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in a fully digital workflow

case report
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interview
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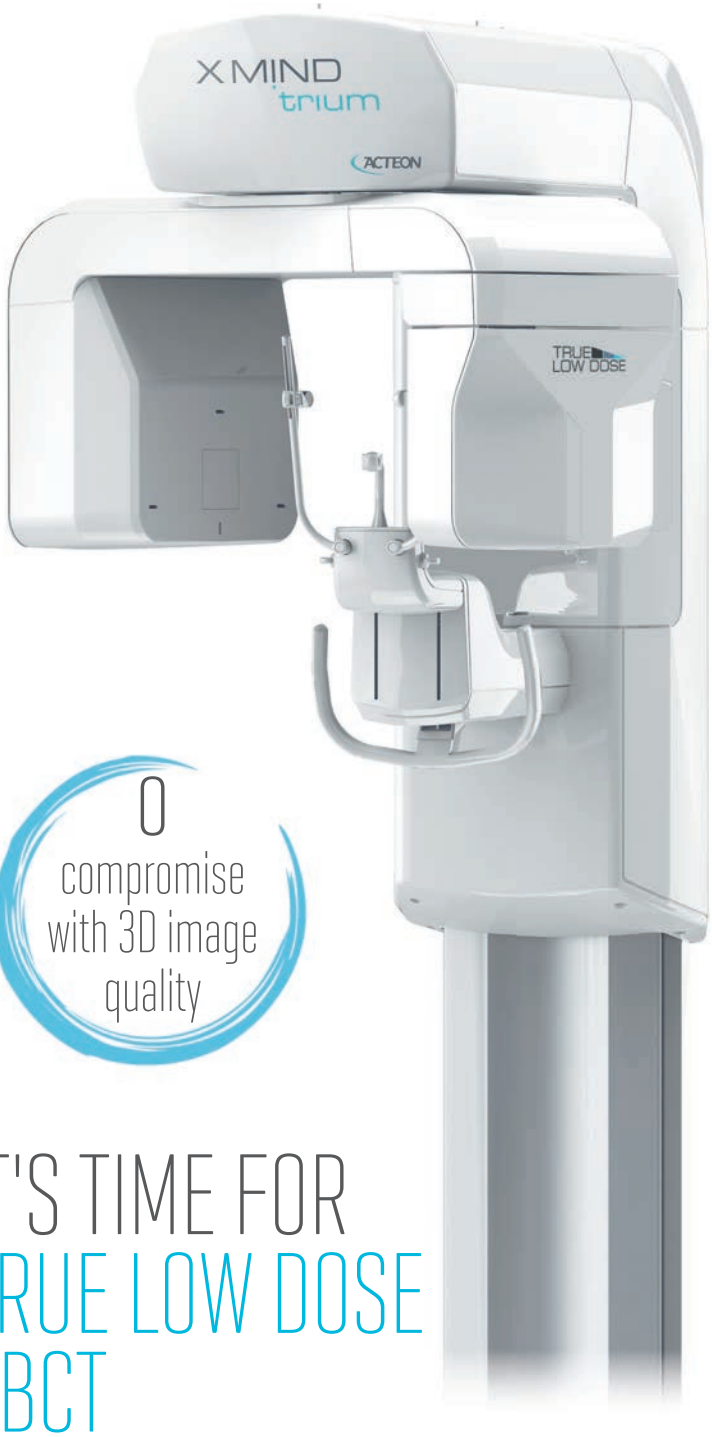

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ACTEON

Dr Scott D. Ganz

Editor-in-Chief

Holiday season 2020—normalcy

We are now in the last month of 2020, and the outlook for 2021 is still not clear. The current pandemic still has a grip on countries around the globe, making it difficult to travel, host and attend educational meetings and symposia, or even visit with our family and close friends. We can only hope that help is on the way with vaccines that are effective and safe, allowing us to return to a sense of normalcy and confidence. In our world of dentistry, we have always maintained a high level of infection control for our patients and staff, and we have always worn protective masks, shields and gowns. Of course, today, we are all taking extra precautions to ensure that we can deliver care in the most effective and efficacious manner. Therefore, dentistry will remain vital, important and essential to the health and welfare of the population worldwide.

The COVID-19 pandemic has focused the globe on communicating remotely, whether it is with our family or our colleagues. Our new normal may not allow for in-person meetings in the foreseeable future, which means that our educational opportunities will need to be visualised on a computer screen, tablet or smartphone. For many educators, this will require a somewhat different skill set, in terms of delivery, presentation materials, and the use of videos and animations which may or may not reproduce satisfactorily, depending on the speed of internet or Wi-Fi connections. Additionally, it is an entirely different experience when one is presenting alone in a room facing a video camera where there is no direct feedback from what it is when speaking to a small group of clinicians or from a larger podium at a major conference. Our educational experiences will therefore become a modified reality for both the recipients and those delivering the content. Clinicians who were forced to close their practices may have elected to spend more time online reading and watching educational videos, gaining important insights from experts around the globe. Similarly, we might even predict that during government sanctioned lockdowns authors from around the globe may have taken the required time away from their offices to write new articles or textbook chapters or to prepare new lectures, videos or webinars.

What has *not* changed are the numerous publications which will continue to deliver excellent content on a wide range of subjects, research and general interest topics. We are fortunate that the pages of our publications are made possible through a digital medium using software applications like Microsoft Word to compose the text and image editing software to prepare illustrations or clinical photographs for print or online presentation. All submissions are submitted online in a digital format. The articles are then compiled, reviewed, edited and then, once approved, sent for final layout to be approved prior to publication. We are fortunate that even during the pandemic the various offerings from Dental Tribune International have continued to provide high-quality content of interest to our readership. We thank you for your patronage and appreciate your dedication to our chosen profession through our offerings. We also want to thank all of our incredible contributors, who spend countless hours documenting and preparing the manuscripts that you find within the pages of digital.

Wishing everyone a very safe holiday season and a happy new year!

Dr Scott D. Ganz
Editor-in-Chief


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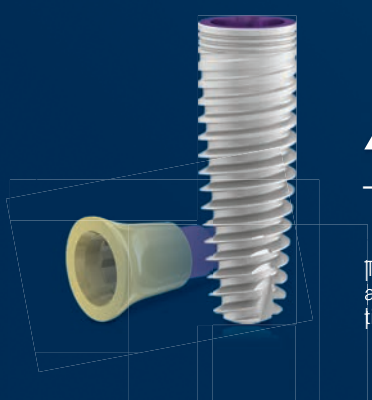
IT'S SIMPLE WHEN YOU HAVE ALL THE OPTIONS



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Cooperation is key

By Iveta Ramonaite, Dental Tribune International

Giuseppe Romeo is of the opinion that dental technicians need to have an open conversation with dentists to promote future cooperation. *(Image: © Giuseppe Romeo)*

Giuseppe Romeo is a dental technician and owner of a prosthetic dentistry laboratory in Turin in Italy. In this interview, he speaks to Dental Tribune International about how COVID-19 has affected his work in the laboratory and about the impact that the pandemic has had on his personal and professional life.

Mr Romeo, could you tell us a bit about yourself and your work in general?
My situation is unusual because I'm based in Turin, but I was born in New York. I lived in the US for the first five years of my life. Then we moved to Italy because my parents decided to come back here. I received my education as a technician in Italy, and after I finished my five years of school, I moved to Switzerland and did a two-year master's degree at the University of Geneva. During that time, I had the possibility of working with Dr Pascal Magne, Prof. Dr Uls Belser and Didier Dietschi, and had the chance to work in Michel Magne's laboratory. Michel was not only my professor but also my mentor, my teacher. I worked with him for ten years. After that, I moved back to the US and stayed in Los Angeles for five years, working at the University of Southern California for three of those years. During my time in the US, I had the opportunity to become an assistant clinical professor in restorative science. And then, at the beginning of 2015, I came back to Italy.

It is safe to say that COVID-19 took everyone by surprise and that its suddenness left no time for preparation. What was your initial response to the pandemic and the confinement measures ordered by the authorities?
Yes, it was a strange time for me as well. I was completely astonished at the pandemic taking place all around the world. I stopped travelling immediately, and this was a big change for me. I love travelling, and I go see patients and dentists in different countries. Here in the laboratory, we had to pay close attention to proper disinfection procedures and to learn how to best deliver the cases. Fortunately, not all the dentists that I work with had to close their offices. I continued to work in the laboratory during the lockdown in Italy. Everything had to be customised, very well disinfected and boxed differently than before.

There is still a lot of uncertainty about the post-COVID-19 era in dentistry. As a dental technician, do you feel optimistic about the long-term changes the pandemic may produce in dental laboratories and the dental field in general?
I know that most of the clinical offices still don't have the same volume of work, since they can't see the same number of patients a day. This reduced number of patients has subsequently reduced the quantity of work, and this has been reflected in the dental laboratory. Dental laboratories have the same problem because they are the mirrors of the clinical office, of the current state of affairs. In my case, because I specialise in veneers and the aesthetic zone, employing the precision of the microscope, I still had some requests coming in because some patients and dentists still appreciate the quality of my work. Compared with the big laboratories, COVID-19 hasn't affected work in my laboratory much. Big laboratories focus on production volumes. Mine is a small laboratory—there are three of us, sometimes four—and so the quantity of the work and the quality of the work are completely different from that of big laboratories.

Lastly, there's a lot of discussion around the mental health of dentists and dental technicians at the moment. Has the pandemic affected you personally?
I can tell you that I have a lot of defects as a person, but one of my strengths is that I always seek to rise to the challenges of life and that I'm always thinking positively. I try to talk with dentists and other people and to stay active in my job and my relationship with dentists and their patients. That is why I don't think that COVID-19 will affect me in the future because I'm still working every day and I can see the result. This is what we have to go through right now, and we have to stay humble. We have to fight every day and we can't surrender. I think that we can find a solution because dentists want to have a conversation with dental technicians in order to understand and address the situation. I have to admit that I had to lower the price for some cases, but it was not damaging for me. It helped me to have a better relationship with the dentist and the patient. So when dentists and patients realise that a dental technician is open to creating something for the future, I think that there is a good possibility for better future cooperation.

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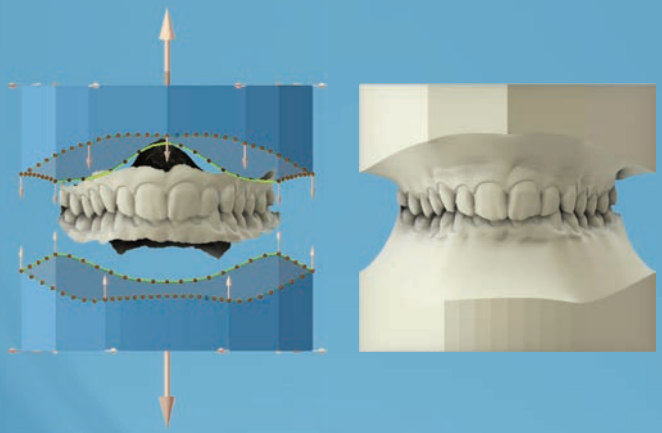
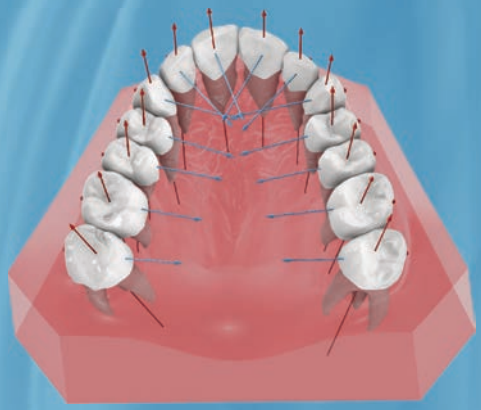


Virtual Setup



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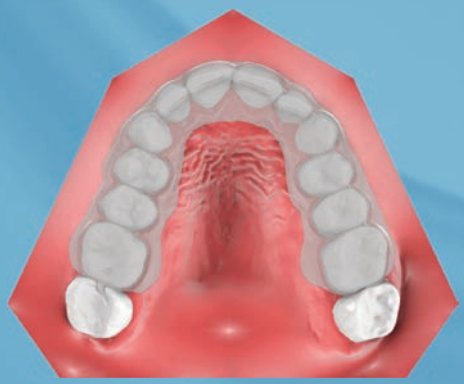

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The diode laser in a fully digital workflow for prosthetic treatment

Dr Carmine Prisco, Italy

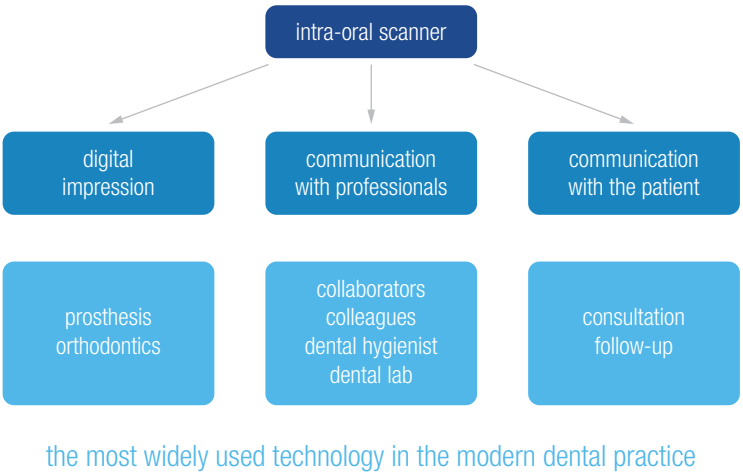


Fig. 1: The intra-oral scanner is the most widely used technology in today's dental practice.

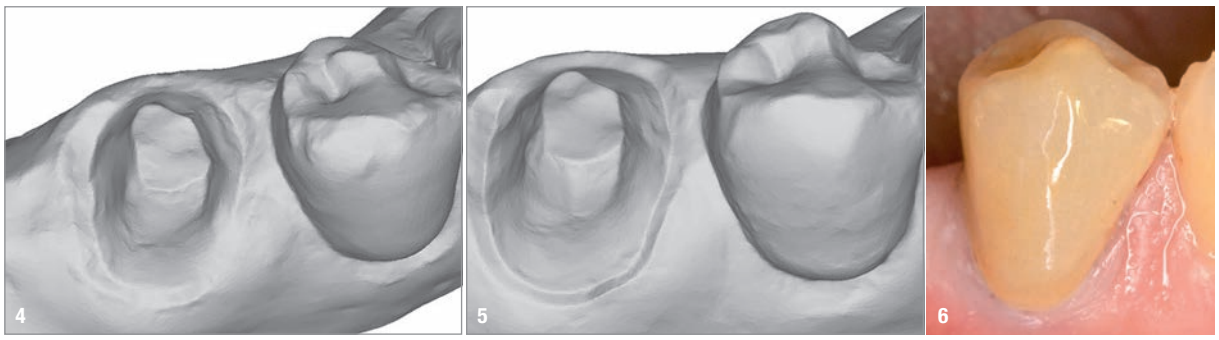
Modern dentistry has undergone an incredible evolution owing to the many new available technologies. The digital transformation and the technological evolution in dental surgery represent a very interesting opportunity for the modern dentist to develop his or her practice. Technologically supported dentistry is completely oriented towards patients' needs, well-being and comfort. Reduced treatment times, minimal invasiveness and better care with predictable results are the guiding principles.[1] A fully digital workflow in prosthetic dentistry respects these principles. The purpose of this article is to show how the use of a diode laser can be integrated into the procedures of a fully digital workflow to make it more effective, simpler and faster.

The intra-oral scanner is the most widely used technology in the modern dental practice (Fig. 1) and its use is the first step to a fully digital workflow in prosthetic dentistry. The optical impression is used both for a virtual 3D diagnostic analysis of a dentition to plan a minimally invasive treatment[2] virtually and for taking impressions during the various phases of the digital workflow.[3] Transferring a correct impression to the laboratory is fundamental for the success of a prosthetic treatment, and the use of a diode laser is effective in obtaining a clearly readable impression. Versatility and simplicity of use make the diode laser particularly useful in digital prosthetic dentistry for the following: periodontal health, pre-impression troughing and haemostasis, minor pre-impression surgery and second-stage implant surgery.

Periodontal health

Good periodontal health is an essential condition for any prosthetic treatment: the prosthetic patient always needs adequate periodontal pretreatment for a correct digital impression and for the full success of the therapy. While

Fig. 2: The settings of the 980 nm diode laser used with single-use fibres. **Fig. 3:** The laser settings for completely drying the sulcus with a programme in continuous-wave mode.



Figs. 4 & 5: Comparison of the impression without and with treatment of the sulcus shows that the use of the diode laser yields a clearer and more defined impression. **Fig. 6:** There is no significant gingival retraction one year after crown positioning.

many laser-assisted therapeutic protocols have been reported in the literature, the laser-assisted full-mouth disinfection protocol[1] is the one used in our daily clinical practice and is naturally adapted to the patient's periodontal health status. In accordance with the guiding principles of technologically supported dentistry, our goal is to perform the tooth preparation and the optical impression in a single session. The absence of gingival inflammation is an essential condition. Therefore, a session of photodynamic and photothermic therapy a few days ahead is always recommended for a bactericidal effect. A 10 % povidone-iodine solution is placed in the gingival sulcus before inserting the fibre of the laser (PRIMO, MEDENCY), employing a pulsed mode of 50 microseconds on and 50 microseconds off for 30 seconds at a power of 2 W.

Pre-impression troughing

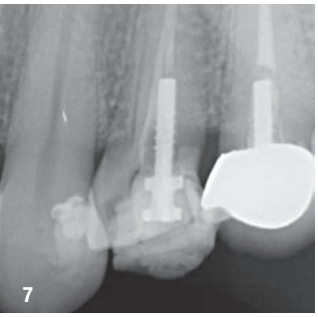
Many tooth preparation systems for one-piece complete-coverage crowns, bridges[4] and veneers,[5] like vertical preparation without a finishing line, are discussed in the literature. In our clinical experience, in order to obtain a good optical impression, a simple principle of tooth preparation must be respected when using an intra-oral scanner: juxta-gingival preparation in non-aesthetic areas whenever possible and minimal intra-sulcular preparation in aesthetically relevant areas. However, a minimal gingival displacement can help the dentist while taking the impression. Many studies on the evaluation of non-invasive gingival displacement systems are reported in the literature.[6] The diode laser can be used for gingival displacement. While techniques involving gingival retraction cords or a diode laser lead to similar amounts of gingival retraction, use of the diode laser requires less time, is simpler for the operator and is more comfortable for the patient than are retraction cords.[7] Pre-impression taking with a diode laser does not create gingival retraction problems compared with use of a cord impregnated with aluminium chloride. The amount of recession has been reported as clinically insignificant for both techniques.[8]

A 980 nm diode laser is used with single-use fibres of 10 mm and 400 µ. The laser is set on a pulsed mode of 10 microseconds on and 10 microseconds off for 20 seconds at 2.2 W (Fig. 2). A single rapid and gentle movement of the activated fibre in the gingival sulcus is sufficient to achieve the desired result. The optical impression is taken with the WOW intra-oral scanner (Biotech Dental). Sometimes, a haemostasis treatment may be recommended to achieve the complete drying of the sulcus with a programme in continuous-wave mode for 20 seconds at 2 W (Fig. 3). Comparison of the quality of the impression without (Fig. 4) and with (Fig. 5) treatment of the sulcus showed that the use of the diode laser yielded a clearer and more defined impression. In accordance with the results reported in the literature,[8] there was no significant gingival retraction one year after crown positioning (Fig. 6).

Minor pre-impression surgery

In some cases, minor gingival surgery is necessary for a good result of a prosthetic treatment. Modern dentistry, thanks to the use of advanced technologies, makes it possible by reducing the number of sessions and the inconvenience to the patient. A classic case is a subgingival partial fracture of a tooth that had undergone endodontic treatment at one time (Fig. 7). After tooth reconstruction with a root fibre-reinforced post and composite, the use of a diode laser for minor surgical gingival correction is strongly recommended. The aim was to remove the excess gingival tissue and bring the fracture margin outside the gingival sulcus (Fig. 8). The laser is used with single-use fibres of 10 mm and 400 µ, and the programme is set to a pulsed mode of 25 microseconds on and 50 microseconds off, 6.5 W and an average power of 2.17 W. Its cutting performance without oedema and with immediate coagulation allowed for preparation of the abutment and impression taking in the same session.

It is recommended to allow the gingival tissue to rest for 10–15 minutes between abutment preparation and impression taking. We use this time for the adaptation of a



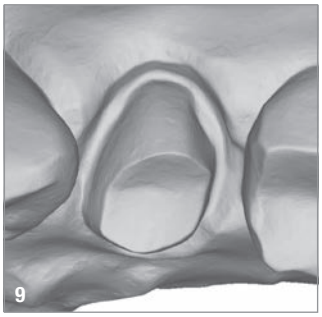
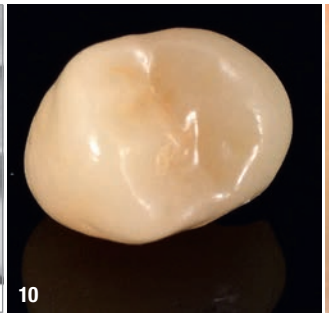




Fig. 7: The radiograph shows a subgingival partial fracture of a tooth which had undergone endodontic treatment at one time. **Fig. 8:** A diode laser can be used to remove excess gingival tissue and thereby bring the fracture margin outside the gingival sulcus. **Fig. 9:** Correct impression files need to be sent to the dental laboratory. **Fig. 10:** An all-zirconia crown was fabricated by Laboratoire LDA. **Fig. 11:** At the two-month follow-up visit, the results appeared stable in terms of the crown fit and gingival healing.

temporary crown. A correct temporary crown is necessary to gain good healing of the gingiva without retraction. Immediately before the impression taking, a haemostatic treatment with the laser allows the practitioner to obtain a clear and defined digital model, sometimes supported by the gentle use of an intra-oral scan powder spray. The WOW scan software immediately shows the STL and the PLY colour files. To send a correct impression to the dental laboratory, analysis of the STL file is essential (Fig. 9). A week later, an all-zirconia crown (Laboratoire LDA; Fig. 10) was positioned on the dental abutment. The quality of the crown fit and of the gingival healing yielded a stable result at the two-month follow-up visit (Fig. 11). The dentist who uses a diode laser and an intra-oral scanner, and who is supported by a dental laboratory using a fully digital workflow, can solve similar cases in just two sessions.

