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digital

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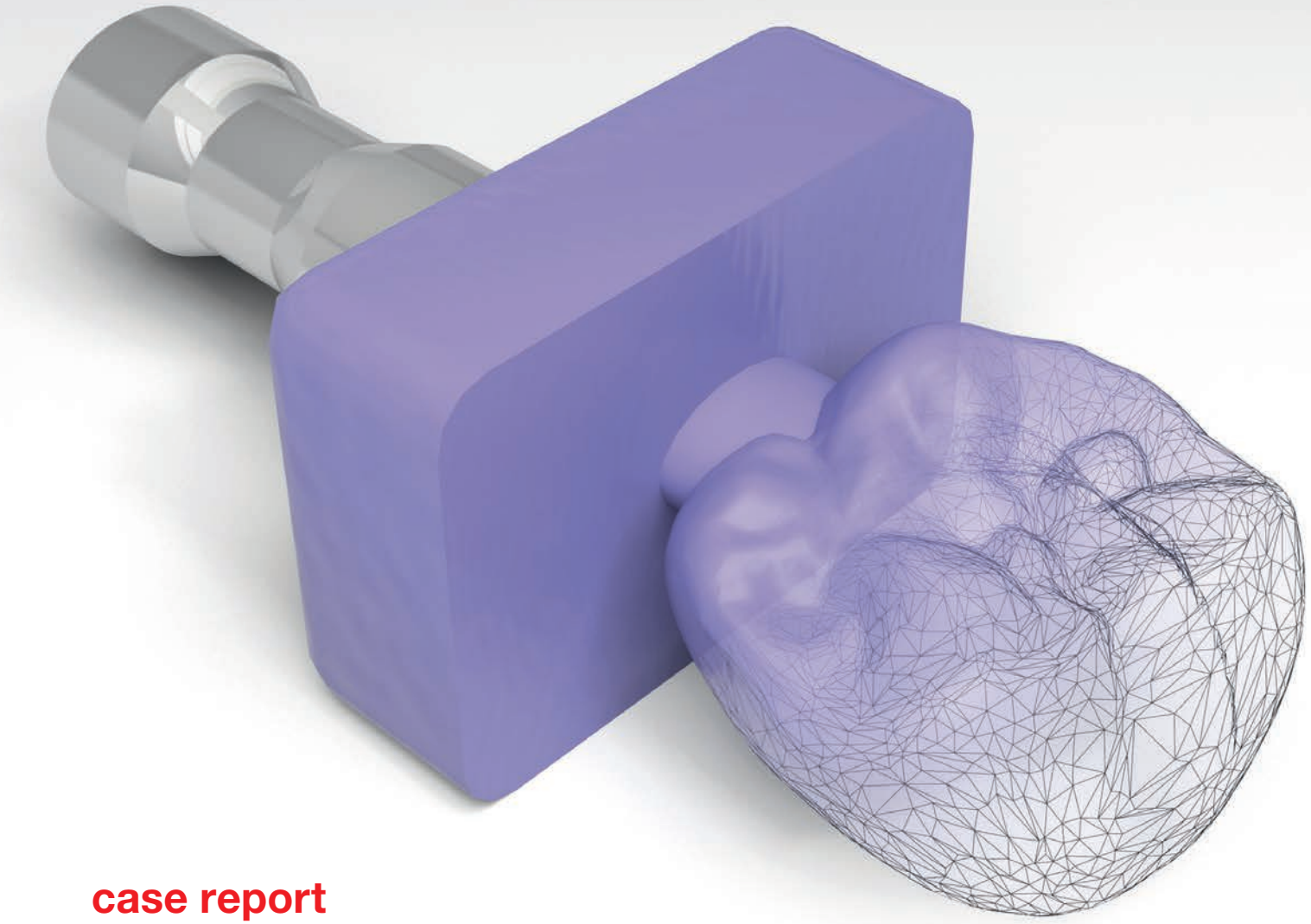

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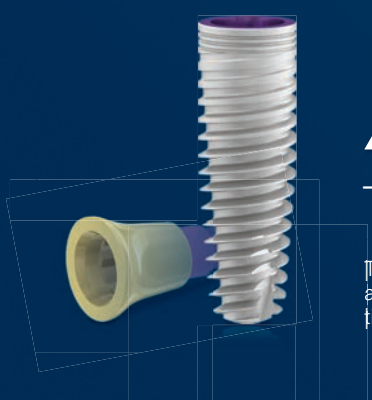

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Dr Scott D. Ganz

Editor-in-Chief

Our new world

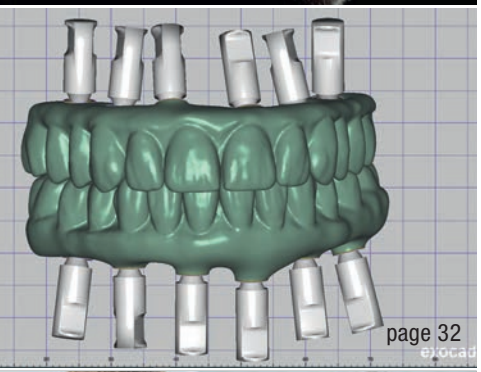
In January, it appeared that the new year would start off very promising: 2020 was to be a great year of innovation, learning and prosperity in the dental industry. It was during that month that many of us became aware of something happening in China, an evolving epidemic caused by a new coronavirus strain. We were still going to events, travelling around the globe and busy in our practice of dentistry. In January, I had the honour of presenting at a major meeting in Istanbul in Turkey, where we were still shaking hands, hugging and sitting shoulder to shoulder listening to our colleagues present their work from the podium. At the end of January, the International Digital Days inaugural meeting was held in Paris in France—a wonderful and successful venue, plenty of vendors and products demonstrated, high-level presentations delivered by speakers from many different parts of the globe, and hands-on workshops too! There were also dinners with our colleagues, friends and corporate partners all in close proximity within the crowded restaurants. We went on planes, trains and automobiles; it was part of our everyday world. And then Europe started to notice that the virus was spreading.

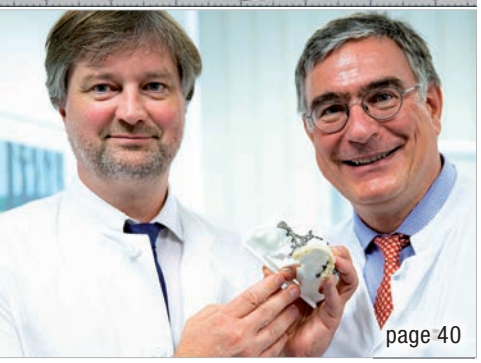
In the US, one of our largest dental meetings, the Chicago Dental Society Midwinter Meeting, was held in late February, and there were thousands of participants at the various associated meetings located all around the heart of the windy city, one of which was a highlight for me: LMT LAB DAY, where digital is a major focus of an event held always at the Hyatt hotel. After long daily sessions, the bars were full at night, as were the great restaurants of Chicago. Then our world suddenly changed and came to a screeching halt.

Within a few weeks, the McCormick Place convention centre in Chicago was transformed from one of the largest event halls in the US to a hospital to care for people ill with COVID-19. The same happened to the Javits Center in New York City and many others in the US and around the globe. The dental industry has been hard hit owing to our constant exposure to aerosols generated from intra-oral procedures. However, we in the dental industry are resilient, resourceful and innovative. Brilliant minds set to work immediately to help with the lack of certain supplies crucial to containing the spread of the virus, using the technology that we know so well, digital. We should be so proud of our industry for its ingenuity in producing 3D-printed face mask frames to help seal off the face from exposure, in response to the severe shortage of personal protective equipment, even offering free STL files for downloading, and 3D-printed nasopharyngeal test swabs, which are needed to collect samples, designed by clinicians and laboratory technicians fluent in CAD software. There are innovative designs for 3D-printed face masks with snap-on HEPA filters or specially fabricated suction devices to reduce exposure to aerosols.

Our new normal has redefined countries, cities, states, towns and populations across the globe. We will come out of this better and stronger. We are seeing an entirely new aspect of the power of technology and the new digital workflow that we rely on today and highlight in our publication. Stay safe, stay strong, stay healthy and keep innovating!

Respectfully,
Dr Scott D. Ganz
Editor-in-Chief





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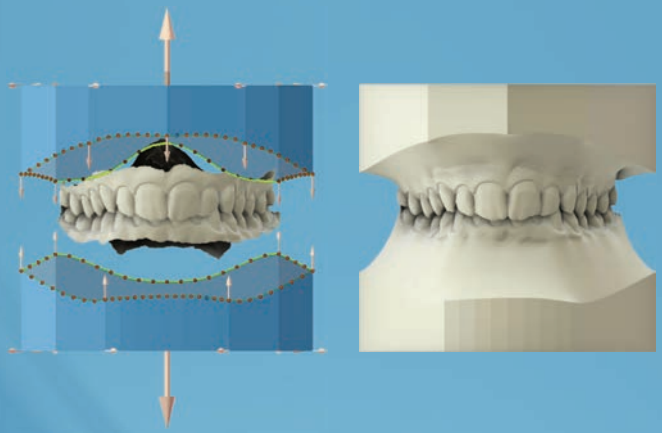

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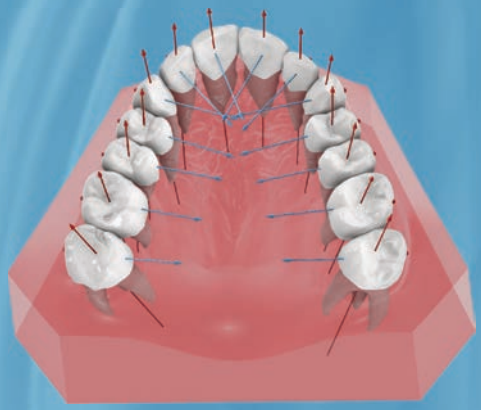
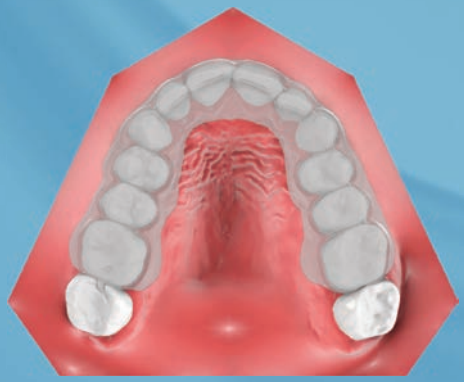


Clear Aligner



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The art of a personalised smile design

Dr Galip Gürel, Turkey; Drs Dimitar Filtchev & Georgi Iliev, Bulgaria; Dr Braulio Paolucci & Adriano Schayder, Brazil

Introduction

Aesthetics has become one of the most important outcomes of dental treatments. Regardless of the complexity of the case, patients are seeking better-looking smiles. For many years, we, as dentists or laboratory technicians, have been using all the basic aesthetic rules in order to properly create a smile design. These rules should be fundamental to the design. At the end of the treatment, the patients should feel happy. If one can evoke this feeling with a smile design, both the dentist and the patient will be satisfied giving and receiving more than standard, well-aligned teeth. However, the final aesthetic results may often fail to meet the patient's expectations, owing to a disharmony between the smile design and the patient's identity. Patients' demands and the level of information needed have driven the profession to question itself regarding the customization of smile designs, which if ignored may lead to dissatisfaction with the aesthetic outcome, even though all the aesthetic principles and rules which tend to establish standards have been taken into account.

The mock-up

Visualisation of the smile design will have a great impact on the patient's understanding of the rest of the treatment. It is much more powerful than only verbally explaining what will be done. Prior to initiating any treatment, it is necessary to visualise the desired outcome. It then becomes possible to formulate the steps required to achieve this result.

Mock-ups facilitate significant improvement in communicating with the patient by showing him or her the potential final outcome of the treatment and allowing an easy comparison of the pre- and postoperative situations, and mock-ups allow the clinician to be able to check the functional aspects. Whether it is a case of worn dentition that requires altering the vertical dimension or just a straightforward veneer case, the aesthetic plane of occlusion and function will be based on the length—incisal edge position—and position of the anterior teeth. It is very difficult to convey the envisioned final length of the central incisors to the patient just by adding composite to the incisal edges of the central incisors; thus, the patient needs to see the whole smile, including the length and position of the posterior teeth. There are different ways to make the mock-up. It can be created directly in the patient's mouth or indirectly either through a wax-up or by using digital tools.

The personalised smile design

Every human being is unique and special and the design of his or her smile should reflect his or her personality. Shape, texture, colour and combination of teeth convey direct messages, and when it comes to creating smile designs, dentists must consider the unity of the whole, which means bringing the biology, structure, function and aesthetics together with a fifth element, personality. Personality is the quintessential part here, because the other four elements are traditionally laid to balance it like a keystone. Through the large number of smile design elements, such as incisal edge, dominance of central incisors, tooth axis and shape, as well as subelements such as morphological details of each tooth, it is possible to establish, based on the dental scientific literature, which should be determined by the facial typology and which could visually represent the unique personality of each patient, beyond his or her personal preferences and expression of his or her will.

Visual language

Each type of line or shape has a specific emotional meaning.[1] Lines represent the most basic elements of visual language. Horizontal lines, because they conform to gravity, express stability, passivity and calmness, while vertical lines represent the movement of the point against gravity, expressing strength and power, just as inclined lines arouse the sensation of instability, tendency to movement and dynamism. Curved lines are associated with delicacy, sensuality and the feminine gender.[2]

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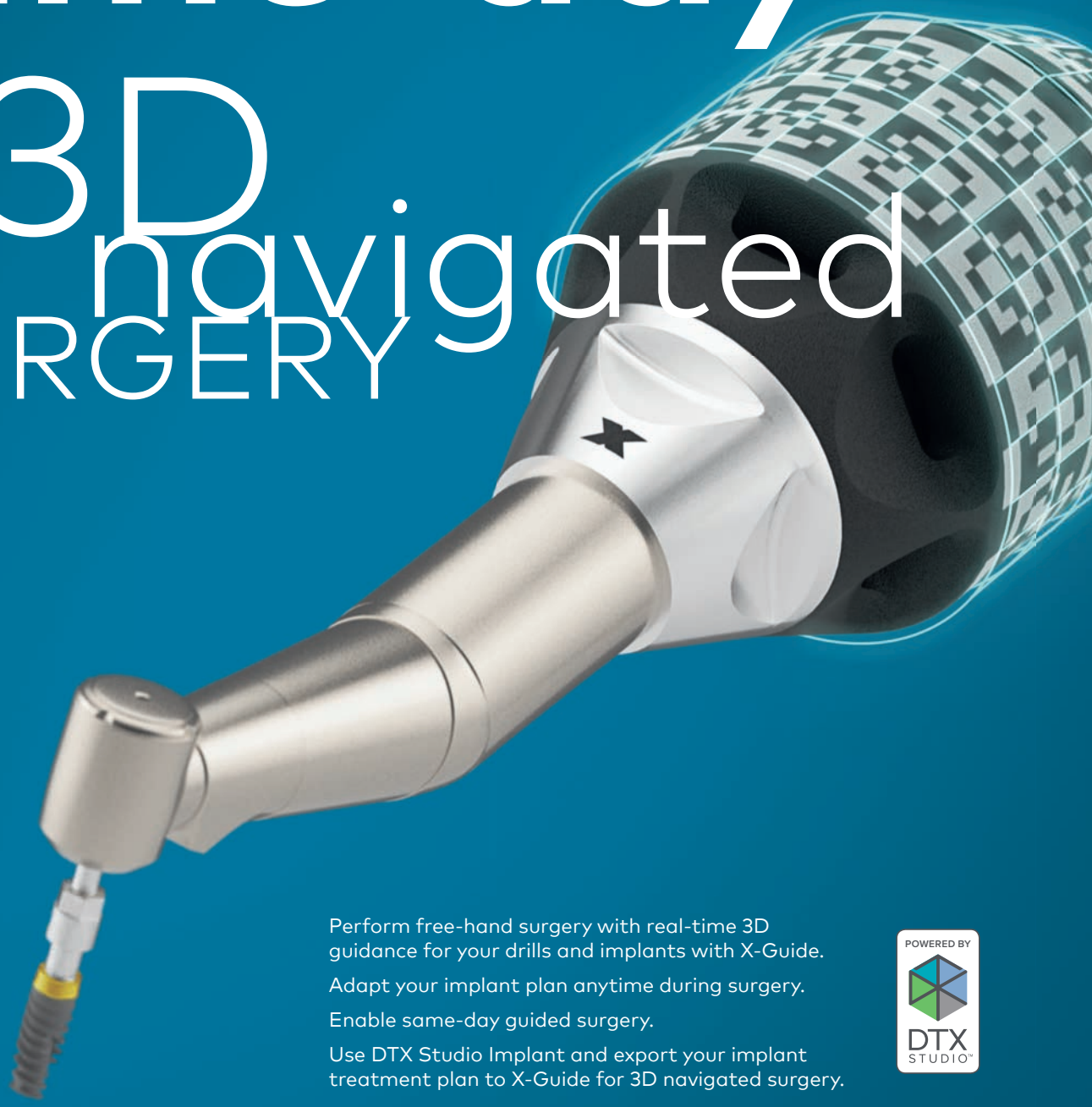

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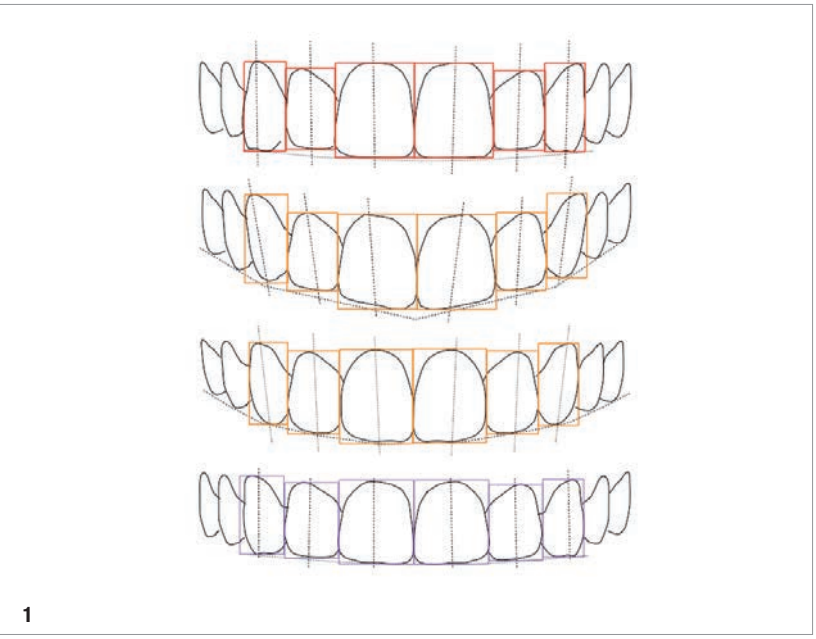

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Fig. 1: When the dentist first evaluates a new patient with aesthetic concerns, many critical factors may be overlooked. The verbal information exchange should be translated into a visual representation in order to aid in understanding what the final expectations should be at the end of the treatment, for the patient and the dentist. The basic means of this communication starts with a 3D preview of the design in the patient's mouth (APT: Aesthetic Pre-evaluative Temporaries) even before the rest of the treatment is planned. No matter what clinical difficulties a dentist will face and how problems will technically be solved, if the patient does not like the final aesthetic outcome, the treatment will be considered a failure.

The combination of lines generates the most basic forms, transferring to them their own expressions. Thus, the vertical rectangle expresses strength by the predominance of the vertical element on the horizontal, the triangle dynamism, the oval delicacy, the square stability and immobility with the balance between its vertical element and horizontal one. These basic shapes can be observed in the facial contour as well as in the incisors' shapes and 3D configuration of the dental arrangement, thus the incisal silhouette.

The visual language knowledge applied to the main expressive elements of smile design, such as dental shape, incisal edge, interdental ratio or dominance of central incisors, and 3D positioning of the teeth in the arch, determines four smile design types with primary expression (Fig. 1):

– Strong: composed mainly of rectangular dental shapes, strong dominance of the central incisors and canines over the lateral incisors (radial symmetry), as well as plane incisal edge and rectilinear 3D dental positioning on the arch from an occlusal view.

– Dynamic: triangular or trapezoidal dental shapes, standard dominance, inclined incisal edge and angled 3D dental positioning on the arch.

– Delicate: oval dental shapes, medium dominance, curved incisal edge and standard 3D dental positioning.

2a 2b 2c 2d

Figs. 2a–d: The aim of this aesthetic treatment was to enhance the patient's smile. However, additional to all the aesthetic smile design basics, the facial analysis and the personality of the patient should be reflected in this design, in order to create the most natural, minimally invasive, personalised smile design.

– Calm or stable: smoothly rounded square dental shapes, weak dominance (current symmetry), horizontal incisal edge and 3D rectilinear or standard dental positioning on the arch.

Case presentation

The patient had short teeth and was not happy with the narrow buccal corridors and the yellowish colour of her teeth (Figs. 2a–d).

Aesthetic analysis and Rebel Simplicity

Aesthetic design can be challenging for dentists. Rebel (Visagismile) is a recent digital previsualisation technique that allows the clinician to:

– efficiently design the new smile;
– improve the communication between the dental team members involved in the treatment;
– obtain better communication and achieve better patient motivation; and
– visualise the final aesthetic result even before the treatment is started.

3D Rebel smile design plays an important role in the entire treatment planning and will guide the actual clinical treatment. This approach makes it possible to share the treatment plan among team members and to create a 3D visualisation of the case in the patient's mouth. The digital project will be tested and approved even before starting the actual treatment. Accordingly, it will allow the dentist to present the treatment solution.

The Rebel workflow

Rebel offers probably the simplest steps for transferring all the necessary information to the Rebel digital laboratory.

These are the three mandatory steps:
1. a single mock-up on a central incisor to be digitally scanned;
2. a full-face photographic protocol; and
3. a simple questionnaire.

Single central incisor mock-up and intra-oral digital scanning

A composite mock-up is performed on one (or two) of the central incisors in order to identify the incisal edge position vertically and the position of the facial surface buccolingually (Fig. 3). This is no different from creating any direct mock-up; however, the greatest advantage of creating this mock-up for Rebel is that the dentist does not need to concern himself or herself with the perfect design of this mock-up, meaning that he or she does not need to choose the shape of the tooth (square, triangular, rounded, etc.), the angulations of the axes of the teeth, surface texture, etc. These details of the smile design will be provided by the Rebel artificial intelligence-based software, according to the facial analysis and the personality of the patient. Therefore, this will allow any dentist at any level to start working with mock-ups and end up with high-level wax-ups.

