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CAD/CAM

international magazine of dental laboratories

technique
Surface texture: Using horizontal and vertical lines to simulate natural tooth appearance

industry news
CEREC advances the restorative capabilities

case report
Production of complete maxillary and mandibular dentures using CAD/CAM technology

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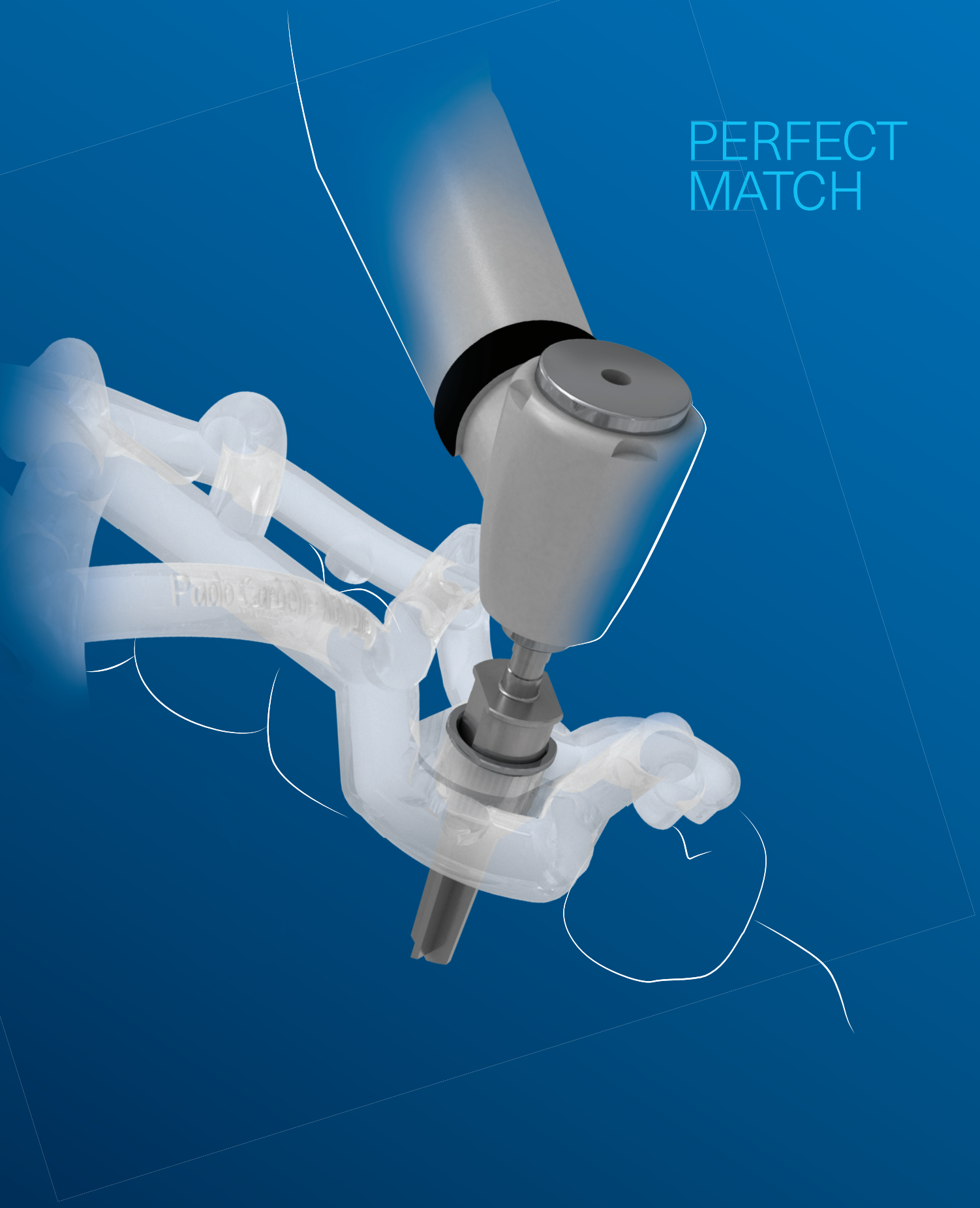