Second-stage implant surgery

The use of lasers for second-stage implant surgery is a widely discussed topic in the international literature. Implant surgery consists of two distinct techniques: the transmucosal one-stage technique and the two-stage technique. Diode lasers represent a good aid for the two-stage technique in implant dentistry, resulting in decreased trauma to bone and soft tissue, a reduction of pain, an immediate haemostatic effect and a reduction of the risk of postoperative infections. The effects of diode and Er,Cr:YSGG lasers in second-stage implant surgery applications were compared in a cross-sectional study, and the use of these two different lasers showed no statistically significant differences in clinical results.[9] Diode lasers are cheaper and smaller, and meet clinicians' needs, being their preferred choice for second-stage implant surgery. Another study showed that laser utilisation with the recommended parameters yielded no risks of dangerous thermal elevation to the tissue and implants.[10] The laser is used with single-use fibres of 10 mm and 400 µ, and the programme is set to a pulsed mode of 1 microsecond on and 1 microsecond off, 1.6 W and an average power of 0.8 W. The protocol facilitates implant exposure and immediate optical impression taking in a single session.[11] The use of the laser, thanks to its immediate haemostatic effect, allows immediate screwing of the scanbodies on to the exposed implants to obtain a correct digital model to be sent to the dental laboratory (Fig. 12).

The choice of healing screw after the impression taking is essential to obtain an excellent final result. The Kontact series of implants (Biotech Dental) has a wide range of healing screws, and the choice depends on the type of tooth to be replaced, on the condition of the gingiva and on the patient's occlusion. A week later, when the gingival healing was complete (Fig. 13), it was possible to



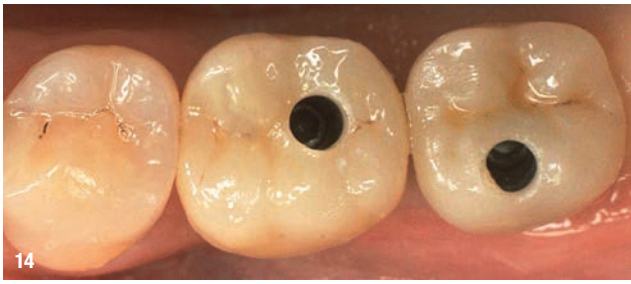


Fig. 12: The laser allows immediate screwing of the scanbodies on to the exposed implants to obtain a correct digital model to be sent to the dental laboratory.
Figs. 13 & 14: After successful healing of the gingiva, the healing screws can be removed and the crowns can be positioned.

remove the healing screws and to position the crowns. Two screw-retained single zirconia crowns on Ti-base abutments were produced by the laboratory, checked by the practitioner and then positioned in the patient's mouth. The occlusion, gingival health and points of contact were respected and the result was achieved in just two chair sessions (Fig. 14). The diode laser can be used effectively for second-stage implant surgery, providing both the dentist and the patient with additional advantages over the conventional methods used for implant exposure.[12]

Conclusion

Modern dentistry is patient-centred in order to ensure maximal comfort to the patient throughout the whole treatment. Correct use of modern technologies to adequately address the patient's needs and expectations through effective and high-quality therapies is the principle on which modern dentistry is founded. The goal is to achieve a minimally invasive treatment, which reduces the number and duration of chair sessions, overall duration of the treatment and inconvenience to the patient. Technology that is correctly chosen and employed represents a fundamental aid to achieving this desired result. The combined use of the diode laser in the ideal surgery and of the intra-oral scanner, supported by a specialist dental laboratory in a fully digital workflow, represents a way of achieving the aforementioned result in prosthetic dentistry.

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about

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Digital procedures for the design of a sequential occlusion in a complex clinical case

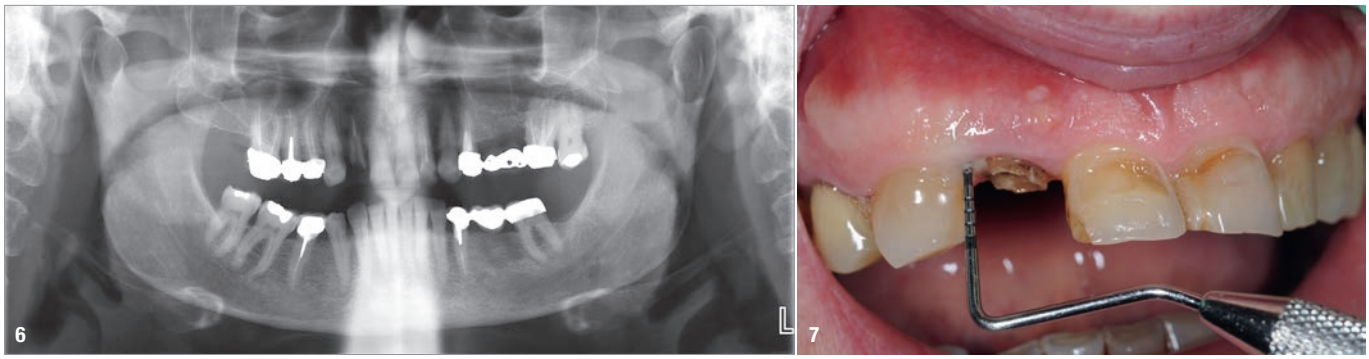
Dr Mario Perotti, Maurizio Melano & Marco Marzolla, Italy

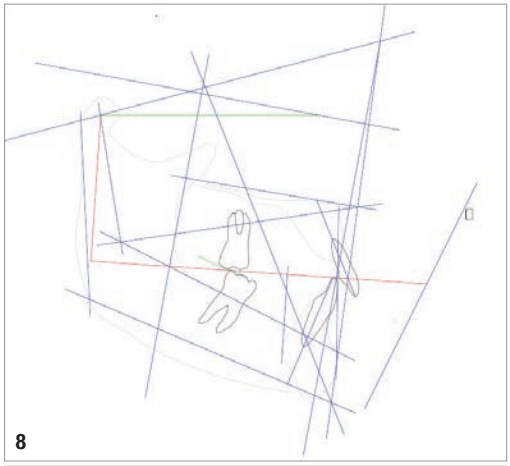
Introduction

The average lifespan of the human population has been increasing for many years, and this has led to an increasing number of patients developing malocclusion and parafunctional habits, subsequently causing wear or fracture, the introduction of incongruous dental treatments, and loss of teeth.

Anyone who deals with cephalometry knows that the morphology of the skull and the conformation of the occlusion are not visible at average values in the population; on the contrary, they show great individual variability. The design of a new occlusion can be approached according to the criteria expressed by different schools of thought: some of them consider the use of a canine-dominant occlusal function, others the construction of group functional guidance, and still others the construction of a bilateral balanced occlusion. The gnathological school of Prof. R. Slavicek envisions the programming of a canine-dominant occlusal sequential function.

Whichever occlusal set-up the clinician considers correct for his or her clinical case, it remains a dentist's duty to provide





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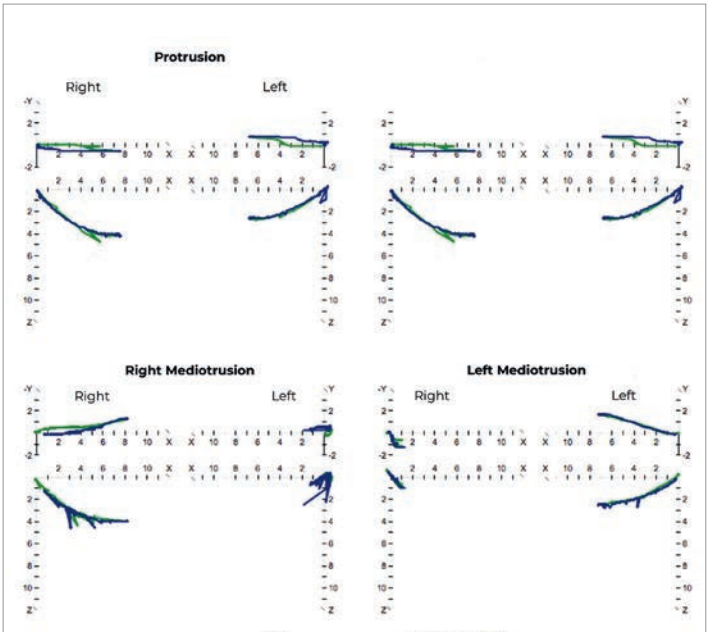

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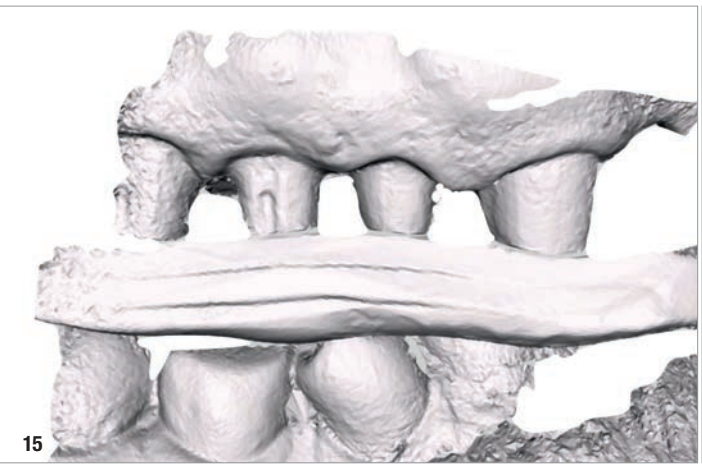
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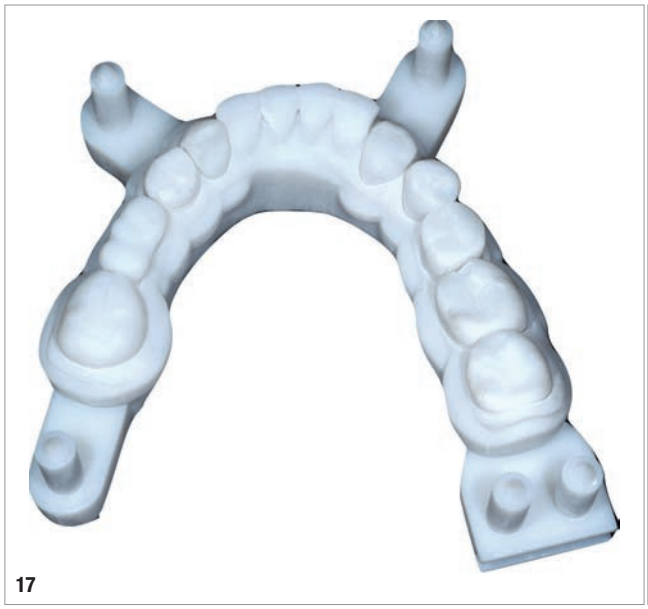
the dental technician with all the necessary data for the construction of a new occlusion, such as the inclination of the occlusal plane, the vertical dimension of occlusion (VDO), and the values of the posterior and anterior determinants of the occlusion, such as the values of the sagittal condylar inclinations, of the Bennett angles and of the incisal guides.

The aim of this article is to report on the use of digital tools in diagnosis, pre-therapy and therapy for the design of a canine-dominant occlusal sequential function in a complex clinical case, which showed a loss of VDO, the loss of some teeth and multiple fractures of existing prosthetic restorations. In this instance, careful planning of the occlusal function, while respecting the patient's anatomy, led to tissue healing, the maintenance of neuromuscular health, and the proper and lasting integration of new prosthetic restorations.

The accurate programming and waxing of a canine-dominant occlusal sequential function requires great expertise in design and technical execution. The purpose of this paper is to present our use of digital procedures in diagnostics path, with reference to CAD occlusal programming and the construction of prosthetic structures through CAM, with the aim of simplifying the management of a complex workflow. This leads to greater occlusal design customisation for an emerging group of patients with impaired dental function.

Case report

A 66-year-old patient, with a medical history of non-insulin-dependent diabetes mellitus and ischemic cardiac vasculopathy, presented for treatment of periodontal abscess at the residual root of tooth #12 and multiple fractures of the existing prostheses (Figs. 1–6). During the visit, severe malocclusion was highlighted, as well as loss of VDO, wear and fracture of prosthetic restorations and residual teeth, and evidence of cervical abfraction. The patient also showed modest muscle soreness on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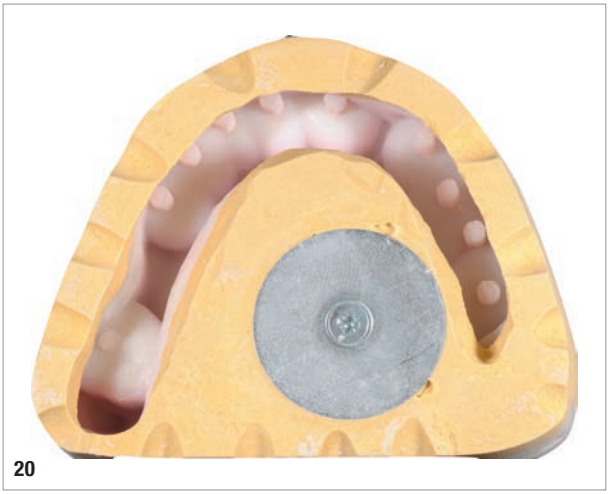

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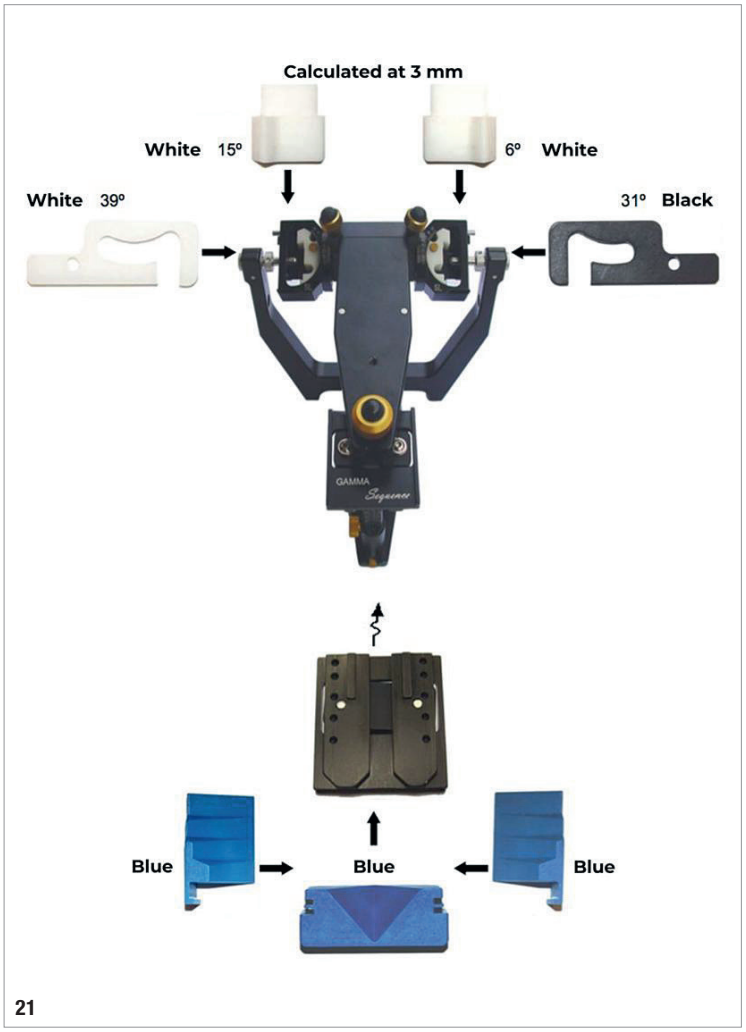
palpation during the visit, especially in the medial and lateral pterygoid muscles, reduced opening of the mouth and slight noise produced by the temporomandibular joints.

Infection of the root of tooth #12, with 9 mm probing depths, was immediately attributable to a vertical fracture (Fig. 7). Once the fractured root of tooth #12 had been extracted, the patient would require fixed prosthetic full-arch rehabilitation, providing for as few endodontic and surgical procedures as possible. We agreed on a full-arch prosthetic rehabilitation that would allow, after studying the gnathological case and going through interlocutory therapy with PMMA interim prostheses, the definition of a sequential function at therapeutic reference position through a controlled increase in VDO and stabilising jaw relations, then appearing conspicuously compromised.

Therefore, cephalometric analysis was performed (Fig. 8) based on a lateral radiograph (Fig. 9), and axiography of border movements (CADIAX compact, GAMMA Dental; Fig. 10) was recorded to set up an average-value articulator (Artex TR, Amann Girrbach), assembling stone models with the facebow, to mill first interim prostheses made at an arbitrary 5 mm VDO increase on the incisal rod and improvement of overbite and overjet, for an interlocutory pre-therapeutic purpose and immediate aesthetic resolution.

Once the necessary causal periodontal and restorative therapy had been completed, an intra-oral scan of the arches (TRIOS 3 Pod, 3Shape; Figs. 11–14), and the jaw relations with reference position wax were recorded (Fig. 15). The scan images were printed in resin (VisiJet RWT white, 3D Systems) with detachable abutments using a 3D printer (ProJet MJP 2500 Plus, 3D Systems; Figs. 16–18). The resulting models were plastered to mounting blocks (Figs. 19 & 20) and mounted with reference position waxes and a facebow in a fully adjustable arcon articulator (Reference SL, GAMMA Dental).

The articulator programming deriving from the axiographic record was then set as indicated by the software (GAMMA Dental Software), both for the regulation of the condylar and incisal guidance and for the adjustment of sagittal condylar inclination and Bennett angles (Fig. 21). The resulting prosthetic space,



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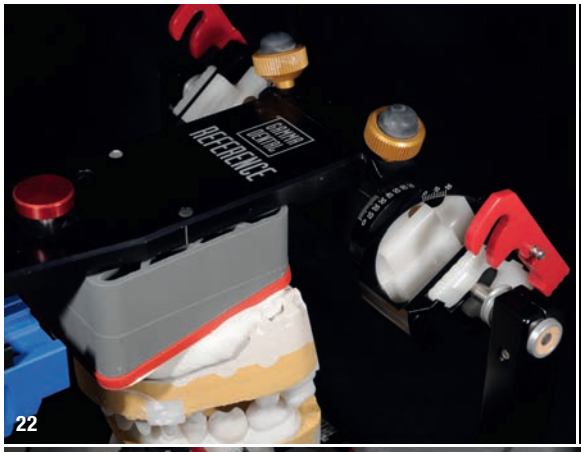

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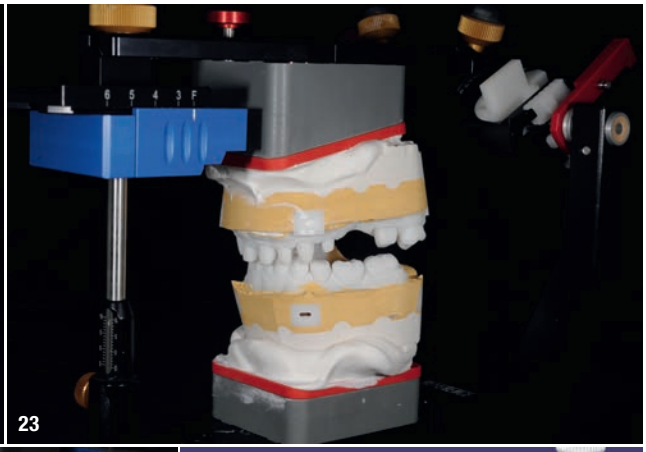

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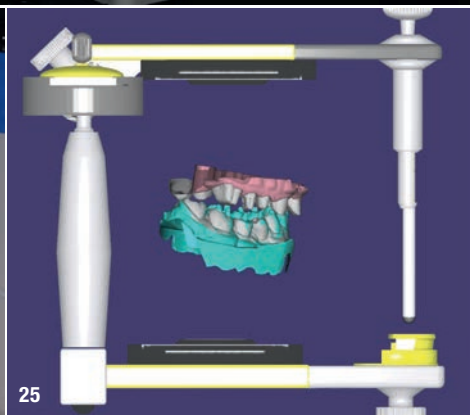
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at an adequate VDO expected for the rehabilitation of vital anterior teeth whose anatomy cannot be further modified was insufficient for a stable restoration of the occlusal relations, particularly regarding the functional tracks. It was therefore decided to use two red protrusion stops (+2 mm) to reposition the mandible on the chosen therapeutic reference position (Figs. 22 & 23). This would allow an improvement in the jaw relations, a gain of prosthetic space in the premolar and molar regions, and the maintenance of a prosthetic space conforming to a correct anatomy for vital teeth #13 to 23.

The patient was then made aware of the updated treatment plan: the purpose of planning a therapeutic reference position rehabilitation was shown, and the proposal to overlap the mandibular arch for the design of a new occlusal plan was explained.

