequate volume and primary closure. Inevitably, this ends with a large wound and incorrect mucogingival position. In areas
Intentional replantation: A viable treatment option for specific endodontic conditions

Intentional replantation is defined as the purposeful extraction of a tooth in order to pair a defective or cause of treatment failure and thereby the return of the tooth to its original socket. Any tooth that can be atraumatically removed in one piece is a potential candidate for intentional replantation. However, specific indications include:

- all other endodontic non-surgical and surgical treatments have failed or are deemed impossible to perform;
- limited mouth opening that prevents the performance of non-surgical or peri-radicular surgical endodontic procedures;
- root-canal obstructions; and
- restorative or perforation root defects that exist in areas that are not accessible via the usual surgical approach with excessive loss of root length or alveolar bone.

The contraindications may include:

- long, curved roots;
- advanced periodontal diseases that have resulted in poor periodontal support and tooth mobility;
- multi-rooted teeth with diverging roots that make extraction and replantation impossible; and
- teeth with non-restorable caries.

To provide the best long-term prognosis for a tooth that is to be replanted intentionally, the tooth must be kept out of the socket for the shortest period possible, and the extraction of the tooth should be atraumatic to minimise damage to the cementum and the periodontal ligament. The periodontal ligament attached to the root surface should be kept moist in saline, Hank’s Buffered Salt Solution (HBSS), Viaprot or Dyeoxide solution for the entire time the tooth is outside the socket.

We have documented three clinical cases to exemplify the potential of intentional replantation as a viable treatment option in select endodontic cases.

Case I

A 14-year-old male patient presented with a separated Lentulo spiral extending 4 to 5 mm beyond the apex of the mesiobuccal root canal of tooth #4 (Figs. 1a–d). The tooth was badly broken and the instrument tightly screwed into the root canal. All efforts to remove the spiral were futile, and we were concerned that it would fracture at the apex.

Apical surgery was ruled out because accessibility to the mesiobuccal root would have been limited. We decided to replant the tooth intentionally and discussed this treatment option with the patient, who agreed to our proposal. Since the tooth was badly broken, we planned to reinforce its core with a post in the distal canal prior to extraction.

Once we had obtained adequate anaesthesia, the tooth was extracted atraumatically with an extraction forceps. We did not use surgical elevators and took care that the teeth did not go beyond the cemento-enamel junction (CEJ), as this may have damaged the cementum and the periodontal ligament.

Following extraction, we kept the tooth moist by immersing it in Viaprot. With the breaks of the forceps, we held the tooth by its crown and cut out the overextended Lentulo spiral. Thereafter, we performed a 5 mm long root-end preparation with an ultrasonic tip at the apical end of all three canals. A retrograde filling was then done with mineral trioxide aggregate (MTA). The extraction socket was then irrigated with normal saline and gently suctioned to remove blood clots. The socket was filled with tricalcium phosphate in order for the tooth to be 5 mm higher than before. This helped in planning a good post-endodontic restoration.

The tooth was carefully reinserted into its socket and brought into occlusion with digital manipulation and patient bite force. The tooth was stabilised in its socket with a sling suture. The patient was re-evaluated after seven days, and the sutures were removed.

Case II

A 22-year-old male patient presented with a history of trauma to his maxillary anterior region. Clinical examination revealed an Ellis Class III fracture of tooth #12, with the fracture line extending to the root palatally. Once the tooth had been atraumatically extracted, it was kept moist in Viaprot. We inserted tricalcium phosphate in the apical 5 to 4 mm of the socket and reinserted the tooth with a 180° rotation to bring the deep fracture line into a more accessible labial side. The tooth was then splinted with fibre-reinforced composite for a period of three weeks. The root-canal treatment was completed at a later date, and the facial surface was built up with composite. We decided not to proceed with the crown immediately after stabilisation to prevent loading of the tooth. The patient was recalled periodically for follow-up.

Case III

A 23-year-old female patient presented with pain in her upper right anterior tooth. There was no history of trauma, and clinical examination revealed a deep palatal gingival groove (PGG) with respect to tooth #12 (Figs. 2a–e). The intraoral peri-apical radiograph revealed a peri-apical radiolucency. We decided to extract the tooth, seal the groove and then replant the tooth. After adequate anaesthesia had been obtained, the tooth was extracted with all the necessary precautions and immersed in Viaprot. With help of the forceps, it was then held by its crown. The PGG was debrided with the tip of the ultrasonic scaler and sealed with glass-ionomer cement (GIC). The tooth was then gently curedted and the tooth reinserted. Sutures were placed in the inter-dental area and endodontic treatment was completed one week later. The apical 4 to 5 mm of the root were sealed with MTA, and the root of the root canal was back-filled with thermo-plasticised gutta percha. The patient was re-evaluated after seven days.