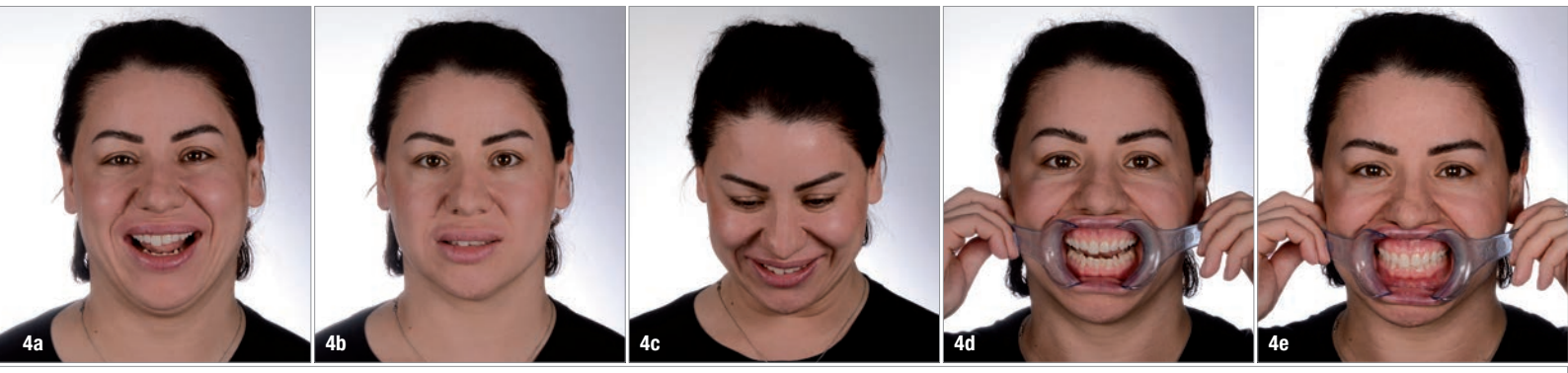

3

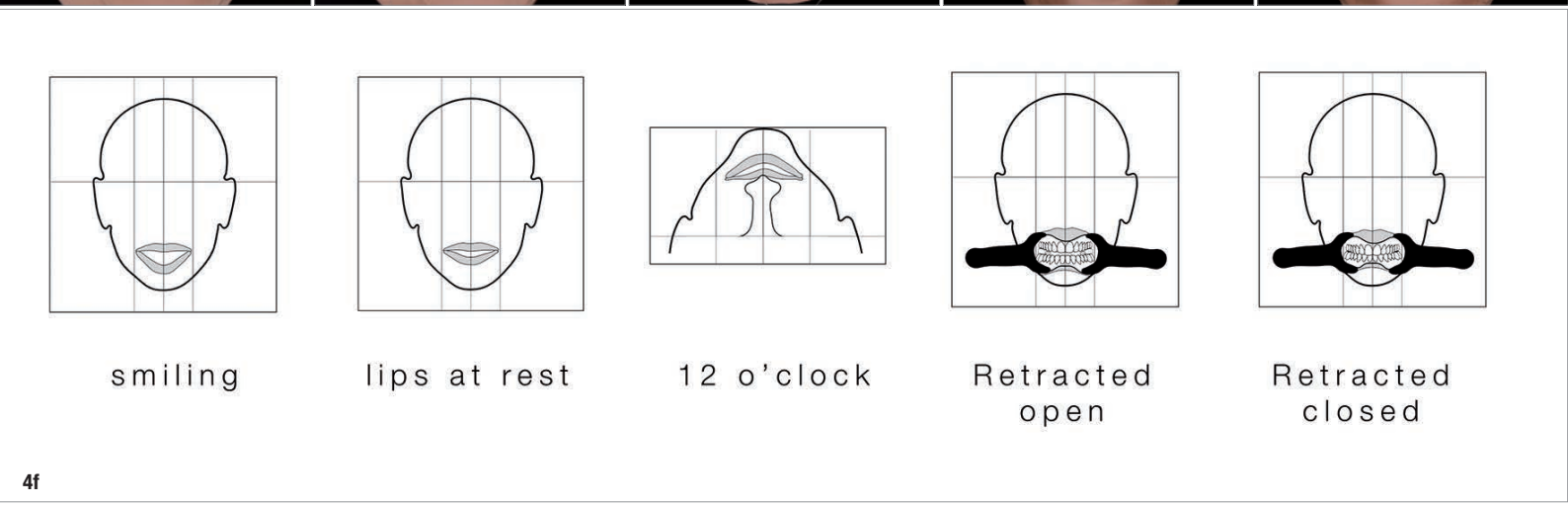
Fig. 3: Once the mock-up on the central incisor has been completed, it should be digitally scanned. It can be scanned with any intraoral scanner that can produce an STL file. Most intra-oral scanners convert the 3D scan into an STL file automatically. However, if the dentist does not have an intra-oral scanner in the dental practice, an analog impression of the upper jaw (preferably with the direct mock-up done on the central incisors) is taken and sent to the nearest dental laboratory that owns a scanner (laboratories that work with a CAD/CAM machine will have a digital scanner). The dental technician can digitalise this impression for the dentist and upload the STL file to Rebel, in order to complete the order via a provided link.

If the dentist does not wish to make a mock-up, then he or she can alternatively write down the additional length that would be needed to be added to the central incisors vertically, and the volume on the facial aspect (e.g., 0.3 mm thicker facially). In that case, the dentist can easily relate the existing length of the teeth to the upper lip position with the help of a periodontal probe. This information should be noted (the additional length that is needed to be added to the central incisors vertically and the volume on the facial aspect e.g., 0.3 mm thicker facially) and included in the file that will be sent to Rebel.

Full-face photographic protocol

The software requires five full-face photographs for facial analysis and classification of the patient and for relation of the 3D intra-oral digital scan to the facial





Figs. 4a–f: The forehead and the ears of the patient should be visible. It is crucial to keep the head upright (not tilted to the right or left, or up or down). The eyes should preferably be positioned parallel to the horizon.

features. The following are the five full-face photograph types needed (Figs. 4a–f).

I. Full-face photograph in rest position
This photograph is for the automatic facial recognition process of the software, and part of the new Rebel smile design will be based on this facial analysis of the patient. Technically, it is very important that the forehead and the ears of the patient are visible. If the patient has long hair, it should be held away from the face. It is crucial to keep the head upright (not tilted to the right or left, or up or down), preferably positioning the eyes parallel to the horizon and keeping the lips apart. The software automatically checks the required full-face photograph and sends a message immediately to the dentist if the necessary technical requirements have not been met so that he or she can retake the photograph.

II. Full-face photograph of patient smiling
Keep the patient in the same position with the eyes open and parallel to the horizon and the head upright (not tilted to the right or left, or up or down). This time, ask the patient to keep his or her lips apart in a soft smile (if possible, ensure the incisal edges of the maxillary incisors are displayed).

III. Photograph of face in 12 o'clock position
There are two simple ways of taking this specific photograph. An easy way is to keep the patient in the same position and ask him or her to incline his or her face 45° forward while giving a full smile, taking the photograph so that it shows the relationship to the maxillary central incisors and the displayed arch position to the lower lip line. The dentist can also move the patient to a supine position on the dental chair and to the 12 o'clock position, ask him or her to smile fully, and take the photograph from a 45° angle.

IV. Full-face photograph with mouth closed and lips retracted
The patient should be asked to hold the full-mouth retractors, again keeping the position of the eyes parallel to the horizon and his or her head upright (not tilted to the right or left, or up or down), and keeping his or her teeth closed and the occlusal plane parallel to the horizon.

V. Full-face photograph with mouth open and lips retracted
The same protocol as for the mouth closed should be repeated, but this time with the teeth (upper and lower jaws) separated.

Questionnaire

An interview to reveal the character and the personality of the patient is completed through a questionnaire available in the software and gives the dentist the primary and complementary characters of the patient (Fig. 5). The temperamental type of each individual is defined by a unique combination of diverse characteristics of the four main temperaments, and therefore, for a precise and practical evaluation, it is necessary to apply a specific questionnaire.

As the dentist is about to send the three mandatory files, he or she will also be asked to include for the Rebel digital laboratory, a description of the clinical case regarding any specific designs, such as the buccal corridors and perfect imperfections, and the intensity of the surface texture, or choose some of the optional features provided if needed. When the entire Rebel workflow has been completed, the software will guide the dentist to exit, and at a click of a button, the file will immediately be sent to the Rebel digital laboratory via e-mail.

Rebel digital laboratory

It has a very sophisticated simplicity, owing to a very complex software behind it which enables the dentist to do the most simplistic, yet most predictable and personalised, 3D wax-up. For every level of dental practice, reproducible and accessible to all professionals, a concept for smile design customisation was developed by Paolucci[3] and Paolucci et al.[4] The concept, called "Visual Identity of the Smile," arose from the association of different knowledge such as aesthetic and functional dental fundamentals, artistic visual language, facial recognition and personality typology. For the objective application of this concept, the Rebel software was developed.

Rebel software is able to perform facial reading, personality assessment and personal preference evaluation of each patient and convert that information into mathematical language. Through pre-programmed algorithms, an initial 2D smile design is created. The software is capable of transforming this 2D smile design into a 3D customised model automatically. The model generation is performed by a custom 3D library, developed specifically for Rebel Simplicity. Every model is personalised according to the proposed tooth configuration.

The Rebel system is actually a virtual laboratory that converts the 2D design into 3D and creates a digital wax-up immediately. The 2D design is created by relating the facial perception and the personality of the patient to the smile design, by applying algorithms for

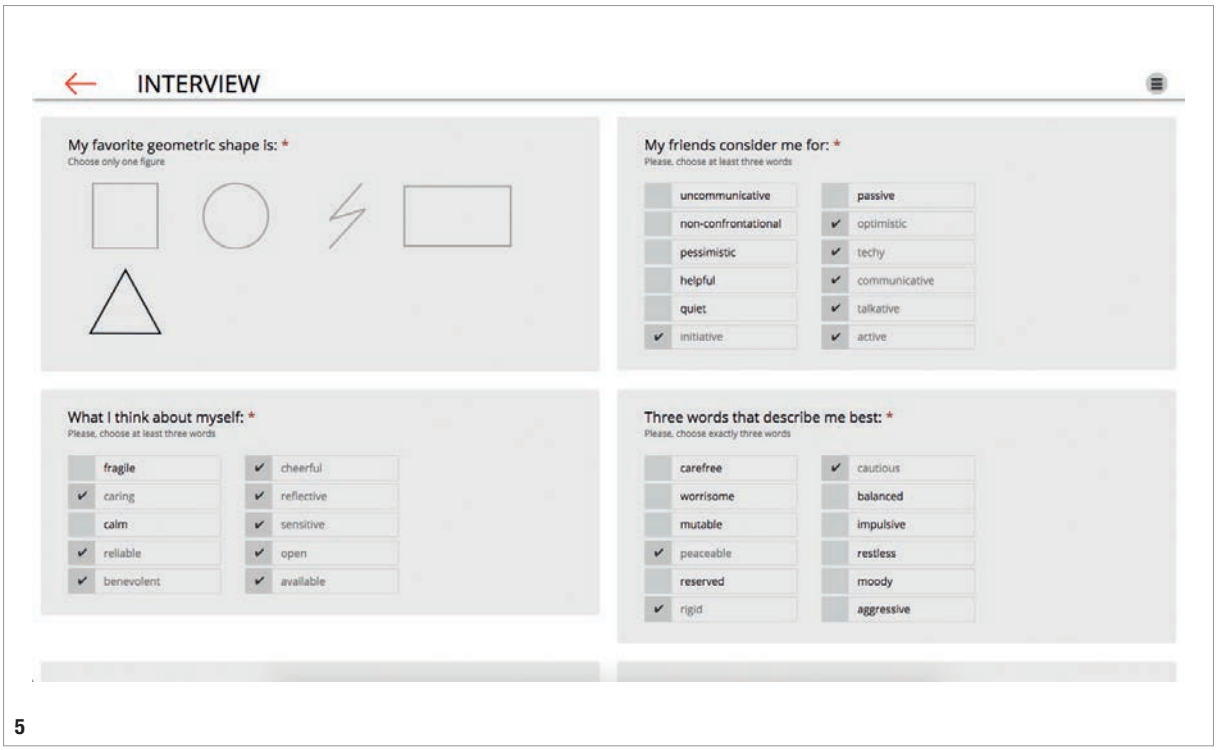


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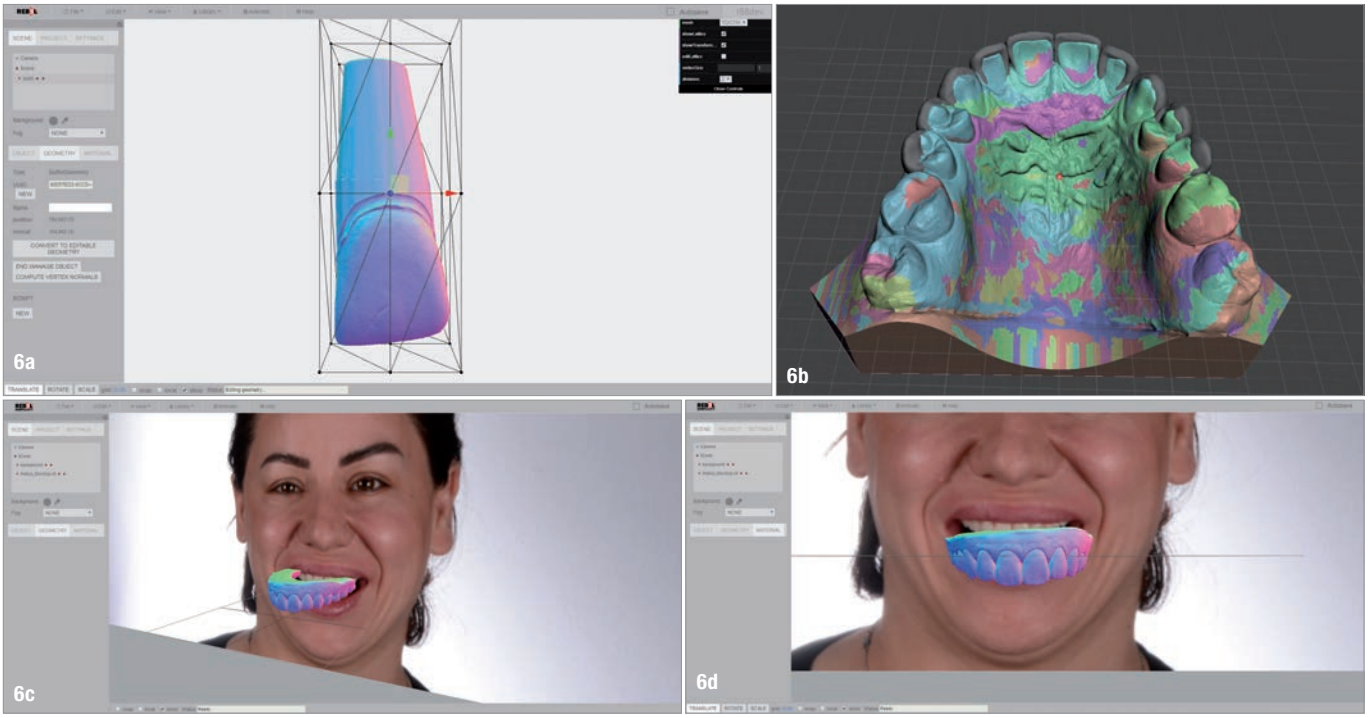
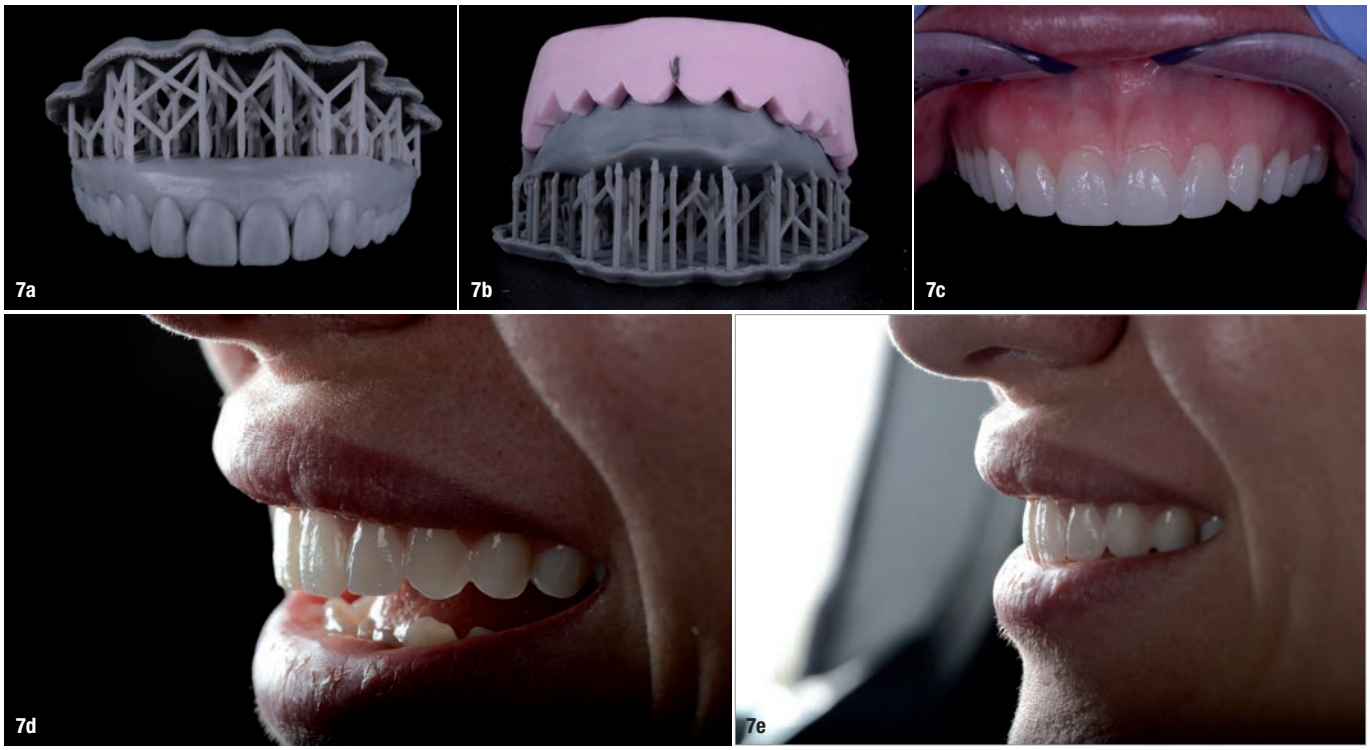
Fig. 5: The optimal tooth shape is determined with the help of the interview. The questionnaire is based on popular psychological tests of personal self-assessment. The first question is an adapted test by Dellinger[10] and the other three questions concern personality traits based on the theory and questionnaire by Eysenck and Eysenck.[11] The questionnaire is checked by a computer algorithm to classify the patient's personality. Based on the data from the interview, a software algorithm automatically calculates the temperament as perceived by the patient. The temperament is a combination of strong, dynamic, delicate and calm. After this procedure is done, the dentist and/or the technician will have a full idea of the facial analysis and the personality of the patient.



Figs. 6a–d: Rebel is a recent digital previsualisation technique that allows the clinician to efficiently design the new smile, improve the communication between the dental team members involved in the treatment, obtain better communication, and achieve better patient motivation thanks to the visualisation of the final aesthetic result even before the case has started. By the same token Rebel will enhance the predictability of the entire treatment and guide the actual clinical treatment. This approach allows the sharing of the treatment plan with team members and creates a 3D visual perception of the case in the patient's mouth. The digital project will be tested and approved before the actual treatment starts and allows the dentist to present the treatment solutions.



Figs. 7a–e: After the STL file has been 3D-printed **(a)**, the dentist can easily transfer this design to the patient's mouth by making a silicone impression of the digital wax-up **(b)**. The harder this silicone transfer impression, the more precise this transfer will be, in order to duplicate all the details, such as the line angles that give the ideal shape of the teeth, as well as surface texture. This transfer should be done prior to everything. The dentist should evaluate the new design well before starting the tooth preparation with the APT (Aesthetic Pre-evaluative Temporaries) or as the final mock-up. This way, not only the ideal 3D smile design, but also a great 3D communication opportunity, will be given to the dentist and the patient. The final aesthetic design should be approved at this time.

computing the optimal combination of the incisal silhouette, tooth axis, dominance of the central incisors and the combination of individual tooth shapes out of thousands of possibilities. It may sound complicated; however, it is the simplest way of creating one of the best 3D digital wax-ups possible.

Rebel employs very sophisticated artificial intelligence-based software with algorithms; however, it provides great simplicity to the end users, the dentists and dental technicians (Figs. 6a–d).

Back to chairside/3D printing

This STL file is then sent to the dentist via e-mail, ready to be 3D-printed (Figs. 7a–e).

Tooth preparation through the Aesthetic Pre-evaluative Temporaries

The design of the APT (Aesthetic Pre-evaluative Temporaries). creates a very solid reference for the tooth preparation. With the use of a depth cutter, the dentist can start preparing the teeth through the APT. His or her work will lead to the most minimally invasive tooth preparation (Figs. 8a–d).[5,6]

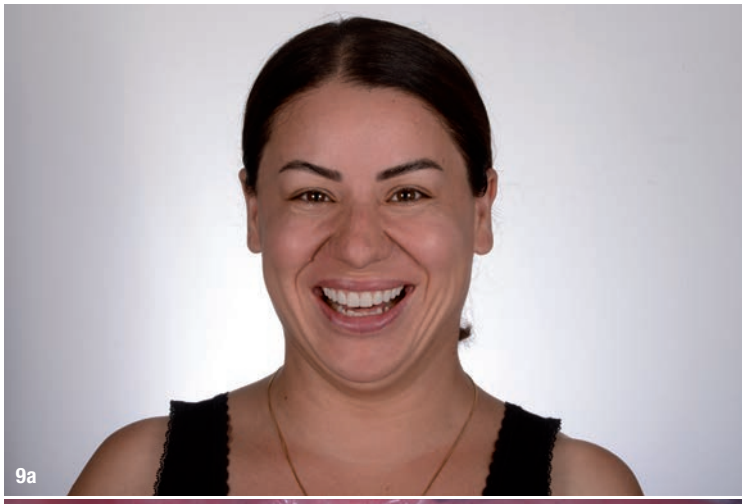
Porcelain laminate veneers are tried-in and after the aesthetic acceptance of the patient and the dentist, they are bonded to the teeth under rubber-dam isolation (Figs. 9a–c, page 14).

Conclusion

The combination of the basic rules of aesthetics together with the reflection of the facial analysis and the personality of the patient in the smile design creates a more natural and personalised smile.[7–9] This principle presumes harmony between the smile design and the patient's personality. However, in the dental practice, its application has been limited owing to the lack of an objective method for assessing the patient personality and incorporating its results into the smile design.

Currently, Rebel can help the clinician to provide smile designs that consider patients' emotions, sense of identity, behaviour and self-esteem. Combining modern digital technologies with the classic treatment rules can be used to achieve predictable aesthetic results.

Figs. 8a–d: Once the final design has been approved by the dentist and the patient, the dentist can anesthetise the patient and start preparing the teeth through the APT (Aesthetic Pre-evaluative Temporaries). As soon as the teeth have been prepared, it is then the choice of the dentist to continue the case digitally, by taking an intra-oral digital scan, or to continue with the conventional analog way. The patient leaves with the provisionals.


9a


9b


9c

Figs. 9a–c: In the same way, the laboratory can produce these veneers digitally by milling or using pressable ceramics or utilising feldspathic veneers. In this case, the material chosen was the IPS e.max Press pressable ceramic (Ivoclar Vivadent), after one-third incisal cut-back and feldspathic porcelain applied on top with the micro-layering technique and bonded to the teeth.

The Rebel concept, which can be applied very easily and rapidly, can help the dentist or ceramist to achieve this goal in the most simplistic, practical and personalised way. The authors' clinical experience shows a minimum of 80 per cent success in the acceptance of the final smile design treatment. Finally, before any further investigation and research is done, if the result by applying this technique does not satisfy the patient owing to the subjectivity of the matter, the dentist can always make minor alterations in order to adopt this design according to the patient's desires.

Editorial note: A list of references is available from the publisher. This article was first published in the Clinical Masters *magazine, volume 6, issue 2020.*

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Dental Anatomical Combinations—smile design harmony based on facial configuration

Giuseppe Romeo, Italy/USA

Figs. 1a & b: Temporary phase: facial analysis and tooth reproduction in a customised smile in a prosthetic restoration on implants.

Introduction

The restoration of the aesthetics in prosthodontic treatment is an area of dentistry where digital technologies are becoming widely used. A number of studies have demonstrated the effectiveness of computer visualisation in clarifying the patient's preferences and achieving a predictable and satisfactory outcome of the prosthetic treatment.[1–3]

Good-quality dental software products in the market all involve systems of smile design assessment according to the overall facial context. Therefore, all concepts and systems relating to smile design require a photograph of the patient smiling naturally.[3]

The expression on the face forms the first impression and has a high social value.[4–6] The facial contour assumes an

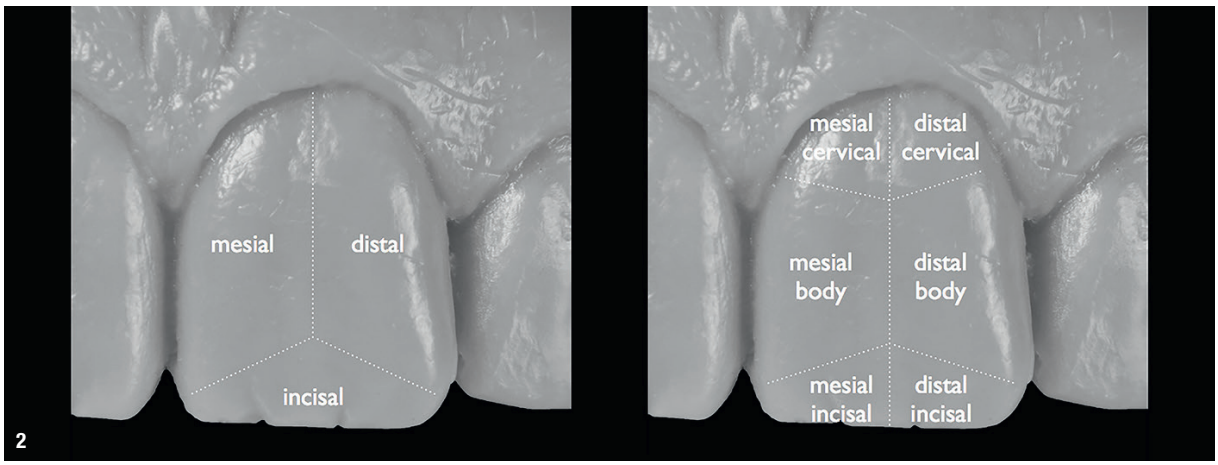


Fig. 2: Segmentation of the tooth surface.[13]

important role, especially for the future definition of the maxillary central incisors (Figs. 1a & b).[7–11]

In the following case report, I will present an aesthetic rehabilitation in the anterior with no-preparation veneers, taking into consideration the patient's expectations for his new future smile and the tooth shape, internal substructure of the veneer due the ceramic layering technique and the external surface appearance of the veneer based on the quality of the veneer texture.