In this newly found therapeutic reference position, the cones of the active centric occlusal relations were shaped on the removable abutments of the mandibular arch. This relation of casts in therapeutic reference position was then scanned with a desktop scanner

Sagittal Condylar Inclination (SCI) SAM®

Right			Left		
3. mm	5. mm	10. mm	3. mm	5. mm	10. mm
40°	39°		31°	27°	
•34°	•34°		•25°	•23°	
20°	23°		15°	15°	

Transversal Condylar Inclination (TCI) SAM®

	Right			Left		
	3. mm	5. mm	10. mm	3. mm	5. mm	10. mm
White	•15°	•11°	•7°	•6°	•8°	
Green	0°	0°	0°	0°	0°	
Blue	0°	0°	0°	0°	0°	
Red	0°	0°	0°	0°	0°	

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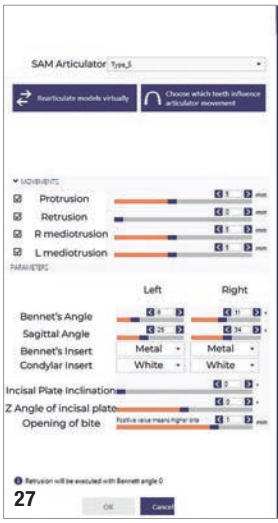

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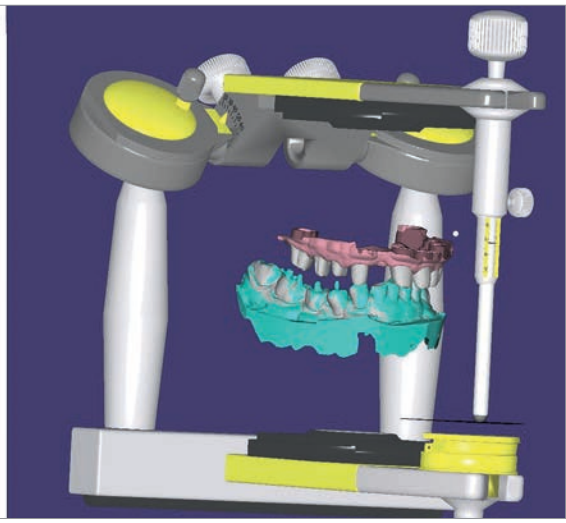

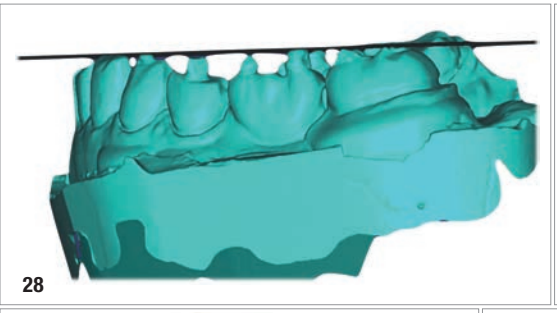
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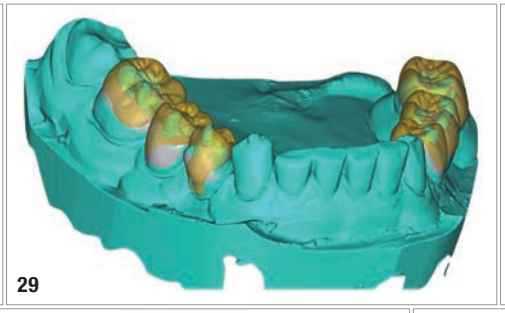
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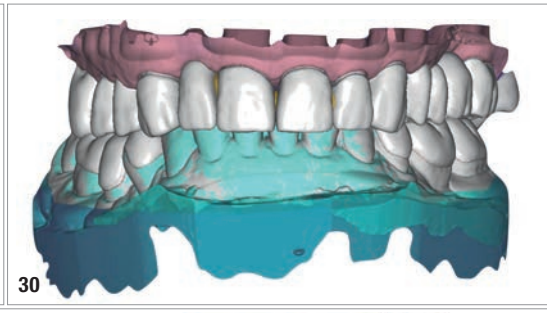
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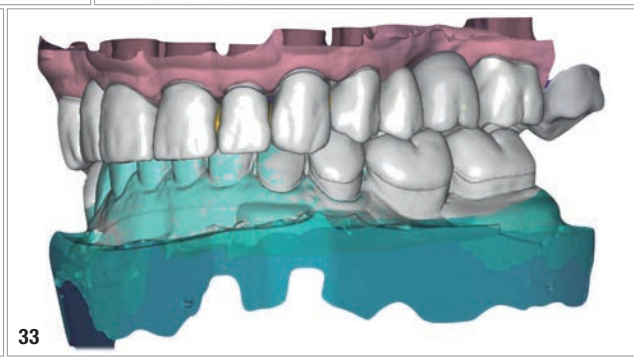
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(Xanos Evo Scan COMPACT, DENTAG; Fig. 24). The casts were thus imported in the correct spatial position into the CAD module (Virtual Articulator module, exocad DentalCAD, exocad; Fig. 25). Not having the virtual analogue of the Reference SL articulator available in this CAD software, a virtual SAM articulator (SAM Präzisionstechnik) system was set, because both of them are designed on the same axioorbital reference plane and the geometry


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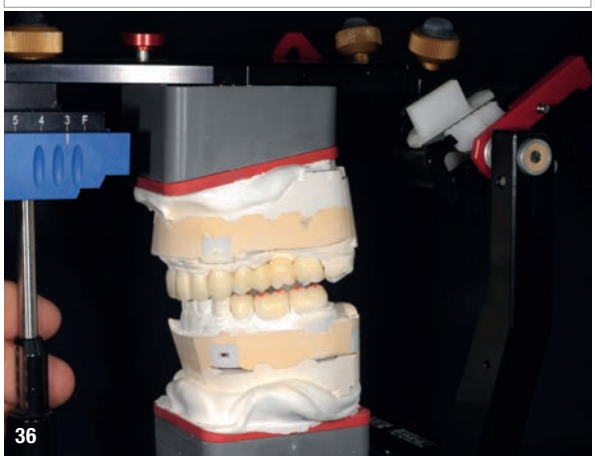
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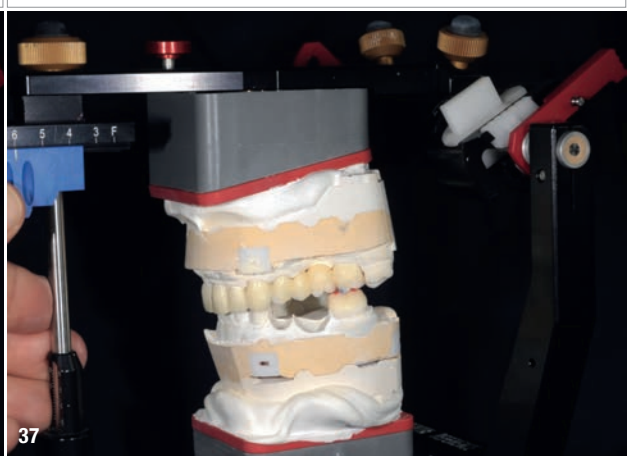
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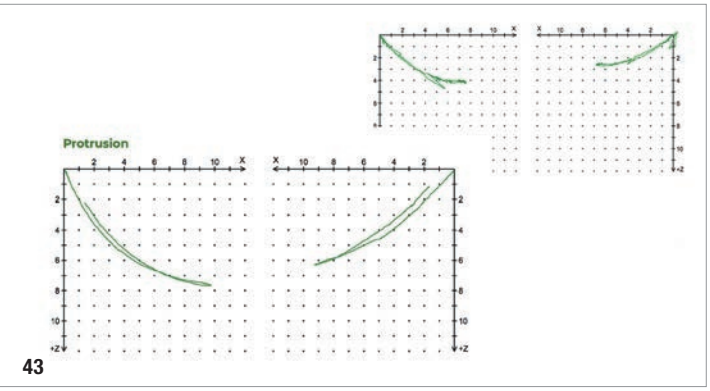
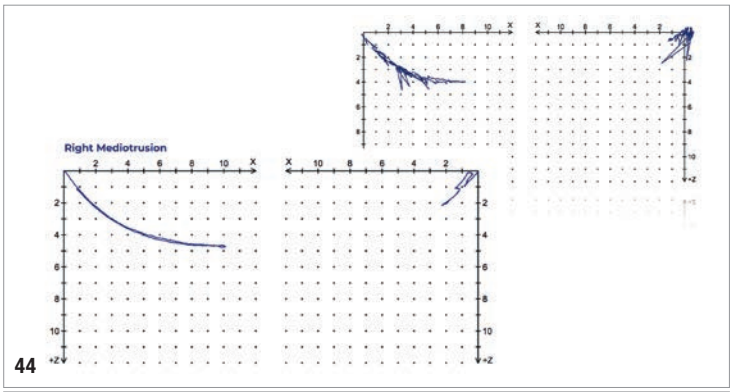
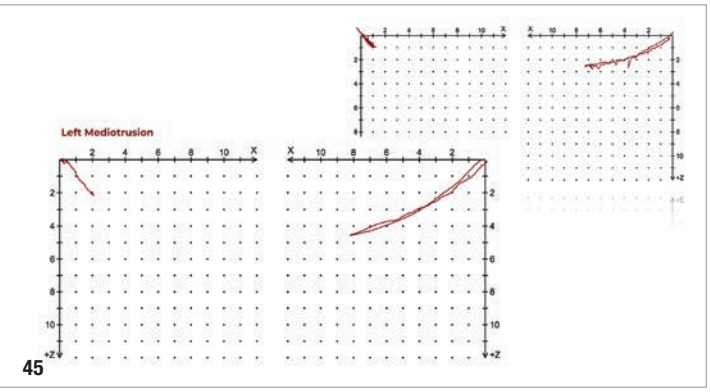
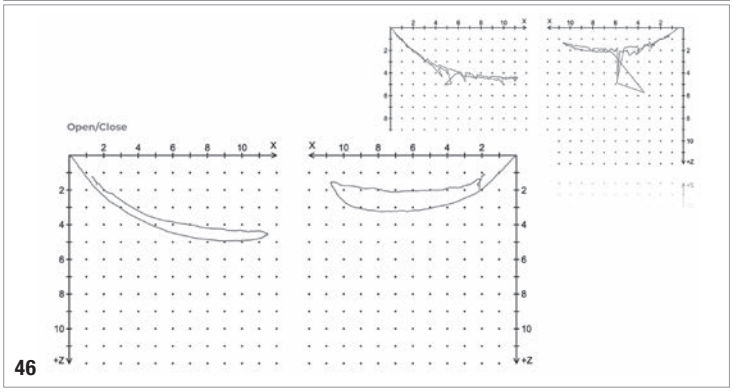
can be superimposed on the Reference SL. For the virtual programming of the articulator's functional parameters, the output for SAM was re-executed from the electronic axiography with GAMMA Dental Software (Figs. 26 & 27). We then proceeded with the CAD modelling of the wax-up, referring to the occlusal plane identified by the centric cones scanned into the articulator (Fig. 28). The virtual articulator allowed a first check of the occlusal relations and allowed a sketch of tracking of the cusps with dynamic virtual instruments, allowing us to reach with our CAD the sought morphology (Figs. 29–33).

The model was then milled in wax (CAD/CAM white wax, YETI Dentalprodukte) with a five-axis milling machine (CAM 5-S1, vhf camfacture), and the individually detachable wax teeth were positioned on casts made using 3D printing. The milled wax teeth were mounted on their models, and the Reference SL articulator, already properly programmed, was sent to the competent master dental technician, who accurately shaped the functional surfaces, according to Slavicek's sequential functional occlusal design principle, with differently coloured waxes, highlighting the centric ratios, the mediotrusive and protrusive tracking functions, and the retrusive protection (Figs. 34 & 35). The removable abutments allowed modelling of the mediotrusive sequence with the incisal tables given by the axiographic registration (blue; Figs. 36 & 37).







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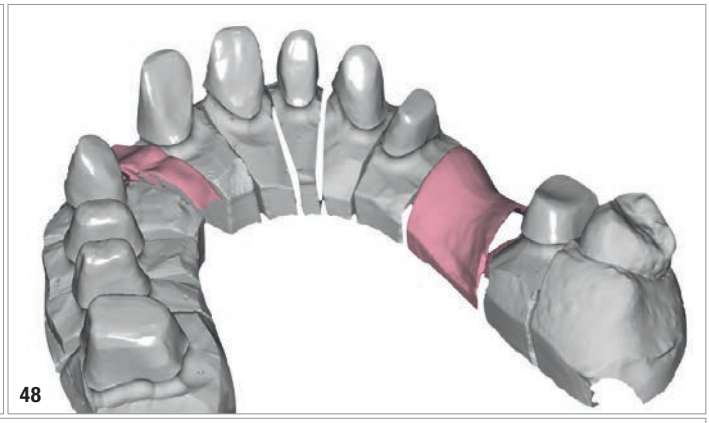
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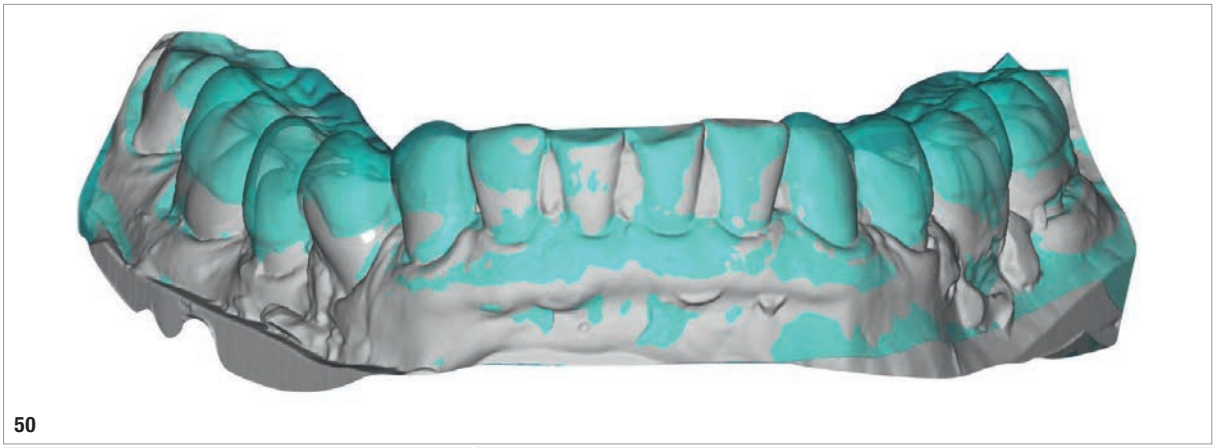
The sequential wax-up was scanned with a desktop scanner (inEos X5, Dentsply Sirona) and virtually captured. The virtual shape was rechecked in the CAD software for thickness, connection and morphology, and for offset adjustments for abutment adaptation. It was then sent for milling (CAM 5-S1) of second interim prostheses made of PMMA with high-stability ceramic micro-fillers (breCAM.multiCOM, bredent).

The finishing of the dental abutments was followed by relining of the therapeutic reference position temporary restorations—previously having protected of all functional occlusal surfaces—and they were then finished and polished. Teeth #33, 42 and 43 were reshaped in the incisal area with direct composite additions, according to the morphology designed during functional waxing.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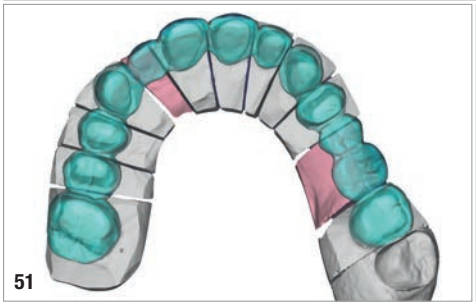
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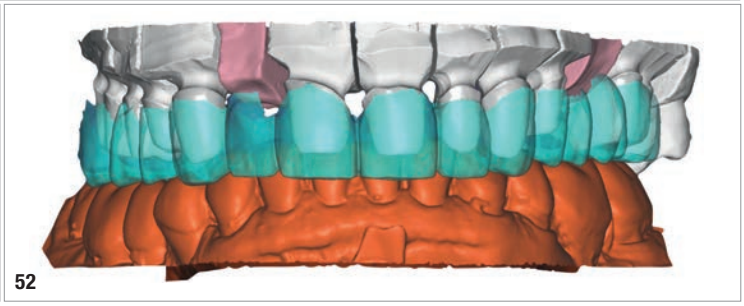
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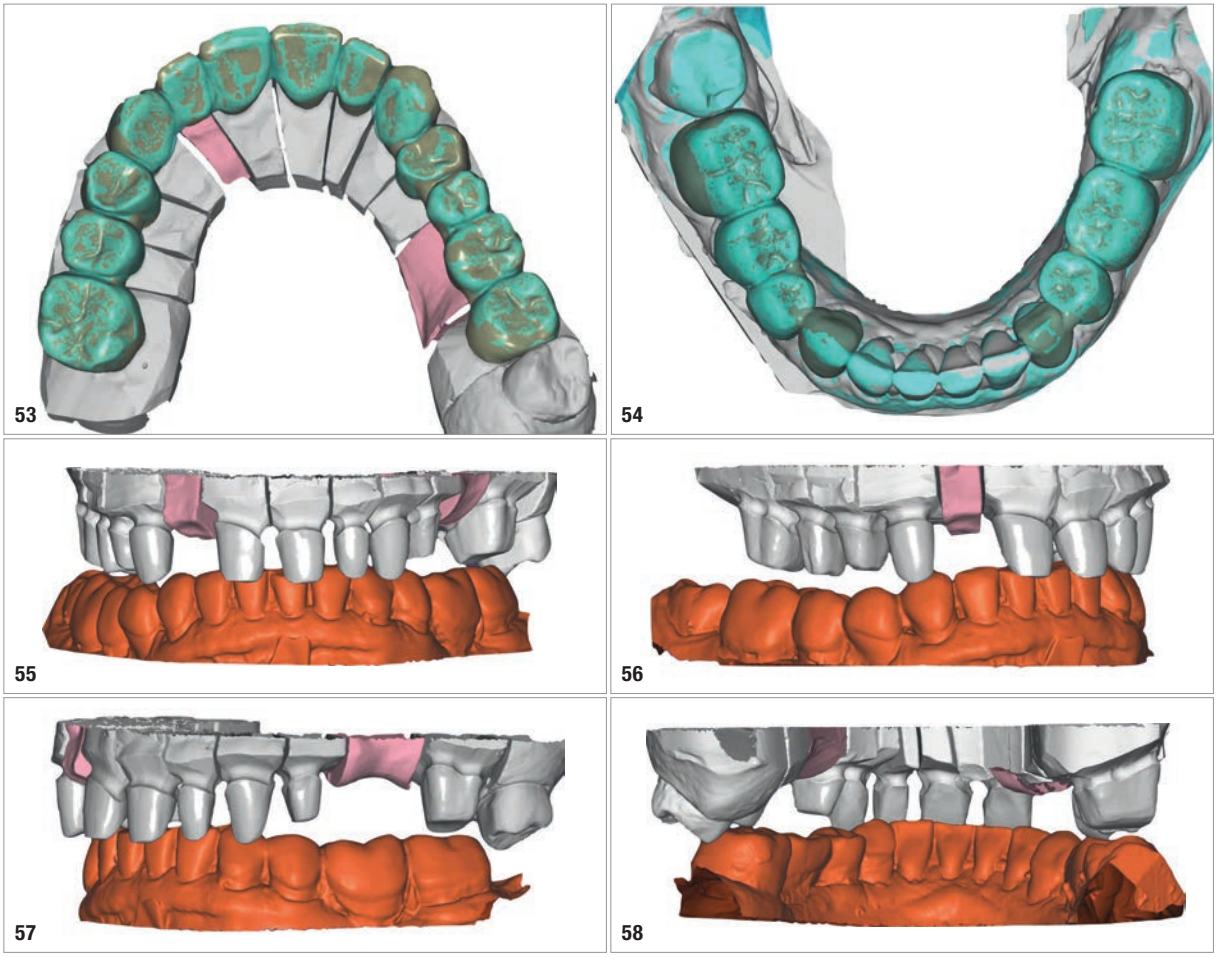

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The clinical response confirmed the satisfying integration of the prostheses from an aesthetic, occlusal, articular and neuromuscular point of view, and the occlusal function was accordant with the plan (Figs. 38–42). The patient used these second interim prostheses for eight weeks, confirming good integration and suitable occlusal function. This was verified with a second electronic axiography, which showed a good neuromuscular response to the new occlusal design and to the modified mandibular posture in therapeutic reference position (Figs. 43–46).

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Finally, we provided the dental impressions for the manufacture of the permanent zirconia prostheses. The stone models were scanned with the inEos X5 and the data sent to DentalCAD (Figs. 47–49), and a second scan was done with the patient's temporary restorations positioned on the casts (Figs. 50–52). The CAD software allowed us to match the scans so that the one with the temporary restorations having been used in therapeutic reference position, with sequential occlusal function already completely programmed, was now used to define the permanent teeth's morphology (Figs. 53 & 54) according to the planned jaw relations (Figs. 55–58).

The permanent prostheses in zirconia (KATANA Zirconia UTML, Kuraray Noritake Dental) were then milled (CAM 5-S1; Figs. 59 & 60), and the dental technician performed the layering and the finishing. Finally, they were cemented by an adhesive procedure (PANAVIA V5, Kuraray Noritake Dental; Figs. 61–65).

Discussion and conclusion

The diagnostic and technical workflow for the design of a canine-dominant occlusal sequential function, inspired by that described by Prof. R. Slavicek, with the aid of the digital tools available today, proved to be convenient for the clinician and the patient, allowing a reduction in working time and procedural complexity.

Time spent in the functional diagnosis and in the design of the sequential occlusion is in fact reduced, despite the absence of dedicated CAD tools, therefore requiring some repetitive CAD modelling procedures to be performed. The design of the obtained morphologies allows the project to be milled in different available materials as needed in shorter times and at lower costs compared with the traditional procedures. Further experience is needed for the refinement of an ideal procedure, and suitable CAD tools should be developed for the purpose.