Discussion

Intentional replantation in dentistry has been performed for more than ten centuries and was used extensively to manage odontalgia. In 1651, Pare recommended its use when a healthy instead of a diseased tooth was mistakenly extracted. In 1712, Pierre Fauchard replanted a tooth and reported it to be stable on follow-up. Several steps in the replantation were debated, for instance the need for amputation of root apices, immediate or delayed replantation, root-canal obturation before or after replantation, or preservation of periodontal ligament cells and the goal of ultimate healing—bony ankylosis or ligament repair.

It was in 1881 that Thompson presented the treatment on replantation of teeth and emphasised the importance of periodontal tissues for treatment success. Later, Evedel in 1887 and Scheff in 1980 addressed the role of periodontal ligament cells with regard to external root resorption after replantation. As the replantation technique became increasingly refined, it was used as an easy alternative for failing root-canal treatment and hence evoked sharp criticism for the technique of replantation per se.
An interview with IFEA congress president Prof. Hideaki Suda

The last World Endodontic Congress (WEC) in Athens, Greece, in 2010 was one of the most successful events the International Federation of Endodontic Associations (IEFA) has ever organised in its 27-year history. The next edition, to be held in Tokyo in Japan from 23 to 26 May 2013, has attracted even more interest from specialists around the world, according to the organisation. 

Endo Tribune had the opportunity to speak with congress president and Tokyo Medical and Dental University professor Hideaki Suda.

Endo Tribune: IFEA’s ninth WEC is being held in Japan for the first time. What has the organisation been like, and what are your initial expectations for the event?

Prof. Hideaki Suda: The selection of the Japan Endodontic Association to host the congress in 2013 was a decision made by the IFEA general assembly in Vancouver, Canada, six years ago. Since then, the local organising committee and its five subcommittees have had over 50 meetings concerning the preparations for the congress. Each subcommittee has also held its own meetings. We expect that the ninth WEC will help to elevate the technical and scientific standards of endodontic research, practice and teaching, as well as disseminate them throughout the world in order to improve the dental care standards in many nations.

In what regard will this congress be different from that in Athens?

Looking back at the last congress, one has to admit that it was not only extremely well organised but also very successful both at an academic and social level. At this point, we can already say that the ninth WEC will be much larger in size and participation numbers, as we already have over 1,100 preregistrations from 41 member and non-member countries. Almost 500 research papers have been accepted and will be presented in Tokyo. Furthermore, there will be nine symposia and 17 table clinic presentations, where the newest scientific methods and technologies will be on display.

Owing to Japan’s unique hospitality, I am sure that participants will enjoy their stay throughout the event.

Japan is the country where the apex locator was developed, amongst other things. How would you describe the level of endodontic treatment and research in the country?

Another Japanese development was the application of adhesive dentistry principles to endodontic treatment. As you may also know, Prof. Shinya Yamanaka from the Kyoto University was awarded the Nobel prize last year for inducing pluripotent stem cells. Tissue engineering of the dental pulp has become one of the hottest topics for research in Japan and we may see the regeneration of the pulp become a reality in the near future owing to this development.

Unfortunately, there are still only a few general practitioners who are specialised in endodontic procedures, most of which are performed under the Japanese health insurance service. There.

New techniques and treatment methods such as CBCT and the use of lasers and microscopes in endodontics are topics with which many of the papers are concerned.

Other topics include pain control, the newest apex locators, MTA, novel root-canal irrigation methods, the management of tooth fractures, as well as root-canal preparation and filling. Single-file preparation methods in particular will be demonstrated during the pre-congress courses by four world-famous endodontists.

Which presentations are you looking forward to most?

Highlights will definitely be the plenary and keynote lectures, where the latest information on regeneration of the dental pulp, re- and auto-transplantation of teeth, biofilms in endodontics, treatment outcomes, and retreatment will be presented. In addition, we are looking forward to the country representative speakers session, where the current trends in endodontic treatment in each member country will be discussed.

The general assembly will also meet again during the congress. What will be discussed at this gathering?

The theme of the congress is “Shaping the future of endodontics”. Will the programme be primarily focused on new techniques and treatment methods?

“...a large part of the profession is very keen on learning about the latest scientific and technological developments.”

Besides reports from officers and representatives from different regions, the general assembly meeting on Sunday, 26 May, will select the location of the 12th WEC in 2019. Last time, it was decided that the next congress (in 2016) will be held in Cape Town in South Africa. Future concepts concerning science and business will also be discussed. Through these activities, we hope to foster international professional relationships and the exchange of information in endodontics.