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Magda Wojtkiewicz

Managing Editor

Preparing for a challenge

What do implementing new technologies in your office, meetings, running marathons, difficult patients and mothers-in-law have in common? They are challenges. A challenge is a situation or circumstance that could potentially trigger a negative emotional reaction in you. Challenges can be large or small, and they can vary greatly. We all have challenges, but they are very different and what might be a challenge for one person is not for another. Even if it sounds trivial, understanding what the challenge means to you is essential in order to prepare for it and set yourself up for success.

Going digital by implementing technologies like CAD/CAM in the dental office and laboratory is definitely a challenge. Transformation is always a challenge, often a major one, but it can be predictable, and you can prepare yourself and your team for this change.

Most modern dental laboratories started as conventional dental laboratories and had operated with traditional workflows for many years before they started to use all the newest technologies, adopting these step by step. That might be your path too; you just need to be prepared for it.

Preparation is a key to success, and some common stress management techniques can be very helpful here. Start by envisioning the challenge and developing a plan for how you might meet it. Then put the challenge into perspective and assess the risk. Ask yourself how you would feel about the challenge in an ideal world. Maybe you want to feel confident, content, engaged or some other positive emotion. No one wants to feel uncertain, angry or upset. Then practise feeling positively about the challenge. It might sound unnecessary but feeling positive is a skill that must be practised. Every time you begin to feel anxious about the challenge or start having doubts, you should stop and go back to the positive emotions you identified first. Negative feelings can ruin even the best prepared plan. As soon as you feel confident about the challenge, you can start the transformation.

Digital technology is the signature of a brand-new approach and often brings new opportunities. Digitalisation may also involve surprises and U-turns, but even if you can't predict these entirely, you can be prepared for them. Therefore, don't under-estimate the power of preparation. Preparing for a challenge will save you a great deal of energy, might also save you money and more likely will turn the challenge into a success.

What is your challenge? Are you going to respond reactively, or are you going to meet it proactively by preparation to shape its outcome?

Enjoy this issue of CAD/CAM, which contains many well-documented and clearly illustrated clinical articles, as well as a great deal of useful information about the latest developments in the field of digital dentistry.

Sincerely,

Magda Wojtkiewicz
Managing Editor


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What will the future of dentistry look like

An interview with Dr Victoria Sampson

By Brendan Day, Dental Tribune International

For Dr Victoria Sampson, the connection between oral and systemic health is of central concern when dealing with her dental patients. She employs biomarkers and inflammatory markers to diagnose and monitor patients throughout the course of treatment and collaborates with specialists from other fields to create a more holistic form of treatment. She spoke with Dental Tribune International about her approach to dentistry and how she sees the field evolving in the coming years.

Your approach to dentistry is preventative and minimally invasive in its nature. Do you regard these as areas that will become increasingly important for dental practitioners in the future?

Definitely. We are now living in a society where our patients have more knowledge of their own health and of what treatments are available. They want to have the most preventative and least invasive treatment possible to ensure optimal health.

As an industry, we have modernised in such a way that we are able to catch disease earlier and provide more minimally invasive treatments. We have all lived through a pandemic, which has taught us how important health is and reinforced the idea that prevention is always better than cure. I always try to teach my patients that oral health is a very important part of general health and that in order to be at optimal health, they must also take care of their mouths. We now know that poor oral health can contribute to numerous other systemic diseases and conditions, such as diabetes, heart disease and infertility. Dental professionals are slowly starting to understand that the work they do has

huge consequences for the rest of the body. It is our duty to arrest disease and prevent problems from happening.