This procedure can however be applied to any type of functional occlusion design—even canine-dominant occlusal function, group functional guidance or bilateral balanced occlusion, according to the clinician's choices and experience. The enormous advantage of scanning the interim prostheses in therapeutic reference position after a trial period is evident: acquiring the details of the true function of the patient for the CAD analysis and check and for milling the permanent prostheses in suitable material.

about

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Maurizio Melano is a master dental technician who specialises in occlusal functional waxing and assembling according to Prof. R. Slavicek's school at Danube University Krems in Austria, where he attended a master course.

Guided applications for partial extraction therapy

Drs Scott D. Ganz & Isaac Tawil, USA

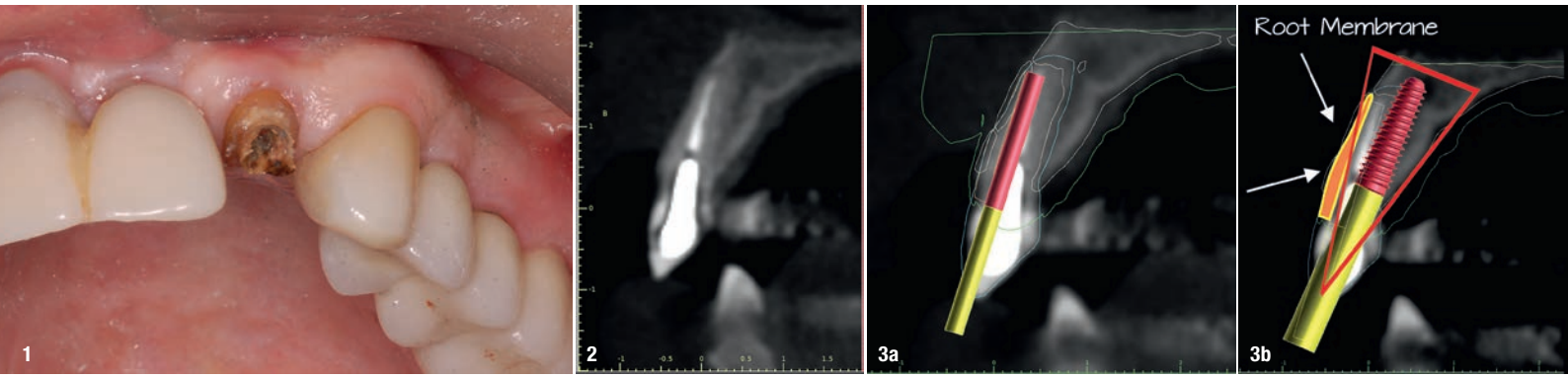


Fig. 1: The patient presented with a horizontally fractured clinical crown, an indication for a partial extraction therapy procedure. **Fig. 2:** The trajectory of the root in relation to the alveolus can be visualised with a cross-sectional image. **Fig. 3a:** Planning the initial drill path using a custom implant design (red) to match the diameter of the initial drill to reach the tooth apex. The abutment projection is shown in yellow. **Fig. 3b:** The simulated implant within the Triangle of Bone (red), placed to avoid the root fragment seen in yellow (white arrows).

Dental implants to replace missing teeth have become an integral part of current conventional dentistry. Accepted protocols now include two-stage delayed loading, one-stage delayed loading, immediate loading in a healed receptor site, tilted implant placement, immediate loading in fresh extraction sites, partial extraction therapy (PET), socket shield technique and root membrane concept.

Technology has provided clinicians with enhanced tools for diagnosis and treatment planning, instrumentation for surgical intervention, improved implant surface treatments and thread design, improved abutment-to-implant connections, sophisticated dental laboratory software and CAD/CAM applications, a greater selection of transitional and definitive restorative materials, static and dynamic navigation, and changes in drill designs and drilling protocols. Dental implant procedures are predictable, effective and essential to address the needs of patients.

Partial extraction procedures in their various formulations have been demonstrated to be proven methodologies for preserving bone and soft-tissue volume.[1–7] Our 2017 article (The Root Membrane Concept: In the Zone With the "Triangle of Bone", Dentistry Today CE, October 2017) reviewed 3D diagnostic tools for planning and executing root membrane and PET procedures based on the

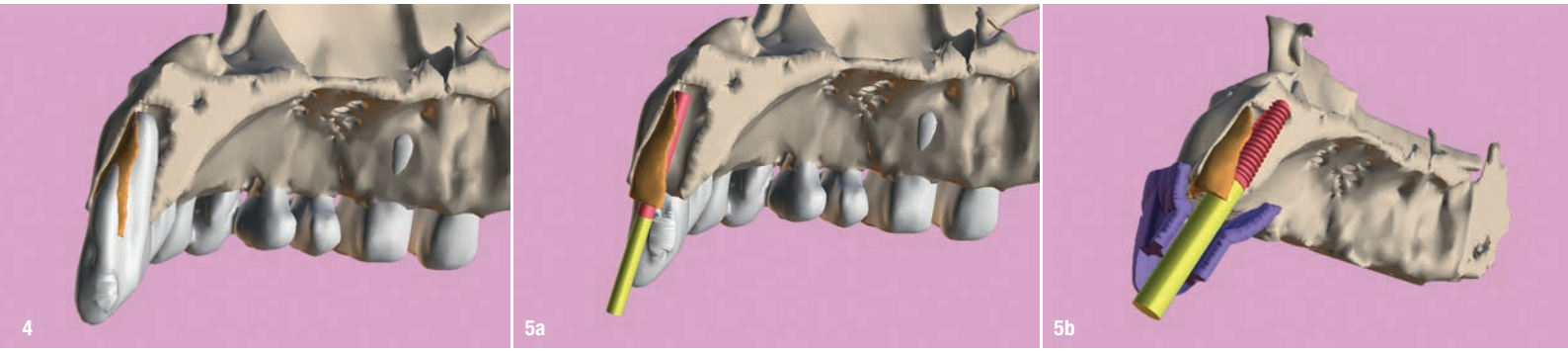
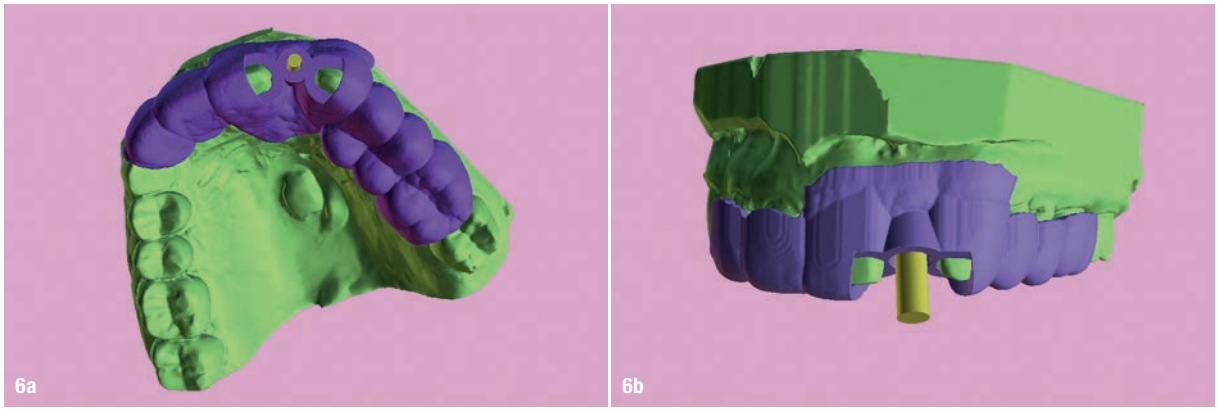


Fig. 4: The segmented root (white) and the root fragment (brown) within the sectioned maxillary surface model. **Fig. 5a:** Virtual sectioning of the segmented root using Meshmixer with a simulated custom implant to reach the root apex. **Fig. 5b:** The apical portion of the simulated AnyRidge implant can then be positioned so as not to touch the root fragment while engaging in host bone for stability.



Figs. 6a & b: Two 3D-printed templates designed on the digitised model (green): one for the initial drill to section the tooth at the root apex **(a)** and the second for using sequential guided drills to drill through the root itself **(b)**.

"Triangle of Bone" concept and specific instrumentation to achieve successful outcomes.[5]

The ability to perform the procedures requires careful diagnosis, treatment planning and excellent control of the drilling process to ensure that the root fragment will be maintained while maximising implant stability. In many cases, it may also be possible to provide immediate transitional restorations when high implant stability is achieved. However, complications can also arise when the root fragment is lost or the implant fails to integrate. It should be noted that PET has mainly been accomplished with a diagnostic freehand method for sectioning roots, osteotomy preparation and implant placement. The current article describes methods of providing PET procedures using full-template guidance based on a thorough appreciation of the existing anatomical structures utilising advanced state-of-the-art treatment planning tools, 3D design software, 3D printing and/or CAD/CAM surgical templates.

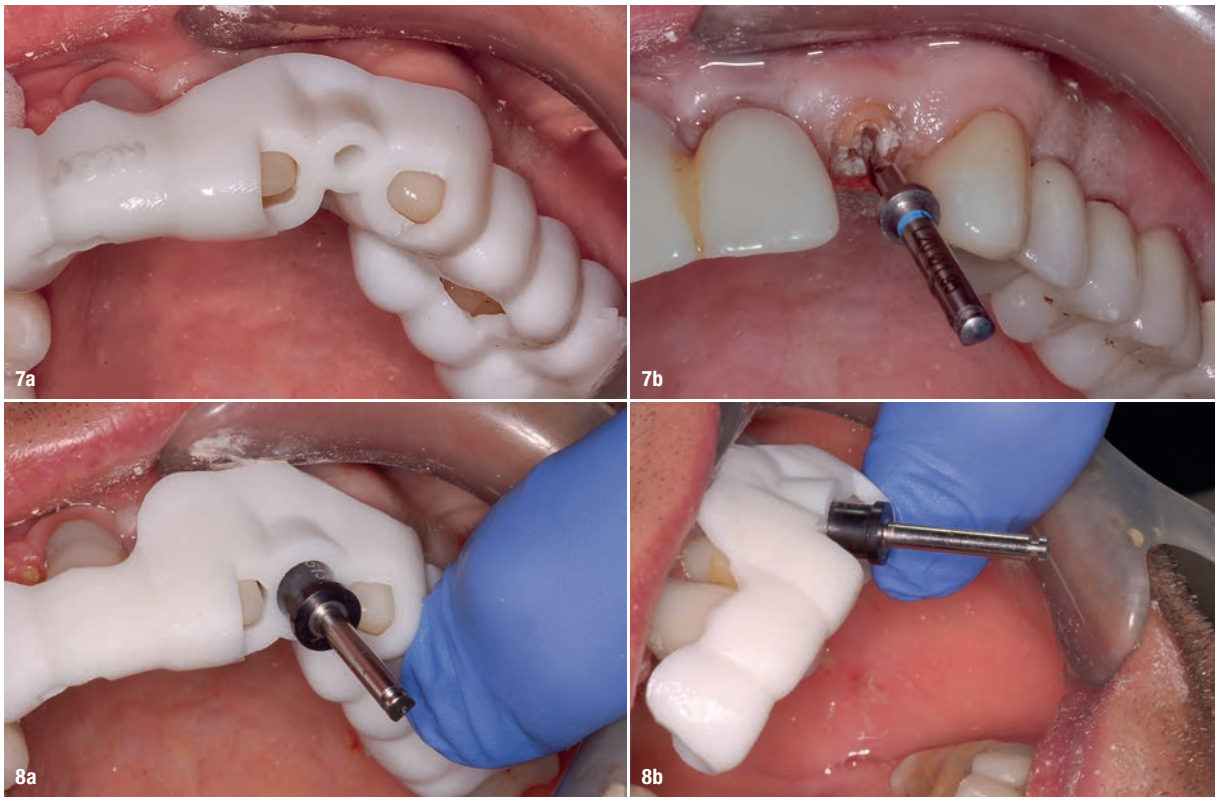


Fig. 7a: A sleeveless guide to accommodate a 2 mm long pilot drill that was used to reach the root apex. **Fig. 7b:** Removing the guide allowed for inspection of the drill embedded within the tooth. **Figs. 8a & b:** Using drill guides with long shanks to engage the sleeveless template allowed for sequential and accurate drilling of the tooth and subsequent bone for implant placement.

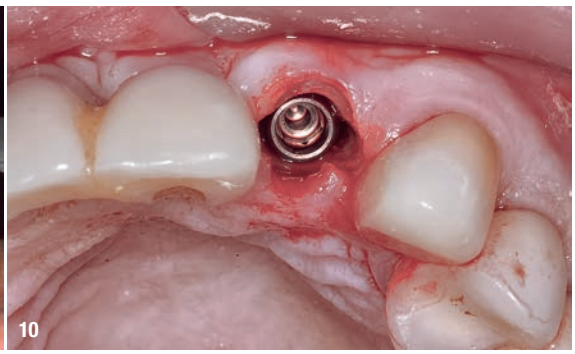
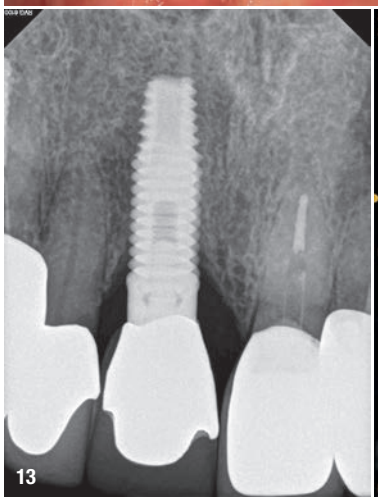


Fig. 9: The cylindrical tooth preparation resulted in the desired crescent shape of the root fragment to provide adequate space for the implant. **Fig. 10:** The implant was placed into the osteotomy through the template using a special manufacturer-specific carrier. **Fig. 11:** The stackable tooth-borne guide and the three other separate components seen in Figures 15a–c.

One indication for PET is when a patient presents with a horizontally fractured clinical crown (Fig. 1). While a 2D radiograph will reveal the extent of the horizontal fracture, length of the remaining root and approximation of the bone apical to the root, there is not enough information to plan for a PET procedure. A CBCT scan is recommended in order to fully appreciate the root position within the alveolus and the potential difference between the trajectory of the bone and the trajectory of the root as can be visualised with a cross-sectional image (Fig. 2).

Utilising interactive treatment planning software makes it possible to plan the initial drill path to accurately section the root to its apex (Fig. 3a). This can be accomplished by creating a custom implant design to match the diameter of the initial drill with an abutment projection in order to



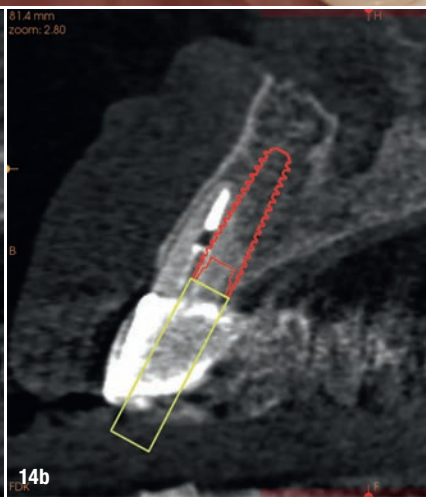
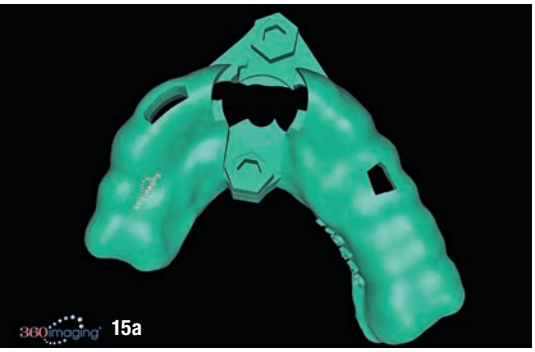
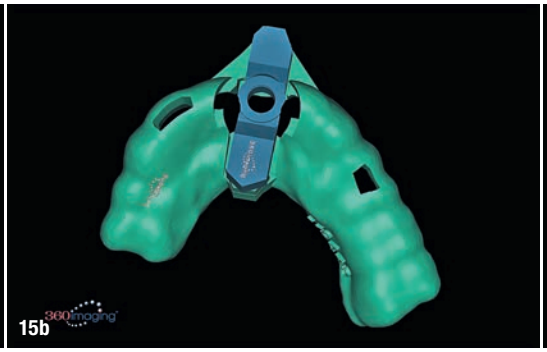


Fig. 12a: A post fracture presenting in the left central incisor, requiring extraction. **Fig. 12b:** The occlusal view illustrated the cervical tissue volume and contours. **Fig. 13:** The pre-op periapical radiograph revealed an existing implant-supported metal–ceramic restoration for the adjacent region #11. **Fig. 14a:** The CBCT cross-sectional image revealed a favourable pre-op condition for a PET procedure. **Fig. 14b:** Using the native Carestream 3D Imaging Software, a simulated implant (red outline) and abutment projection (yellow outline) was positioned within the available bone to avoid the root fragment.





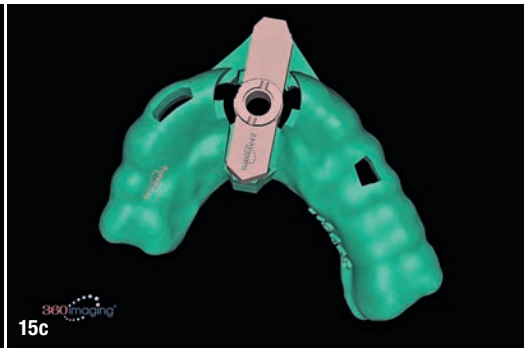


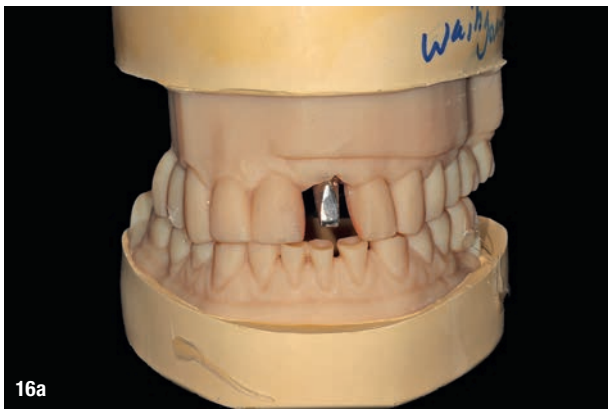
Fig. 15a: The base template was designed to seat firmly on the adjacent teeth, incorporating buccal and lingual hexagonal offsets to engage the different drill guide inserts. **Figs. 15b & c:** Separate inserts were fabricated for the initial drill guide to reach the root apex to accommodate sectioning, followed by a second guide for final osteotomy drilling and implant placement.

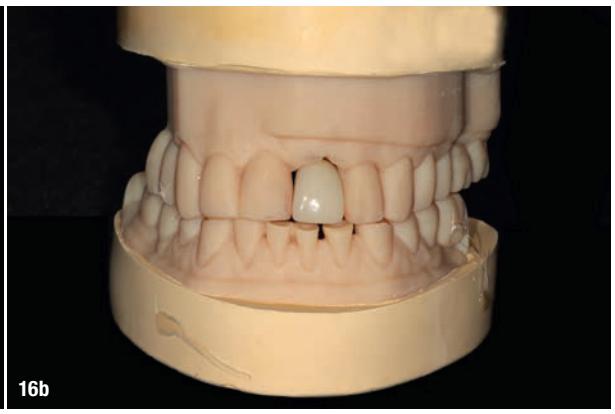
fully appreciate the trajectory through the clinical crown (Blue Sky Plan, Blue Sky Bio). It is important to visualise the root fragment that will remain in order to properly simulate the position of the implant in the alveolus (Fig. 3b). The apical portion of the implant can be positioned to gain stability in host bone using the Triangle of Bone. It is important to note that a cross-sectional slice may only be 0.125 mm in thickness based on the CBCT acquisition, and therefore all images in all views must be visualised to confirm the plan. Utilising 3D segmentation (separating objects by density values), it is possible to define each root and further assess the simulated position of the implant with a sagittal cut through the 3D reconstructed volume (Fig. 4).

The ability to export volumes in STL format allows these objects to be edited and utilised in other software applications, such as Meshmixer (Autodesk). The STL file of the root image was imported into Meshmixer, and the root was virtually sectioned using Boolean difference to mimic the crescent shape for PET (Fig. 5a). The apical portion of the simulated implant can then be positioned so as not to touch the root fragment while engaging in host bone for stability (Fig. 5b).

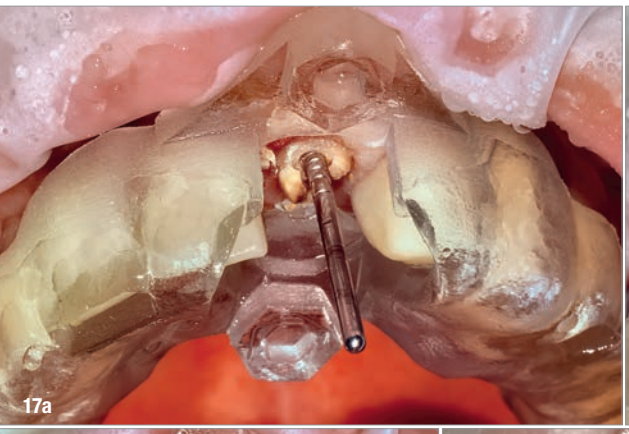
Planning with such precision is predicated on the acquisition of a satisfactory CBCT scan with a proper field of view and the incorporation of occlusal surface data STL files of the arch form, digitised through either an intra-oral scan or a desktop scanner imported into the software. Two 3D-printed templates were then designed on the accurate digitised surface model, one for the initial drill to section the tooth at the root apex and the second to use sequential guided drills to drill through the root itself (Fig. 6).