The challenge of this case was to realign all the teeth with a new dental anatomical combination to close all the spaces. One of the difficulties experienced in this rehabilitation was moving the distal inclination of the maxillary right central incisor to a regular axial position. Furthermore, soft-tissue conditioning was needed in order to create a new cervical contour.[12]

Technique

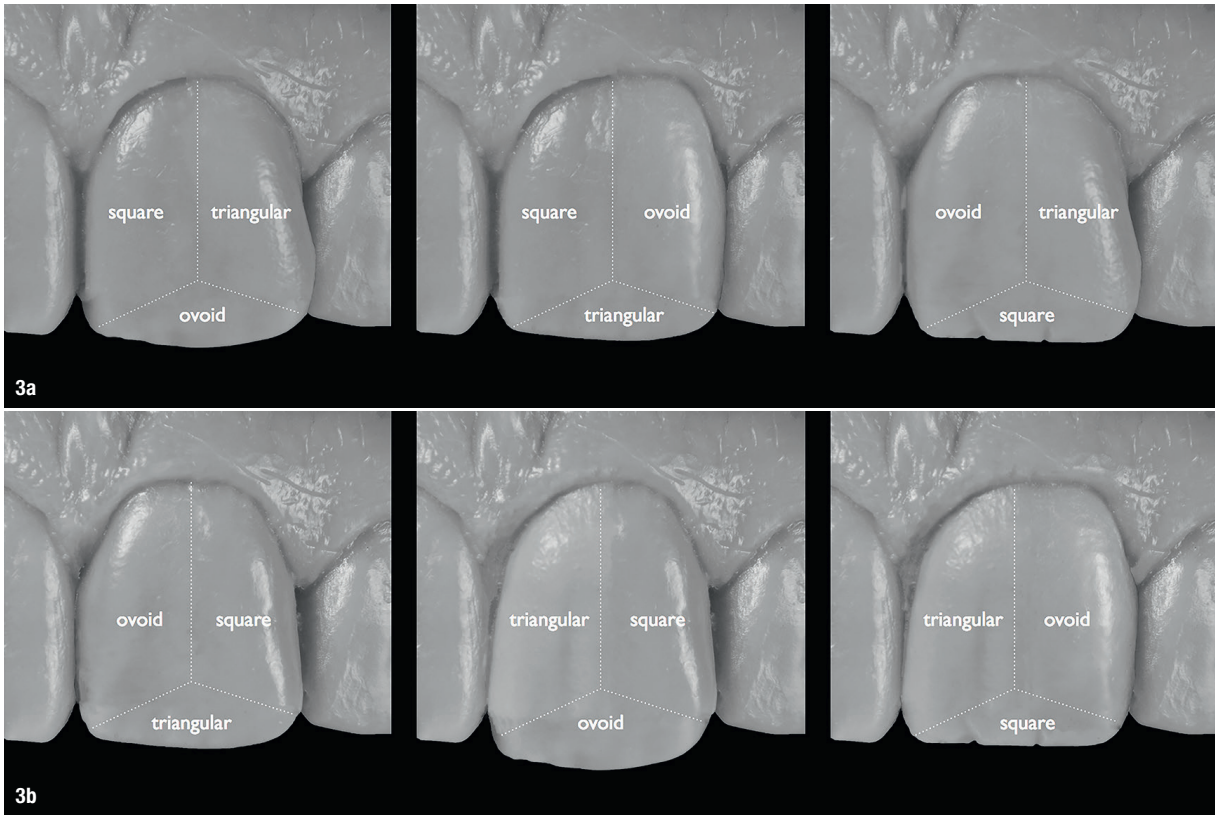
Based on the anatomical concepts and facial details, I used a new tooth form classification system, called "Dental Anatomical Combinations", in order to create the right technical approach in the laboratory.[13] This concept aims to help dental professionals produce different tooth anatomies that extend beyond the standard tooth shapes. The basic principle of this system is the segmentation and recombination of two or even all three of the basic tooth forms.[13] First, the surface of each tooth form is sectioned into smaller segments; for example, by sectioning the tooth into three different segments, a mesial, distal and incisal segment can be obtained. If necessary, these full segments can be further divided in half, resulting in six half segments: mesial cervical, mesial body, mesial incisal, distal cervical, distal body and distal incisal (Fig. 2).[13,14]

Shape Characteristics	Traditional Shape	Final Shape
1	3	1
1	2	1
1/2	3	1
1/2	2	1

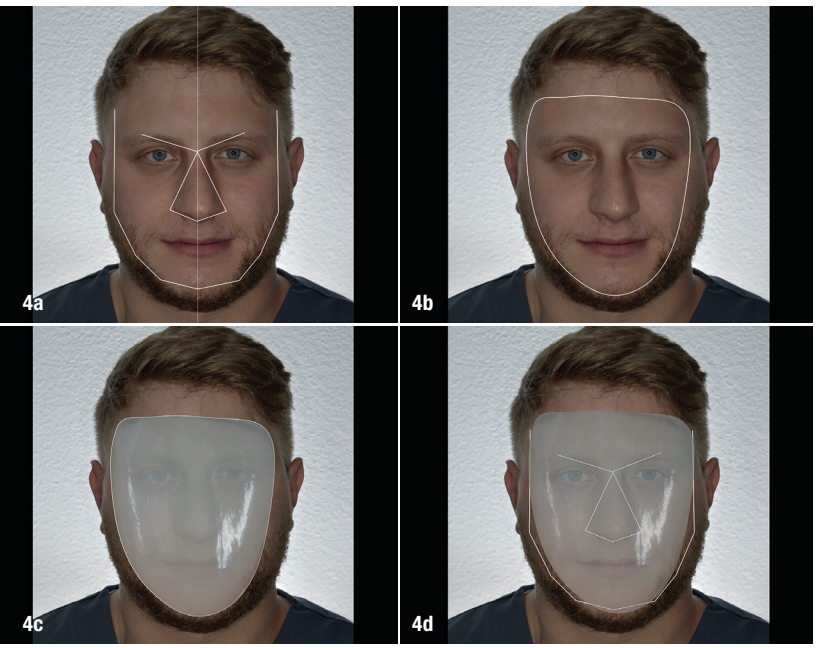
Table 1: Complementary classes.[13]

To create the final tooth form, the full or half segments can be recombined, creating complementary shape classes (Table 1).[13] The class numbering system (1:3, 1:2, 1/2:3 or 1/2:2) indicates which segment was used (the number before the colon signifies whether a full [1] or half [1/2] segment) and with how many basic tooth forms for recombination (the number after the colon signifies the number of basic tooth forms [2 or 3]).[13]

The first complementary class, 1:3, uses one full segment of each of the three principal tooth forms, resulting



Figs. 3a & b: Complementary class 1:3. Full tooth segments of all three basic forms are combined.[13]



Figs. 4a–d: Facial details taking into consideration the bifrontal, bizygomatic and bignathic areas. Tooth shape design on top.

in six different shape combinations (Figs. 3a & b).[13] The second complementary class, 1:2, uses one full segment combined with two principal tooth forms. This results in 18 different tooth shapes.[13] The third and fourth complementary classes, 1/2:3 and 1/2:2, involve half segments combined with three or two principal tooth shapes, respectively.[13] By dividing the tooth vertically or obliquely into two parts, the segments are always in contrast with the final shape, giving the tooth a more dynamic appearance.[11]

Case report

The laboratory starts digital analysis of the face of the patient on his bifrontal, bizygomatic and bignathic areas, drawing on top of the face a proposed anatomical configuration of the tooth that is mainly related to the aspects of the two central incisors.[15] Based on all the information from the office, this is the first step in a customised smile makeover (Figs. 4a–d).

The no-preparation veneers would be created working on an alveolar model that would allow the dental technician to condition the soft tissue on a hard material like dental stone. Soft-tissue modifications made on a hard material will assure a good result in the mouth once the restoration is placed (Figs. 5–8).

The veneers were made with a layering feldspathic ceramic technique. Because of the Shade A1 plus value chosen, the laboratory stratified the ceramic (Creation, KLEMA Dentalprodukte), using Shade A1 Dentin at the cervical surface and BD-A dentin with a higher value from the middle third towards the incisal edge. A white translucent ceramic material was used on the middle of the tooth surface to determine the quality of the value. In the incisal area, several translucent ceramic masses with blue, pink and opal transparency effects were applied (Figs. 9–13).[16]

After the glazing and manual polishing, the veneers were removed from the refractory cast and adapted to the master dies in dental stone. This step was realised using the microscope to assure precision and better fit. After this procedure, the last manual polishing was done to guarantee the smooth surface of the margins (Figs. 14–17). At this point, the veneers were ready to be delivered to the dental office for try-in and cementation.

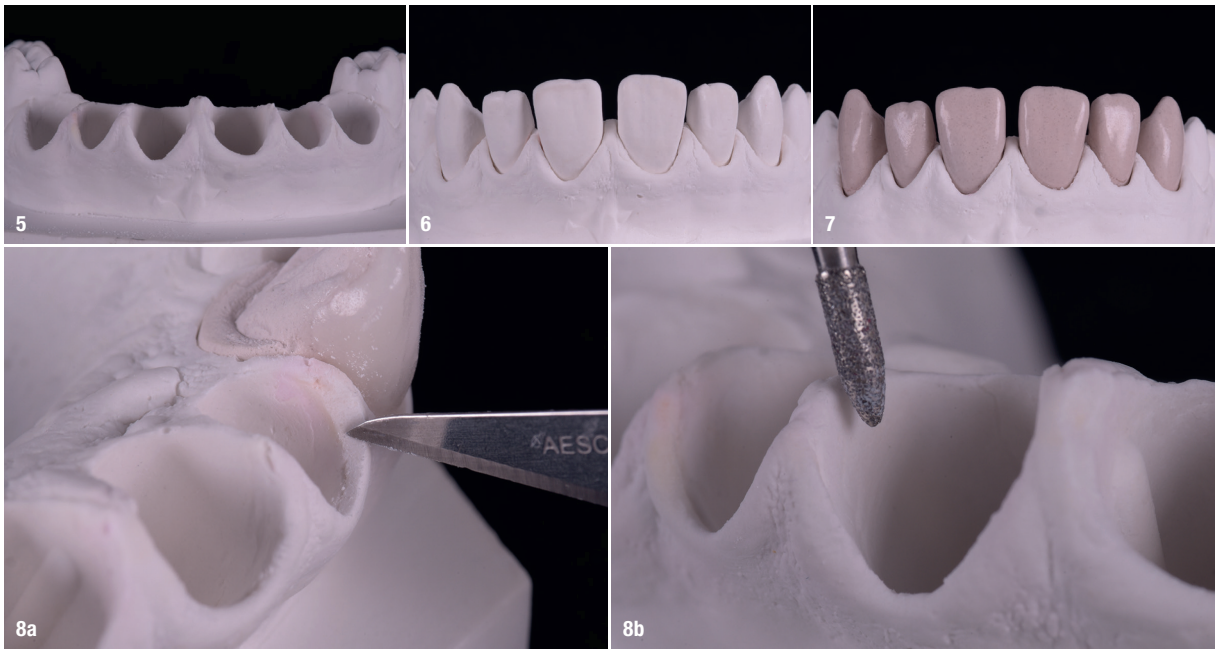
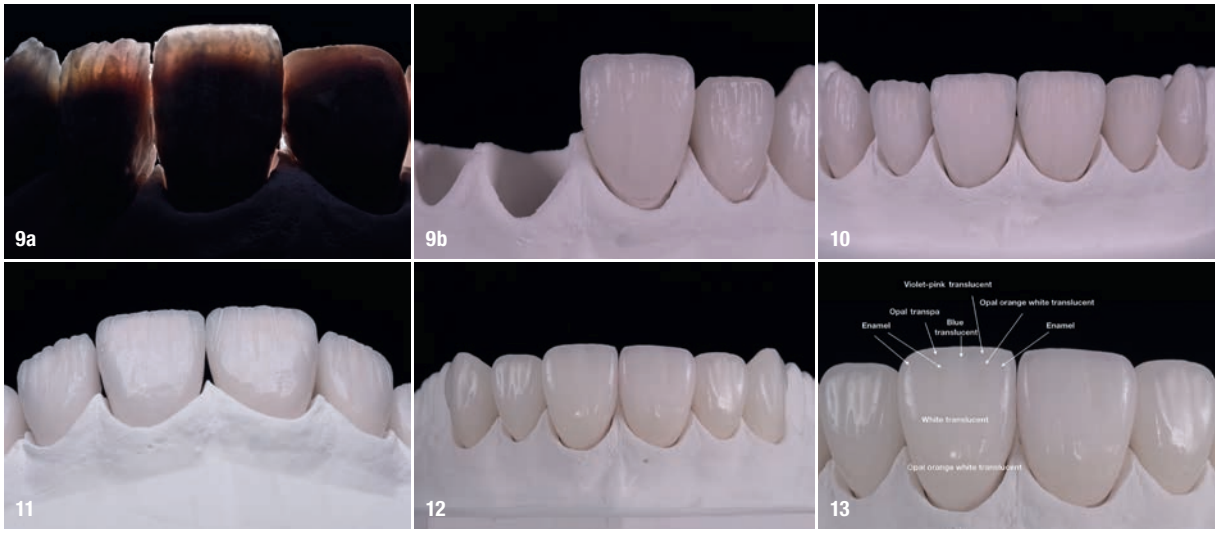


Fig. 5: Soft-tissue model of the alveolar model. **Fig. 6:** Alveolar model with original teeth. **Fig. 7:** Refractory dies on alveolar model. **Figs. 8a & b:** Soft-tissue conditioning on the model.



Figs. 9a & b: Ceramic layering. The first effects were brushed directly into the moist ceramic material via infiltration **(a)**. Result after the first firing ready to be worked on three surfaces, making vertical grooves for the staining procedure **(b)**. **Figs. 10 & 11:** Veneers with vertical grooves, placed on the cast ready for staining under microscope magnification. **Fig. 12:** Final result after correction baking and glazing. **Fig. 13:** Teeth with sectioned ceramic masses.

An important topic of this aesthetic rehabilitation is the precision of the margins. I would like to explain the difference between the meaning of "emergence profile" and "angle profile", which are in close connection regarding precision, but they have different specific meanings. The emergence profile concerns the precise relationship between the surface contour of the soft tissue and the facial contour surface of the tooth in its emergence profile that must not be overcontoured compared with the gingival margin. The emergence profile precision thus relates to two areas: the soft tissue and the facial contour of the tooth.

The angle profile concerns the relationship in precision between the technical margin of the veneers and the clinical finishing line preparation on the natural tooth in order to decide, under the microscope, the precise fit of the veneer and the suitable emergence angle inclination of the margin, which will determine subsequently the future emergence profile design (Fig. 18).

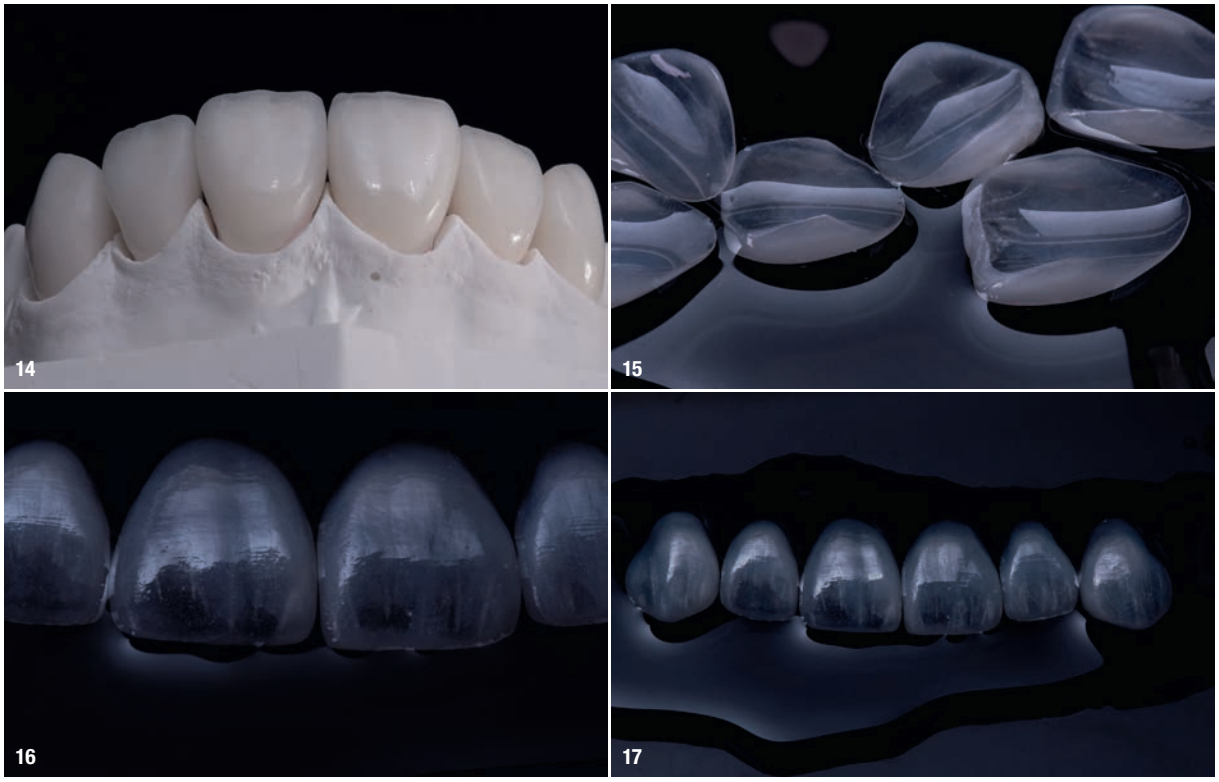


Fig. 14: Manually polished veneers on the model. **Figs. 15–17:** Accurate finishing line and veneer texture.

Fig. 18: The emergence profile versus the angle profile. Emergence profile (on the left): the relationship between the soft-tissue area and the facial surface of the tooth. Angle profile (on the right): the relationship in precision between the finishing line of the veneer (with suitable emergence inclination) and the clinical finishing line preparation. **Fig. 19:** Initial full-face photograph and smile. **Fig. 20:** Initial intra-oral situation. **Figs. 21a–c:** No-preparation veneers from tooth #13 to tooth #23 inserted in the mouth and created on an alveolar model, allowing the technician to condition and evaluate a new soft-tissue design that pushes the gingival margin back. **Figs. 22a & b:** Personalised smile in the facial context. Accurate tooth proportion with a precise finishing line, a sophisticated ceramic layering technique and veneer surface texture.

Conclusion

The technique described here employs a new concept for planning the individual shape of the teeth in the context of the patient's face.[17,18] Knowing the possibilities of anatomical configurations of the tooth, by combining the facial transition line segments and incisal edges, allows the dental technician to create a variety of individual shapes, avoiding common standard production. This is very significant from the dental technician's point of view in terms of how to use a specific technique to create a new, beautiful smile with natural-looking teeth (Figs. 19–22). Combining digital and analogue means of working is a constructive way to ensure harmony between individualised teeth and the facial type for the new custom smile redefinition.[19]

Acknowledgements

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

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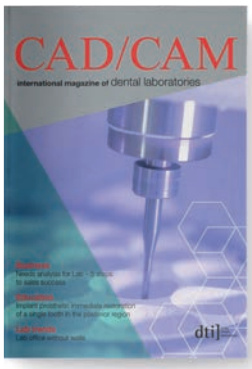

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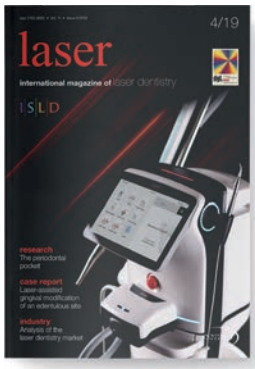

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Immediate implant placement and restoration in fractured central incisor with external root resorption

Drs Eirik Aasland Salvesen & Ida Koll-Frafjord, Norway

Fig. 1: Initial situation, extra-oral view. **Fig. 2:** Initial situation, intra-oral view.

Introduction

Many factors can be related to apical root resorption and rounding, among them orthodontic movement and occlusal trauma. In severe cases, the tooth can even become mobile. In normal situations, a fractured tooth above the gingival margin can be restored with conventional dentistry using an intra-radicular post and prosthetic crown. However, in cases where the root length is no longer optimal for use as a retentive element for an intra-radicular post, alternative options must be considered, which can include a removable partial prosthesis, a fixed three-unit bridge or a dental implant.

One of the main benefits of an implant that is placed and provisionalised immediately is the potential for an aesthetic outcome and preservation of the existing bone morphology and gingival architecture. To enable this type of treatment, adequate primary stability is a prerequisite, and the choice of implant design is directly linked to the expected outcome. Straumann BLX implants combine all properties to match all clinical situations from the surgical to the restorative perspective.

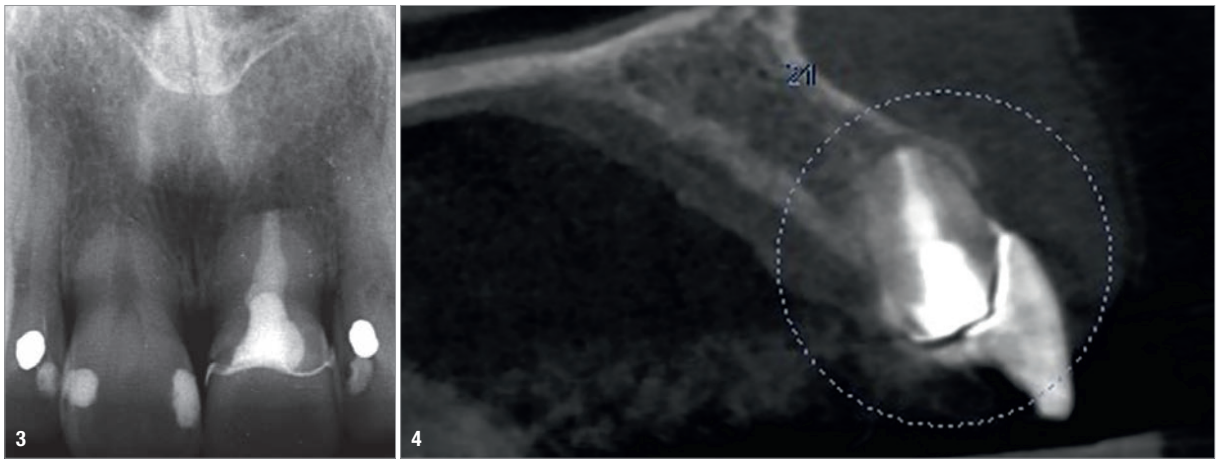


Fig. 3: Pre-op periapical radiograph. **Fig. 4:** Pre-op CBCT scan.

Initial situation

A 53-year-old female patient presented to the office with a fractured left central incisor which had been repeatedly bonded to a ceramic crown (Figs. 1 & 2). Anamneses and examination established good systemic and oral health, a well-balanced occlusion and no smoking habits. Cone beam computed tomography (CBCT) and a periapical radiograph showed external root resorption with very limited insertion into the alveolar bone, insufficient for adequate conventional intra-radicular post placement (Figs. 3 & 4). Considering that the fractured tooth was in the aesthetic zone, the patient requested restoration in the safest and fastest way possible.

Treatment planning

Given the clinical and radiographic situation with the position of the root towards the labial wall and sufficient apical bone, extraction followed by immediate implant placement (Straumann BLX) and immediate restoration was chosen as the treatment option. An immediate temporary abutment would be placed and chairside tooth shell pick-up technique for the provisional restoration.

Surgical procedure

Intra-sulcular incisions were performed to release the marginal gingival fibres to allow a minimally invasive extraction. The socket was carefully cleaned to remove any ligament and debris left. Special attention was given to assessing the alveolar wall integrity. A distance of 3 mm was observed between the gingival margin and the labial wall margin. Implant bed preparation considered a medium-density bone workflow, starting with the needle drill aimed at the palatal wall to create an entry point for the next drills, creating an osteotomy that allows for a greater area of implant engagement (Fig. 5). The Ø2.2 mm pilot drill was used to the respective implant length planned, followed by the use of an alignment pin to check the 3D orientation (Figs. 6 & 7). The Ø2.8 mm and Ø3.2 mm drills were used to finalise the osteotomy (Fig. 8). The site was then properly probed to assess for possible wall perforation.