Thank you very much for this interview.
There are many reasons for an adverse outcome of a replantation: the tooth can fracture during extrac-
tion and may be completely lost, periodoni-
tal tissues can be damaged, reducing the likelihood of reattach-
ment; infection; external root resorp-
tion; and ankylosis. Therefore, it is extremely important to understand that intentional replantation should be the last choice, selected only when all other options of treatment—
non-surgical and surgical—have been exhausted. Replantation can be a treatment of choice in cases in which a surgical approach can be dif-
ficult, for example on the lingual root of a mandibular molar, or in cases in which a surgical approach would be very invasive, such as the removal of thick bone from the buccal aspect of a second mandibular molar.

Intentional replantation has a better prognosis when the extra-oral time is kept as short as possible and trauma to the periodontal ligament and cementum is minimised.1 It is advisable to perform routine en-
dodontic treatment intra-orally be-
fore the tooth is extracted to min-
imise the extra-oral time. It is also suggested that a team of two dentists work in tandem to prevent prolonged treatment time, thus improving the chances of success. The use of eleva-
tors should be avoided, and the breaks of the extraction forceps should not go beyond the CEJ. The cortical bone integrity should be maintained, and the tooth should be extracted asatraumatically as possible.

The medium in which the tooth is
kept must play an important role. Saline, HBSS, milk, Viapain, to name a few, are widely used. Viapain is used for organ transplantation and pres-
servation. Owing to its antioxidant activity, the solution keeps the peri-
donatal ligament moist and reduces the likelihood of surface resorption.2

We generally use-ultrasonic tips to prepare the root-end and the de-
bridement of the PGG. It conserves the tooth structure and produces significantly less smear layer com-
pared with burs.3 Commonly used root-end filling materials are amal-
gam, Intermediate Restorative Ma-
terial (IRM), Super EBA, GIC, Diaket,
composite and MTA. The sealing ability and marginal adaptation of
MTA have been proven to be su-
perior and not adversely affected by blood contamination. In addition, MTA promotes deposition of new ce-
mentum and stimulates osteoblastic adherence to the retro-filled surface.

In two of our cases, tricalcium phos-
phate was placed in the apical few millimetres of the socket. This was
done in order to bring the defect
upgradingly so that the integrity, aesthetics and prognosis of the case
were improved. Tricalcium phos-
phate is an osteo-conductive mate-
rial that acts as scaffold for bone
growth and is gradually degraded and replaced by bone.4

A palato-gingival groove is a de-
velopmental anomaly that repre-
sents an infolding of enamel and
Hervey’s epithelial root sheath.5 PGG can vary in depth, length and
complexity, causing varying de-
grees of periodontal defects. Mild
grooves terminate at the CEJ, whereas moderate grooves con-
tinue apically along the root surface. A treatment option for a PGG termi-
nating close to CEJ is to expose the
groove surgically and to seal it there-
after. As presented, the groove ex-
tended beyond the apex in Case III. Here, the defect was sealed extra-
orally and the tooth replanted. GIC was used to seal the PGG, as it chem-
ically adheres to the tooth structure and has a good sealing ability and antithetical effect.6

After replantation, the tooth was
splinted for ten days. The splint en-
abled physiological movement of
the tooth to prevent ankylosis. En-
dodontic treatment was completed
one week after replantation in order
to prevent inflammatory resorption
and ankylosis and to allow splicing of
periodontal fibres, which limits the
segregation of potentially harmful
root-filling materials into the trau-
matised periodontal ligament.7 Fi-
nal restoration of the tooth was de-
layed to avoid loading and to ensure that proper healing of periodontal ligament took place.

In recent years, several bis-mod-
ulators, such as enamel matrix pro-
tein,9 hydroxyapatite and platelet-
rich plasma,10 have been used in
intentional replantation cases to improve the success rates. Guided tissue-regeneration techniques can also be employed along with these supplements to further improve the likelihood of success. We conclude that intentional replantation is a viable treatment option in carefully selected cases in which all other treat-
ment options have been exhausted.

We would like to acknowledge the assistance of Dr Akanksha Gupta and Dr Nikhil Sinha.

Our thanks are due to the assistance of Dr Akanksha Gupta and Dr Nikhil Sinha.
Endodontic retreatment: Achieving success the second time around

Dr Brett E. Gilbert
USA

Root-canal treatment has been shown to have a success rate of 93%. However, non-surgical retreatment techniques have shown that endodontic retreatment can achieve success rates of 92% to 98%. 

The success rate of retreatment procedures, according to a meta-analysis by Nget et al. in 2007, is 95%. This analysis considered the largest studies with the largest sample sizes at that time. They found a weighted pooled success rate of 68% to 85%, with at least a one-year follow-up. 

Intra-radicular bacteria are the primary etiology of post-treatment disease. These microorganisms are found within the root-canal system and their presence is associated with root-canal treatment failure. 