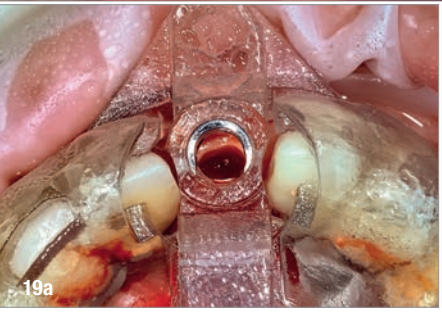
A 2 mm pilot drill, which was long enough to reach the root apex with the tooth-borne surgical guide in place, was utilised with a sleeveless guided approach (Fig. 7a). Removing the guide allowed for inspection of the drill through the tooth (Fig. 7b). Using guided drills with long shanks in a sleeveless guide allowed for sequential and accurate removal of the tooth and subsequent bone beyond the apex of the natural tooth root (R2Gate, MegaGen; Fig. 8). The cylindrical tooth preparation/osteotomy resulted in the desired crescent shape to provide space for the implant (Fig. 9). The root was then sectioned mesiodistally using specialised drills (Root Membrane Kit, MegaGen) and the palatal section removed. Utilising

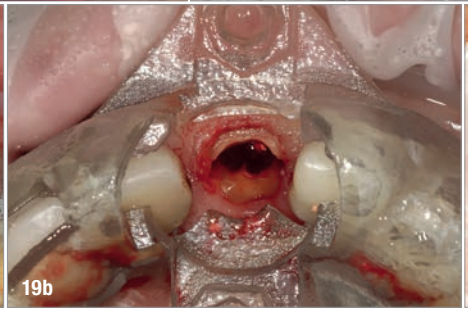


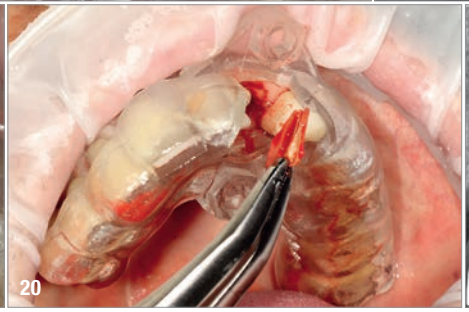


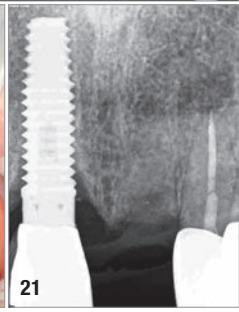
Figs. 16a & b: The accuracy of the implant and template design allows for true restoratively driven planning combined with CAD/CAM applications for the design and fabrication of a patient-specific abutment and transitional restoration.



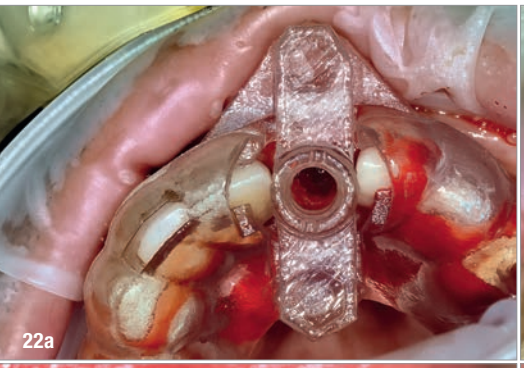


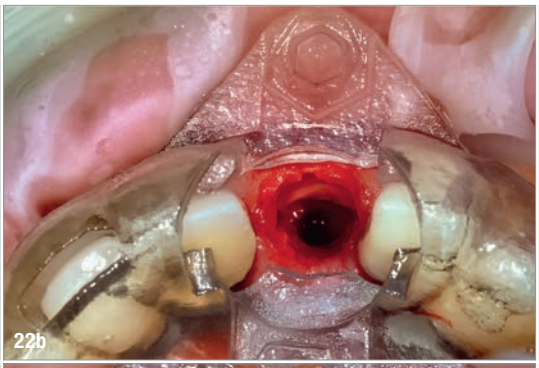


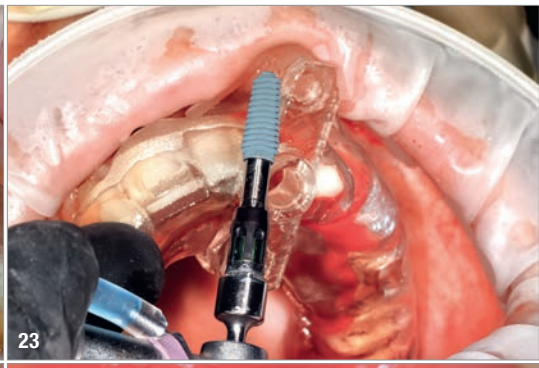


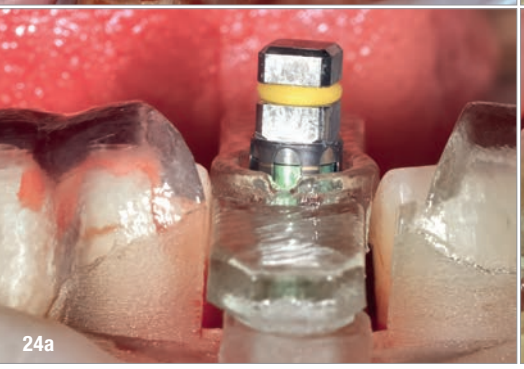


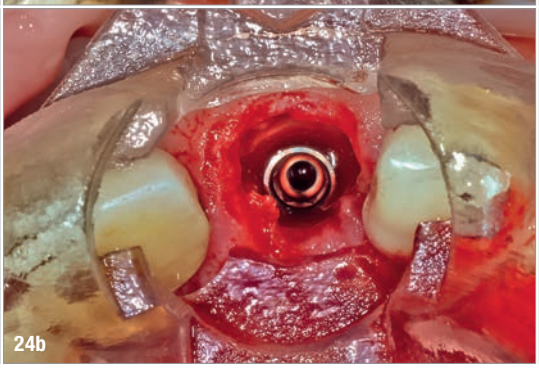
Figs. 17a & b: Utilising the tooth-borne template and the first insert, initial long shaper drills were used to reach the apex of the root. **Fig. 18:** A periapical radiograph with a drill in place confirmed that the apex length had been reached and that all the gutta-percha had been removed. **Figs. 19a & b:** The second metal cylinder insert allowed for the long, round diamond drills to shape the root into the desired crescent shape **(a)**. The insert was removed to access the palatal root **(b)**. **Fig. 20:** The sectioned palatal root was carefully removed. **Fig. 21:** A periapical radiograph confirmed that the palatal root and all the gutta-percha had been completely removed.



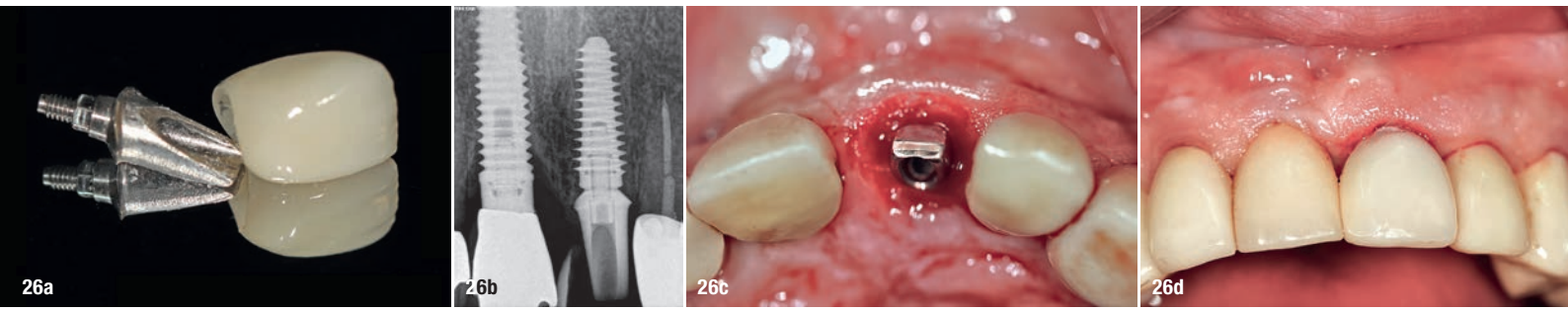








Figs. 22a & b: The final insert was designed to receive the guided sleeveless drills for accurate osteotomy preparation **(a)**. The osteotomy was prepared to avoid proximity to the remaining root fragment while leaving sufficient restorative space as previously planned **(b)**. **Fig. 23:** The implant, seen prior to placement, using the R2Gate surgical carrier for full-template guidance through the sleeveless guide. **Figs. 24a & b:** Depth control and rotational positioning were accurately confirmed with the notch indicator on the template corresponding with the insertion tool **(a)**. The occlusal view illustrated that the anti-rotational internal conical–hexagonal connection was positioned towards the facial aspect **(b)**. **Fig. 25:** Using an implant-specific SmartPeg, a baseline ISQ value of 76 confirmed sufficient initial stability to place an immediate restoration.



Figs. 26a–d: The prefabricated CAD/CAM abutment and transitional crown **(a)**. A post-op periapical radiograph confirmed successful sub-crestal placement of this platform-switched design **(b)**. The abutment in place **(c)**. The soft-tissue contours were excellent; no sutures were required for the transitional restoration **(d)**.

the template, the implant was placed into the osteotomy using the correct implant carrier to achieve full-template guidance and stability measured using resonance frequency analysis (RFA) to obtain the implant stability quotient (ISQ; Fig. 10).

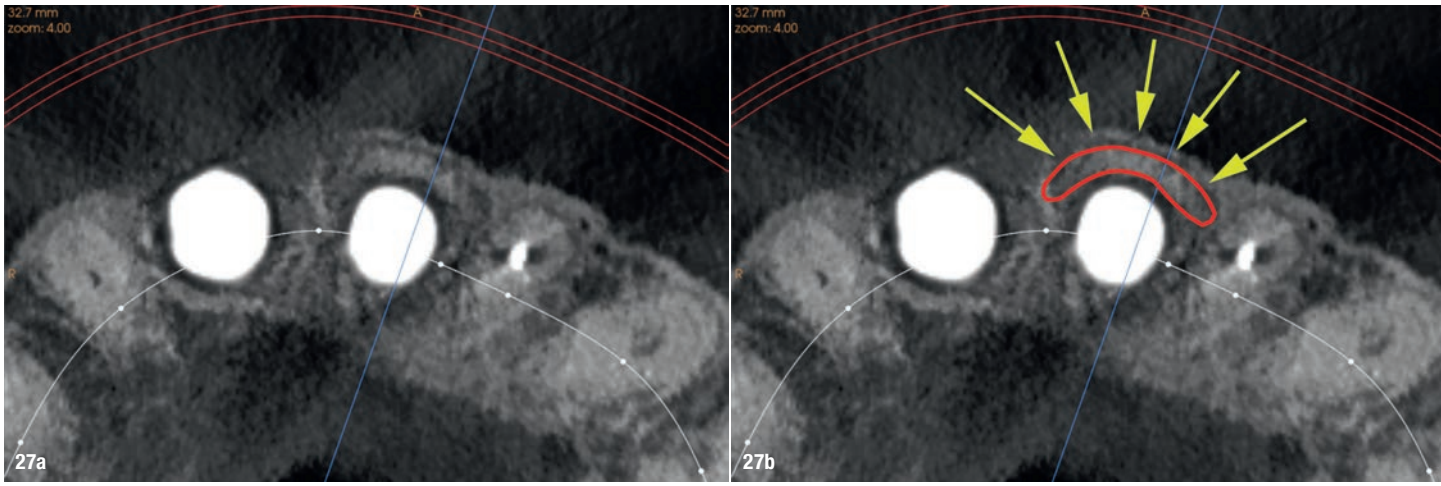
The concept of drilling through the root is not new and has been reported in the literature.[8] Using guided methods for the socket shield technique has also been reported using a CAD/CAM-fabricated template.[9] However, the ability to use technology to plan and execute a fully guided procedure for a PET, socket shield technique and root membrane technique illustrates additional methodology to aid clinicians in successful outcomes.

The first concept described the use of two separate templates, one for separating the root at the apex and the second for drilling through the tooth and placing the implant. Continuing the evolution, we present a second option, which does not require the removal of the base template, but has inserts to allow for the different drills and angulation required for the PET technique: the stackable tooth-borne guide. The new technique has four separate components: (1) a base template (stackable tooth-borne guide); (2) a pilot drill guide for the root apex (APEX STACK); (3) a crescent-shaped guide for shaping root fragments (PET Shaper STACK); and (4) a guide for osteotomy drilling and placing the implant through the guide (Surgical Guide STACK; Fig. 11).

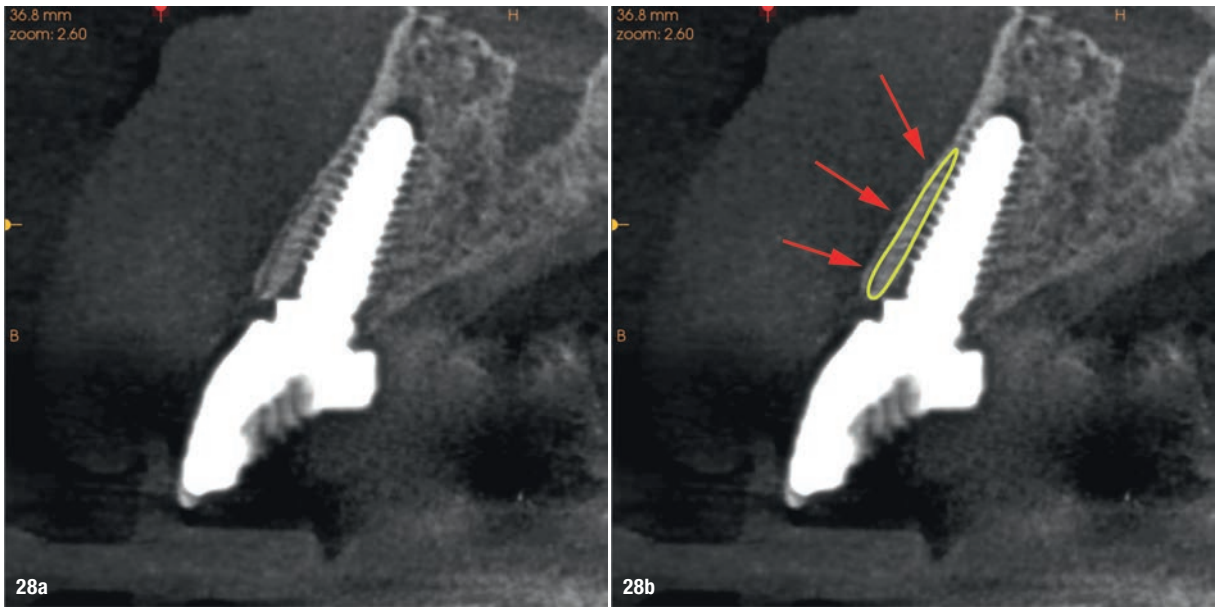
Case report

A 62-year-old male patient presented with a hopeless prognosis for a post fracture in the left central incisor requiring extraction (Figs. 12a & b). The preoperative periapical radiograph revealed an existing implant supporting a metal–ceramic restoration for the adjacent region #11 (Fig. 13). The CBCT (CS 9600, Carestream Dental) cross-sectional image revealed a favourable preoperative condition relating to the trajectory of the endodontically treated root to the alveolus for a PET procedure (Fig. 14a). Using the native Carestream 3D Imaging software, a simulated implant and abutment projection was positioned within the available bone to avoid the root fragment (Fig. 14b).

The final positioning of the implant, as determined by the restorative requirements, and design and fabrication of



Figs. 27a & b: The post-op CBCT scan axial view revealed the intact crescent shape of the root membrane **(a)**, as outlined in red in facial to the opaque implant position **(b)**.



Figs. 28a & b: The post-op cross-sectional view clearly illustrated the position of the implant **(a)**, the definitive restoration located palatal to the root membrane **(b)**, as outlined in yellow (red arrows).

the tooth-borne stackable surgical template, was accomplished using dedicated interactive treatment planning software (360dps, 360Imaging). The base template was designed to seat firmly on the adjacent teeth, incorporating buccal and lingual hexagonal offsets to engage the different drill guide inserts (Fig. 15a). Separate inserts were then fabricated for the initial drill guide to reach the root apex to accommodate sectioning, followed by a second guide for final osteotomy drilling and implant placement (Figs. 15b & c). The accuracy of the implant and template design provides the opportunity for true restoratively driven planning, which can then be combined with CAD/CAM applications to also design and fabricate a patient-specific abutment and transitional restoration in advance of the surgical intervention (Fig. 16).

Prior to the guided drilling, a Gates–Glidden drill was used to remove any gutta-percha within the root. Utilising the tooth-borne template and the first insert, initial long shaper drills (IS1, IS2 from the Root Membrane Kit, MegaGen) were used to reach the apex of the root (Root Membrane Kit; Fig. 17). A periapical radiograph confirmed that the apex length had been reached and that all the gutta-percha had been removed (Fig. 18). The second insert had a metal cylinder that allowed for the long, round diamond drills to shape the root into the desired crescent shape (Fig. 19a). The insert was removed to access the palatal root (Fig. 19b). Using appropriate instrumentation such as periotomes, elvatomes or FRINGS forceps (both TBS Dental), the palatal portion of the root was carefully removed (Fig. 20). A periapical radiograph confirmed that the palatal root had been completely removed (Fig. 21). The next insert contained the final diameter to receive the guided sleeveless drills for osteotomy preparation (Fig. 22a). The osteotomy was prepared to avoid proximity to the remaining root fragment while leaving sufficient restorative space, as previously planned in the software simulation (Fig. 22b). Implant placement

Fig. 29: The definitive restoration exhibited excellent retention of the soft-tissue profile. **Figs. 30a & b:** The occlusal view revealed the volume maintained with the soft-tissue cervical contours **(a)**, and the lateral retracted view revealed an excellent soft-tissue emergence profile **(b)**.

(AnyRidge, MegaGen) was facilitated by the R2Gate surgical carrier for full-template guidance at the appropriate torque values (Fig. 23). Depth control and rotational positioning were accurately confirmed with the notch indicated on the template to correspond with the insertion tool (Fig. 24).

The initial plan was for immediate extraction, immediate placement and immediate restoration. Therefore, it was essential to measure the implant's stability with an objective technology, RFA, which provides an ISQ value utilising an implant-specific SmartPeg (Osstell; MEGA ISQ, MegaGen). The baseline ISQ value (76) confirmed sufficient initial stability to place an immediate restoration (Fig. 25). The prefabricated CAD/CAM abutment was then secured to the implant, and a postoperative periapical radiograph confirmed successful sub-crestal placement for this platform-switched design (Fig. 26a). The transitional acrylic restoration was then placed and examined for any occlusal interferences (Fig. 26b). It was important that the restoration be out of occlusion to avoid premature forces that could complicate integration. The soft-tissue contours were excellent, and no sutures were required, since no flap was raised (Figs. 26c & d). After a period of eight weeks, the implant stability was measured to be at 80 ISQ, confirming that the integration process had continued to progress successfully and that the implant was ready for the definitive restoration. An intra-oral scanner and scanning abutment were then utilised to capture the position of the implant and soft-tissue emergence profile. The postoperative CBCT scan revealed the intact crescent shape of the root membrane (Figs. 27 & 28). The definitive restoration was then delivered and exhibited excellent retention of the soft-tissue profile (Figs. 29 & 30).

Conclusion

PET, root membrane and socket shield concepts have gained popularity as the techniques have been refined and their efficacy proved in published long-term studies. The purpose of retaining the root is to maintain the periodontal ligament attachment to the bony walls of the socket in order to prevent subsequent resorption and loss of tissue volume which often occurs after tooth extraction. PET has been proved to preserve bundle bone and tissue volume with and without immediate implant placement, yet this minimally invasive treatment modality is highly technique-sensitive and may result in complications if proper protocols are not followed. Therefore, a complete understanding of the 3D anatomical presentation is essential for preliminary diagnosis, treatment planning and execution of the procedure. The present article has described two alternatives that maximise the diagnostic phase using state-of-the-art CBCT imaging and planning software to provide full-template guidance with a new stackable tooth-borne guide with specific inserts for the root preparation as well as the osteotomy preparation and delivery of the implant. As with most techniques, further clinical trials are recommended to provide additional long-term data to validate these treatment modalities.

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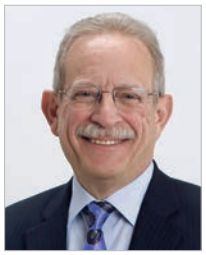
about



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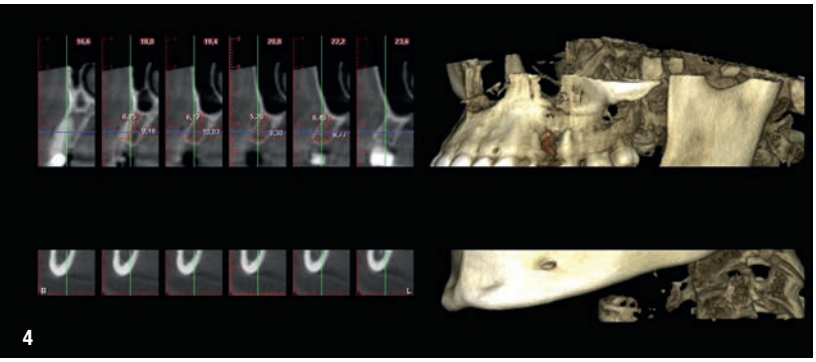
Fully validated digital workflow with Straumann CARES Digital Solutions and coDiagnostiX

Dr Ferit Bayram, Turkey

Introduction

Immediate loading of dental implants with a fully digital workflow offers several advantages, for example reduced chair time for both the surgical and prosthodontic procedures. Digital prosthetic design enables future temporary crowns to be planned and prepared with optimal margins, occlusion and contact with neighbouring teeth. Evaluating the bone quality and quantity, and selecting the appropriate implant and its position are crucial factors for the future crown. Fully guided surgery ensures prosthetically driven implant placement with an ideal position.