A 4 × 14 mm implant was placed, starting with the surgical handle engaging the apical part of the implant, following the same orientation as that of the needle drill and correcting the implant direction as it moved within the osteotomy (Figs. 9 & 10). Primary stability (45 Ncm) was achieved at

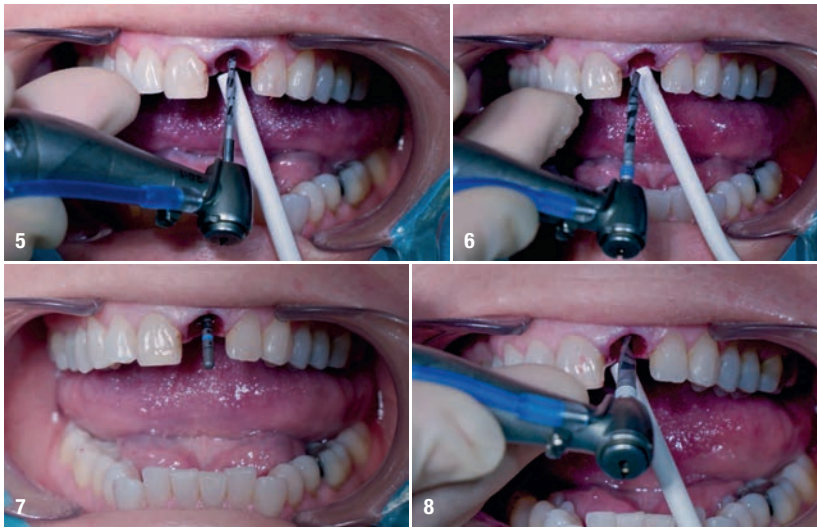


Fig. 5: Initial osteotomy with needle drill. **Fig. 6:** Osteotomy with Ø2.2 mm drill. **Fig. 7:** 3D confirmation with Ø2.2 mm alignment pin. **Fig. 8:** Osteotomy with Ø3.2 mm drill.

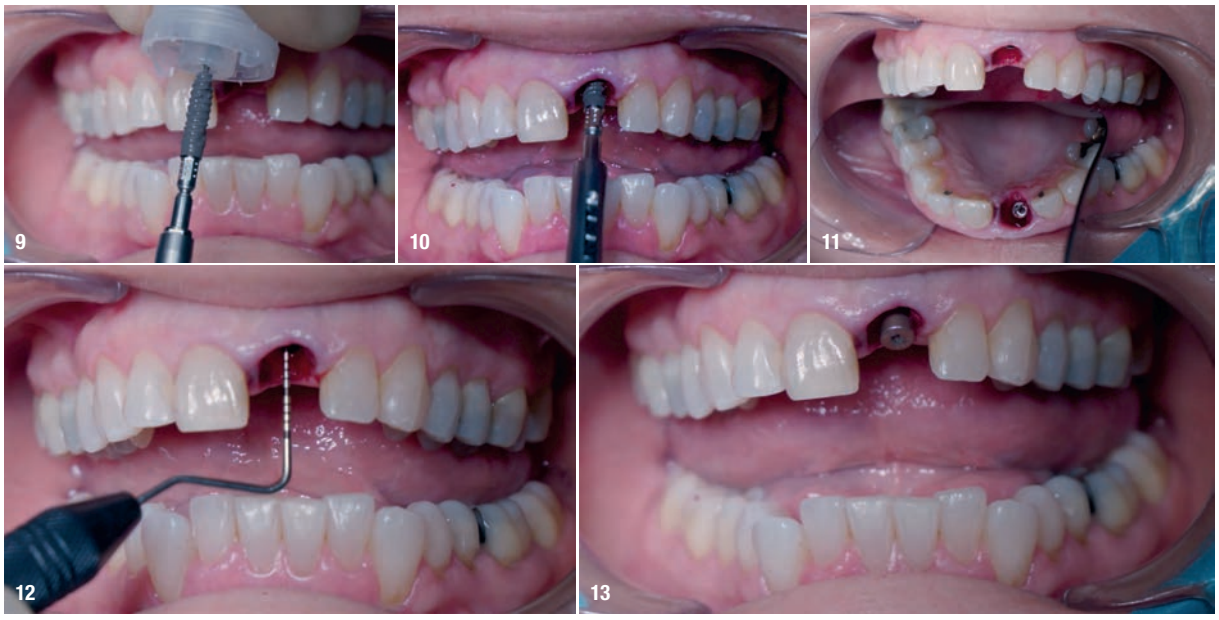
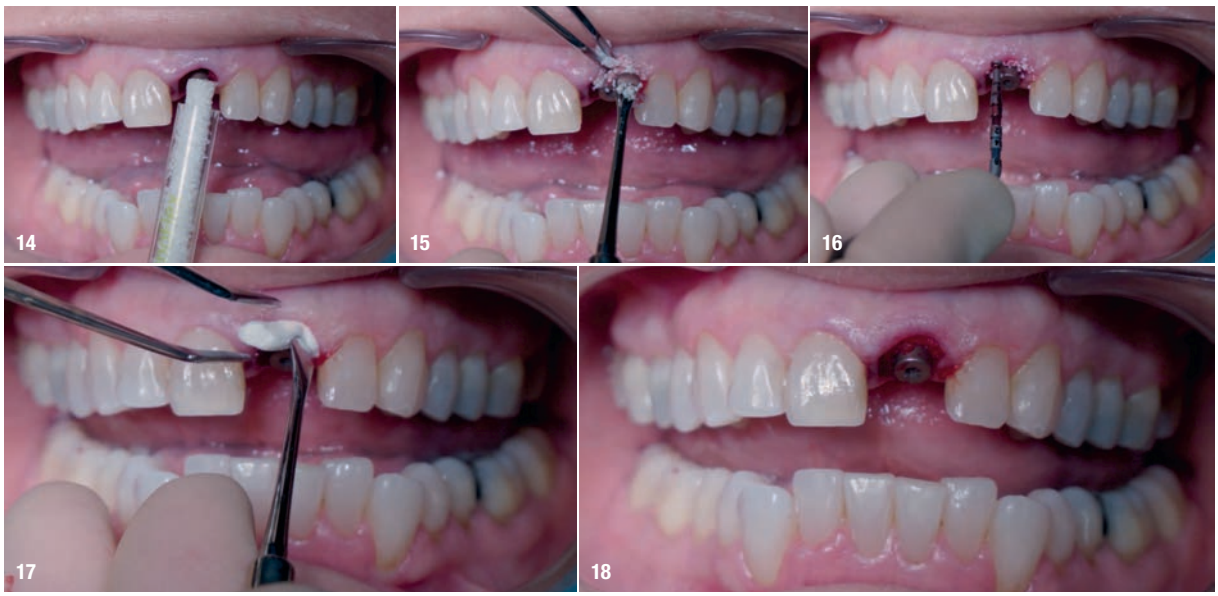


Fig. 9: Implant pick-up. **Fig. 10:** Implant placement with surgical handle. **Fig. 11:** Final implant position assessment. **Fig. 12:** Final implant position assessment in relation to gingival margins. **Fig. 13:** Healing abutment to protect connection.



Figs. 14 & 15: Straumann XenoFlex being applied in labial gap. **Fig. 16:** Granule condensation with surgical probe. **Fig. 17:** Application of collacone (botiss biomaterials). **Fig. 18:** Biomaterial application finalised.

the final position. After placement, the implant position was verified horizontally with an occlusal mirror and vertically with a surgical probe, and at this point, the abutment gingival height was selected (Figs. 11 & 12). A healing abutment was placed on to the implant (Fig. 13) to protect the connection so that granular bone substitute (Straumann XenoFlex) could be applied in the gap between the implant and labial wall. This was gently compacted in with the 2.8 mm side of the surgical probe (Figs. 14–16). Collacone (botiss biomaterials) was used to keep the bone granules away from the gingival margins in order to avoid soft-tissue fenestration and fibroblastic infiltration (Figs. 17 & 18).

Prosthetic procedure

A Ø 4 mm temporary abutment with a gingival height of 2.5 mm was placed on to the implant, and it showed no crestal bone interference, allowing for appropriate creation of the emergence profile (Fig. 19). The tooth shell, which was designed and milled in PMMA prior to the procedure (Figs. 20 & 21), was tested to ensure that the contours and retention wings were appropriate and caused no interference (Figs. 22 & 23). The palatal side, including a small portion of the incisal edge, was opened in order to allow screw channel access (Figs. 24 & 25). The lateral wings of the tooth shell allow the provisional temporary crown to stay immobile during the pick-up procedure, which is a common problem clinicians face when performing the immediate pick-up technique.

The tooth shell was bonded to the temporary abutment using flowable light-polymerising composite, and a slim emergence profile was created to the subgingival portion using the same material (Fig. 26). At this point, the retention wings were removed. With no compression to the soft tissue, the provisional crown was seated and the incisal edge adjusted to ensure that the antagonist tooth was not touching it in excursive movements. The provisional crown was torqued to 25 Ncm, and the screw

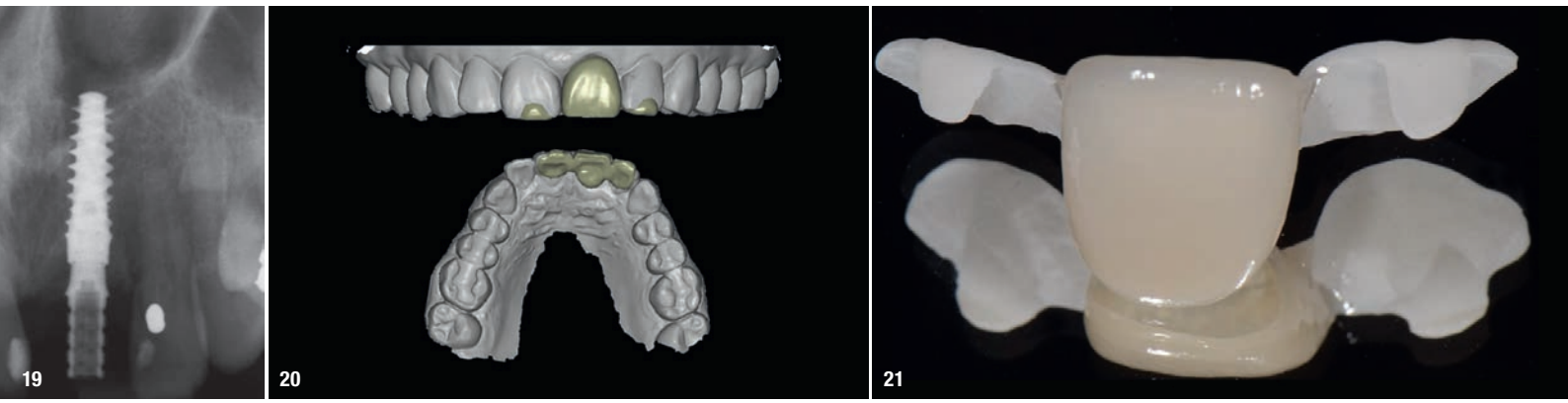
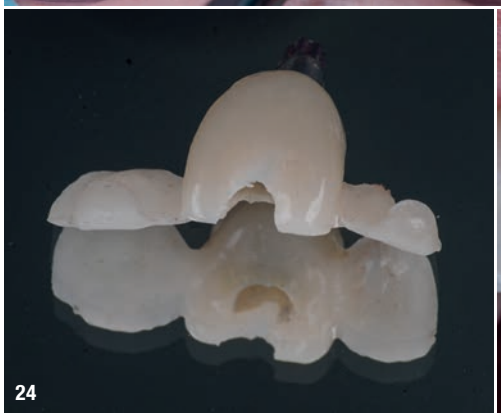


Fig. 19: Periapical radiograph to confirm temporary abutment gingival height. **Fig. 20:** Temporary crown designed in coDiagnostiX (Dental Wings). **Fig. 21:** Temporary crown milled in PMMA.



Figs. 22 & 23: Fitting assessment of provisional tooth shell. **Fig. 24:** Screw access open. **Fig. 25:** Temporary provisional tooth shell in position for pick-up of the temporary abutment.

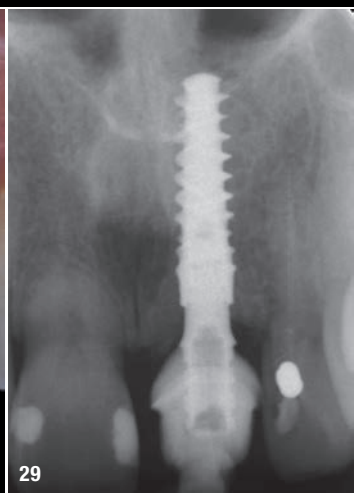


Fig. 26: Temporary provisional tooth shell after pick-up impression taking and emergence profile creation. **Fig. 27:** Temporary crown seated and polished. **Fig. 28:** Temporary crown one week post-op. **Fig. 29:** Periapical radiograph one week post-op.

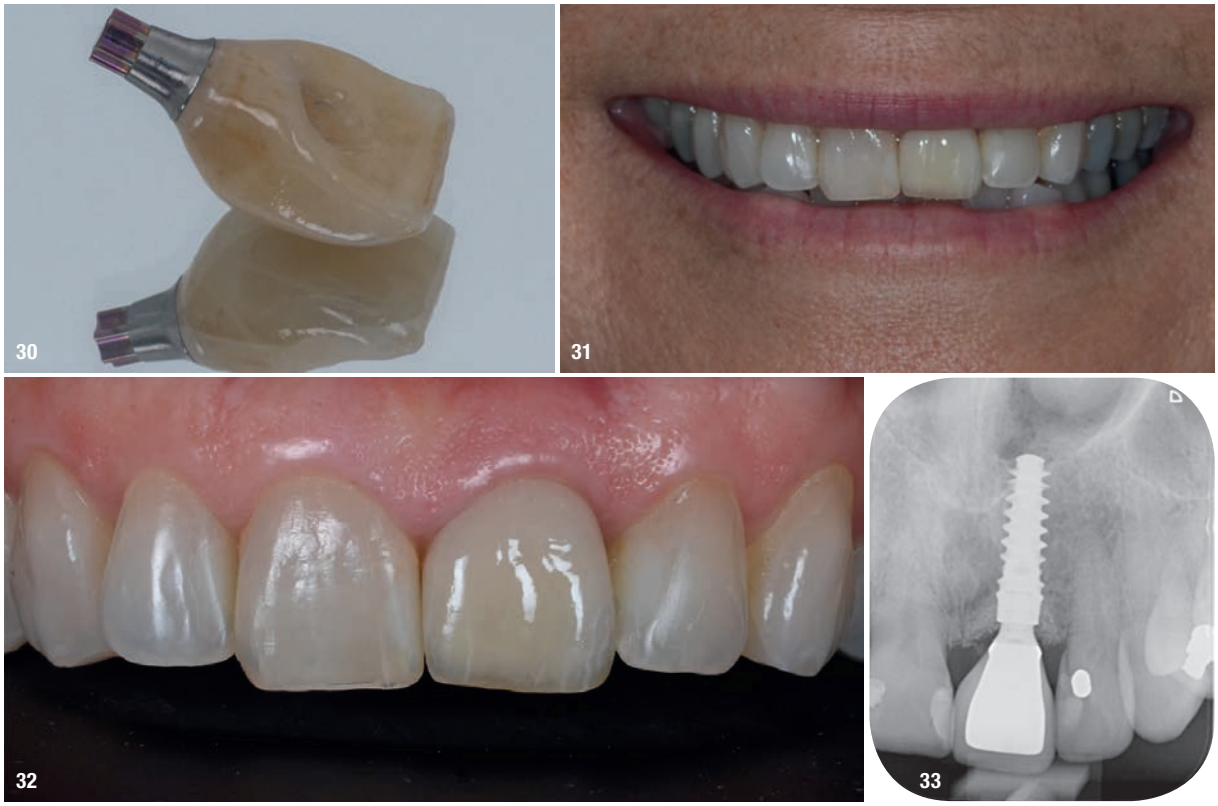


Fig. 30: Monolithic ceramic crown cemented to a regular base/wide base Variobase abutment. **Fig. 31:** Final result while smiling. **Fig. 32:** Final result close up. **Fig. 33:** Final result radiograph.

access hole properly closed and polished (Fig. 27). The patient was seen seven days later for postoperative and periapical radiographic control (Figs. 28 & 29).

The final prosthesis was designed using Straumann CARES Visual following a digital workflow. During the design step, it was possible to see that the screw access hole would stay completely to the palatal side with no interference in the aesthetics of the restoration. A monolithic ceramic crown (Prettau Zirconia, Zirkonzahn) was milled and cemented extra-orally to a regular base/wide base Variobase (Straumann) with a gingival height of 1.5 mm, corresponding to the healing remodelling of the bone architecture (Fig. 30). The restoration was seated and screwed to a torque of 25 Ncm after occlusion, contact points and excursive movements had been checked (Figs. 31–33).

Treatment outcome

The patient was a dental nurse in a dental practice and thus had direct interaction with many patients during her working shifts. For her, it was extremely gratifying to be able to leave the dental chair knowing that the compromised tooth had been extracted and the implant placed and restored immediately. The final crown matched the texture and shade of the adjacent teeth, bringing harmony to the smile. The patient referred to the final crown as “the cherry on the cake”.

about

Dr Eirik Aasland Salvesen
graduated with a DDS from the University of Bergen in Norway and specialised in periodontics. He is the co-founder of Oris Dental, a large dental service organisation in Norway, and the executive director of Oris Academy. Since 2004, Dr Salvesen has lectured worldwide on dental implants, periodontics and hard- and soft-tissue augmentation, and since 2006, he has been providing surgical courses and lectures internationally, in cooperation with leading dental companies. A proponent of immediate treatment protocols, Dr Salvesen shares his experience with the global community of dental professionals. He is a long-time International Team for Implantology fellow and has more recently been involved in product development for Straumann.

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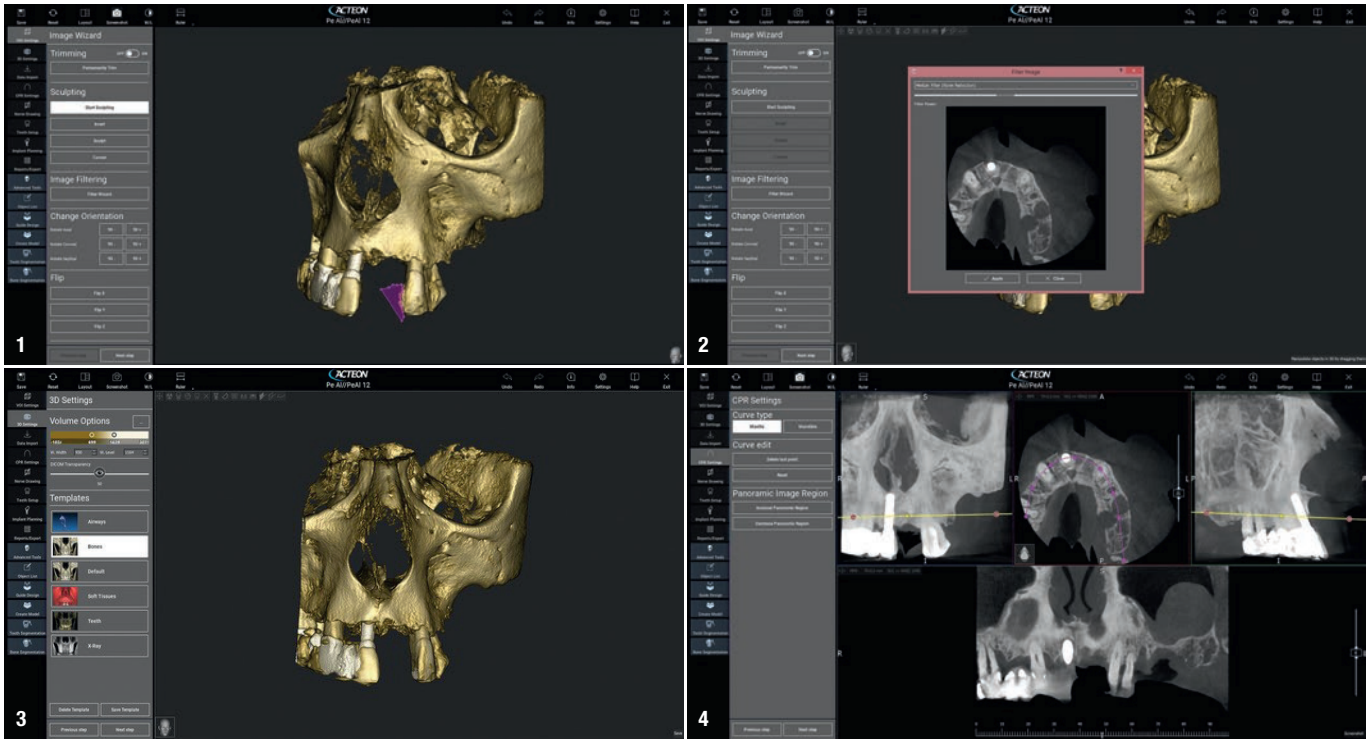
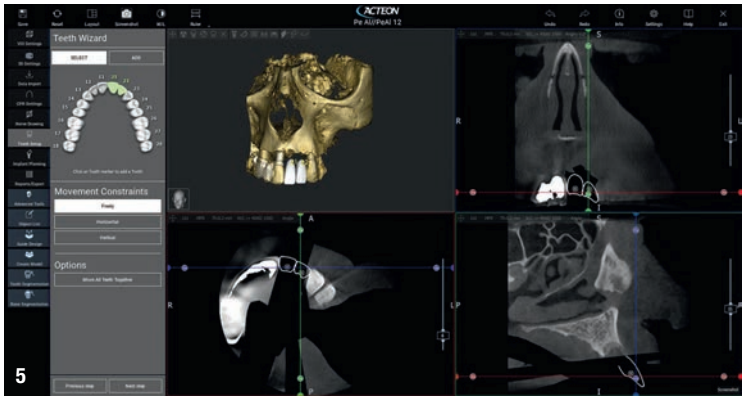
Implantation in a case of severely reduced interproximal width of the alveolar ridge in the anterior upper jaw

Dr Henrik-Christian Hollay, Germany



Introduction

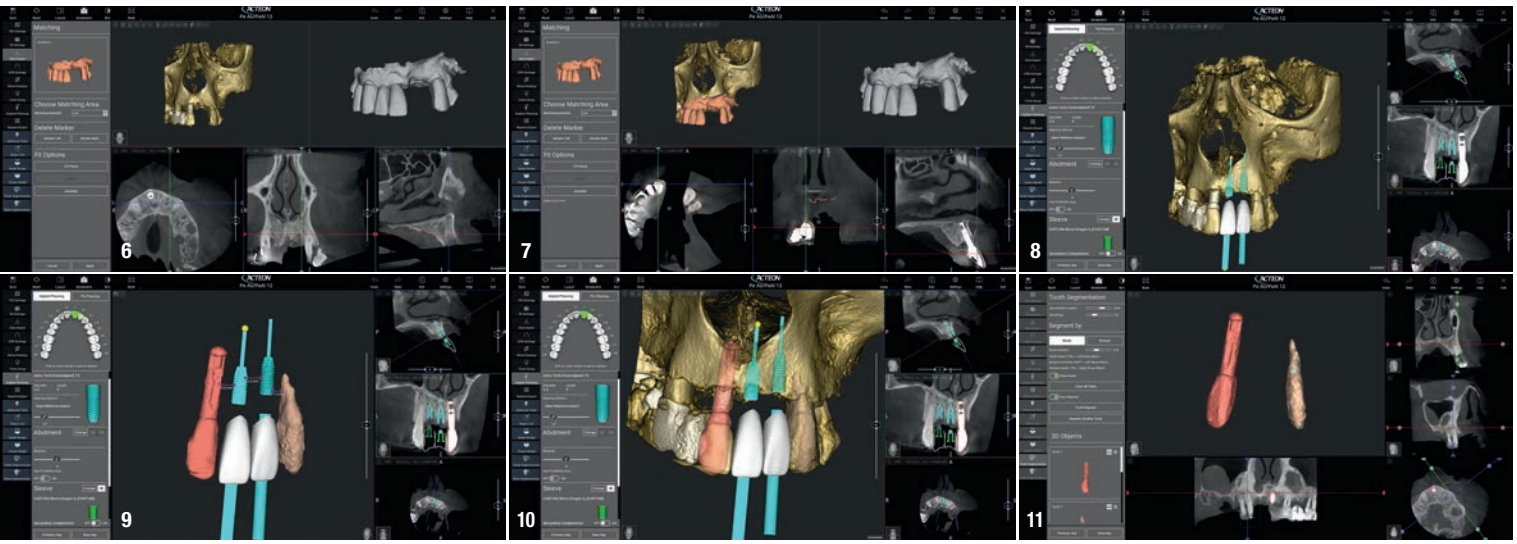
As dentists, we often are faced with the challenge of restoring tooth loss situations in the upper jaw that offer only very little room between related neighbouring structures. Especially the vertical reduction of the alveolar ridge forces us to plan the implant position more cranially, and owing to the tapering oval form of the upper jaw, the space becomes reduced.