The bacteria present in the initial infection of a root canal differ markedly from the bacteria infecting a previously treated tooth. 

There are high numbers of Enterobacteriaceae, for example, Enterococcus faecalis, which has been shown to be a common isolate in 27 to 77% of teeth with post-treatment disease. It is resistant to many treatment methods. 

The bacteria present in the initial infection of a root canal differ markedly from the bacteria infecting a previously treated tooth. Pre-treatment flora is polymicrobial with equal numbers of Gram-negative and -positive bacteria. Post-treatment bacteria are predominately Gram-positive and have been shown to be able to survive in harsh environments and to be resistant to many treatment methods. 

Root-canal treatment has been shown to be a common isolate in 27 to 77% of teeth with post-treatment disease. It is resistant to many treatment methods. 

The bacteria present in the initial infection of a root canal differ markedly from the bacteria infecting a previously treated tooth. Pre-treatment flora is polymicrobial with equal numbers of Gram-negative and -positive bacteria. Post-treatment bacteria are predominately Gram-positive and have been shown to be able to survive in harsh environments and to be resistant to many treatment methods.
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We ❤️ to create
with irritants and medicaments, and allows communication between bacteria to aid in survival capabilities.\textsuperscript{13,14} The presence of \textit{E. faecalis} is well documented; however, a role in post-treatment disease has yet to be proven definitively.\textsuperscript{20} Its survival mechanisms, however, shine a light on the persistent capabilities of these bacteria, and our clinical techniques must be focused on the challenge of eliminating them.

Iatrogenic issues encountered during the initial root-canal treatment may be the cause of intracanal bacterial infection. These issues may include perforation, incomplete cleaning and shaping, inadequate canal enlargement, missed canals, ledging, canal transport, over-instrumentation, as well as aspiration of the canal by debris or separation of instruments. Failure to use or using too small a volume of an appropriate irrigant solution, such as sodium hypochlorite, is an iatrogenic error.

Full-strength 6% sodium hypochlorite has been shown to be highly antiseptic and able to dissolve tissue and disrupt bacterial biofilms.\textsuperscript{14,20} These qualities are ideal for the debridement of residual bacteria and tissue debris. The use of a rubber dam to isolate the treatment field is the standard of care for endodontic treatment. Failure to use a rubber dam may be a fundamental contributor to post-treatment disease. The following case illustrates the ability to overcome prior incomplete treatment to achieve successful healing (Figs. 3a–c).

**Clinical example**

Restorative failure is a common cause of post-treatment disease. Failure to place an effective permanent access restoration in a timely manner can allow for bacterial entry into the root-canal system by coronal leakage. Submarginal leakage on a crowned tooth can also allow bacterial entry to occur.

Decay in a previously treated tooth is another source of bacterial contamination. Structural damage to a tooth by trauma, cracking or fracture may provide an entry point for bacterial contamination of the canals. Our patients are responsible for their own oral health and must commit to effective oral hygiene techniques. Failure of the patient to perform effective oral hygiene can result in the failure of the even the most well executed root-canal and restorative treatments.

With the bacterial challenges clinicians have to face, retreatment techniques must be capable of effective elimination of bacteria and their substances. The use of a dental operating microscope and ultrasonic instruments allows clinicians to uncover all existing canal anatomy properly to ensure that they are able to cleanse the root-canal system completely. The following clinical case illustrates the extent of the canal space left untreated in the initial root-canal therapy by not opening the mesiobuccal canal adequately and not locating and cleansing the hidden second mesiobuccal canal. A heat source such as a System B tip (Axxis, SybronEndo) is efficient for the removal of gutta-percha and resin materials from the coronal third. Hand and rotary files can remove root fillings and shape canals to appropriate working lengths. Current NiTi rotary files are highly flexible and resistant to separation and allow us to mechanically enlarge the apical third of root canals safely and efficiently without alteration of the natural canal morphology, which allows effective irrigation to reach the complex apical root-canal anatomy where bacteria are able to hide and resist debridement.