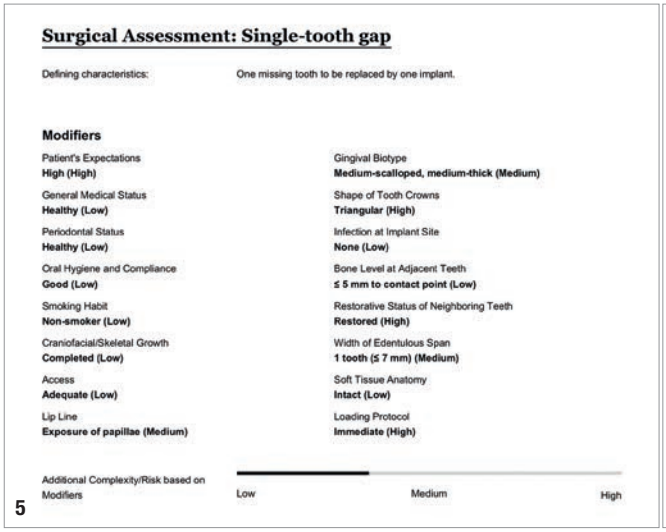
This report presents a successful restoration of a single missing tooth in the aesthetic zone, using Straumann CARES Visual and coDiagnostiX software (Dental Wings). A fully digital workflow with digital planning, guided surgery, CAD/CAM production of a temporary crown and immediate loading on the same day of operation met the patient's high aesthetic expectations.



This case was part of the solution-driven learning programme at Marmara University in Istanbul in Turkey. This advanced education format encourages students to identify, analyse and solve an open-ended problem by themselves. Mentoring plays a key role in this student-centred approach. Over a period of three days, six postgraduate students received cases with a single missing tooth in the aesthetic zone. Using coDiagnostiX and Straumann CARES Visual, which they had previously been trained in, they restored the cases and presented the results before their Marmara University peers. Dr Bayram's case was selected for publication through an open competition. Drs Gökhan Göçmen, Şükrü Can Akmansoy, Zeliha Şanıvar, Seda Keban and Gökhan Gedikli attended the programme together with Dr Bayram, and Prof. Yasemin Özkan and Dr Umut Arslan mentored the attendees. Straumann Turkey and the medical education department at Straumann's headquarters supported the whole programme.

Case report

A 20-year-old female patient was referred to our department for a missing tooth #25 (Fig. 1). She had no known allergies and no medication history. Her chief complaint was poor aesthetics due to the missing premolar, and her aesthetic expectations were high. Intra-oral examination revealed a medium-thick gingival phenotype, good periodontal status, good oral hygiene and enough restorative space to place an implant-supported prosthesis (Figs. 2 & 3). 3D radiographic imaging with CBCT revealed a sufficient buccolingual width of 5.5 mm with an appropriate vertical dimension of 10.0 mm, requiring neither simultaneous



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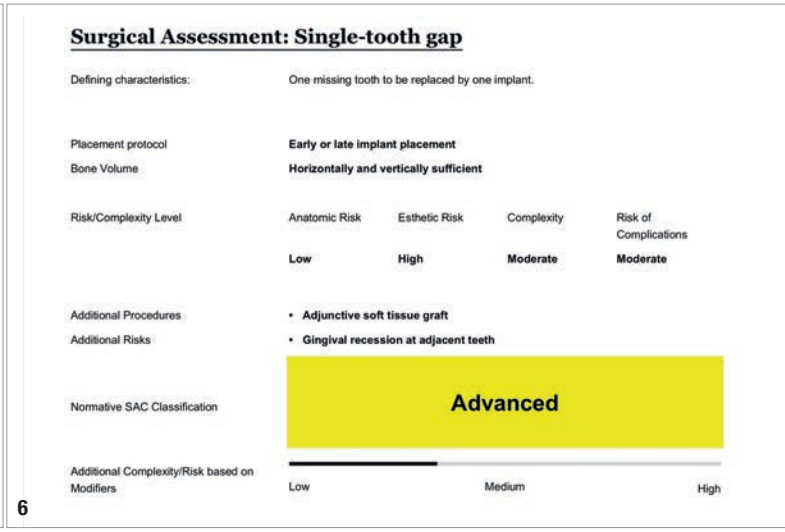

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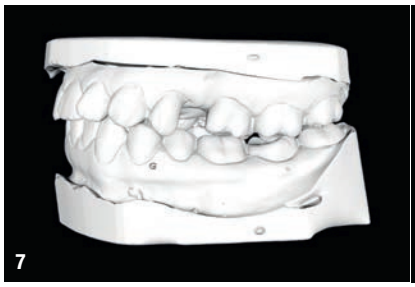
nor staged bone grafting (Fig. 4). Bone density was Type 2 according to the Leckholm and Zarb classification.

The SAC Assessment Tool was used to identify the degree of complexity and potential risks involved in this case. Because of an immediate loading protocol and the other modifiers, this case was determined to be advanced (Figs. 5 & 6).

Treatment planning

After discussing different treatment alternatives, we decided on immediate loading with a fully digital workflow to deliver a digitally produced temporary crown on the same day of surgery. For the education programme, diagnostic cast models were prepared in advance by the mentors, and scanned STL data was given to the mentees (Figs. 7 & 8). These STL files were imported into coDiagnostiX, where DICOM images from the patient's CBCT scan were segmented and merged. After segmenting and landmarking important anatomical points, prosthetically driven implantation was planned, taking account of the available bone volume and the soft-tissue profile, using coDiagnostiX.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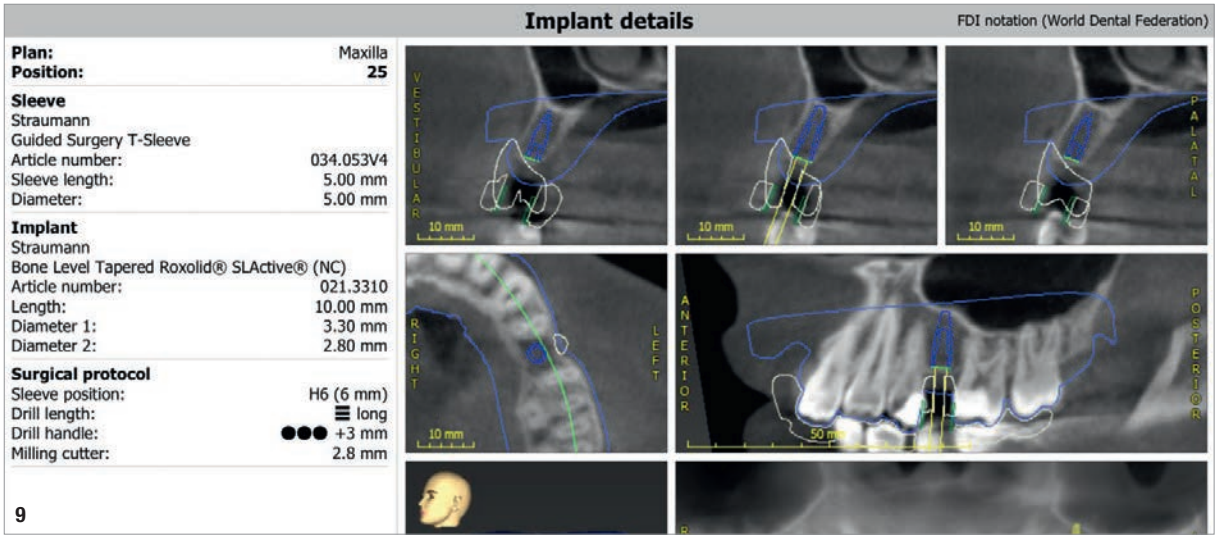
A Straumann Bone Level, narrow-necked, Roxolid, SLActive implant was selected (diameter: 3.3 mm, length: 10.0 mm; Fig. 9). The surgical guide was designed with a sleeve of 5 mm in diameter and 5 mm in height. This guide design was sent to the laboratory and printed using the Straumann CARES P30 printer.



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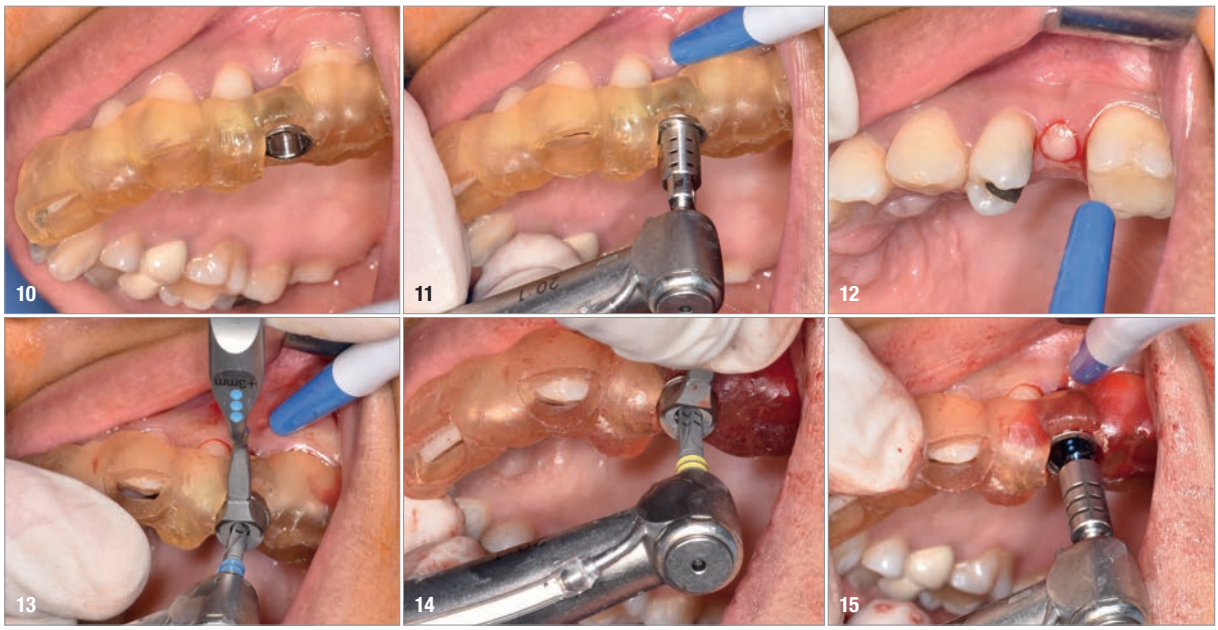

Surgical procedure

The implant bed was prepared with Straumann Guided Surgery using the printed surgical guide. Proper fitting of the surgical guide, stability and bilaterally balanced passive seating were confirmed before the surgery (Fig. 10). First, local anaesthesia was administered (40,000 mg articaine hydrochloride and 0.012 mg epinephrine hydrochloride; Ultracaine, Hoechst Marion Roussel). Following the surgical protocol, the mucosa was removed with a mucosa punch (Figs. 11 & 12) and then a 2.8 mm diameter guided milling cutter was used to even the alveolar bone. Using a 2.2 mm diameter BLT guided pilot drill and a 2.8 mm diameter BLT guided drill with a Straumann drill handle with three dots on the side, the implant bed was prepared with copious sterile saline irrigation (Figs. 13 & 14). The osteotomy was completed with a 3.3 mm diameter guided profile drill in combination with an H6 C-handle (Straumann). The implant was then placed, achieving a final torque of 50 Ncm (Fig. 15). After removal of the guided implant transfer piece, the implant stability quotient (ISQ) value of the implant was measured with the Osstell device. This showed an ISQ value of 74, a value that allowed immediate loading (Figs. 16 & 17). No suturing was necessary thanks to the flapless approach.

The patient was prescribed 1,000 mg amoxicillin and clavulanic acid (Augmentin, GlaxoSmithKline) twice daily for five days, 50 mg diclofenac (Cataflam, Novartis) every 8 hours in case of pain, and chlorhexidine (Klorhex, Drogsan Pharmaceuticals) for gargling. The patient reported no discomfort after surgery.

Prosthetic procedure

A digital impression was obtained with an intra-oral scanner (TRIOS, 3Shape), initially from the upper jaw, with and without a scan body connected to the implant (Fig. 18). The lower jaw and the patient's occlusion were scanned, and the data was transferred as an STL file to Straumann CARES Visual, in which the temporary prosthesis was designed (Fig. 19). The designed screw-retained temporary


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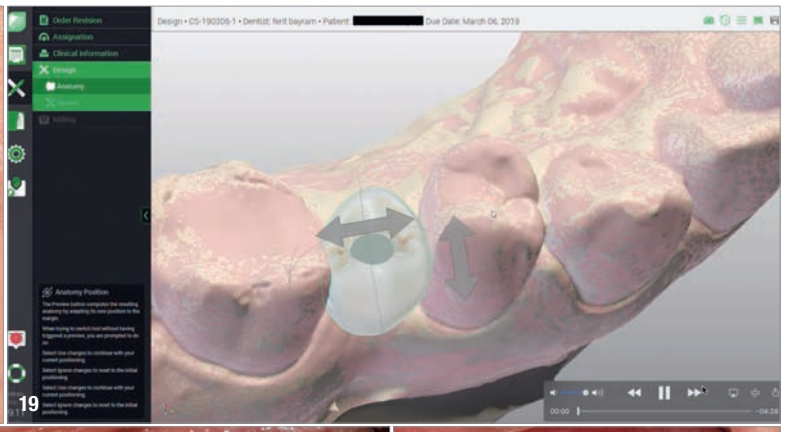
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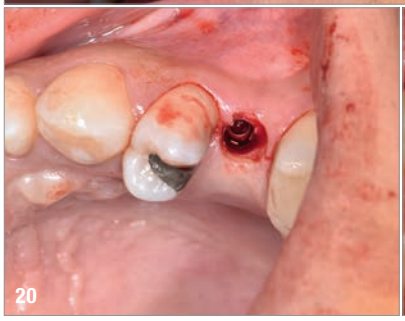
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crown was sent to the third-party dental laboratory and manufactured using PMMA blocks (Sigmadent). Self-adhesive resin cement (Multilink Speed, Ivoclar Vivadent) was applied to the Straumann Variobase, and the temporary restoration was bonded extra-orally. After polymerisation of the resin cement, excess cement was removed from the Variobase–temporary crown complex, and the lower margin of the crown was polished. The temporary crown was placed on the implant and tightened by hand (Figs. 20 & 21). After adjustment of the contouring and the occlusion of the crown, a small cotton plug was inserted into the screw access channel. The occlusion required only minor adaptations owing to accurate digital preoperative planning. The rest of the channel was filled with a temporary filling material. The provisional implant restoration was worn for three weeks to allow proper recontouring of the soft-tissue complex (Fig. 22). After three months, the patient was still content with the aesthetics and function of the provisional restoration and ready for the definitive restoration (Figs. 23 & 24).


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Treatment outcomes

A fully digital workflow—digital planning, guided surgery, digital impression taking, CAD/CAM of a temporary crown for immediate loading on the day of surgery—has three main advantages, if properly selected, planned and applied: reduced chair time, exploiting all the potential anatomical and biological conditions, and presenting the patient with a perfectly acceptable prosthetic rehabilitation in one day. The total treatment time and the number of surgical procedures are also reduced.

The expectation of a successful outcome with this treatment protocol relies on two basic principles: proper indication and sufficient primary stability. Factors affecting primary stability, such as implant design, drilling protocol, bone density and morphology, should be taken into consideration before deciding to proceed with this treatment protocol.

about

Dr Ferit Bayram received his DDS and PhD from Marmara University in Istanbul. He is currently practising at the same university in the Department of Oral and Maxillofacial Surgery and continues his academic work, which focuses on oral surgery, advanced implant surgery and orthognathic surgery.

KATANA Zirconia Block: Useful tips for processing

Mathias Fernandez Y Lombardi, Germany

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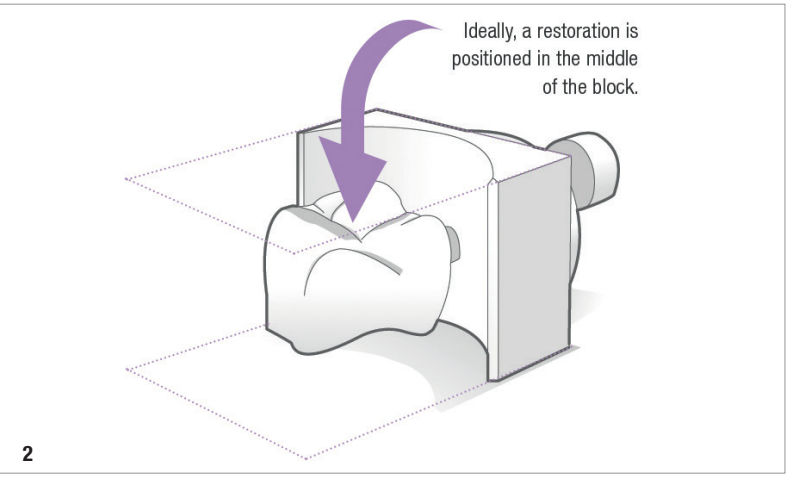
KATANA Zirconia Block (Fig. 1) has hardly any features in common with the zirconia that was so popular in dental laboratories two decades ago and was used as a framework material. In many cases, this innovative zirconia serves as a functionally and aesthetically sensible alternative to high-strength glass-ceramics. Its flexural strength is higher than that of lithium disilicate, its translucency on a level with the low-translucency variant of the ceramic and its surface—if smoothly polished—antagonist-friendly, causing low wear. Apart from its natural translucency, the multilayered structure of KATANA Zirconia Block, with four gradient shades precisely imitating natural colour gradients found in anterior and posterior teeth, leads to highly aesthetic outcomes.

In order to exploit the full potential of the cubic zirconia KATANA Zirconia Block, users of the CEREC system need to adopt slightly different automatic and manual processing strategies than for glass-ceramic processing. The following answers to frequently asked questions provide information on the most important differences, as well as, tips and tricks that help achieve the best possible results.

Computer-aided design

What is the best position of the restoration in the block to leverage all benefits related to the multilayered structure?
Ideally, a restoration is positioned in the middle of the block (Fig. 2). In addition, the selected block should be one shade darker than the determined shade. This will lead to a natural shade appearance of the resulting restoration. If the restoration is placed at the upper margin of the block, parts of the body shade—and with it chroma—will be lost, which will make the restoration appear too light.

How are chipping effects in the area of the milling sprues (most often occurring in bridges) effectively prevented?
Marginal chipping in these areas might appear due to an uneven force distribution during milling. The problem



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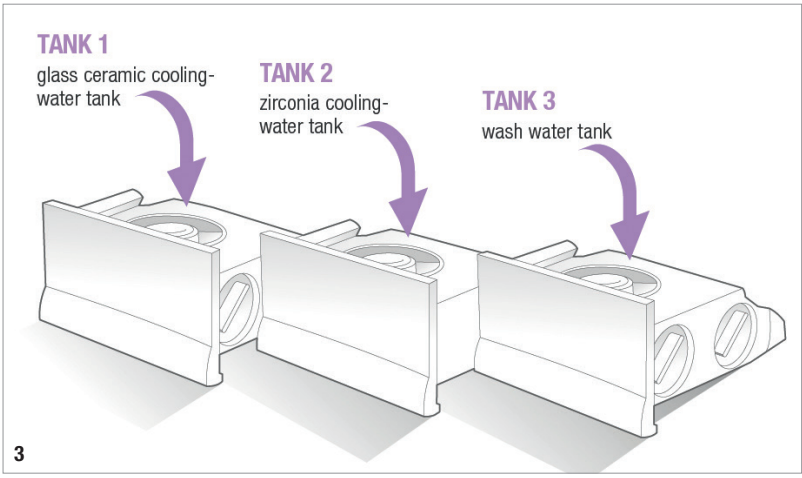

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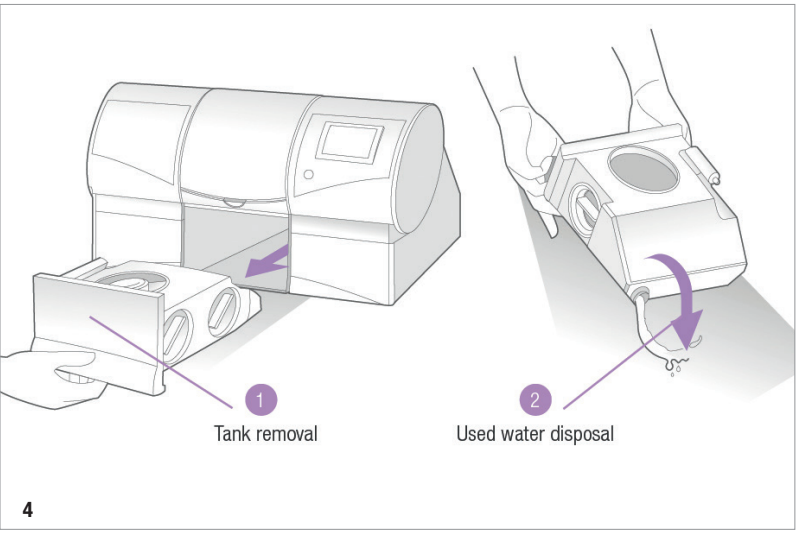

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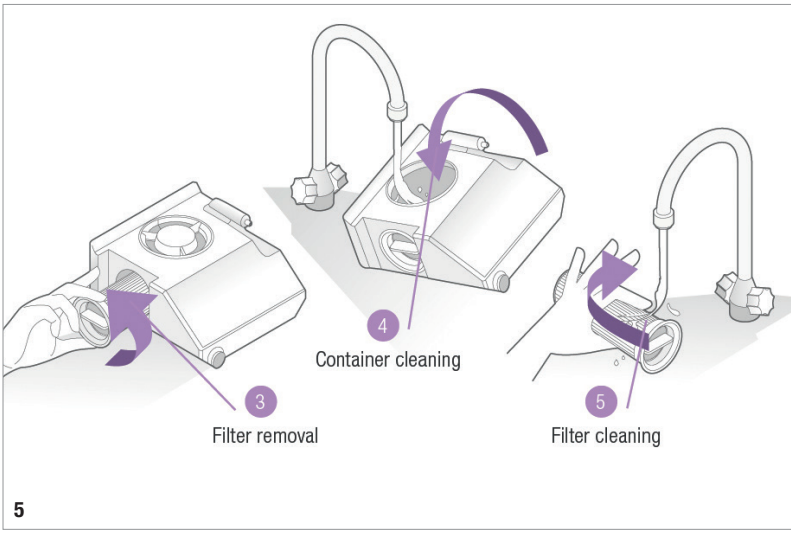

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is easily overcome by designing two milling sprues per crown or bridge unit.