In most cases, the correct correlation and distance cannot be measured using 2D radiography. 3D radiographic diagnostics like CBCT offer us the possibility of measuring the exact parameters and precisely planning a restoration. The following case report describes a highly precise implant positioning procedure to replace teeth #21 and 22.

Anamnesis

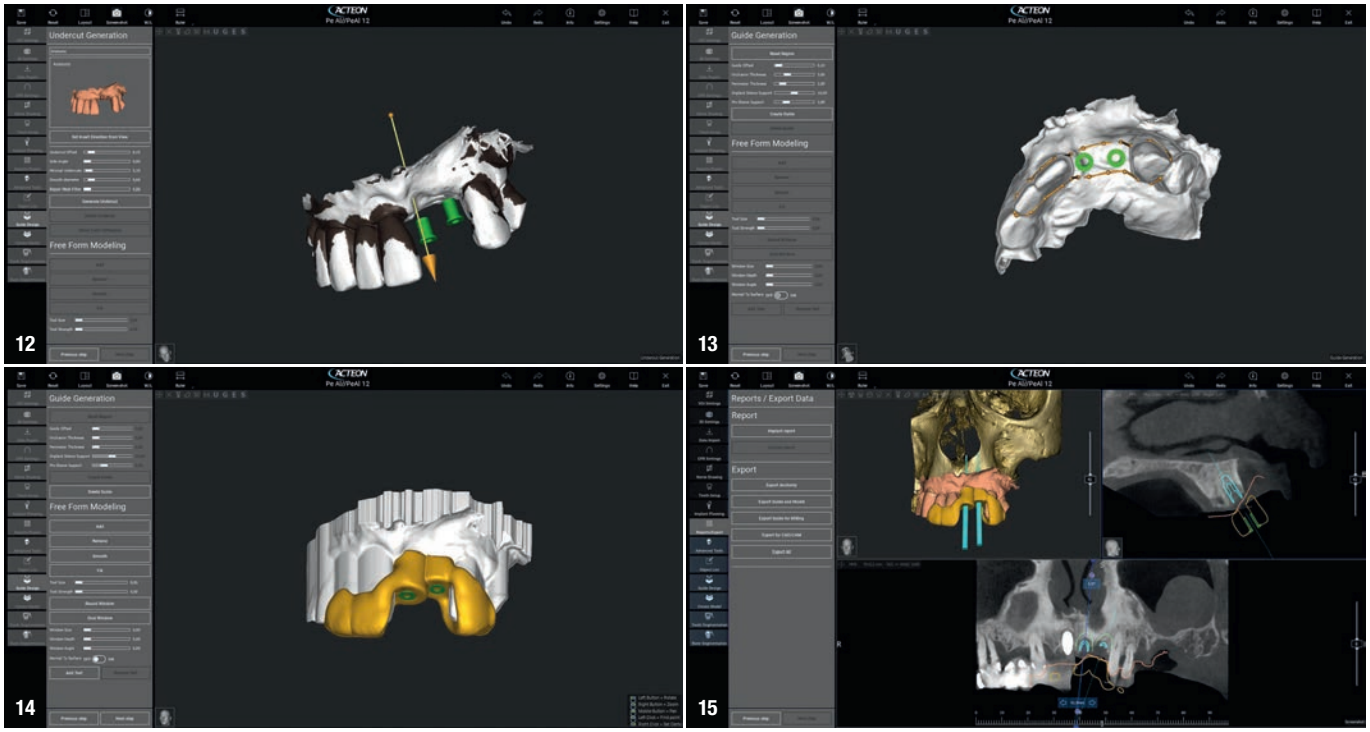
The 79-year-old patient was referred to our clinic by his general dentist with the request for a fixed restoration



of regions #21, 22 and 25. The patient's health was appropriate to his age. He was a non-smoker and reported suffering from minor heart problem, which had been treated about five years before and for which he took ASS 100 daily. His pre-existing periodontal disease had been continually treated for several decades, but had led to loss of the second molars on both sides of the lower jaw and the first molar in the left lower jaw in 2013. Implantation in region #36 was done in our clinic.

In October 2019, his treating dentist extracted teeth #21, 22, 25 and 26 owing to massive loosening, owing to periodontal lesions. The healing process was uneventful. After a healing period of around three months for the extraction sites, we started planning the restoration. For that purpose, we took a CBCT scan (X-Mind trium, ACTEON; position: seated; 80 × 80 mm; 90 kV; 8 mA; 1,128.38 mGy cm^2).

The evaluation of the situation with the ACTEON Imaging Suite software (Version 5.0; Figs. 1–4) showed significant vertical bone loss at all examined remaining teeth and the implant in region #11 directly next to one of the implantation sites. The distance measured between the neighbouring structures, tooth #23 and implant #11, was 15 mm. As the implant-to-implant distance should

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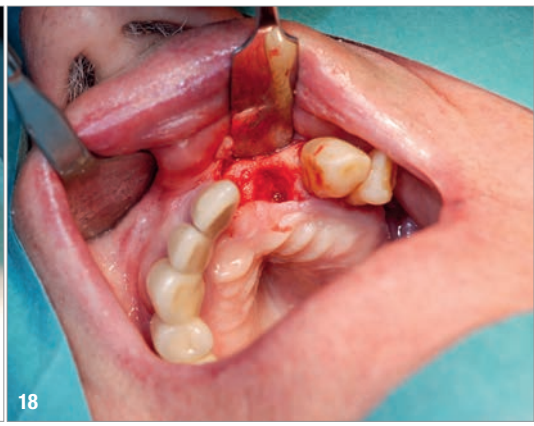
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not be less than 3.0 mm and the implant-to-tooth distance must not be less than 1.5 mm, according to all known guidelines, the working space could be described as limited. The vertical length of the alveolar ridge towards the nasal floor was measured as 10 mm.

Owing to the limited residual bone, which narrowed the choice of usable implant lengths, and the expectable negative implant-to-crown relation, we decided not to use diameter-reduced implants and chose a size of 3.5 × 9.0 mm. These implant diameters added to the mandatory safety distances between the structures exactly suited the situation. To ensure the correct positioning of the axes of both implants, we created virtual teeth to simulate the future prosthetic crowns (Fig. 5).

Even with a great deal of experience in dental surgery and a good eye for the situation, the precise insertion of implants regarding axes and horizontal dimensions is a challenge that can easily lead to failure. To avoid this risk, we decided to insert the implants guided with a surgical template.

Planning

The surgical template was not designed for a fully guided workflow, but for transferring the defined position. After the precise planning of the implant locations, drill sleeves (StecoGuide, steco-system-technik) with an inner diameter of 2 mm were set and an intra-oral scan (Primescan, Dentsply Sirona) of the soft tissue was matched with the DICOM bone formation (Figs. 6–10). To clear the view on the distances between the planned implants and the neighbouring structures, tooth #23 and implant #11 were segmented as stand-alone images (Fig. 11).

The construction of the surgical template was done with ACTEON Imaging Suite as well and resulted in an exportable STL data file of the surgical template (Figs. 12–15). The template was printed using a stereolithographic procedure (Form 2, Formlabs) and an autoclavable plastic material (Dental SG, Formlabs). After the rinsing and hardening procedures, the sleeves were worked in manually (Fig. 16). The complete surgical template was sterile-packaged at 121 °C and a pressure of 2 bar.

Surgical procedure

A professional dental cleaning was done a few days before the procedure. For further bacterial reduction, we used chlorhexidine digluconate directly before the procedure. We first administered local anaesthesia (Ultracain D-S forte, Sanofi-Aventis; two vestibular appli-


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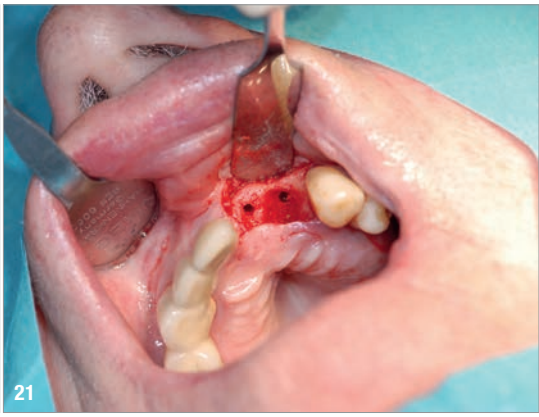
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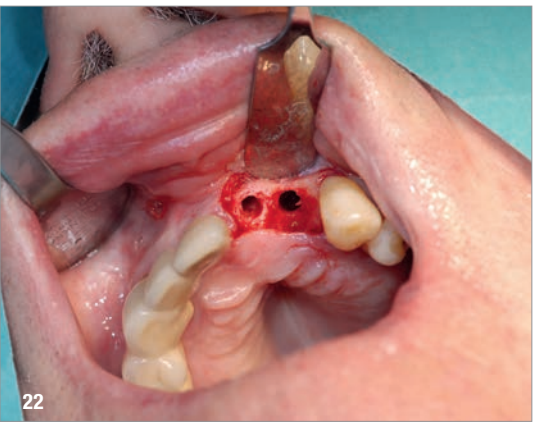
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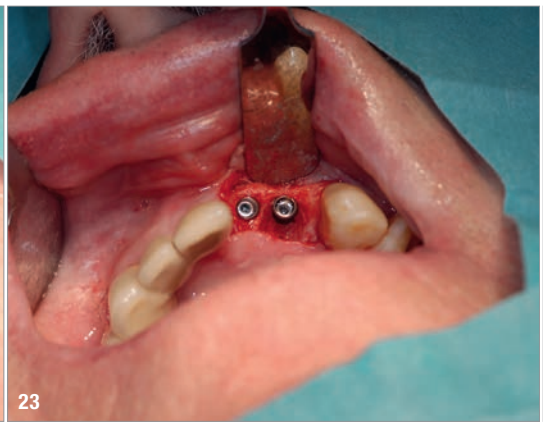
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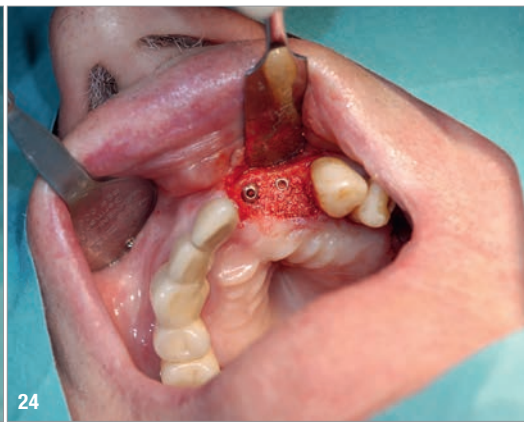
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cations and one palatal application). Thereafter, we raised a flap at the implantation site, avoiding vestibular periosteal elevation (Fig. 17). The open bone surface was cleaned with diamond-coated rotating burs (degranulation kit designed by Dr Efraim Kfir; Strauss & Co.; Fig. 18).

With the surgical splint, we started the transfer of the planned implant positions, using the depth preforming drill with a diameter of 2 mm (Astra Tech OsseoSpeed TX implantation kit, Dentsply Sirona) and a penetration depth of around 5 mm (Figs. 19–21). The final depth, as well as the widening of the implant bed, was achieved without the splint (Fig. 22). Two implants (Astra Tech OsseoSpeed TX) were inserted (Fig. 23), and the small bone defect palatal of the collar of the implant in region #22 was restored with self-hardening beta-tricalcium phosphate (GUIDOR easy-graft CLASSIC 400, Sunstar Suisse; Fig. 24) and sutured with a PTFE suture (GORE-TEX Suture, P5K17; Gore Medical; Fig. 25). We tried to take the postoperative radiograph as parallel as possible (Fig. 26).

Conclusion

The outcome of this special case was able to be improved by the use of 3D planning and 3D guided surgery procedures. The re-entry was planned for June 2020. Since we were able to minimise the risk of damaging the neighbouring structures to a large extent, the healing process had been uneventful by the time of writing and the greatest part of the implant surface was covered with native bone, we expected a positive end result.

Once one is familiar with the procedure, the workflow of intra-oral scan and CBCT scan capture, followed by planning and construction using ACTEON Imaging Suite can be done very easily and quickly—although guided surgery does have its own risks. The demonstrated case offered good visualisation of all relevant structures. The description of the surfaces of all neighbouring structures was sufficient to easily match the intra-oral scan, and the neighbouring structures were firm enough to position and retain a surgical template. As the matching process is significant for the outcome of the surgical procedure, this is the most important step in the entire workflow.


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To improve the already very reliable procedure, it would be great to widen the possibilities of the STL file transfer system. Once it is possible to transfer an image of templates of implants in STL format, positioned in a DICOM data set and matched with the anatomy taken with an intra-oral scan, back to a restorative construction software programme like exocad, CEREC or inLab, we would have the possibility of backward planning completely digitally to determine the perfect implant position.

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Full-arch implant surgical and restorative considerations

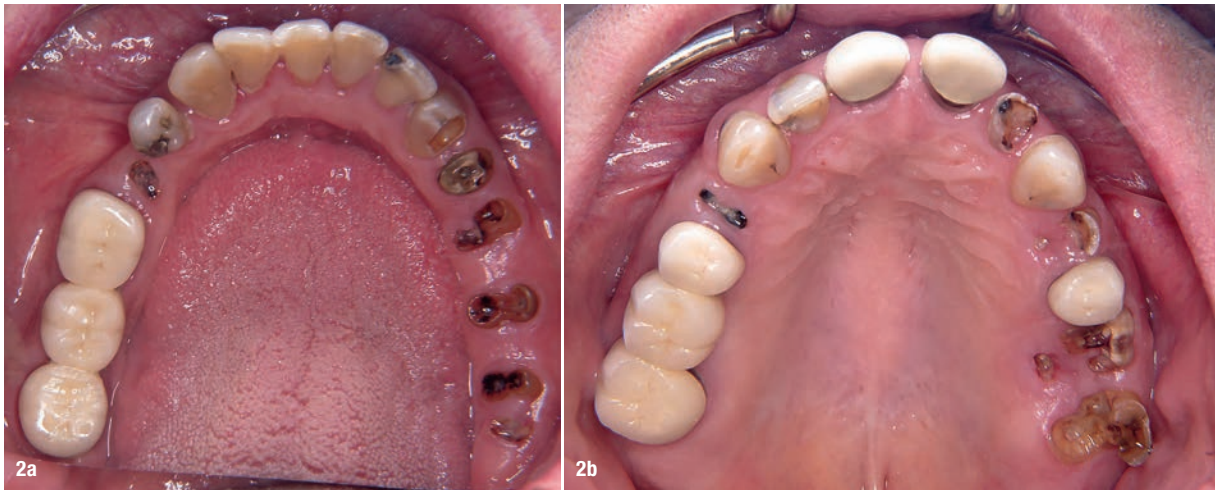
Innovations in the digital workflow with the iJIG

Drs Scott Ganz & Isaac Tawil, USA

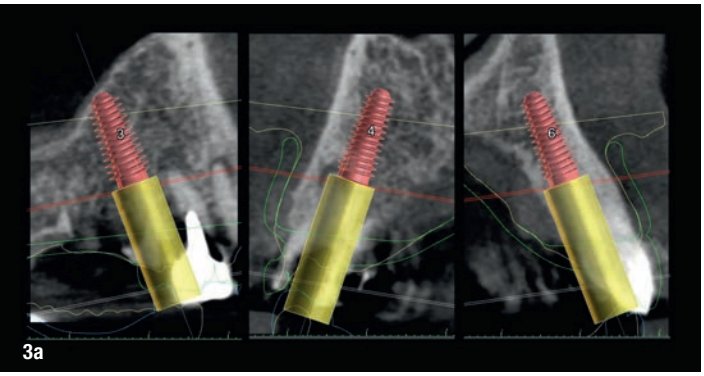
Figs. 1a–c: The pre-op intra-oral retracted view revealed missing, broken, fractured and decayed teeth with plaque and calculus accumulation and severe soft-tissue inflammation.

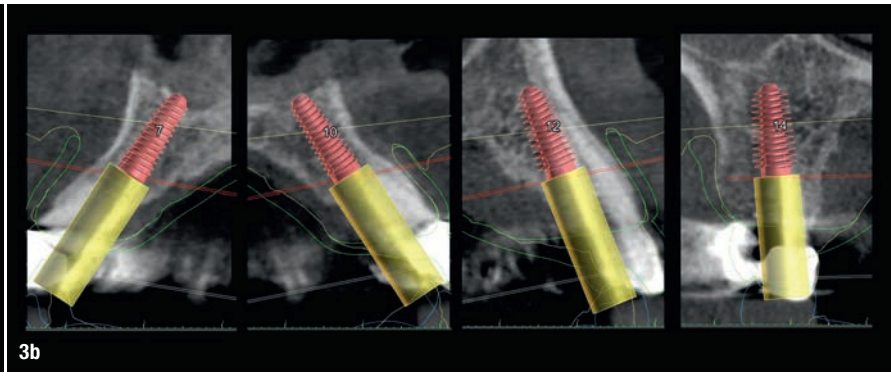
When a patient presents with a failing dentition, there are several different treatment options available if contemplating a fixed prosthesis supported by dental implants. This could include extraction and bone grafting, allowing the ridge to heal before implants are placed, or extractions and immediate placement of implants with concurrent bone grafting to fill any voids in the remaining bony architecture. These two examples would usually leave the patient with a removable complete denture during the healing phase prior to loading of the implants for either a fixed or removable restoration. A treatment alternative was presented by the authors in CAD/CAM *4/2019* which described the necessary steps for achieving restoratively driven surgical planning for full-arch implant reconstruction where implants are loaded on the day of surgery with a prefabricated fixed provisional restoration.

Immediate loading of dental implants offers many advantages over delayed treatment alternatives, including the following: (a) the surgical phase is generally completed in one visit; (b) the pre-established occlusion can be planned in advance to achieve an immediate functional and aesthetic result; (c) the overall treatment time to definitive restoration is reduced; and (d) the number of patient visits is reduced. As technology continues to evolve, so too do the variations in protocols that have



Figs. 2a & b: The patient complained of pain and difficulty chewing and exhibited a reduced vertical dimension of occlusion and hyper-erupted posterior teeth.





Figs. 3a & b: Cross-sectional images show the planned positions of each implant. The yellow projections reveal the trajectories and positions of the screw access holes as they emerge through the tooth set-up outline (green). The red line represents the coronal portion of the implants and where the bone would be reduced.

been developed to enhance the process of delivering both preoperative and postoperative treatment. This current article presents innovations that can improve the workflow essential to improving efficiencies and achieving success with single and dual full-arch implant reconstruction.

Diagnostics and surgery

A 58-year-old male patient presented with a failing dentition. The preoperative intra-oral retracted view illustrated missing, broken, fractured and decayed teeth, plaque and calculus accumulation, as well as severe soft-tissue inflammation (Figs. 1a–c). The patient complained of pain and difficulty chewing and exhibited a reduced vertical dimension of occlusion and hyper-erupted posterior teeth (Figs. 2a & b). The pre-existing intra-oral condition was recorded with impressions and stone casts that were then digitised with a desktop scanner. Additionally, an intra-oral scan (3Shape) recorded the existing occlusion. The patient's anatomy was fully assessed with 3D imaging technology and interactive treatment planning software. Cone beam computed tomography (Carestream) was essential in order to visualise the periapical pathology exhibited by multiple teeth. Utilising the digitised casts, the dental laboratory completed a virtual tooth set-up to establish the correct plane of occlusion, function and aesthetics. The virtual occlusion was merged with the original tooth set-up to assist in the diagnostic phase of selecting the appropriate implant receptor sites. The dimensions and volume of the alveolar bone, thickness and opacity of the cortical plates, and overall bone density were important in evaluating each implant receptor site, necessary for initial stability. Cross-sectional images reveal the planned positions of each implant to achieve a screw-retained fixed restoration on seven proposed implants (Figs. 3a & b).

The surgical phase was planned to utilise the full-template guided surgical protocol as described in the first article (CAD/CAM *4/2019*) and therefore only summarised here. On the day of surgery, the necessary components included the tooth-borne fixation base with pin guide, anchor pins, bone reduction guide, osteotomy drill guide, carrier guide and transitional full-arch prosthesis, and various 3D-printed models for both maxillary and mandibular arches (Fig. 4; CHROME GuidedSMILE, ROE Dental Laboratory). The fixation base was first secured to the pin guide and then seated on the maxillary teeth. The facial anchor holes were drilled through the guide holes in the metal

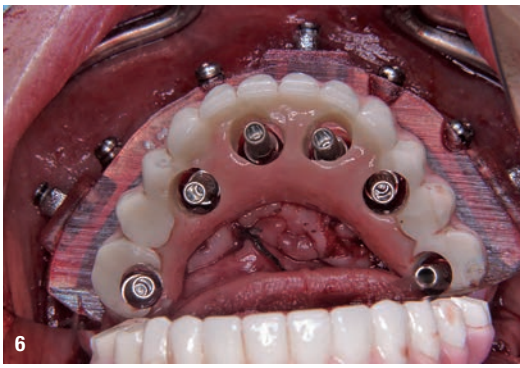
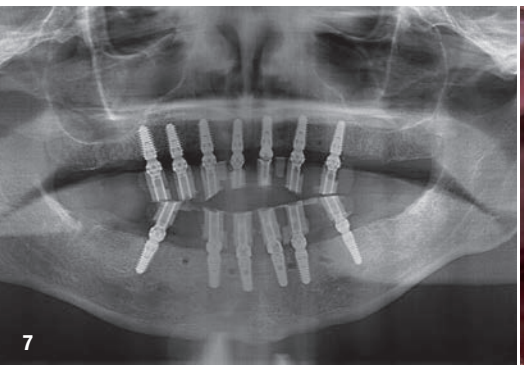


Fig. 4: The necessary components included the tooth-borne fixation base with pin guide, anchor pins, bone reduction guide, osteotomy drill guide, carrier guide and transitional full-arch prosthesis, and various 3D-printed models for both maxillary and mandibular arches. **Fig. 5:** The fixation base was first secured to the pin guide and then seated on the maxillary teeth so that facial anchor holes could be drilled and anchor pins placed through the guide holes of the fixation base. **Fig. 6:** The carrier guide was used to accurately position the transitional prosthesis so that it could be secured to the implant sleeves with dual-polymerising composite material.



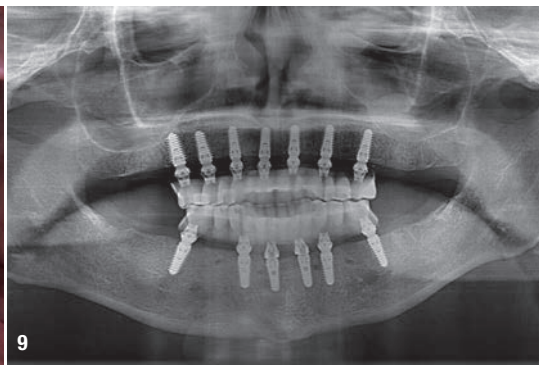
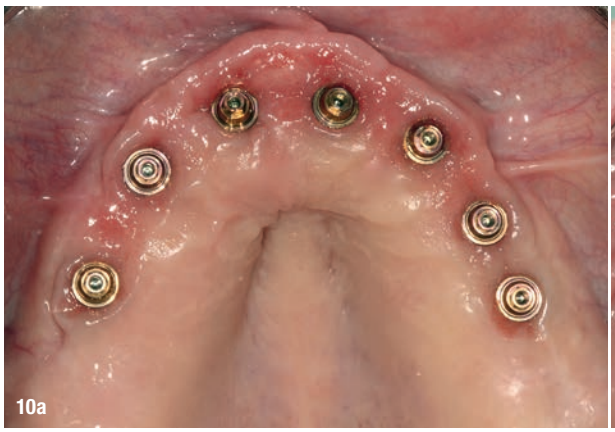


Fig. 7: The post-op panoramic radiograph revealed an excellent surgical result for both arches after the placement of 13 implants. **Fig. 8:** The transitional maxillary and mandibular restorations were evaluated for proper bite and occlusion. **Fig. 9:** The panoramic radiograph at two months revealing the transitional screw-retained prostheses.