Once the canals have been located and instrumented, the ability to irrigate becomes essential to successful treatment. The irrigant solutions target the bacteria we are trying to eliminate. While sodium hypochlorite is a potent and proven antiseptic and tissue dissolver,\textsuperscript{22} 2% chlorhexidine has been shown to prevent the adhesion of \textit{E. faecalis} to dentine.\textsuperscript{23} EDTA 17% is often used as an effective root canal irrigation agent.\textsuperscript{24} With the use of effective elimination of bacteria and their substances, clinicians are able to achieve successful healing after retreatment. As we continue to strive to maintain healthy natural teeth for our patients, endodontic retreatment should be part of our armamentarium to attain healing after retreatment. We are able to continue to strive to maintain healthy natural teeth for our patients, endodontic retreatment should be part of our armamentarium to attain healing after retreatment. As we continue to strive to maintain healthy natural teeth for our patients, endodontic retreatment should be part of our armamentarium to attain healing after retreatment. As we continue to strive to maintain healthy natural teeth for our patients, endodontic retreatment should be part of our armamentarium to attain healing after retreatment.
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MÉRIGNAC CEDEX, France: The new EndoSuccess kit from Satelec was designed to address problems that commonly occur during non-surgical endodontic retreatment procedures. According to the French instrument manufacturer, which is part of the Acteon Group, the mini-tips of this product line are made of an alloy especially selected for this specific clinical application.

A major innovation, the use of Niobium-titanium an alpha-beta microcrystalline structure alloy, is claimed to allow optimal handling with ultrasound in even the most challenging circumstances and with the best mechanical and clinical performance. Even under intensive usage, it provides good stability/time ratios, the company said. With only a diameter of 3 µ, three to four times smaller than that of standard steel, the grain of the alloy has excellent ultrasound transmission, allowing practitioners to work efficiently and with the required resistance at high power.

The Newton technology in Satelec piezoelectric generators furthermore gives the tips unbeatable efficiency, as the instruments are driven with great precision and respond specifically to the power settings chosen by the practitioner.

According to Satelec, EndoSuccess tips are compatible with all Suprasson generators.

MUNICH, Germany: VDW's latest innovation makes use of the advantages commonly associated with gutta-percha, as the new GUTTAFUSION carriers for the thermoplastic obturation of root canals are now made entirely of this material. These obturators now feature a core made of cross-linked gutta-percha that remains stable even when heated and therefore simplifies post space preparation procedures, according to the German specialist company.

In addition, they are coated with gutta-percha, which flows evenly when heated in the GUTTAFUSION oven, for example, filling the whole root-canal system, including ramifications, isthmuses and the apex.

Root canal fillings done with GUTTAFUSION can be removed easily for retreatment, the company said. Specially designed for use with tweezers and fingers, the obturator handle allows for easy application of the obturators in molars. According to VDW, no other instruments are required for separation.

GUTTAFUSION has a high radiopacity and is compatible with most rotary NiTi systems. The three obturator sizes correspond to the R25, R40 and R50 instruments. The correct obturator size can also be determined with a NiTi size verifier, which is available in sizes 20 to 55. GUTTAFUSION obturators for RECIPROC are particularly convenient.

In addition, they are coated with gutta-percha, which flows evenly when heated in the GUTTAFUSION oven, for example, filling the whole root-canal system, including ramifications, isthmuses and the apex.
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Endodontic irrigants and
dentistry systems

Dr Gary Glassman
Canada

Endodontic treatment is a pre-
dictable procedure with high
success rates. Success depends
on a number of factors, including
appropriate instrumentation,
successful irrigation and decon-
amination of the root-canal space
to the apices and in areas such
as isthmuses. These steps must be
followed by complete obturation
of the root canals, and placement
of a coronal seal, prior to restora-
tive treatment.

Several irrigants and irrigant
delivery systems are available, all
of which behave differently and have
relative advantages and disadvan-
tages. Common root-canal irrig-
ants include sodium hypochlorite
(NaOCl), chlorhexidine gluconate,
alcohol, hydrogen peroxide and
ethylenediaminetetraacetic acid
(EDTA). In selecting an irrigant and
technique, consideration must be
given to their efficacy and safety.

With the introduction of mod-
ern techniques, success rates of
up to 98 % are being achieved.1
The ultimate goal of endodontic
treatment per se is the prevention
or treatment of apical periodontitis
such that there is complete healing
and an absence of infection.2 While
the overall long-term goal is the
placement of a definitive, clinically
successful restoration and preser-
vation of the tooth. For these to be
achieved, appropriate instrumenta-
tion, irrigation, decontamination
and root-canal obturation must
occur, as well as attainment of a
coronal seal. There is evidence that
apical periodontitis is a biofilm-
duced disease.3 A biofilm is an
aggregate of micro-organisms in
which cells adhere to each other
and form a surface. These adherent
real estate for infections can
include walls, root surfaces for
effective access, as well as
pulpal tissue, bacterial deconta-
nation and remove the
organic layer that is created on
the wall of the root canal during
instrumentation. The ability to
deliver irrigants to the root-canal
terminus in a safe manner without
caus- ing harm to the patient is as
important as the efficacy of those
irrigants.

Over the years, many irrigating
agents have been tried in order to
achieve tissue dissolution and
bacterial decontamination. The
desired attributes of a root-canal
irrigant in-
clude the ability to dissolve necrotic
and pulpal tissue, bacterial decon-
tamination and a broad antimicrobial
spectrum, the ability to enter deep
into the dentinal tubules, homoc-
biotic activity too, but do
not dissolve necrotic
tissue.