Computer-aided manufacture

Is wet or dry milling the best option for processing KATANA Zirconia Block?
The best results are obtained with dry milling. This procedure also leads to time-savings, as there is no need for drying after processing.

When opting for wet milling, are there any particularities that need to be respected for KATANA Zirconia Block?
Those users opting for wet milling and utilising the same machine for the processing of zirconia and glass-ceramics should implement a system utilising three water tanks (Fig. 3). One tank is filled with rinsing water, the tank used for processing of glass-based ceramics is filled with water and additives (such as Dentatec, Dentsply Sirona) and the one used for processing of zirconia is filled with purified or distilled water without any additives.

Moreover, a prerequisite for a high quality of the manufactured restorations is that the machine has to be cleaned thoroughly every time before a different material is processed (Figs. 4 & 5). The following components need to be cleaned:

– the milling tools;
– the interior of the machine;
– the water tank(s); and
– all the filters.

Typically, zirconia reacts to milling additives (Dentatec) in the water with a reduced translucency, so their use cannot be recommended. Residue of glass-ceramic particles found on milling tools, in the water or in the interior of the machine might also have a negative impact on the aesthetic appearance of KATANA restorations (typically, white spots on the surface).

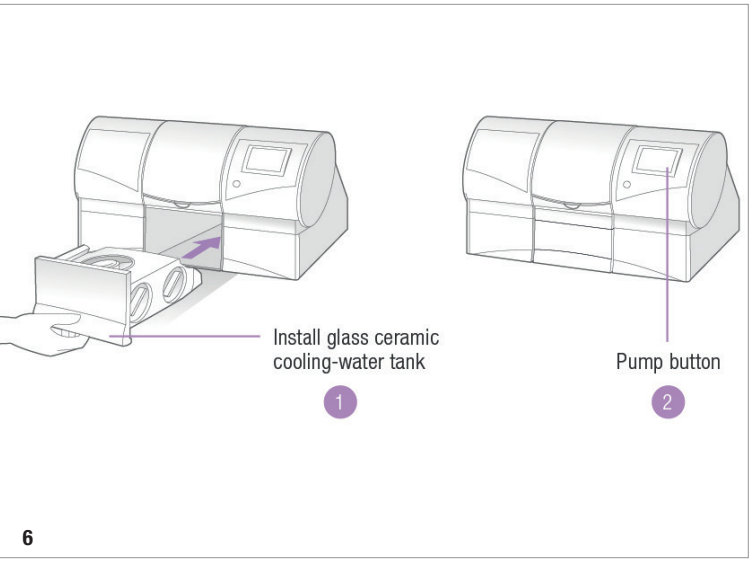
When is it necessary to replace milling tools used for the processing of KATANA Zirconia Block?
It is recommended to replace the toolsets every ten to 15 units. At this time, the degree of tool wear amounts to approximately 50 %. Those who continue using the tools accept an increased risk of weakening the oxide ceramic's microstructure: worn milling tools are likely to produce microcracks and microchipping. When these defects occur between the different units of a bridge, they increase the risk of chipping and fracture.

Manual post-processing

Are there any specific measures to be taken when removing the block from the machine?
When machining is completed, the restoration should be touched only by individuals wearing gloves. Even after thorough washing, bare hands will release fats, which may lead to smear formation and a reduced translucency of the oxide ceramic material.

How are the restorations cleaned after sprue removal?
Powder residue should be removed after processing with a gentle stream of air. Alternatively, a fine (and obviously clean) brush may be used for the removal of the zirconia dust. Powder residue remaining on the restoration surface might lead to the occurrence of white spots or to smear formation. Steam cleaning of the restoration should be avoided, as this measure dramatically increases the pores in the material and alters the material properties.

When is the right time to add fissures and texture to the surface of the restoration, and how is this task accomplished?
Ideally, all those details that cannot be incorporated by a milling machine (surface texture, fissures, etc.)



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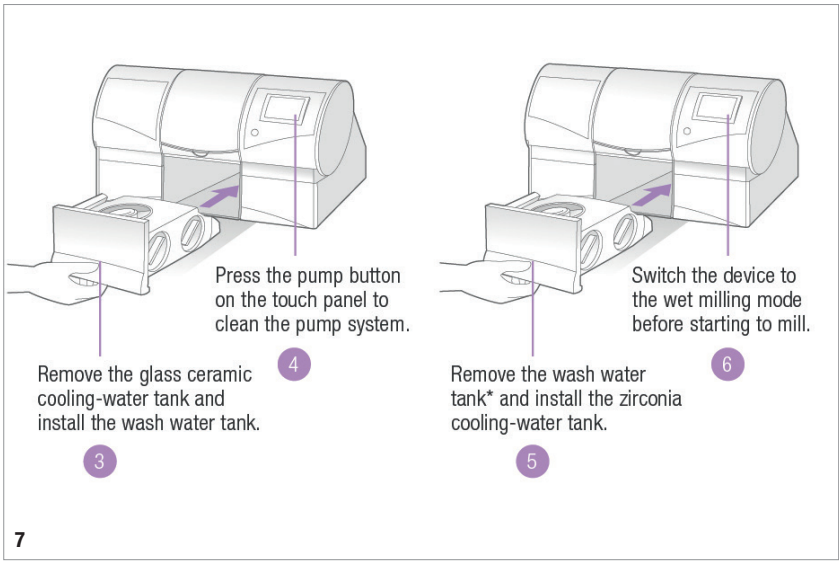

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are added in the restoration's pre-sintered state, that is, between milling and final sintering. Diamond-coated milling tools for oxide ceramics should be used at a low speed (7,000–10,000 rpm) for this purpose.

Tank management: Cleaning procedure after using glass-ceramics

Ensure that the glass-ceramic cooling water tank is installed. Press the pump button on the touch panel to wash away any glass-ceramic powder that is inside the milling chamber and then thoroughly flush milling debris from the milling chamber filter and milling powder from beneath the milling chamber filter (Figs. 6 & 7).

Final sintering

What are the particularities to be respected during final sintering of restorations made of KATANA Zirconia Block? Zirconia restorations are subject to volumetric shrinkage (approximately 20 %) during sintering. Therefore, it is essential not to place the restoration on a rigid carrier during sintering. If the volume of the restoration is reduced while the volume of the carrier is not, the risk of fracture is high. Ideally, the restoration is placed on its largest side.

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What measures should be taken to avoid discoloration of a restoration during sintering?
Discoloration (usually leading to a green-yellowish appearance) might be the result of contamination of the sintering furnace with metal oxides. These metal oxides originate from other materials processed in the furnace. They are released during sintering and absorbed by the restoration. Running a decontamination program on a regular basis is an effective measure to help prevent discoloration. For this purpose, white zirconia (either collected from odds and ends of non-shaded blanks or purchased) is placed in the furnace chamber and a sintering program is started. As the CEREC Speed-Fire furnace (Dentsply Sirona) does not offer a specific decontamination program, the user simply creates two separate jobs for the sintering of two single crowns, but sinters them together. The second job is used for the decontamination cycle. During this procedure, the white zirconia absorbs the metal oxides, which has a cleaning effect on the furnace.

Characterisation

Which techniques are best suited for optical refinement of monolithic restorations made of KATANA Zirconia Block?
A material designed for this kind of refinement is CERABIEN ZR FC Paste Stain (Kuraray Noritake Dental). The paste-like shading solutions are filled with ceramic particles. Therefore, the optical effects achievable with these pastes are much more durable than those obtained with classical stains. As all the pastes are fluorescent, it is possible to produce a natural long-term fluorescence effect without an additional work step. With just four shades of the liquid ceramic—A+, Grayish Blue, Value and Clear Glaze—it is possible to perfectly characterise 85 % of all restorations made of KATANA Zirconia Block. The firing temperature is 750 °C, and the coefficient of thermal expansion values of CERABIEN ZR FC Paste Stain and KATANA Zirconia Block are precisely adjusted to each other. The product is also very well suited for glass-ceramic characterisation (Fig. 8).

How can the restoration be held during characterisation?
The easiest option is the use of putty material on a carrier. The crown is simply placed on the unset putty and then positioned on the carrier. The surface of the restoration should be cleaned with a gentle stream of air before applying the pastes. Thanks to the ceramic particles in CERABIEN ZR FC Paste Stain, the pastes stay put during processing and do not flow away.

Polishing

How does one ensure a low wear of the antagonist?
Zirconia stands out owing to its hardness, which makes careful polishing of the surface a prerequisite for clinical use. After characterisation with CERABIEN ZR FC Paste Stain, polishing of all occlusal contact areas is mandatory as well. The KATANA Twist DIA polishing set (Kuraray Noritake Dental) even allows for intraoral use.

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> "Zirconia restorations are subject to volumetric shrinkage (approximately 20 %) during sintering."

Placement

What kind of resin cement is recommended for the definitive placement of restorations made of KATANA Zirconia Block?
The best possible results are obtained with PANAVIA V5 (Kuraray Noritake Dental; Fig. 9). This adhesive resin cement system is responsible for the development of a particularly strong bond between the tooth structure and the restoration, and this also has a strengthening effect on the restoration.

about

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DEDICAM: Clear concepts at maximum flexibility

An interview with Jörg Elbel & Martin Steiner

Jörg Elbel and Martin Steiner. *(All images: © CAMLOG)*

In 2013, CAMLOG embarked on the path to digital implant restoration with DEDICAM. Step by step, the product and service portfolio was expanded so that DEDICAM has advanced from being a pure supplier of products to being a service partner for digital concepts—and increasingly with an international footing. We spoke to Jörg Elbel, global director of digital dentistry, and Martin Steiner, DEDICAM divisional manager in the Germany, Austria and Switzerland region, about the developments.

What are the current trends in dentistry?
Elbel: The dental market is in a stage of transition worldwide. The digitisation of individual work steps and, increasingly, entire process chains is the decisive topic, and there are large regional differences. The degree of complexity is greatly increased by the numerous options and developments. We see various technologies in diagnostics and in data collection from the patient, including intra-oral scanning, therapy planning and additive manufacturing in the form of 3D printing. The manufacturing technologies bring with them a diversity of materials and modern therapy concepts.

Steiner: Above all, digitisation serves the benefit for users and patients in the form of simplifying work processes. This leads to changes, and this transition is not always easy. Direct communication in the planning process and predictable results are enormous benefits. Backward planning is a prime example of the great potential of the digital workflow. This enables the treatment team to plan the work steps in such a manner that the patient can review the result with the help of imaging techniques prior to the surgeon even picking up an instrument. Planning reduces complications and work steps

can be combined, which results in fewer sessions. This benefits the treatment team and the patient, for whom the basis for decision-making becomes more transparent.

What does digital dentistry mean to you?
Steiner: Digital dentistry means to us a maximum integration of all the digital process steps for dental rehabilitation. The main part deals directly with the patient: covering anamnesis, diagnostics, consultation, planning, design and production. In our opinion however, digital dentistry is also involved in upstream and downstream processes, that is, in procurement, logistics, data collection, data security, data processing and documentation.

The DEDICAM brand has taken a new direction with "Digital Concepts". What does this mean?
Elbel: At BioHorizons Camlog, we have consolidated our digital segment in the department of digital dentistry. With DEDICAM in Europe and Vulcan in the US, we offer our customers holistic concepts to help them attain the next level of efficacy. As a result of the increasing complexity of the digital workflow, many users wish for simple and reproducible solutions—in other words: digital concepts. We bring these digital concepts to life individually together with our customers.

Steiner: We support surgeons, prosthodontists and dental technicians in their daily business with products and services to enable operating a seamless digital workflow throughout the process chain. Over the years, we have cultivated this with DEDICAM prostheses and will now increasingly drive this within the dental network. Successful concepts are above all characterised by the quality of cooperation between partners. This has to be transferred to the digital world. We offer support during implementation, which may also have an impact on *business* orientation. Possible examples are the Munich implant concept and COMFOUR for the rehabilitation of edentulous jaws.

What makes DEDICAM unique?
Steiner: Our customers are free to decide which services they wish to use and to what extent. Flexible entry and exit during the entire process are reminiscent of hop-on, hop-off buses, which will no doubt bring back memories of exploring a city in the past for some. This means clear concepts at maximum flexibility. We give companies the choice. It is important to us that no user feels trapped in a system or process. It is therefore open to every customer whether and to what extent we support him or her implant planning. The virtual model data set created on the basis of planning can be processed further by the scan and design service or by another partner. Afterwards, we take over manufacturing of the designed construction data set or someone else does. With regard to the portfolio of materials and constructions, we offer a broad range which leaves almost nothing to be desired and which is available in the accustomed CAMLOG quality.

With DEDICAM in Europe and Vulcan in the US, we offer our customers holistic concepts to help them attain the next level.

Elbel: Our aim is not simply to obtain as many orders for prostheses as possible. With our services, we would like to reach out to all protagonists of the implant dentistry disciplines as partners at eye level and offer support, know-how and technologies where necessary. The objective is to integrate BioHorizons Camlog's implants into the digital workflow in the best possible manner and thus create added value.

> "It is important to us that no user feels trapped in a system or process."

What are the benefits for users when outsourcing parts of their processes to DEDICAM?
Steiner: A major advantage is the combination of outstanding product quality and excellent service with constant optimisation of the overall portfolio. What our customers profit most from is the time they gain by outsourcing to DEDICAM. Depending on the business orientation of a practice or a dental laboratory, this is a relevant factor. Whenever certain areas are outsourced, more internal resources always become available, which in turn can be invested in work which cannot be covered by a service provider, such as the implantological work of the surgeon or the aesthetic finishing by the dental technician.

Elbel: The high requirements and established standards in the Germany, Austria and Switzerland region also meet with international acclaim. Consequently, we are working on establishing our concepts internationally to support customers all over the world as partners. When choosing a partner, it is important to be able to rely on each other, especially when considering the rapid development of technologies and concepts.

High-quality dental treatments with CAD/CAM technology

An interview with Janne Ruokola

According to Janne Ruokola, the digitalisation of workflows is happening all over the world, and Planmeca Romexis offers excellent tools for this.

Janne Ruokola, Planmeca's sales manager for CAD/CAM products, has been working with CAD/CAM technology for more than ten years. In his career, he has seen first-hand how dental professionals can benefit from going digital. He believes digital workflows will become the new standard all over the world and recommends making the digital transition step by step with Planmeca's complete solution.

You have years of experience with different dental CAD/CAM systems. How did you originally come to work with CAD/CAM technology?

I have a degree in precision mechanics and worked as a service representative after my graduation. I maintained dental equipment for three years before I transferred to CAD/CAM sales over ten years ago.

Because of my technical background and experience of working in dental clinics, I found the possibilities CAD/CAM can offer extremely interesting.

CAD/CAM solutions can really help dental professionals to offer even better treatments to their patients.

> "Digital dentistry also supports patient communication, as the dentist can easily use software for demonstrating the desired end result before starting the actual treatment."

Why should dental professionals go digital—and who would you recommend it to?
General practitioners, dental specialists and technicians as well as dental hygienists can all benefit from digital workflows. With CAD/CAM technology, a dental clinic can offer its patients new services and better treatments—even during a single visit. CAD/CAM allows dentists to design and manufacture inlays, onlays, crowns, veneers, bridges, dental implants and surgical guides in-house and to plan orthodontic treatments and maxillofacial surgery directly in the clinic.

Digital dentistry also supports patient communication, as the dentist can easily use software for demonstrating the desired end result before starting the actual treatment. As I see it, the increased predictability of treatment is one of the most important benefits of digital dentistry.

I believe CAD/CAM technology will become more common even when performing dental check-ups. For example, digital impressions can be used to capture the patient's current oral health condition and for treatment follow-ups.

Why should a dental professional choose Planmeca's CAD/CAM solutions?
Going digital can be a big step for a dental professional. However, there is nothing to be afraid of—it is not even necessary to digitalise the complete treatment workflow at once. One can easily start by taking digital impressions and integrate the intra-oral scanner with other Planmeca devices later. The open Planmeca ecosystem allows dental professionals to proceed at their own pace.

I worked with another dental equipment manufacturer for several years, so I know other systems well too. What distinguishes Planmeca is the unique Planmeca Romexis software platform. It is the biggest competitive advantage for clinics as well, as it integrates all different workflows into a single software program, making dentists' work remarkably easier and allowing them to treat more patients in less time. With Romexis, dentists can utilise the captured patient data quickly and easily for different indications.

The integration of different devices with one another has a great number of benefits, starting from the compatibility of different data. However, purchasing all dental equipment from one manufacturer does not automatically mean that all collected patient data actually works together without any problems. In this regard, Planmeca's complete solution is indeed unique, as all Planmeca devices are connected to a single software platform, guaranteeing seamless compatibility of the different data.

This way, CBCT and CAD/CAM data can be easily and seamlessly combined in Romexis without error-prone and time-consuming data transfers. Additionally, all treatments can be planned and designed in Romexis, so no separate software is needed for different workflows, and as a result, the personnel do not need to learn to use multiple software programs. However, all Planmeca solutions are open and thus compatible with other services, such as orthodontic applications, which means dental professionals can work exactly as they prefer, if they choose Planmeca.

You have been following the development of CAD/CAM technology for over ten years now. What does the future of dentistry look like?
I believe that workflows will be digitalised to an even greater extent in the future. Both dentists and patients benefit from automated workflows, which reduce the risk of human error, increase the quality of the treatments and make the work more efficient. The digitalisation of workflows is happening all over the world, and Planmeca Romexis offers excellent tools for this.

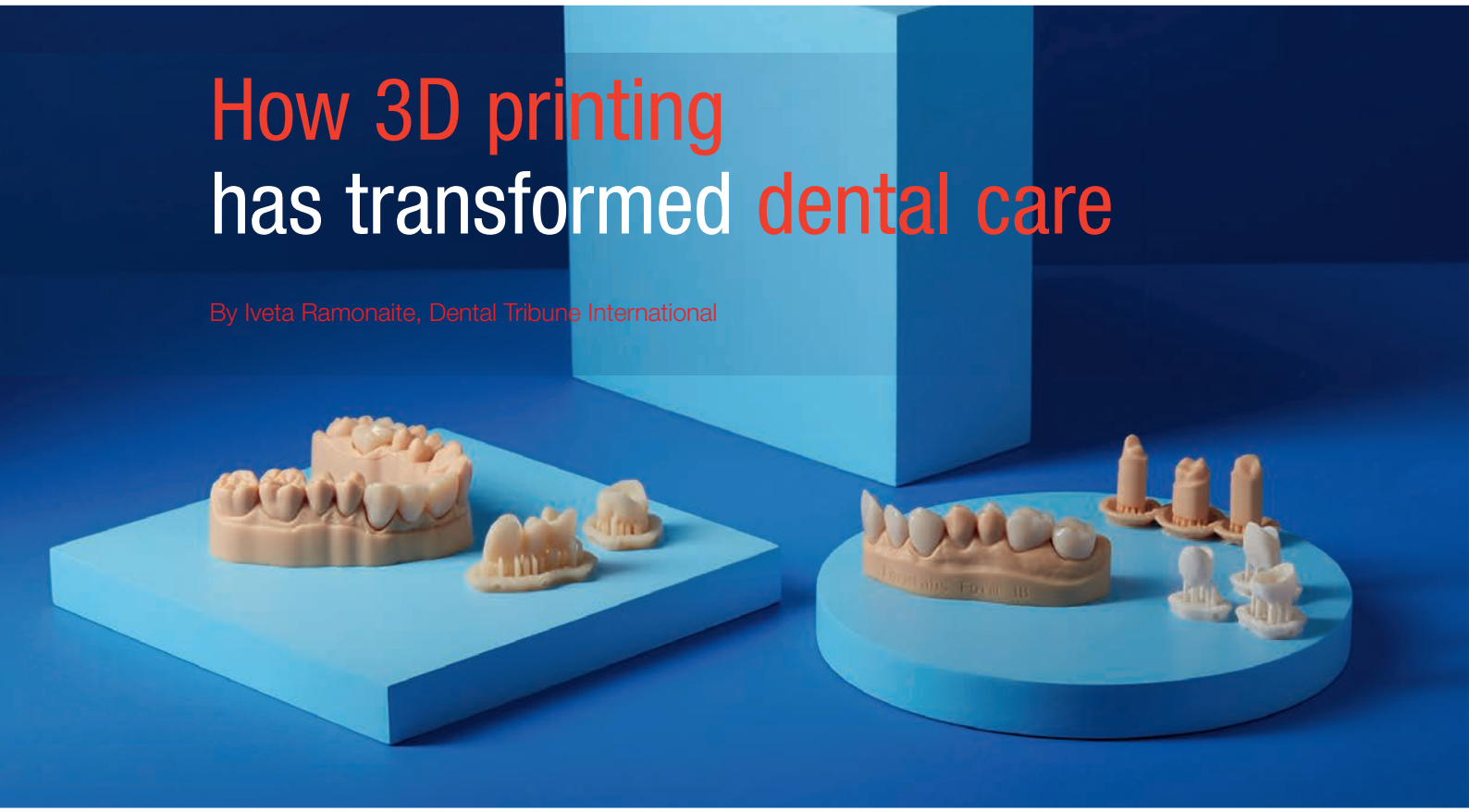
> "I believe that workflows will be digitalised to an even greater extent in the future."