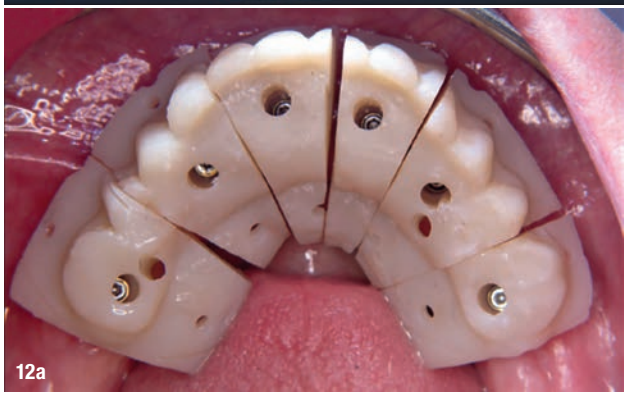
guide, and anchor pins were then placed transcortically through the buccal surface of the fixation base (Fig. 5). The teeth were extracted, and the bone was levelled according to the surgical plan (red line on cross-sectional images). Based upon the software plan (Blue Sky Plan), seven implants were placed (AnyRidge, MegaGen). Using resonance frequency analysis, implant stability values (ISQ, Osstell) were measured for each to ascertain stability for loading. Multi-unit abutments were placed on each implant based upon the tissue height and to redirect the screw access hole correctly within the envelope of the restoration. Titanium sleeves were then attached to each implant, and the carrier guide was used to accurately position the transitional prosthesis so that it could be secured to the implant sleeves with dual-polymerising composite material (STELLAR DC, Taub Products; Fig. 6). The process was repeated for the mandibular arch. The postoperative panoramic radiograph showed an excellent surgical result for both arches after the placement of 13 implants (Fig. 7). The transitional maxillary and mandibular restorations were evaluated for proper bite and occlusion (Fig. 8). After an adequate healing time (Fig. 9), the prostheses were removed and the soft-tissue maturation was evaluated relative to the multi-unit abutments (Figs. 10a & b).

Restorative phase

The conventional restorative phase would usually commence with intra-oral impressions to relate the implant positions to a master cast for the dental laboratory to design and fabricate the definitive prosthesis. From the master cast, it would be required to complete a verification index of the implants and determine the vertical dimension of occlusion, centric relation and bite registration using standardised prosthodontic protocols. However, current technology allows for the introduction of improved digital workflows that greatly aid the restorative phase. A combination of analogue and digital solutions were developed over time with the introduction of the iJIG (ROE Dental Laboratory). The initial purpose of the iJIG was to help with the design and fabrication of a full-arch restoration from an existing full-arch transitional restoration on multi-unit abutments. Simply, the iJIG is a verification jig with teeth. The device allows the clinician to lute passive sections together in the mouth, equilibrate the occlusion, capture the bite and pick up the intaglio soft tissue. This device provides all of the necessary records to fabricate a definitive or prototype restoration. It is also necessary to submit photographs of the full face and full smile, especially if aesthetic changes are desired.



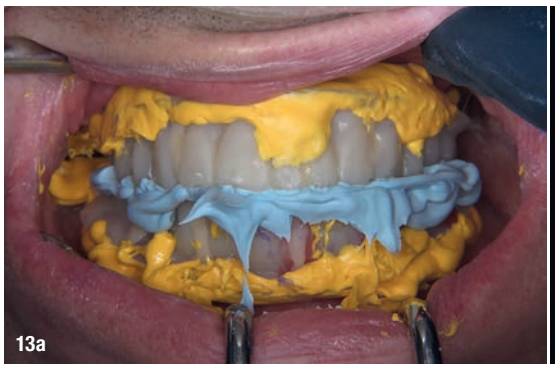

Figs. 10a & b: The prostheses were removed after an adequate healing time, and the soft-tissue maturation was evaluated relative to the multi-unit abutments.

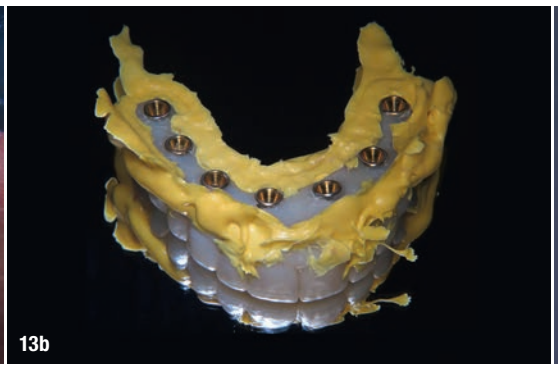


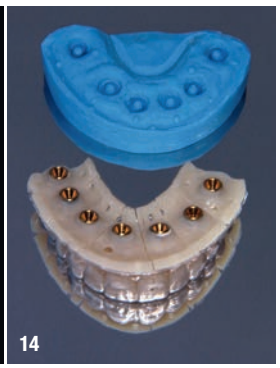
Figs. 11a & b: The maxillary and mandibular iJIGs were sectioned and held together with a clear vacuum-formed overlay for seating and then intra-oral luting. **Figs. 12a & b:** Each section of the iJIG was tightened on to the multi-unit abutments and luted together with either flowable composite or autopolymerising or dual-polymerising resin.

The first-generation iJIG involved removing the existing transitional prosthesis for digitisation with a 360° scan with either an intra-oral scanner or a desktop scanner. The prosthesis was then reseated to scan the opposing arch and to digitally record the bite relationship. The first generation was adequate in concept, but very challenging for both the clinician and the dental laboratory technician trying to decipher the images of the cylinders and trajectory of the access holes to align the components. To overcome this difficulty, special iJIG analogues (ROE Dental Laboratory) were developed to accurately capture the positions of the implants and prosthetic components. The third generation utilised CAD software to develop digital tooth set-ups with anatomical teeth that were used to compensate for the equilibrated and worn teeth as a result of function during the healing phase. The fourth-generation iJIG is a prosthetic device that was designed based on the concept of "see your smile before surgery". With CHROME GuidedSMILE, most patients receive a nearly true-to-form smile simulation and subsequent virtual tooth set-up based on STL files that mimic the simulation.

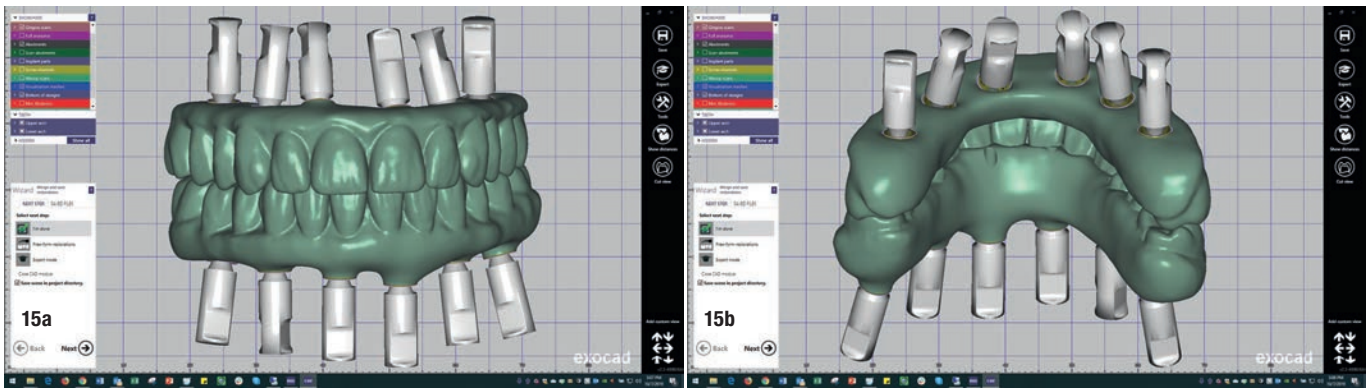
During the planning phase, the implants were positioned based upon the merging of intra-oral scans or digitised stone casts in combination with the transitional prosthetic design exported as an STL file. Therefore, the original implant and tooth planning phase rendered an ideal set-up







Figs. 13a & b: The iJIG prosthesis was reinserted, and a polyvinylsiloxane impression material was injected via syringe to capture the tissue interface and bite relationship. **Fig. 14:** A stone model was created from the impression to capture the location of the multi-unit abutments.

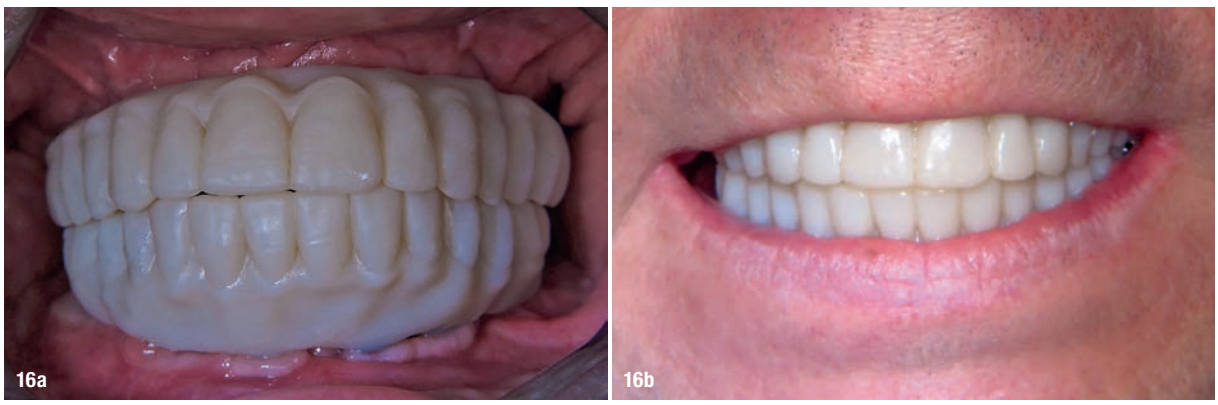


Figs. 15a & b: The digitally articulated maxillary and mandibular arches were designed based on the updated information in order to correct any occlusal adjustments, tissue gaps, aesthetic considerations or functional changes.

STL file based on the simulated smile design and stored in the computer until the final restorative phase began. The new STL files of surgical/prosthetic/intra-oral scans were merged with the original tooth set-up. The new iJIG was then fabricated based upon previously approved and actual transition prostheses worn during the healing phase. This replica was then used to register slight changes in implant position, soft tissue, occlusion and aesthetics. The maxillary and mandibular iJIGs were sectioned and held together with a clear vacuum-formed overlay for seating and then intra-oral luting (Figs. 11a & b). Each section was tightened on to the multi-unit abutments and approximated to be luted together with either flowable composite or autopolymerising or dual-polymerising resin (Figs. 12a & b). It was important that all sections were fully seated and passive. It is recommended that the fit of the prosthesis be verified with radiographs.

After careful luting, the full-arch try-in prosthetic was removed and tray adhesive applied to the intaglio surface and circumferential margins. The prosthesis was reinserted, and a polyvinylsiloxane impression material was then injected via syringe to capture the tissue interface and bite relationship (Figs. 13a & b). The prostheses with the impression material attached and the bite registration were then sent to the laboratory for processing. A stone model was then created from this impression to capture the location of the multi-unit abutments (Fig. 14). Once the dental laboratory received the new information, it was digitised and entered into the CAD/CAM software to complete the design (exocad DentalCAD, exocad). It is essential that the positions of the implants be accurately represented with the appropriate analogues within the software library. The digitally articulated maxillary and mandibular arches can then be ideally designed based on the updated information to correct any occlusal adjustments, tissue gaps, aesthetic considerations or functional changes (Figs. 15a & b). Based upon the new virtual design, resin-based, 3D-printed clinical prototypes were fabricated and evaluated intra-orally (Figs. 16a & b).

Recently, the fifth-generation iJIG introduced a more anatomical emergence design with the inclusion of an intra-oral soft-tissue scan. As previously described, the preoperative condition was captured with an intra-oral scan (Fig. 17). After the healing phase was completed, an intra-oral scan was utilised to record the positions of the multi-unit abutments and the surrounding soft tissue for both the maxillary and mandibular arches (Figs. 18a & b). Utilising the iJIG special scanning analogues attached to the implants, the entire prosthesis was then scanned and digitised extra-orally and merged with the opposing



Figs. 16a & b: The 3D-printed resin clinical prototypes were fabricated based upon the new virtual design and evaluated intra-orally.

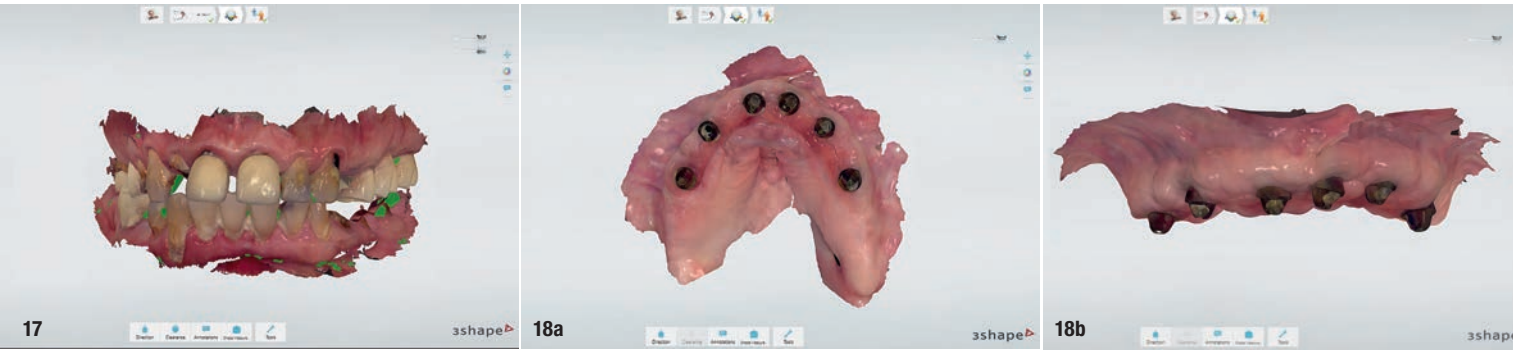
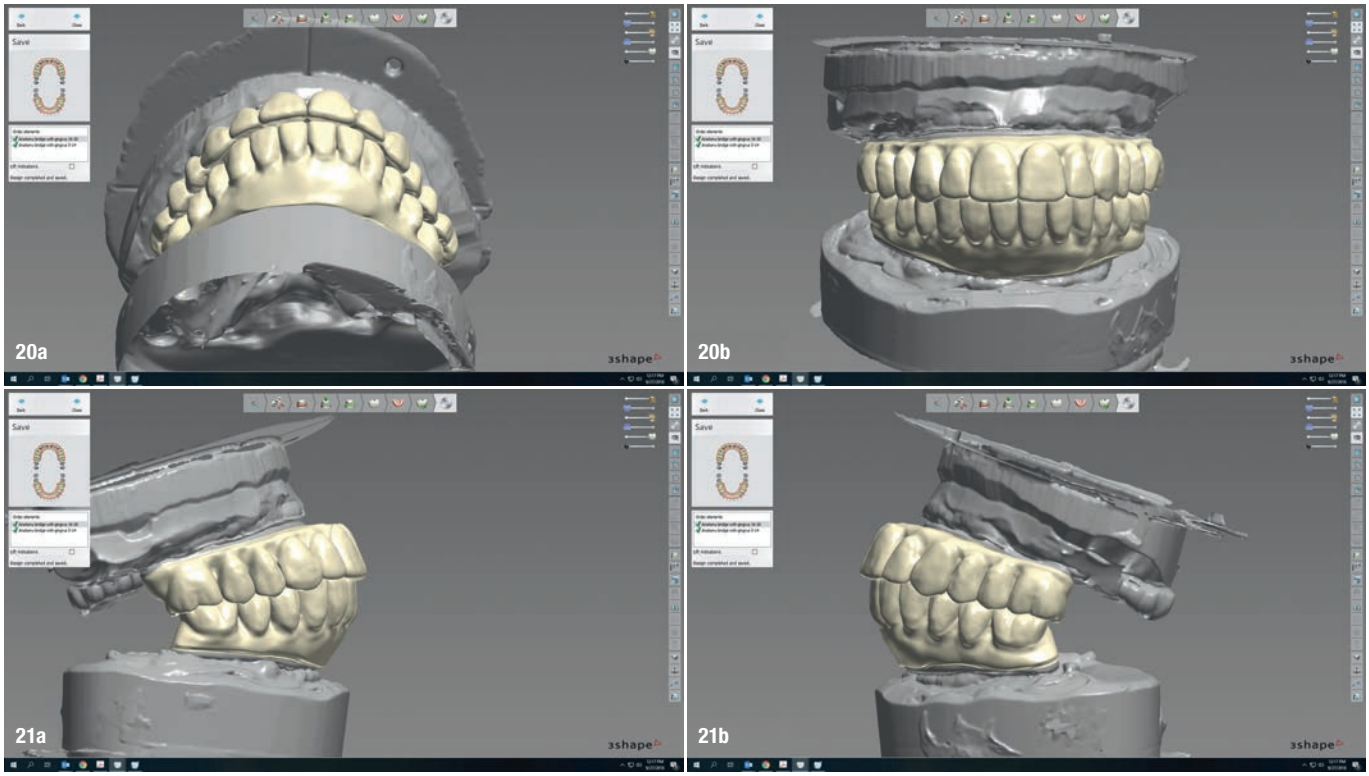


Fig. 17: The pre-op condition was captured in colour with an intra-oral scan. **Figs. 18a & b:** After the healing phase was completed, an intra-oral scan was utilised to record the positions of the multi-unit abutments and the surrounding soft tissue for both maxillary and mandibular arches.

arch and bite scans as previously described (Figs. 19a–d). The introduction of the soft tissue aids in the design of the prototype iJIG in establishing the material-to-ridge relationship of the final prosthetic tooth position, tissue contours, cantilevers, etc. The iJIG and resin try-in phase provides the clinician with essential information to deliver a more accurate and predictable definitive restoration.

The sixth generation requires the previously described seating procedures. The information was again introduced into the CAD/CAM software (3Shape) to complete the design of the definitive prosthesis, taking into consideration all changes in occlusion and aesthetics (Figs. 20a & b). The lateral views of the virtual design are illustrated in Figures 21a and b. The definitive screw-retained monolithic zirconia restorations were delivered for both arches. The screw access holes were first covered with PTFE tape and then filled with composite (Figs. 22a & b). The definitive prostheses can be visualised in the retracted views, showing an acceptable functional and aesthetic result (Figs. 23a–c).

Figs. 19a–d: Utilising special iJIG scanning analogues attached to the implants, the entire prosthesis was then scanned and digitised extra-orally and merged with the opposing arch and bite scans.

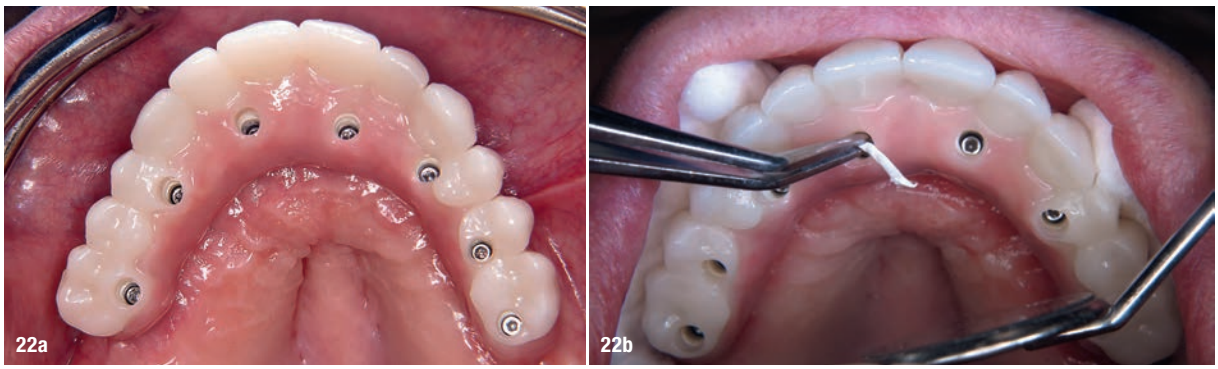


Figs. 20a & b: The CAD/CAM software was utilised to complete the design of the definitive prostheses, taking into consideration all changes in occlusion and aesthetics. **Figs. 21a & b:** The lateral views of the virtual CAD prosthetic designs.

The definitive prosthesis could be fabricated in zirconia, nano-ceramic bonded to titanium or nano-ceramic bonded to TRINIA (both Crystal Ultra materials, Digital Dental).

Conclusion

With careful diagnosis and treatment planning, it is possible to predictably manage full-arch immediate implant-supported restorations. The first of our two-part series described the 3D assessment of patient anatomy to provide the blueprint for tooth extraction, bone reduction and immediate implant placement with concomitant transitional restoration made possible with an innovative full-template guided solution. The article further described a stackable guide system that provided a combination of a drill guide, bone reduction guide, implant insertion guide and connection to the full-arch maxillary restoration. The second part of the two-part series described the steps necessary to complete a simultaneous dual full-arch prosthetic reconstruction after confirmation of osseointegration and satisfactory soft-tissue maturation surrounding the multi-unit screw-receiving abutments. Conventional analogue prosthetic protocols have required intra-oral impressions that capture the implant abutments within a stone master cast to be mounted on to an articulator at the proper vertical and centric relation position. The dental laboratory technician was then tasked with creating a wax-up with denture teeth to confirm the bite, lip support, phonetics and aesthetics. From this analogue



Figs. 22a & b: The definitive screw-retained monolithic zirconia restoration in the maxilla **(a)**. The screw access holes were obturated with PTFE tape, followed by a composite filling **(b)**.

Figs. 23a–c: The definitive maxillary and mandibular prostheses as seen in the retracted views, showing an acceptable functional and aesthetic result.

protocol, a screw-retained definitive restoration was completed. It was not until a digital workflow and the advent of CAD/CAM software and milling machines that the analogue wax-up was then digitised to create a virtual design and STL file for fabrication of full-arch monolithic zirconia restorations. To enhance the digital workflow, the evolution of the time-saving iJIG device was presented.

As previously described, immediate loading of dental implants for full-arch reconstruction offers many advantages over delayed treatment alternatives, but it does require a prefabricated prosthesis at the time of surgery. For the purposes of this article series, the transitional restorations were all digitally designed and produced with a nearly true-to-form smile simulation for delivery via a stackable guide system at the time of surgery.

The current iteration of the iJIG manages the small differences from the original transitional restoration to the desired definitive restoration with an accurate and time-saving innovation. The iJIG can potentially reduce restorative time to three visits. The iJIG is compatible with most implant systems, including those of MegaGen, Nobel Biocare, BioHorizons, Neodent, Zimmer Biomet (former Biomet 3i implants), Straumann, Hiossen, Thommen Medical and Keystone Dental. Other systems, which include those of Zimmer Biomet (former Zimmer implants), Implant Direct, CAMLOG, Dentsply Sirona (Astra Tech Implant System), MIS Implants Technologies, Straumann and Paltop, require specific original equipment manufacturer multi-unit abutment replicas in order to accurately scan the prosthesis.

The present case study required bone reduction to achieve the necessary restorative space for the completion of successful dual full-arch FP-3 prostheses, utilising the CHROME GuidedSMILE concept with advanced digital workflows. The same full-template guided protocols have also been demonstrated in cases where preservation of the alveolar and interproximal bony architecture was desired, which resulted in an FP-1 prosthetic (pink-free) design, or when zygomatic implants were to be used to support a fixed restoration necessitated in the severely atrophied maxillary arch. More research and additional multicentre studies will help in understanding the long-term success of these innovative surgical and restorative protocols.

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Disclosures: The authors report no disclosures.

contact

Dr Scott Ganz received his specialty certificate in maxillofacial prosthetics/prosthodontics from the University of Texas MD Anderson Cancer Center in Houston in the US, and this led to his focus on the surgical and restorative phases of implant dentistry and his subsequent contribution to 15 implant-related textbooks. He is a fellow of the Academy of Osseointegration, a diplomate of the International Congress of Oral Implantologists (ICOI), US ambassador of the Digital Dentistry Society, President of the US branch of the Digital Dentistry Society and a co-director of Advanced Implant Education (AIE). Dr Ganz is on the faculty of the Rutgers School of Dental Medicine in Newark in New Jersey in the US and maintains a private practice in Fort Lee in New Jersey. He can be reached at drganz@drganz.com.

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IPS Implants Preprosthetics is a "useful addition for a specific patient group"

By Franziska Beier, DTI

In order to provide an alternative implant solution for those patients with poor medical preconditions, Prof. Nils-Claudius Gellrich, director of the clinic for oral and maxillofacial surgery at the Hannover Medical School in Germany, and Dr Björn Rahlf, senior physician for oral surgery at the same clinic, designed the IPS (individual patient solution) Implants Preprosthetic. In conversation with Dental Tribune International, Gellrich and Rahlf spoke about the patients for whom it is suitable and how they developed this individual implant.

Prof. Gellrich and Dr Rahlf, you provide your patients with the IPS Implants Preprosthetic. For which patients is it intended?
Gellrich: We only use the IPS implant in patients for whom a clinical necessity exists. These include tumour patients and patients with acquired malformations caused by trauma or atrophy but also those with congenital malformations who, as they get older, lose their teeth and exhibit poor bone and soft tissue. When attempting to provide these patients with a conventional dental implant restoration, you reach a point where you can no longer treat them adequately, resulting in the need for an alternative.