The irrigant that satis-
fies most of the
requirements for a
root-canal irrigant is
NaOCl.4-8 It has the
unique ability to dis-
solve necrotic tissue
and the organic com-
ponents of the smear
layer.4,5 It also kills
resistant endodontic
pathogens organised in biofilms.8,9
There is no other root-canal irrigant
that can meet all these require-
ments, even with the
use of methods such as
lowering the pH.8,9 Increasing

Fig. 2: Root-canal complex (DTA/Photo courtesy of Dr Ronald Ordinaka Zapata, Brazil, www.facebook.com/TheInternal
AnatomyOfTheHumanTeeth).

The challenge for successful
dentistry treatment has always
been the removal of vital and
necrotic remnants of pulp tissue,
which leads to clean beyond what
may be achieved by these instruments.19
In addition, Ensiferacervicis and
Acetobacterisowashi prevention or treat-
ment of apical periodontitis such
as Acetobacterisowashi – which are
both implicated in endodontic
infections and in endodontic failure–
penetrate deep into dental tubules,
making their removal through
mechanical instrumentation impos-
sible.19,20 Finally, E. faecalis commonly
expresses multiring resistance,11,12
complicating treatment.

Therefore, a suitable irrigant
and irrigant delivery system are es-
sential for efficient irrigation and
dentistry systems.

EndoVac® SET-UP

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Micro cannula tubing

EndoVac® SET-UP

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Micro cannula tubing

Master delivery tip

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suction

Micro cannula

Fig. 2: EndoVac set-up — Fig. 2. Irrigation accident with widespread trauma.
Irritant delivery systems

Root-canal irrigation systems can be divided into two categories: manual agitation techniques and machine-assisted agitation techniques. Manual irrigation includes positive-pressure irrigation, which is commonly performed with a syringe and a side-vented needle. Machine-assisted irrigation techniques include sonic and ultrasonic systems, as well as newer systems such as the EndoVac (SybronEndo), which delivers apical negative-pressure irrigation, the plastic rotary F File (Plastic Endo),

and the Vigringe (Vigringe), the Ruseendo (Air Techniques), and the EndoActivator (DENTSPLY Tulsa Dental Specialties). Two important factors that should be considered during the process of irrigation are whether the irrigation system can deliver the irrigant to the whole extent of the root-canal system, particularly to the apical third, and whether the irrigant is capable of debriding areas that could not be reached with mechanical instrumentation, such as lateral canals and isthmuses. When evaluating irrigation of the apical third, the extent of the root-canal system, particularly to the apical third, and the volume of irrigant that is flushed through the canal, the greater the chance of apical extrusion of the irrigant. This must be avoided; were NaOCl to extrude past the apex, a catastrophic accident could occur.

Apical vapour lock

Since roots are surrounded by the periodontium, and unless the root-canal foramen is open, the root canal behaves like a close-ended channel. This produces an apical vapour lock that resists displacement during instrumentation and final irrigation, thus preventing the flow of irrigant into the apical region and adequate debridement of the root-canal system. Apical vapour lock also results in gas entrapment at the apical third. During irrigation, NaOCl reacts with organic tissue in the root-canal system, and the resulting hydrolysis liberates abundant quantities of ammonia and carbon dioxide. This gaseous mixture is trapped in the apical region and quickly forms a column of gas into which further fluid penetration is impossible. Extension of instruments into this vapour lock does not reduce or remove the gas bubble, just as it does not enable adequate flow of irrigant.

The phenomenon of apical vapour lock has been confirmed in studies in which roots were embedded in a polyvinylalcohol impression material to resist fluid flow through the apical foramen, simulating a close-ended channel. The result in these studies was incomplete debridement of the apical part of the canal walls with the use of a positive-pressure syringe delivery technique.

Micro-CT scanning and histological tests conducted by Tay et al. have also confirmed the presence of apical vapour lock. In fact, studies conducted without ensuring a four-ended channel cannot be regarded as conclusive on the efficacy of irrigants and the irrigant system. The apical vapour lock may also explain why in a number of studies investigators were unable to demonstrate a clean apical third in sealed root canals.

In a paper published in 1983, a research Chow determined that traditional positive-pressure irrigation had virtually no effect apical to the orifice of the irrigation needle in a closed root-canal system. Fluid exchange and debris displacement were minimal. Equally important to the primary findings, Chow set forth an infallible paradigm for endodontic irrigation: “For the solution to be mechanically effective in removing all debris, it has to: (a) reach the apex; (b) create a current; and (c) carry the particles away.”