At the moment, there is already a clear consensus on the benefits of guided implant treatments among dentists, so they will become more common in the near future. Implants and surgical guides will be increasingly fabricated chairside so that dentists can treat their patients even faster and more safely.

In addition to implantology, I believe guided treatments will become the standard for other indications as well. For example, I believe guided root canal therapy based on radiographic and CAD/CAM data will become more common soon.

How 3D printing has transformed dental care

By Iveta Ramonaite, Dental Tribune International



3D printing offers a high level of customisation of dental products, is highly efficient and cost-effective, and has many applications across a wide range of industries, including dentistry. *(Image: © Formlabs Dental)*

Dentistry has come a long way since the first introduction of digital technology. Georgio Haddad is an intrapreneur who is in charge of the development of dental strategic partnerships and initiatives at Formlabs. Haddad spoke to Dental Tribune International about the various applications of 3D printing in dentistry, reflected on how 3D printing has reshaped the dental industry and weighed the risks associated with embracing the technology.

How has the introduction of digital dentistry facilitated the carrying out of dental procedures, and why should dental professionals consider investing in new technology?

Digital technology has changed the way we deliver dental care. With advanced imaging, case diagnoses have improved significantly, and treatments are now more predictable. With milling and 3D printing, professionals can produce extremely high-accuracy dental products in order to offer their patients the best results. As technology continues to evolve, these products are produced faster and become more cost-effective, improving the end result for the patient.

Dental professionals are lucky to be in such a dynamic field. Staying curious and investing in new technology is a must in order to keep up with the increasingly high standards of patient care.

3D printers offer an infinite number of applications. How is 3D printing used in dentistry, and what are some of the advantages of 3D printing for dentistry?

3D printing is used in many areas of dentistry. There are three basic categories:

– *Applications that would not be possible or would not make sense without 3D printing.* These products cannot efficiently be made differently and include surgical guides, models for aligner thermoforming and indirect bonding trays.
– *Applications for which 3D printing improves on traditional manufacturing methods.* These products can be made without 3D printing, but printing offers increased accuracy and control, and shorter delivery times. This category includes castable and pressable frameworks, temporary restorations, splints and custom trays.
– *Novel applications for which 3D printing offers a disruptive alternative.* These are the real cutting-edge use cases, such as fully 3D-printed dentures and permanent restorations. They are not the most common uses, yet, but indeed some of the most exciting.

3D printing offers advantages beyond opening up new applications. Products are more accurate, turnaround time is shorter, and it allows for a more flexible and open communication between the practice and the laboratory.

3D printing is a powerful technology on its own, but the real impact comes from the people who use it. We see new 3D printing applications all the time, whether they are born of necessity or innovation. That is why Formlabs is committed to increasing access to powerful digital technology.

What are some of the criticisms of dental 3D printing, and do the benefits offered by using 3D printing outweigh the associated risks?
Ten years ago, the biggest problem with 3D printing was the prohibitively high cost of a printer. Luckily, with the success of manufacturers such as Formlabs in the market, printers are more affordable, more reliable and easier to use than ever before.

Now, the only risk lies in having false expectations. A 3D printer is a piece of equipment, and learning to use a desktop unit like the Form 3B is easy, but it does take some time. Those who choose to adopt digital technology should embrace the learning curve, ask for advice from their peers and seek out professional development opportunities.

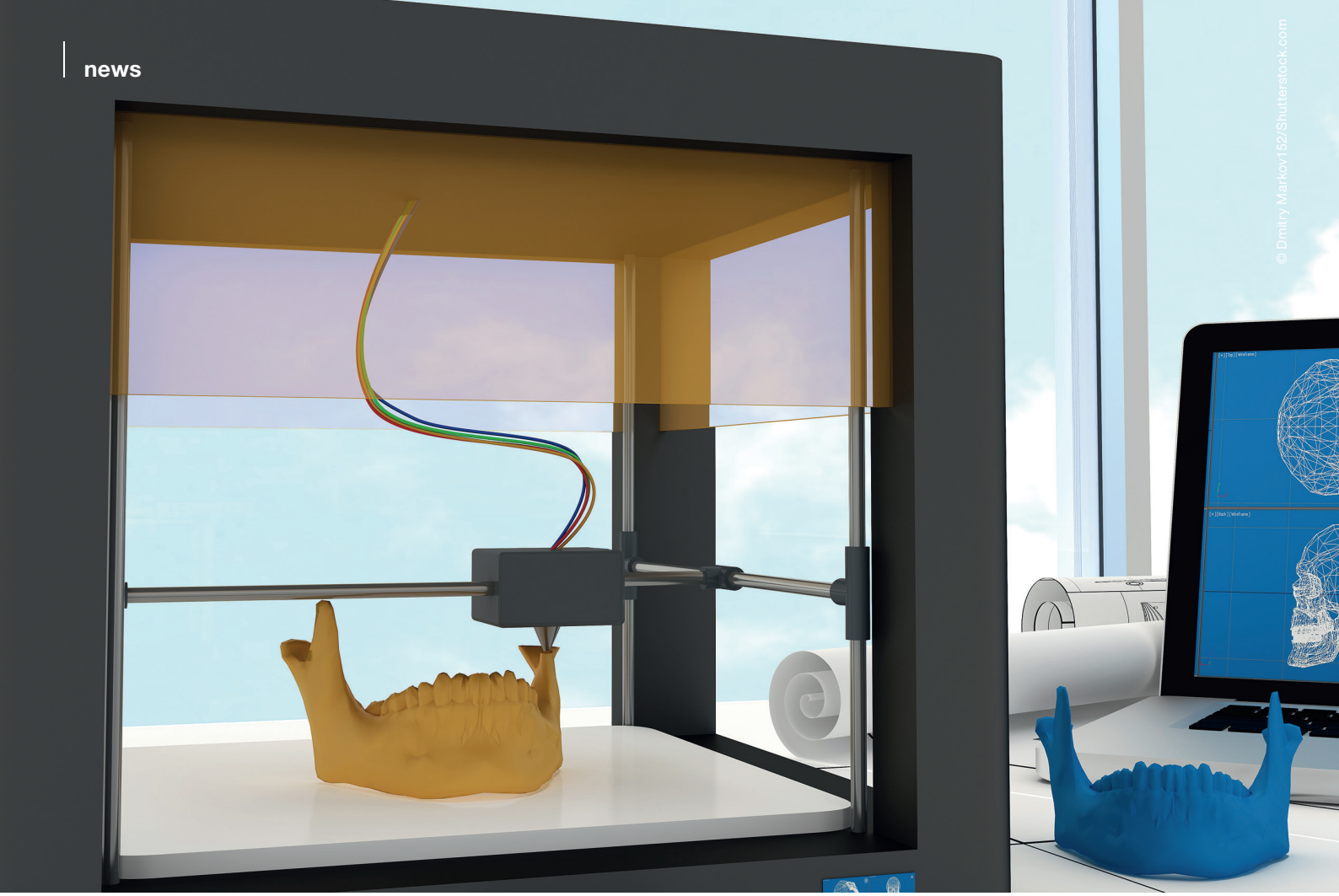
Moving forward, 3D printing needs to overcome the dental industry's skepticism about novel printing materials and applications such as printed dentures and permanent restorations. Manufacturers like Formlabs need to be proactive about teaching experts and validating new technology in the industry in order to achieve a mindset shift. But it will eventually happen. We have already seen it many times in the dental industry. Implants, zirconia, intraoral scanners, chairside milling and many other materials and technologies overcame the initial skepticism. I am glad to be part of the movement that is leading and revolutionising digital dentistry.

Georgio Haddad, dental strategic partnerships and initiatives lead at Formlabs, a 3D-printing technology developer and manufacturer. *(Image: © Georgio Haddad)*

> "3D printing is a powerful technology on its own, but the real impact comes from the people who use it."

Editorial note: The Formlabs Dental webinar, titled "Revolutionizing digital dentistry with 3D printing—accessible solutions and new applications," is available on demand at www.dtstudyclub.com. Registration is free of charge.

Formlabs' Form 3B printer. *(Image: © Formlabs Dental)*



3D printing continues to revolutionise dentistry, and recent evidence suggests that dental professionals can greatly benefit from printing 3D dental prostheses in-house.

Study highlights benefits of in-house 3D printing for immediate dental implant placement

By Iveta Ramonaite, Dental Tribune International

Owing to the growing popularity of point-of-care 3D printing and the subsequent creation of 3D-printing laboratories, a recent study aimed to compare the benefits of printing dental prostheses for fibula and implant reconstructions in-house with those of using traditional techniques that involve outsourcing to dental laboratories. The researchers found that in-house printing offers considerable benefits, such as reducing the waiting period before surgery, but that it requires an initial investment in 3D-printing equipment.

3D printing has recently helped to save the lives of many health care professionals fighting on the front line against COVID-19. It was seemingly impossible to comply with the updated recommended infection control practices in light of the shortage of proper personal protective equipment, and 3D-printed masks and face shields were produced to assist in this situation. Dental Tribune International (DTI) has also previously reported on the advantages of using a fully digital workflow and printing clear aligners in-house. The benefits of 3D printing are manifold, and so are its applications for medical use.

The present study included 12 patients who underwent free fibula reconstruction of the mandible or maxilla with immediate implants and immediate restoration. The restorations were created before surgery, and the first five patients each received a prosthesis that was fabricated by a dental labo-

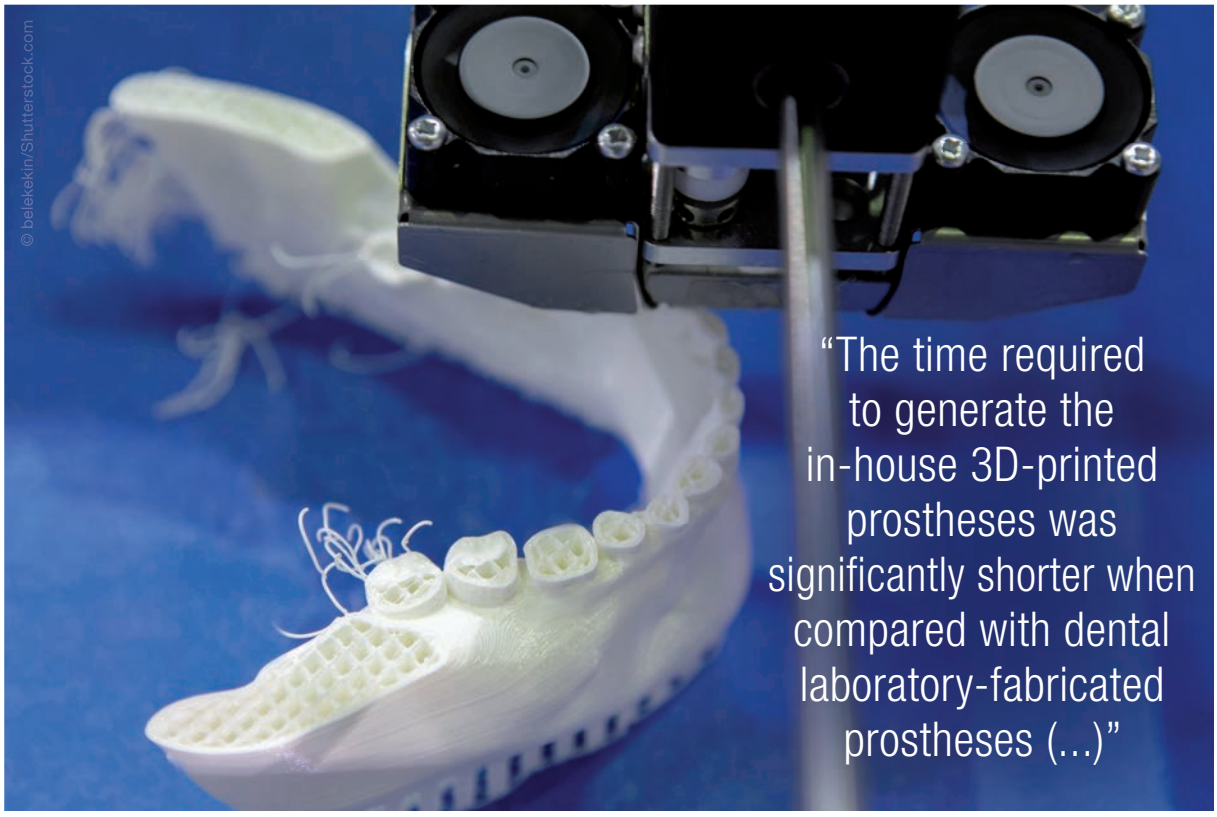
ratory after virtual surgical planning. The remaining patients each received a prosthesis that was designed by a surgeon and 3D-printed via the in-house laboratory.

The researchers fabricated a dental prosthesis using point-of-care 3D printing within 24 hours of the virtual surgical planning session. The time required to generate the in-house 3D-printed prostheses was significantly shorter when compared with dental laboratory-fabricated prostheses, which typically take weeks. Additionally, the procedure was more cost-effective. Whereas the prostheses created by an off-site dental laboratory averaged $617.00, each in-house 3D-printed prosthesis cost an average of $8.34 for resin, and the researchers noted that a full-arch prosthesis 3D-printed in NextDent Micro Filled Hybrid costs under $50.00. The price includes the costs for the resin and the export fee for Blue Sky Plan, a 3D-printing software.

"The study describes a digital workflow to design and 3D-print an immediate provisional dental prosthesis to be placed during jaw reconstruction when using a fibular free flap. This surgery has been called 'Jaw in a Day.' Previous methods involved third-party dental laboratories which require additional time, laboratory expertise and are more expensive. Our technique allows surgeon-guided virtual planning, just like we do with the jaw and fibula," Dr Fayette C. Williams, fellowship director in the Division of Maxillofacial Oncology and Reconstructive Surgery at John Peter Smith Health Network, told DTI. "Creating a 3D-printed dental prosthesis in-house allows more control for the surgeon to create the occlusal scheme. It is also much quicker. I can generate this prosthesis in one day, whereas dental laboratories can take two or more weeks," he added.

According to the researchers, outsourcing dental prostheses to a dental laboratory has previously created a delay in the treatment, which has limited its usefulness to benign conditions. In the present study, the digital workflow used allowed for immediate dental restoration for patients with malignant disease. "This time is significant for a patient with cancer waiting to get their surgery to remove their jaw and tumor," Williams explained. Despite its clear advantages, the researchers believe that the digital workflow presented in the study is most suitable for patients with teeth in place preoperatively that will be removed with their tumor. For more complex cases, it is necessary to familiarise oneself with image manipulation and prosthesis planning. Additionally, the researchers calculated that the total initial cost of a 3D printer and post-processing supplies can reach around $3,000.00, plus additional costs associated with using the software.

Editorial note: The study, titled "Immediate teeth in fibulas: Planning and digital workflow with point-of-care 3D printing," was published on 1 August 2020, in the Journal of Oral and Maxillofacial Surgery.



A recent study found that printing dental prostheses for fibula and implant reconstructions in-house eliminates the additional waiting period before surgery, making the treatment suitable for patients with malignant disease.

Dentsply Sirona sets new standards in digital dental events

By Jeremy Booth, Dental Tribune International

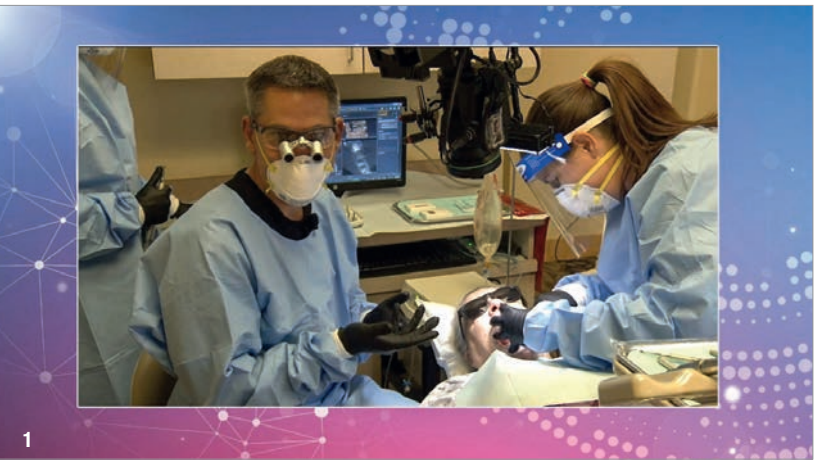


Fig. 1: Streaming live and on-demand: DS World 2020 offered attendees over 70 continuing education opportunities and lectures, and six live surgeries. *(All images: © Dentsply Sirona)*

DS World typically takes place in Las Vegas, but was held virtually this year owing to the SARS-CoV-2 pandemic. More than 4,500 dental professionals from over 25 countries attended the event, and the company said that its success showed that the dental business and continuing dental education are thriving even amid the greatest health crisis of the modern era.

DS World 2020 was streamed live from 13 to 20 November and attendees were able to view the sessions on demand as well. This meant that dental professionals from around the world effectively were able to be in two or more places at once—a clear advantage that enabled them to make the most of an ambitious programme that included more than 70 courses, continuing education (CE) opportunities, lectures from leading key opinion leaders and six live surgeries.

CEO Donald M. Casey welcomed participants to the event by thanking dental teams for the commitment that they had made to their patients and dental practices during the pandemic. He said that dentistry has, in his mind, always been absolutely essential, and that this fact was made clear when elective dental treatment was suspended during the first wave of the pandemic: "How can anyone not realise the importance and—more importantly—the expertise that you bring in order to treat your patients safely." Casey asked: "What is more important than oral health? Because we all know that oral health is the gateway to total health."

A leading role in dentistry

The opening session of DS World 2020 drew inspiration from outside of the dental industry through a conversation between the host, Dr Sameer Puri, vice president for clinical education at CDOCS, and world-renowned speaker and author on the topic of leadership Simon Sinek. "Leadership is not about being in charge; it's about taking care of people in your charge," Sinek said. He pointed out that most dental professionals are leaders

Fig. 2: CEO Donald M. Casey welcomed participants to the event by thanking dental teams for the commitment that they had made to their patients and dental practices during the pandemic. **Fig. 3:** In conversation about leadership: Dr Sameer Puri (left), vice president for clinical education at CDOCS at Dentsply Sirona, and world-renowned speaker and author Simon Sinek.

Fig. 4: Dentsply Sirona's new Schick AE intra-oral sensor.

in their discipline, but often do not receive training in what leadership requires in the dental practice. "Leadership is a skill," he said. "We have to study it, learn it, and practice it like any other skill." Sinek's advice to dental professionals who are running a small business and trying to survive the tough pandemic business environment was to do all that they can to continue learning about leadership. "Study it, read an article, watch a TED Talk," he said, adding that the best leaders have one thing in common: they get together and they talk about it.

During the opening session, Puri and Casey also encouraged attendees to take full advantage of the CE opportunities that were on offer in close to all dental disciplines at DS World 2020. They pointed out that a virtual format did not mean reduced personal contact and networking opportunities. Casey urged attendees to interact with key opinion leaders and other attendees during breakout sessions and panel events. The live surgeries focused on topics such as the digital workflow for implant therapy in the aesthetic zone, and whereas the surgical procedures were available on demand, participants were invited to take part in synchronous post-procedure discussions.

New products for a new era in dental care

"Let's deliver on innovation," Casey told the dental press in an online briefing, remarking that it was through innovation that the company planned to change the global face of dentistry and dental education. Attendees had the chance to learn about the intra-oral scanner Primescan and the SureSmile Aligner during online lectures, and breakout sessions presented the opportunity for attendees to experience advancements in procedural workflow and digital dentistry, such as the new Axeos 2D/3D imaging system and the Schick AE intra-oral sensor. Dentsply Sirona says that Axeos—which won the Red Dot Award for product design this year—is its extra-oral radiography unit with the largest field of view and delivers optimal image quality at low-dose optimised exposure. "Axeos has exactly the right balance between excellence, speed and precision," Prof Chung How Kau, chairman and professor of orthodontics at the Department of Orthodontics at the University of Alabama at Birmingham, was quoted in press material as saying. The Schick AE sensor is a reliable diagnostics tool owing to its low dose exposure, optimised resolution and improved display of the anatomical structures, company information states. The sensor combines a theoretical resolution of 33 lp/mm with newly optimised data readout and filtering functions in order to enhance diagnostic capabilities. Before the event, Dr Leonard Patella, who specialises in implant and cosmetic dentistry in Garden City, New York, told Dentsply Sirona: "I get a solid basis for a safe and accurate diagnosis of my patients, even in lower X-ray dose ranges."

The virtual format of this year's DS World was necessary due to health and travel restrictions, but the success of the event lends support to the idea of the strength of online clinical education. Dr. Michael Watson, who practices dentistry in Wake Forest, North Carolina, said that the virtual format of DS World 2020 had proved useful to many dentists. He stated in press material that "this format of clinical education will continue to be a great option for dental professionals, especially those who want to experience this level of presentation without having to travel or close their offices."

"This is one of the great things that we have learned in 2020: how you can do virtual events and really interact with people," Casey said.

Dentsply Sirona has announced that next year's DS World will return to the desert metropolis of Las Vegas—where it has been held previously—as an in-person event. Casey told attendees that the event will be held at Caesars Forum in Las Vegas from 23 to 25 September 2021.

Fig. 5: The Axeos 2D/3D imaging system has the largest field of view among Dentsply Sirona's extra-oral radiography units.

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