What inspired you to create this implant solution, and how does it work?
Gellrich: In addition to the clinical aspect, which I have just described, we have been focusing on computer-assisted surgery for 20 years. We have been dealing with modern biomedical technology, patient-specific implants that are functionalised and 3D analysis. Based on this experience, we realised that it could be advantageous to attach the bone anchorage for our patient-specific implant made of titanium at a location remote from the point where the post passes through the mucosa into the oral cavity. This avoids lengthy treatment protocols that would normally require at least three surgical procedures and a delay of one year before a patient receives a prosthesis.

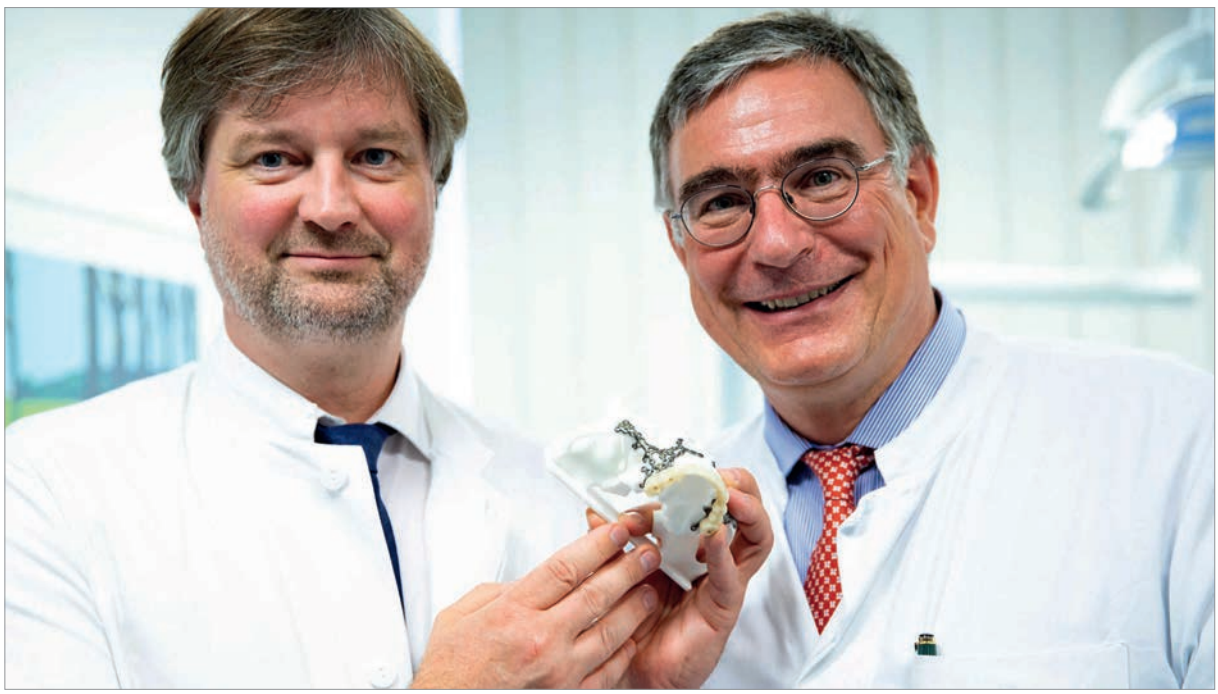

Fig. 1: With the IPS Implants Preprosthetic, Dr Björn Rahlf (left) and Prof. Nils-Claudius Gellrich offer their patients a customised dental implant solution. *(All images: © MHH/MKG Chirurgie)*

Fig. 2: So far, 41 patients have been treated with the IPS Implants Preprosthetic. **Fig. 3:** Dr Björn Rahlf (left) and Prof. Nils-Claudius Gellrich at the clinic for oral and maxillofacial surgery at the Hannover Medical School in Germany. **Fig. 4:** IPS Implants Preprosthetic can be individually adapted to each patient, since the framework structure and the post length can be individually adapted to the defect situation.

Our initial goal was to be able to guarantee prostheses after six to 12 weeks. Today, we can even offer immediate care on the day of outpatient treatment. Although this means that the planning phase for the implant is somewhat more intensive, the time for invasive clinical procedures for the patient has become significantly shorter.

Rahlf: Also important to mention is that our patients are spared a major operation in which bone is usually transplanted from their iliac crest or the fibula to the jaw, because these operations often result in complications. With the IPS, we can operate independently of the bone volume because the bone does not necessarily have to be situated where conventional implants would be placed. Instead, we can analyse the existing bone structure, which determines the implants, and we can have the posts emerge from the bone where they are needed for the prosthetic solution. Soft tissue must, nevertheless, be transplanted in many cases, for example to ensure the unrestricted movement of the lips. However, this is not a problem, as the human body has sufficient soft tissue and this transplantation is not very difficult to perform.

Gellrich: The clinic's cooperative partner is the KLS Martin Group, a globally operating medical technology company based in Tuttlingen in Germany. IPS Implants Preprosthetic is a registered trademark. KLS Martin now also offers the digital interface to prosthetic solutions.

How many patients have received the IPS so far?
Rahlf: The first time we considered this idea was in 2014; the first treatment followed in 2015, and the current number of patients is 41. However, some of them have received more than one IPS, which means that we have placed a total of 45 implants.

Gellrich: We treat sick patients, patients who are often also undergoing irradiation and patients with congenital malformations—meaning all of them have poorer medical preconditions. However, so far, over a period of more than five years, none of the implants has failed. I hope that, with this method, we will also be able to show that, for example, even very old people can still live for many years with a high load capacity and chewing comfort. The oldest patient we treated was 91 years old and the youngest 19.

Is the IPS implant currently only available in your clinic?
Rahlf: We organised an event where we showed other university professors in Hanover how the method works. We have also been to international congresses and have presented the method at these. The demand is great, and some colleagues have already planned and implemented their first major cases.

Gellrich: In Germany, colleagues are now slowly starting to use the method, some of them at a clinic in Kassel. We also have guest students who come from other clinics to watch live operations at our hospital.

Are there clinical studies on your implant application available?
Rahlf: We have already published a clinical study[1] that described the kind of system it is and how it works. In a current follow-up study[2], we have been investigating whether the quality of life of our patients was improved by the IPS implant.

Would you like to add anything else?
Gellrich: To avoid any misunderstandings, I would like to emphasise that the IPS, contrary to some misconceptions, is not a reinvention of the old subperiosteal implants that were used from the 1930s or 1940s up until the 1970s. The great difference is that subperiosteal implants were an alternative to normal implants at that time; however, this does not apply to our implant solution. Firstly, the indication is different, and secondly, subperiosteal implants were not functionally stable at any time. The IPS implant, however, is a functionally stable anchorage that a normal implant restoration could never achieve in a comparable form in one of our patients, even under the ideal conditions of a perfect bone graft. It is a line extension in implant dentistry, an individual supplement, not a replacement, and certainly not in competition with conventional implants. We consider it a useful addition for a specific patient group.

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

A new solution in the field of digital workflows

By OEMUS MEDIA AG

Fig. 1: Adrian Hunn was elected new CEO of Dentalpoint at the beginning of 2020.

In this interview, new Dentalpoint CEO Adrian Hunn talks about the new competence centre for Zeramex Digital Solutions and master dental technician Peter Hölldampf, laboratory manager at the Germany-based machining centre Geiger Dentaltechnik, a close partner of Zeramex, discusses material-specific aspects of zirconium dioxide.

Mr Hunn, the company Dentalpoint, which owns the Zeramex brand, opened its new competence centre for Zeramex Digital Solutions last year. There are probably at least some users, dental technicians and dentists who have not heard of it yet. Can you explain exactly what a competence centre is and how the customer can benefit from it?
Hunn: The market is demanding new solutions in the field of digital workflows, so it is a logical step for the R & D department at Zeramex to find new ways, approaches and, ultimately, solutions for our two-part and 100 % metal-free systems to meet this demand. And our R & D department has done a great job in this regard over the past two years. We are now able to offer fully customised and 100 % metal-free solutions from the new Zeramex Digital Solutions competence centre. Our customers now have the possibility of sending digital data to our competence centre by secure data exchange, which enables them to order, for instance, customised abutments directly from us. But that is by no means all. Our product portfolio embraces fully customised abutments, one-piece monolithic crowns, and custom-made crowns with and without screw holes for ZERABASE abutments, all made to the highest degree of precision. Whether for restorations of anterior or posterior teeth, we have the perfect solution for each and every situation. In addition, customers can choose to have their crowns ready coloured and glazed. A 3D-printed model can also be produced on request so that the practitioner can check the restoration before insertion and show it to the patient as a tangible model. Of course, every order comes as standard with the required 100 % metal-free VICARBO screw. In addition to the direct implementation of the orders, our competence centre offers advice in the field of data processing and in the selection of the perfect product for the individual needs of the customer.

> “In the near future, the competence centre will certainly provide users with innovations as well as enhancements of existing products.”

It has been a few months now since Zeramex Digital Solutions was first launched. How much has the new competence centre appealed to users and how strong is the demand?
Hunn: As I pointed out earlier, the ordering process is very simple and uncomplicated and therefore runs very smoothly. This meant that, at start-up, only minor changes to the ordering process were necessary. The simplicity with which customers can get high-quality, customised and, above all, metal-free solutions adapted

to the specific gingival situation generated a great deal of very positive feedback. This interest, combined with the fact that the demand for digital solutions is already very great, made it possible for us to achieve an even better start than we expected. Customers and users with whom we have long-standing, close relationships naturally knew about our project at an early stage and were involved in product and process optimisation. Not only did they support us in this project, but they also confirmed that there will almost certainly be great demand for the new competence centre in future.

The word "future" brings us to the next question. Will the digital workflow at Zeramex offer even more options in future? Are you already working on further developments in the Zeramex Digital Solutions department, and if so, what form will these take?
Hunn: I thought you might put this question to me [laughs]. Indeed, there are product enhancements that are already in development and, in some cases, almost completed. In the near future, the competence centre will certainly provide users with innovations as well as enhancements of existing products. Of course, I cannot yet tell you exactly what these will be. In addition to the product, delivery times are an issue. We are already working intensively on offering the customer shorter delivery times as soon as possible. The aim is that, in future, Zeramex Digital Solutions products will be received by the customer within two days of placing the order.

Mr Hölldampf, you are the laboratory manager at Geiger Dentaltechnik, one of the longest established machining centres in southern Germany and a close partner of Zeramex. In 2000, your laboratory was the first in Germany to use 3M ESPE to implement a pilot project for milling zirconium dioxide with CNC machines which operated on a CAD/CAM basis. What can you tell us about this material, the machining process and your experience with it?
Hölldampf: Yes, that was very exciting back then. Zirconium dioxide was still in its infancy, and when 3M, then ESPE, came to us to test this new process, we were initially quite sceptical about whether it would work. In the test phase, we realised that the material zirconium dioxide was unique and functioned really well and that it would, therefore, be possible to do quite a lot with it. Of course, zirconium dioxide has its pitfalls, and there are a few things to consider when preparing and machining it. At the end of the day, zirconium dioxide is a ceramic. This means that you have to carefully investigate factors like stability values, connector cross sections for bridges and the creation of the correct substrate for subsequent veneering ceramics. There are many factors that come into play. Extremely precise processing must be ensured over all the manufacturing steps. In the past, full-ceramic restorations were really only possible using pressed ceramics or the hot isostatic pressed variant. Milling in the green state, however, was a complete innovation. This new approach was gentle on the material, the machine and the milling tool. In addition, it was possible to achieve much more detailed and precise results.

It is said that stability is still an issue with zirconium dioxide. You have been working with this material for over 20 years. What is your opinion about its stability?
Hölldampf: Zirconium dioxide is a very hard material. If we take a gold crown for comparison, it is much more forgiving in terms of chipping. This is because gold is much more malleable than ceramic. For the ceramic process, this means that an absolutely perfect impression is required in advance. If uncertainties are already present in the impression, this can lead to inaccuracies, and there is a risk of parts of it breaking off. Since pressure cannot be used to apply zirconium dioxide restorations, a perfect fit must be assured. A gold matrix is more forgiving. Because zirconium dioxide is such a hard material, the product has to be extremely precise and a perfect fit, as I said. The fit is the absolutely crucial. In the further course of machining, it is also important to process it carefully without pressure and with the right cooling. Especially in the area of the geometry of implant connections, it is important to use extremely stable ceramic material. The pressure on a natural tooth is simply very different from that on an implant. An implant is firmly anchored in the bone and allows practically no further movement.

Are there still problems with fitting with zirconium dioxide, and does this require a lot of reworking?

Fig. 2: Peter Hölldampf is the laboratory manager at Geiger Dentaltechnik, one of the longest established machining centres in southern Germany.

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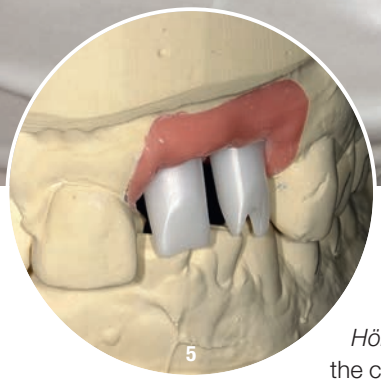

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Figs. 3–5: Zeramex Digital Solutions offers customised and completely metal-free abutments, crowns and even one-piece monolithic crowns.

Hölldampf: Actually, this is no longer really the case. Above all, owing to improvements in the software in recent years, it is now possible to work much more precisely in scanning and then digitally designing the implant. As a result, significantly less reworking has been required in recent years.

> "Especially in the area of the geometry of implant connections, it is important to use extremely stable ceramic material."

Zeramex Digital Solutions offers customised and completely metal-free abutments, crowns and even one-piece monolithic crowns. To what extent have you, in the laboratory, been able to benefit from these innovations?

Hölldampf: The issue is really the connection geometry of the abutment, that is, the prosthetic restoration of the dental implant. Milling this connection geometry in zirconium dioxide is highly problematic, since no manual post-machining should be carried out in this area. Only a perfect first-time fit in the transition area will provide a product that functions perfectly. Because this connection geometry is milled directly by the Zeramex Digital Solutions competence centre, you have to be able to simply count on it being a perfect first-time fit. And this means that we immediately get a super-functioning product in original manufacturer quality that we can use to create our custom restorations.

Are there comparable products on the market with regard to customised abutments or customised monolithic crowns?

Hölldampf: In the past few years, we have had products from various zirconium dioxide implant manufacturers. I would say that there are comparable products, yes, but there have never been other products where you can safely assume there will never be complications when it comes to fitting in the patient's mouth. In Zeramex, we have found a partner whose product simply works. The product is carefully considered and planned down to the last detail and perfectly harmonised with other components. The system is logically structured, all parts fit together perfectly, and the great thing for us is that we can rely on finding the best solution for every job, regardless of the size. We have never had any other product in our laboratory that comes close to the quality of Zeramex.

This interview was first published in the ceramic implants *magazine, volume 4, issue 1/2020.*

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Powered by AGE Solutions

Maestro 3D

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The company

Maestro 3D powered by AGE Solutions was launched in 2007 and was conceived by two former researchers of the National Research Council of Italy in Pisa who specialised in the data planning, visualisation, comparison and processing of 3D data and creation of 3D acquisition systems. The origins of AGE Solutions are to be found in the common passion of the two founding members for computer graphics and in their technical and scientific background that matured during their years in the Visual Computing Laboratory of the Alessandro Faedo Institute of Information Science and Technologies of the National Research Council in Pisa. AGE Solutions is a partner of CERFITT (Research and Training Centre on Technological Innovation and on the Transfer of Technology) in Pontedera.

AGE Solutions is a company that operates in a high-tech specialised field. It pursues integrated development of hardware and software solutions for the creation, processing, analysis and management of 3D data of high quality. These solutions allow automation and significant improvement of many industrial processes (inspection, quality control, reverse engineering) that are otherwise expensive in terms of both time and human resources.

AGE Solutions offers the best quality—price ratio for specific solutions that have found their application in the dental, acoustic and footwear industries and for personalised solutions, realising hardware and software applications, whether stand-alone or original equipment manufacturer, which can be integrated into third-party pre-existing solutions.

The philosophy

AGE Solutions believes that the use of 3D technology should be available to the masses and not only the privilege of a few. It thus seeks to revolutionise the approach to 3D technology, making it user-friendly and easy to employ. For this reason, AGE Solutions opened its own technology to the market, making its exclusive tools for acquisition and processing of 3D data available to all.

AGE Solutions, thanks to the results of years of research on 3D technology and to a highly qualified development team that works with passion and competence, offers quality, flexible and highly innovative hardware and software solutions—at very competitive prices.

The products

For over 12 years, Italian manufacturer Maestro 3D has developed and produced a 3D desktop scanner for stone models and impressions, as well as software for orthodontic treatment and dental restorations. The MDS 500 Dental Scanner is an open dental scanner with two cameras of 5 MP (Fig. 1).

Dental Studio software

Maestro 3D Dental Studio is a software programme based on a proprietary technology and is a complete tool for the realisation of orthodontic, dental restoration and smile creator jobs. The software

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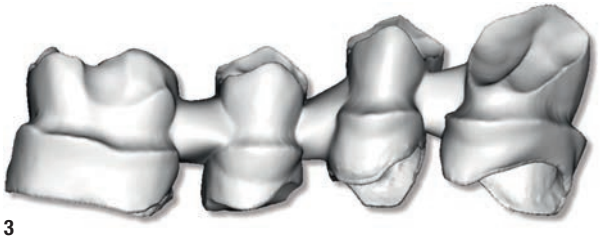

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Comprehensive solutions for guided surgery

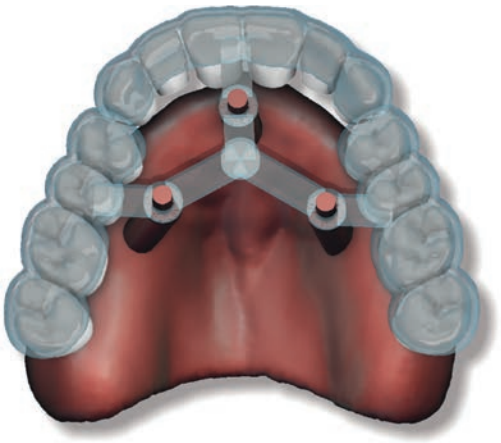
New drill kit for placement of conical connection implants

As part of the company's continuing effort to offer comprehensive solutions for guided surgery in all clinical scenarios, MIS Implants Technologies this spring released its new MGUIDE kit for 16 mm conical connection drills used in implant placement procedures.

The new kit has already been implemented in MSOFT, the MIS software used for guided procedure planning, and is offered through an automatic update. This new offering extends the existing solution for this implant length.

The kit includes all drills for a complete procedure, as well as a marking drill, which is intended for extraction sites. In addition, the kit offers both standard- and narrow-sleeve drills. Orit Kario, MIS digital solutions product manager, highlighted the marking drill, explaining: "It was designed for this specific kit and enables drilling within sockets, providing an added value in immediate placement procedures within extraction sites." The drill's design allows drilling through the socket wall.

www.mis-implants.com



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is modular and is composed of three macro modules: Ortho Studio, Dental Restoration and Smile Creator, which itself consists of the 3D Denture Guide and Digital Mockup modules.

Easy to use by both laboratories and dental practices, and employed in combination with the Maestro 3D dental scanner, it is a complete solution that helps laboratories and dental practices to enter the digital era. Thanks to the union of the Ortho Studio module, the Dental Restoration module and the Smile Creator module in a single software programme, it is possible to exploit these combined functionalities within an intuitive and integrated workflow.

Ortho Studio (Fig. 2)
This well-known orthodontic software allows you to create study models and virtual set-ups to produce clear aligners, among other things.

Dental Restoration (Fig. 3)
Simple and intuitive, it allows you to create dental restorations of up to 16 units, providing real-time feedback and control of all the modelling operations.

3D Denture Guide (Fig. 4)
The software guides and assists the user in positioning artificial teeth, in order to build a printable guide to create a prosthesis for an edentulous patient.

Digital Mockup (Fig. 5)
This module helps dental technicians and dentists to conduct highly aesthetic restorative treatments based on the smile desired by the patient.

www.maestro3d.com

Embracing the challenge of taking IDEM digital

By Monique Mehler, DTI

Mathias Kuepper has extensive experience in trade fairs and exhibitions, including event operations, sales and marketing, project management, and strategic business development. *(Image: © Koelnmesse Singapore)*

Since July 2014, Mathias Kuepper has been working as managing director of Koelnmesse Singapore, where he, in addition to his other responsibilities, organises South East Asia's leading dental show IDEM Singapore, which takes place every two years. Owing to the ongoing SARS-CoV-2 pandemic, the on-site IDEM 2020 was cancelled, and it will now be a wholly digital experience in order to ensure the health and safety of staff and visitors. In an interview with Dental Tribune International, Kuepper explained why Koelnmesse has decided to move IDEM online, shared insights into what it took to replan the event and attempted to answer the big question everyone is wondering about: how will SARS-CoV-2 affect the dental industry in the long run?

Mr Kuepper, at the end of March, it was announced that IDEM 2020 will become a wholly digital experience. What led Koelnmesse to this decision? Were there ever conversations about cancelling the whole show like others in the industry have done?
The decision to go digital in 2020 was, of course, driven by the SARS-CoV-2 situation. It became clear that we would not be able to go through with our initial plan to just reschedule the physical event from April to June, and further postponements were not taken into consideration owing to the escalating situation.

An outright cancellation would have led to a four-year gap with no international event for the dental industry in South East Asia. At the same time, the cancellation of events had led to a shortage of opportunities for dentists to earn sufficient continuing education points this year. With a conference programme already in place, it was therefore an easy decision for IDEM to go digital and offer our scientific content online.

It also provided an opportunity for our loyal exhibitors to be featured online and to network with dental professionals in a safe manner.

One of the main reasons why dental professionals from around the globe attend events is to connect with their peers in person and experience the showcased products first-hand. Now, with a purely virtual event, these important factors are missing. Do you think there is a way for the online version of IDEM to make up for this?

The value of live events and face-to-face meetings is irreplaceable, and we will not be able to replicate this with the digital IDEM. While scientific content can be relatively easily delivered virtually, the networking experience—an encounter during a coffee break and, especially, the opportunity for manufacturers to showcase and personally explain and demonstrate prod-

> "Our primary purpose is to serve the dental community by providing learning and networking opportunities."

ucts—will certainly fall short of a physical event. Thus, instead of trying to recreate these factors, our team will focus on creating new experiences within the digital event.

One advantage of the online event will be that attendees will be able to view and review conference sessions multiple times at their own learning pace. We will strive to introduce new ways for our attendees to engage and for exhibitors to feature their products and solutions. Participants can look forward to connecting with their peers through live chats, discovering new products and interacting with our exhibitors in order to understand how these solutions would assist them in their practices.

Taking the limitations into consideration, we made a conscious decision on our side to offer basic participation in the digital event free of charge to all our loyal IDEM exhibitors and to fully refund the participation fee for the physical event.

What are the greatest challenges in putting the online event together, and how does the organisation process differ from planning a live event?
As you can imagine, we have spent the last two years planning for IDEM 2020; thus, changing at the last moment to building an online event is not without its challenges. Creating a digital event is also new for our team, yet we are embracing the experience.

As many factors are considered when choosing a digital platform to host an event as when choosing a physical venue. The choice of convention centre can make or break a physical event, and in the same way, it was important to ensure that our digital system could support the event in order to provide a positive experience throughout. Some other key considerations were the suitable showcasing of our exhibitors' products and services, and the provision of content accessible to anyone, anywhere at an affordable price.

To meet these requirements, an important change we have made in order to build a positive experience for IDEM 2020 participants is to have the digital event run for two months instead of the usual three days. This will allow everybody to access the conference sessions and explore the exhibition at their own pace and convenience. These changes to the organisation and format of IDEM are also reflected in our marketing approach, which we have shifted to focus on the flexibility and interactivity of the online platform.

Thousands of working hours go into planning a large and prestigious event like IDEM. How did the change from a live event to an online version affect you and the organisation team personally?

Naturally, we were disappointed not to deliver the event we had planned. We had spent a lot of time considering how to bring a fresh approach to IDEM 2020, and we were excited about introducing several new additions and changes to the usual format. One such change, for example, was to have workshops conducted on the exhibition floor.

Although we were unable to host the conference and exhibition in April as planned, we are grateful that we made the decision to move to a digital platform. Our primary purpose is to serve the dental community by providing learning and networking opportunities, and we are still able to achieve this in a reasonable way through our digital event. We are immensely grateful to the exhibitors, speakers and attendees who continue to support and demonstrate their commitment to IDEM.