The apical vapour lock and consideration for the patient’s safety have always prevented the thorough cleaning of the apical 5 mm. It is critically important to determine which irrigation system will effectively irrigate the apical third, as well as isthmuses and lateral canals, and in a safe manner that prevents the extrusion of irrigant.

Manual agitation techniques

By far the most common and conventional set of irrigation techniques, manual irrigation involves dispensing of an irrigant into a canal through needles/ cannulas of variable gauges, either passively or with agitation by moving the needle up and down the canal space without binding it on the canal walls. This allows good control of needle depth and the volume of irrigant that is flushed through the canal. However, the closer the needle tip is positioned to the apical tissue, the greater the chance of apical extrusion of the irrigant. This must be avoided; were NaOCl to extrude past the apex, a catastrophic accident could occur.

Manual-dynamic irrigation

Manual-dynamic irrigation involves gently moving a well-fitting gutta-percha master cone up and down in short 2 to 5 mm strokes within an instrumented canal.
disinfecting root canals, operating at frequencies of 1-4kHz.9,10 There are several sonic irrigation devices on the market. The Varios allows delivery and sonic activation of the irrigating solution in one step. It employs a two-piece syringe with a rechargeable battery. The irrigant is sonically activated in the needle that attaches to the syringe. The EndoActivator is a more recently introduced sonically driven canal irrigation system.9 It consists of a portable handpiece and three types of disposable polymethyl tips of different sizes. The EndoActivator has been reported to effectively clean debris from lateral canals, remove the smear layer, and dislocate clumps of biofilm within the curved canals of molar teeth.9

Ultrasonics

Ultrasonic energy produces higher frequencies than sonic energy but low amplitudes, oscillating at frequencies of 25-50kHz.9,10 Two types of ultrasonic irrigation are available. The first type is simultaneous ultrasonic instrument and irrigation, and the second type is referred to as passive ultrasonic irrigation operating without simultaneous irrigation (PUI). The literature indicates that it is more advantageous to apply ultrasonics after completion of canal preparation rather than as an alternative to conventional instrumentaton.9,10 PUI irrigation allows energy to be transmitted from an oscillating file or smooth wire to the irrigant in the root canal by means of ultrasonic waves.9 There is consensus that PUI is more effective than sonic irrigation in removing pulpal tissue remnants and dentinal debris.9,10 This may be due to the much higher velocity and volume of irrigant flow that are created in the canal during ultrasonic irrigation.9,10 PUI has been shown to remove the smear layer; there is a large body of evidence with different concentrations of NaOCl.9,10 In addition, numerous investigations have demonstrated that the use of PUI after hand or rotary instrumentation results in a significant reduction in the number of bacteria,9,10,77 or achieves significantly better results than syringe needle irrigation.9,10

Studies have demonstrated that effective delivery of irrigants to the apical third can be enhanced by using ultrasonic and sonic devices that demonstrate acoustic micro-streaming and cavitation.9,10,77 Acoustic micro-streaming is defined as the movement of fluids along cell membranes, which occurs as a result of the ultrasound energy creating mechanical pressure changes within the tissue. Cavitation is defined as the formation and collapse of gas and vapour-filled bubbles or cavities in a fluid.10

The Apical Vapor Lock theory, proven in vitro by Tay, has been clinically demonstrated9,10 to also include the middle third by Vera: “the mixture of gases is originally trapped in the apical third, but then it might grow quickly by the nucleation of the smaller bubbles, forming a gas column that might not only impede penetration of the irrigant into the apical third but also push it coronally after it has been delivered into the canal.” However, more recently Munoz10,77 demonstrated that both: passive ultrasonic irrigation (PUI) and EndoVac are more effective than the conventional endodontic needle in delivering irrigant to WL of root canals. This begs the efficacy question. Two recently published studies examined this issue with both systems by testing their ability to eliminate microorganisms during clinical treatment from infected root canal systems.9,10 Paiva fund that after a supplementary irrigation procedure using PUI with NaOCl that 27% of the samples produced positive cultures. colleagues10’s study examining the clinical efficacy of the EndoVac fund no microbial remnants and irrigation of at the end of treatment.

When questioning these different devices, one must remember that microbial hydrolysis via NaOCl is an equilibrium reaction. Hand demonstrated that a 50% reduction of NaOCl concentration resulted in a 500% reduction in dissolution activity. Accordingly, one must consider both the delivery of the irrigant to full working length, via PUI that is mechanical pressure, and the total volume of NaOCl exchanged. The volume of an instrumented root canal 19 mm long shaped to a # 55 with a ~% instrument space equals 0.14 mm3. Described placement of irrigation via a NanoTip (ULTRATECH) at WL – 4 mm and comparison and discussed using PUI with 815 μl of fluid at WL – 1 mm. Prior to PUI, 2 ml of NaOCl was connected to the root canal. However, this canal did not have filled the apical four millimeters9,10 due to the apical negative pressure. According to Munoz, the canal was most likely immediately filled with ultrasound-activated NaOCl for one minute, but as just described – at its oblong 0.14 mm3, has been effectively available for this re-activation and exchange. In contrast, the irrigant can pass through the complete WL for one minute.9,10 The difference in volumetric exchange equals 2.014 mm3 – 14.200 μl, and likely explains the disinfectant differential.

The plastic rotary F File

Although sonic or ultrasonic instrumentation is more effective at removing thin canal debris than rotary endodontic files,9,10 and as compared to PUI irrigation, clinicians must be careful to not twist the needle in the canal, not to over-activate NaOCl and the evacuation hood is connected via tubing to the high-speed suction of a dental unit. The Masterpulpa uses a delivery and suctioning of the irrigant and the evacuation hood is connected via tubing to the high-speed suction of a dental unit. The Master Delivery Tip is connected to a syringe of irrigant and the evacuation hood is connected via tubing to the high-speed suction of a dental unit. The Master Delivery Tip is connected to a syringe of irrigant and the evacuation hood is connected via tubing to the high-speed suction of a dental unit.

During irrigation, the Master Delivery Tip delivers irrigation to the pulpal chamber and sinus without the excess irrigant to prevent over-flow. Both the MacroCannula and MicroCannula require a negative pressure that pulls fresh irrigant from the chamber, down the canal to the root apex through which ex- trusion of the irrigant occurred and the irrigant then found its way into the venous complex. This would require positive pressure apically that exceeded venous pressure (10 mmHg). In vitro study, which used a positive-pressure irrigation technique to mimic clinical conditions and techniques, the apical pressure generated was found to be eight times higher than the normal venous pressure.9,10

This does not imply that NaOCl can or should be excluded as an endodontic irrigant. It is critical, as has been discussed in this article. What this does imply is that NaOCl must be delivered safely.

Safety first

In order to compare the safety of six different intra-canal irrigation delivery devices and conducted using the worst-case scenario of apical extrusion, with EndoVac and the NaviTip, an open apex study.9,10 The study con- cluded that the EndoVac did not exclude the possibility of both NaviTip and delivery and suctioning of the irrig-
ant from the chamber to full working length, whereas other devices did. The EndoVac system resulted in only a very small volume of irrigant, the clinical significance of which is not known.

Mitchell and Baumgartner tested irrigant (NaOCl) extrusion from a root canal sealed with a permeable agarose gel.110 Significantly less extrusion occurred using the EndoVac system compared with positive-pressure needle irrigation. A well-controlled study by Gondim et al. found that patients experienced less post-operative pain, measured objectively and subjectively, when apical negative-pressure irrigation was performed (EndoVac) than with apical positive-pressure irrigation.111

**Efficacy**

In vitro and in vivo studies have demonstrated greater removal of debris from the apical walls and a statistically cleaner result using apical negative-pressure irrigation in closed root-canal systems with sealed apices. In an in vitro study of 22 teeth by Shin and Baumgartner, less debris remained at 1 mm from working length using apical negative pressure compared to use of traditional needle irrigation, while Shin et al. found in an in vitro study of 69 teeth comparing traditional needle irrigation with apical negative pressure that these methods both resulted in clean root canals, but that apical negative pressure resulted in less debris remaining at 1.5 and 3.5 mm from working length.112,113 When comparing root-canal debulking performed using manual-dynamic agitation or the EndoVac for final irrigation in a closed system and an open system, it was found that the presence of a sealed apical foramen adversely affected debulking efficacy when manual-dynamic agitation was used, but did not adversely affect results when the EndoVac was used. Apical negative-pressure irrigation is an effective method to overcome the fluid-dynamic challenges inherent in closed root-canal systems.114

**Microbial control**

Hockett et al. tested the ability of apical negative pressure to remove a thick biofilm of E. faecalis, finding that these specimens rendered negative cultures obtained within 48 hours, whereas other studies have shown that the results were statistically significant. The safest method yet discovered to provide fresh NaOCl safely to the apical terminus is to evacuate it via apical negative pressure. This method has also been proven to be safe because it always draws irrigant to the source via suction—down the canal and simultaneously away from the apical tissue in abundant quantities.116 When the proper irrigating agents are delivered safely to the full extent of the root-canal terminus, thereby removing 100% of organic tissue and 100% of the microbial contaminants, success in endodontic treatment may be taken to levels never seen before.116

This article has been reprinted in part from G. Glassman, Safety and Efficacy Considerations in Endodontic Irrigation (Penwell, January 2013).

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