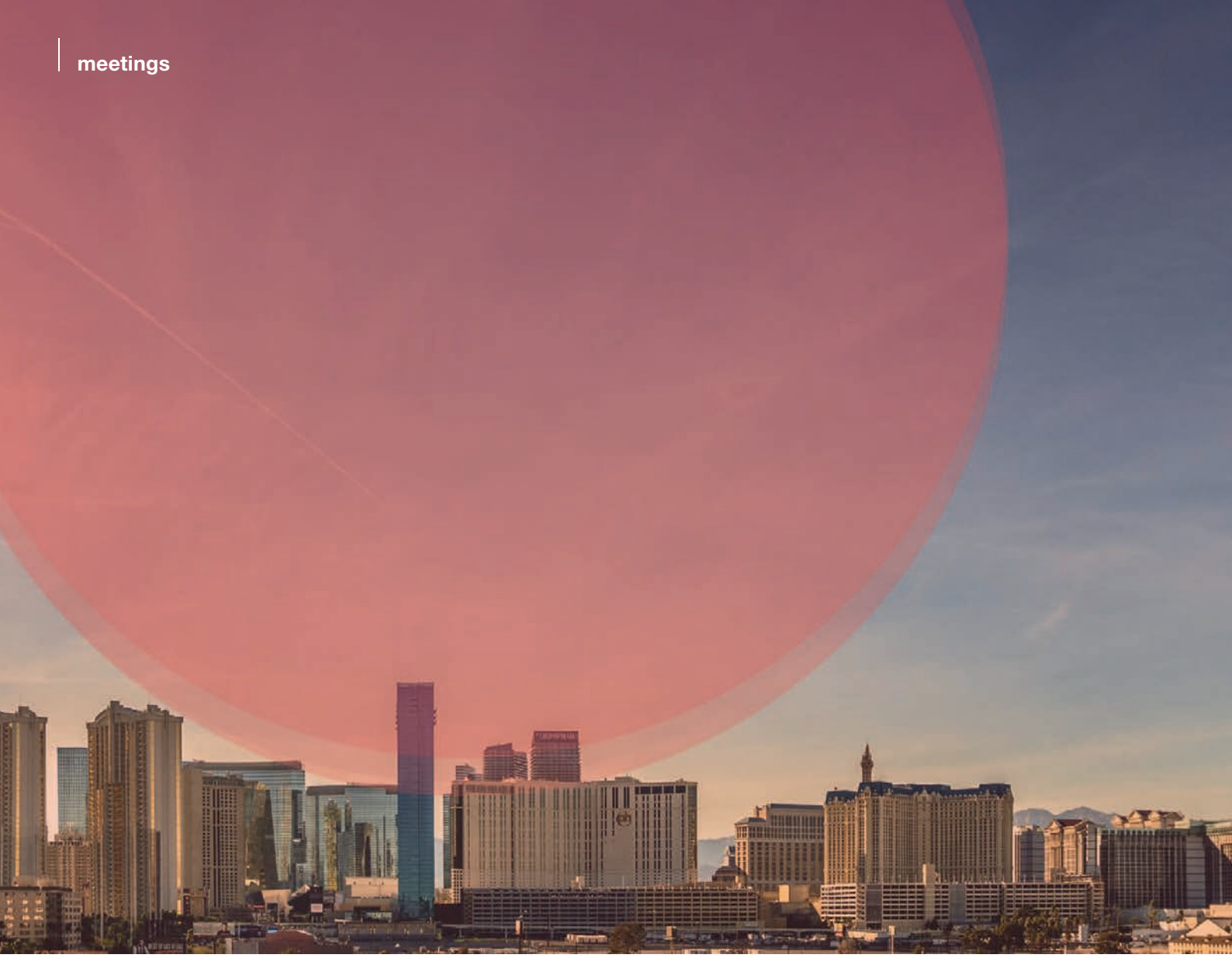
"Dentistry as a profession may have to adapt by learning to conduct business in a new way."

The SARS-CoV-2 pandemic has changed the world. What do you think are the long-term effects on the dental industry?
There are still so many unknowns about SARS-CoV-2, and dentistry as a profession may have to adapt by learning to conduct business in a new way. While hygiene and sanitation has always been a priority, it is now of paramount importance. There will be more emphasis on infection control and the implementation of these measures across different levels.

Continuing education in dentistry will still be essential. As event organisers, it is important for us to continue to adapt in order to deliver relevant content in a timely manner and in various formats, such as online events. The new measures in practice and the restrictions relating to international travel may also be the norm for some time.

For the IDEM organising team, even as we plan to bring the event back to its physical format in 2022, we will continue to stay abreast of these challenges and seek to find convenient ways to ensure that our community is heard and can flexibly participate in the learning programmes. We stand ready, as always, to support the needs of the dental community.

Editorial note: More information on the event can be found on the official IDEM website: www.idem-singapore.com



Virtual Nobel Biocare Global Symposium breaks registration record

By Nobel Biocare

With more than 10,000 unique registrations, the online edition of the 2020 Nobel Biocare Global Symposium, staged by Envista, was not only an extraordinary educational event but also an example of how remote teams can quickly adapt to unprecedented circumstances.

"I was looking forward to meeting our participants in person in Las Vegas; however, when the circumstances changed for all of us, it was more important than ever to turn obstacles into opportunities. I am incredibly grateful to our speakers and impressed by our team, who quickly transformed this year's symposium into our most successful ever online event," said Patrik Eriksson, President of Nobel Biocare Systems.

As many healthcare services and dental clinics around the globe have had to reduce the number of patients they treat or shut down temporarily, it became clear to the Nobel Biocare Global Symposium organisers that this was an opportunity to deliver first-class implant treatment educational content for the dental community.

Nobel Biocare has a long tradition of helping dental professionals in their continuous growth. Progressive

The 2020 Nobel Biocare Global Symposium, which was originally scheduled to take place from 16 to 18 April in Las Vegas in the US, was conducted online on 16 and 17 April instead. *(Image: © Nobel Biocare)*

educational courses and events at any stage of the implantology journey, from novice to expert, are provided through various learning platforms around the world. The comprehensive courses are delivered by industry-leading experts, covering everything, including diagnosis, treatment planning, and surgical and prosthetic processes.

"This digital experience proves that implantology professionals are extremely keen to learn. Maybe we should see it as an advantage that they have the time to attend educational webinars when normally they would be inundated by patient appointments," commented Dr Alessandro Pozzi, a specialist trainer in digital dentistry solutions, on the currently required shift to online education. "In my own sessions, hundreds of clinicians have been building their skills in the DTX Studio suite implant and prosthetic software and increasing their confidence in its daily use. These are valuable tools for clinicians and hygienists at every level, to treat more patients better," he added.

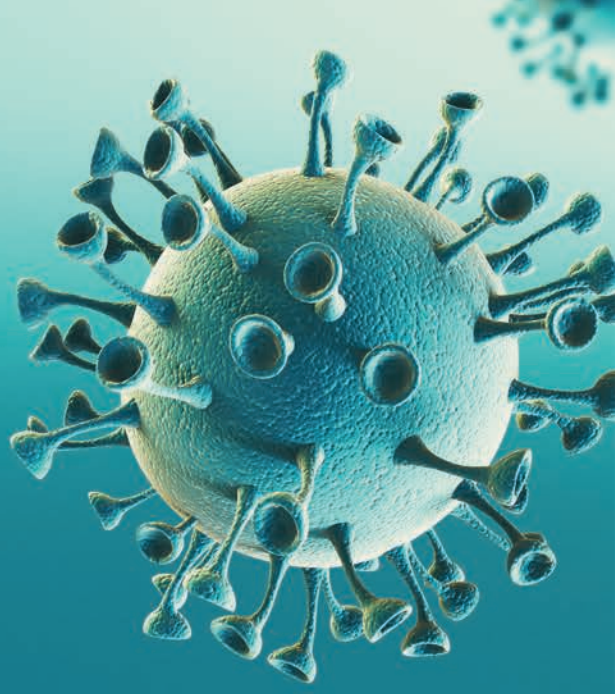
"Our mission is to advance side by side with dental professionals" – Irin Maier, director of clinical affairs and education, Nobel Biocare

Looking to the future of dental education after the COVID-19 pandemic, speaker Dr Sascha Jovanovic, who was one of the first to provide Web-based dental training programmes back in 2003, commented: "It is a very tough time, but we will get out of it, and hopefully the world will be a better place. Looking at online education and training, a lot of us will re-evaluate it. We are going to test how much of the training and education, and the transfer of research, will be possible online. I think it's going to go far. I do webinars, and we have an online education library and use it constantly for our students. I think our world will be different, our training and education will be different and meetings between doctors will be different."

The previous Global Symposium was held last summer in Madrid in Spain and involved more than 1,000 participants. For the 2020 virtual edition, the programme was shortened and included seven live sessions and several on-demand webinars over two science focus days. Participants had the opportunity to raise questions and further discuss with experts several topics, including guided and navigated treatment planning, implant treatment success in the aesthetic zone, soft-tissue grafting, and management of treatment complications. Thanks to the on-demand viewing functionality, more dental professionals and members of the dental team can benefit from these presentations.

Irin Maier, director of clinical affairs and education at Nobel Biocare, said: "Our mission is to advance side by side with dental professionals. Their interest and their active participation and excellent feedback on clinical and product topics, show that there is growing interest in advancing in the implant treatment journey, and achieve better patient outcomes. The interactive comments and remarks we have received will guide us in our efforts towards continuous improvement, science-based innovations and first-class educational tools."

Dental webinars from this symposium are still available free and on-demand on the Nobel Biocare website.



Practice strategies in the age of corona

Dr Anna Maria Yiannikos, Germany & Cyprus

Dear friends and colleagues,

We have all been facing an extremely unknown and difficult situation these past few weeks and yes, it is completely normal to be afraid and feel worried about your clinic's future in the post-coronavirus era. I would like to begin with a quote from Nelson Mandela, who said: "When conditions change, you must change your strategy and your mind. That's not indecisiveness, that's pragmatism."

Some may accuse us of being naive, if we continue to believe that patients in the future will behave the same way they did before the COVID-19 crisis, especially during surgical procedures. We should accept this as a fact. The fear of becoming infected has increased significantly in the past few weeks and is expected to remain heightened for the time being. The need for social distancing measures will remain strong. Unnecessary visits to friends, family and others will mostly be avoided and people will become more health-conscious. Cleanliness and proper hygiene should be paramount these days. In the following I will provide you with 7 essential tips, which, I believe, contain the most important advice I ever gave in an article.

1. Increase electronic engagement

For one thing, set up your website and general online presence in a way that makes it easy for people to book appointments online. In addition, offer new patients to send them the required medical documents via e-mail, so they can fill it out at home before coming to an appointment. They can return these completed forms by e-mail as well, in order to reduce waiting times at the reception area of your practice. Moreover, offer patients a quick video meeting with you via Viber, WhatsApp, FaceTime or Messenger, where they can express their dental issues ahead of a physical consultation. This builds trust, since patients can get to know you before an actual physical appointment and they will be reassured that they will receive exactly the treatment they need with you as their dentist. Further procedures can then be carried out at your clinic. Remember: people need encouragement to take action and you will be there for them when they do!

2. Make sure that your patients feel protected

Owing to the current pandemic, patients are most likely to be more aware of diseases and, of course, you should continue to take the protective measures that you would normally take during dental procedures—these are ever more important during the COVID-19 period. In addition, you may consider providing additional protective gear like shoe shields for walking around the clinic for your patients. This will make them feel safe and protected during appointments and it shows that their safety is important to you.

3. Reassure patients that they can rely on you

Especially in times like these where most people avoid crowded places and try to live by the concept of social distancing, it is vital for you to reassure them that it won't come to any delays in your clinic. Make sure that you establish a system that both reduces waiting times and keeps physical contact between patients at a minimum. In these uncertain times, it is important to assure patients that they won't be running into other patients at your clinic and thus bearing the risk of becoming infected.

4. Show empathy and give comfort

Some people are likely to lose their jobs as a result of the current pandemic, or at least experience a decline in their income. Therefore, showing empathy is vital. Comfort your patients like a friend would do. Apart from that, avoid losing loyal patients only because they are not able to afford certain procedures anymore owing to the current situation. You can minimise this risk by offering patients to prioritise certain dental conditions over others. This should happen in written form, where you need to include the important note that this treatment plan is based on recent findings and will be in place for no more than three months. However, remind them (preferably also in written form) that their dental problems will be likely to deteriorate further over time.

5. Look at things from a patients point of view

Many of you are probably anxious about the likely decline in the number of the cosmetic cases that you would normally have treated in the near future. And yes, the truth is that some people probably will not have the budget for cosmetic surgeries in the months ahead. Many people will reduce their social presence and thus there will not be many opportunities for them to proudly show off treatment results and their new smiles to others. Patients will only accept treatment proposals and spend money on them, if they understand these treatments are beneficial to their health (human beings are conscious about their personal health, after all).

Hence, start to emphasise the strong link between the immune system and dental health when speaking to patients. Try to see the world from their point of view: how does it feel, after living for so many days in lockdown and self-isolation, to face the daily fear of getting infected and/or being socially discriminated, if you behave in a wrong way? Wouldn't you be relieved that your favourite dental clinic implements processes that are aimed at benefitting the health of patients? Furthermore, it is our moral duty to enhance our patient's health, as well as to communicate this approach to them—not only on a theoretical level, but also practically.

6. Think more digitally

I would argue that the more your clinic embraces means of digital dentistry, the more it will thrive! Why? These days, patients will prefer fewer visits to doctors in order to minimise the exposure to possible viral dangers and the risk of getting infected. Hence, digital means such as CAD/CAM systems, or intra-oral scanners and cameras, which imply fewer physical patient contact and a more forward-thinking attitude, should be added to your clinic's armamentarium in order to set your clinic apart and attract new patients even in times of a pandemic.

7. Demonstrate your new processes

Start demonstrating the newly developed processes and rules for your clinic or practice by communicating them to your patients: send newsletters to the patients in your database, produce and post short videos of you and your staff using and applying these new processes and opt for social media channels that have the widest possible reach.

Remember—life will go on!

My dear colleagues, make this "stay home" period a productive one, since there will now be plenty of time to make all the necessary changes to your clinic's workflows and processes. It is important to remember that life will go on after this crisis. However, you need to adapt to and prepare for the post-pandemic era. Be proactive and start designing your own new set of rules. Those who understand this concept are more likely to prosper eventually. In my next article, I will delve more deeply into the implications the current pandemic has for dentists and their clinics in the future. Until then, remember: this is your time to get ready and prepare for the things to come! For any further questions, information, requests and guidance feel free to reach out to dba@yiannikosdental.com.

about

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

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Ten guiding principles as we recover from lockdown and the COVID-19 pandemic

Chris Barrow, UK

One of the lessons we have all observed in recent months is that the effects of COVID-19 and the responses of populations and their governments have varied from one country to another. This has had a knock-on effect in dentistry, with variations in the instructions and guidance given by academia and those who regulate the profession.

Here in the UK, the situation has been made even more complicated by the four governments of England, Scotland, Northern Ireland and Wales issuing different instructions and guidelines to their respective dental populations, leading to wholesale confusion and frustration for both professionals and the patients they serve.

"All things must pass" is a phrase I have reminded my clients of during the lockdown weeks and as they now return to work. Patients, team members and clinicians are having to learn a new dance, Dentistry 2.0, and that takes time. Perhaps the most useful advice I find myself offering is to use the mantra of a marathon runner—"pace not race"—recommending that dental teams ease themselves into the new routines that have been imposed upon them.

An interesting and inspiring observation has been the level of trust and loyalty that has been demonstrated by many patients. They have waited for lockdown to end, have sometimes maintained dental plan payments throughout and now recognise that the catch-up may take some time as patients are triaged according to urgency and importance.

Patients have also displayed high levels of trust in the ability of their dentist to take appropriate measures to ensure their safety and that of the team. It may be unfamiliar for them to see their regular nurse, hygienist or dentist covered in personal protective equipment (PPE), but they know that it is you under there, doing your best.

I have observed that dental team members have sometimes presented more of a challenge when invited back to work. Perhaps because they are healthcare-trained, there have been requests for reassurance that standard operating procedures and PPE will be adequate to ensure their safety.

Also, many have had to deal with domestic issues that have complicated their decision to return to work. Personal health, childcare and vulnerable relatives count among the most common of the issues raised. It has been important for any dental practice owner to maintain a regular and personal dialogue with salaried team members and self-employed clinicians to provide either reassurance or offer compassionate leave.

This month, most of my English clients are making their way back. In the other UK nations (at the time of writing) the debate rages and pressure is building. In Europe, many, if not most, are back and operating with different levels of compliance. Who could have foreseen that dentistry would differ so much, depending on where you are standing?

However confusing this many seem, we all still seek the same ultimate objectives:

1. a safe environment for our patients and team;
2. the opportunity to provide appropriate care, whether that be pain relief, functional repair, preventative maintenance, specialist services or elective treatments;
3. businesses that are solvent and profitable so that trade creditors, lenders, landlords, teams and self-employed subcontractors can be paid in a fair and timely fashion and, equally, that owners can make a decent living and grow prosperous businesses;
4. businesses that play a responsible role in their community, respect the environment and value their people.

These core values remain unchanged, and yet it is important to remind ourselves of them after what has been many months of distraction and crisis management.

Almost all of us are beginning the slow journey back to normality. I recently shared with my UK clients some guiding principles that I hope will assist in this process:

1. **This is what we are good at.** Humans are designed to adapt and survive. Consider, if you will, the 250,000 years over which *Homo sapiens* has evolved and the unimaginable hardships that humans have endured

on that journey. I do not wish to make light of any individual's personal or professional challenges, but I do want to remind you that we are wired to win. COVID-19 is undoubtedly the greatest challenge to humanity that I have witnessed in my lifetime, and I am confident that we can and will prevail.

2. **Stay calm.** When all about you are losing it, leadership is about calmly taking control and demonstrating the way forward. Every dental team member has a leadership role, whether it is calming team members or patients, answering the phone, offering virtual consultations or meeting patients face to face (at a safe distance or in PPE). Emotion is contagious and your calm demeanour can help all of those around you.
3. **Be kind.** That may sound cheesy to you, but I have witnessed many random acts of kindness during the pandemic, and people remember the way you show up in times like this.
4. **Learn a new routine.** During the first weeks of lockdown, what we all had in common was that our existing routines were stolen from us by circumstance. We are creatures of habit, and even though we may have complained about the commute to work, the office hours or other aspects of our pre-COVID-19 life, the fact is that lockdown threw us all into chaos. Some reinvented new lockdown routines quickly; others floundered. Whichever group you found yourself in, return to work is now yet another new landscape, and you will have to develop your new routines quickly and settle in to them.
5. **Communicate.** The winners in lockdown were those who communicated regularly with patients, team members and clinicians via video calls, newsletters and messages. Just because you are back to work, do not stop! It is essential that you listen to the feedback on how your dental business is perceived by all concerned; essential that your communities have the opportunity to tell you how they feel; essential that you tell everyone what you are thinking and what is going on.
6. **Do not be afraid of giving and receiving feedback.** As we all learn the new dance steps, mistakes will be made—and that is OK. That is how we grow. So be open to feedback and be ready to give feedback when you see things that are not right. At the moment, your patients and your team are some of the best consultants you could ask for.
7. **Do not be afraid to ask for help.** When the COVID-19 dental history book of 2020 is written, I like to think that one of the benefits of this horrible situation will have been the growth in unity of the dental profession, both nationally and globally. Have you ever seen so many free webinars? I hope that continues over the years ahead and that dentists do not disappear back into their former silos. Asking for help is a sign of personal strength and confidence. Membership of trade associations and other representative bodies has grown. My wish is that this momentum continues into post-graduate education and beyond.
8. **Be patient.** Dentistry will not be back to how it was before, perhaps ever. However, that indomitable spirit of enterprise that identifies humans will, in my opinion, drive even more experimentation, invention and innovation over the years ahead. I believe that we will see a sudden acceleration in digital innovation, in virtual consulting and in the arrival of new procedures, materials and techniques in every aspect of dentistry and patient care.
9. **Take time to think.** Please do not jump into a new hamster wheel to replace the one you were running in before COVID-19. This is a once-in-a-lifetime opportunity to start again, knowing what you know now. If you were starting your business again, what would you do differently? Well do it!
10. **Seek balance.** Back to that once-in-a-lifetime moment—I have had many of my clients use this time to create lists of aspects of their personal and professional lives that they like and dislike. I have asked them to seriously consider eliminating the tolerations—the people, things and situations that get in the way of their happiness. You can.

Over the months ahead, there is a great deal to consider:

- financial modelling and forecasting;
- marketing for new patients;
- the new patient journey;
- clinical and non-clinical operational systems;
- your team—their structure, roles and responsibilities;
- your overall game plan.

Each of these is on my task list to consider, decide and execute new versions for my clients that apply to the post-lockdown time and (we hope) post-COVID-19 landscape. I am working with a community of over 120 UK practices, and we are taking that journey together, sharing our experiences and collaborating on solutions. Dentistry can no longer be a fragmented collection of small business owners. As I heard on a webinar a few days ago: "We may not all be in the same boat but we are in the same storm". It is only by staying together that we can enjoy strength in numbers.

contact

Chris Barrow has been active as a consultant, trainer and coach to the UK dental profession for over 24 years. His main professional focus now is through his Extreme Business company, providing coaching and mentorship to independent dentistry around the world via face-to-face meetings, a workshop programme and an online learning platform.

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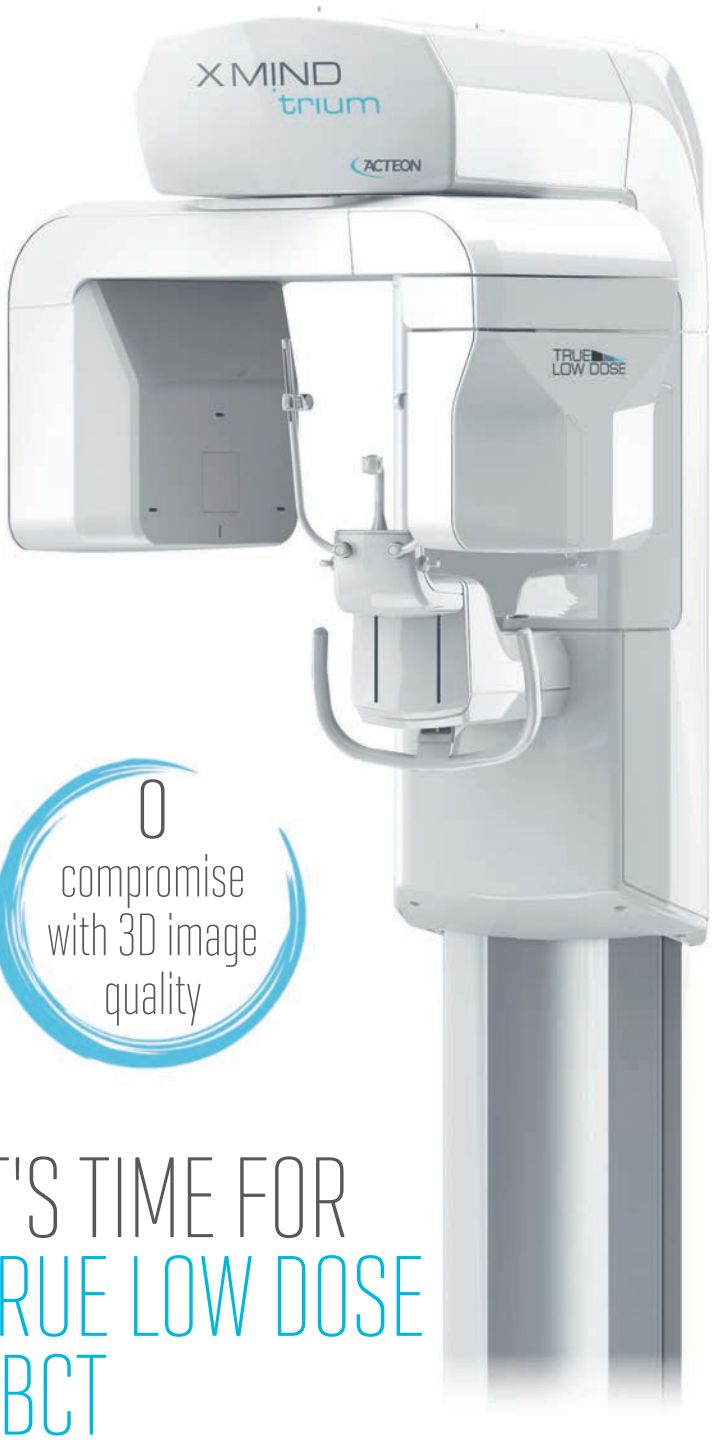

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