What other aspects of dentistry do you think will change or evolve in the future?
I think that we are going to see a huge digitalisation of dentistry in the next ten years, similar to the rest of healthcare. Many dentists already follow a digital workflow to allow for seamless communication with laboratory technicians through intra-oral scanning and CAD/CAM restorations. I think this is just the beginning. There is already so much research going into incorporating artificial intelligence and image recognition to help us diagnose and monitor dental and systemic diseases. I think this soon won't be a thing of the future, but very much something we use to help us every day.

I also think, and hope, that dental professionals will become more aware of how important saliva is and how much information it can give us not only of a patient's dental health but also of their systemic health. I envisage that patients will start going to their dentist for saliva tests in the same way that they go to their doctor now for blood tests. We are already quite used to using the mouth as a site for testing, thanks to COVID-19, and I think this will become more common in the dental practice. We are now starting to understand that saliva can give a snapshot of the oral microbiome, be used for genetic testing and indicate enzyme levels, collagen breakdown, inflammatory markers and even cancer markers. By diagnosing and monitoring dental diseases in a quantitative way, we will hopefully start to achieve better long-term outcomes for our patients. Unfortunately, we usually diagnose dental disease when it is too late and destruction has already occurred—be it periodontal disease or dental caries. If we were able to screen patients for early signs of inflammation, microbiome dysbiosis, high levels of certain enzyme activity or collagen breakdown, we would hopefully be able to prevent the disease from happening.


Dr Victoria Sampson

In your opinion, what can dental teams do to make sure they are prepared to adapt to changes in dentistry?
They need to be open to change. Dentistry can be extremely habitual and dental professionals often stick to what they are used to. When we have the health of our patients in our hands, it can be very daunting to try new things out, particularly when you think your own method already works. Whereas I don't think we should be experimenting on our patients, we should, however, be open to trying new things to enhance our patient's journeys and improve their treatment outcomes. For example, we use bleeding on probing as a diagnostic tool to diagnose inflammation of the gums. This can be subjective and also inconclusive. If we were able to quantitatively diagnose inflammation through looking at inflammatory markers or looking for pathogenic bacteria in the mouth, our patients' treatment outcomes would be improved since we would have a number to work with and a cause of the inflammation to eradicate. We aren't trying to reinvent the wheel, just make it better and more accurate!

I also strongly recommend that dental professionals update their knowledge through regular reading of research papers and attending conferences. Our industry can be quite lonely, and it is important to keep your finger on the pulse by staying updated.

What are you looking forward the most about the round-table discussion of GBT Summit—Virtual Edition?
I am truly excited about having the opportunity to speak to like-minded professionals of such a high calibre on the future of dentistry. We are all practising dental professionals from different countries who will be able to share how we do things and what we expect the future to be like. We also all do very different things in practice but share a similar mindset. I am excited about being able to learn more about what they do and where they see dentistry going in the next five years. I usually lecture alone so I am also looking forward to having fun and interactive discussions!

Editorial note: At this year's GBT Summit—Virtual Edition, Dr Sampson participated in a round-table conversation with Dr Steffen Rieger and dental hygienist Thuy Vu on the future of dentistry. The webinars of the GBT Summit are still available on demand at: https://www.swissdentalacademyonline.com/webinar/gbt-live-treatment-learn-the-technique-in-detail

"Many dentists already follow a digital workflow to allow for seamless communication with laboratory technicians through intra-oral scanning and CAD/CAM restorations."

FDA approval marks major step for Second Opinion AI software

By Jeremy Booth, Dental Tribune International

Second Opinion, an artificial intelligence (AI) diagnostic tool that assists in dental radiography, has been cleared by the U.S. Food and Drug Administration (FDA) for use by dental professionals in the country. This milestone follows the recent approval of the software by health regulators in Australia and New Zealand and the granting of the European CE mark. The software was developed by Pearl, and the company's founder and CEO, Ophir Tanz, said that the clearance was a major step for dentists, who are now free to shift into the AI paradigm in their everyday clinical practice.

Pearl is a leader in developing AI solutions for use in dentistry, and its Second Opinion tool is a real-time pathology solution that assists dentists in accurately detecting and diagnosing common dental conditions using dental radiographs. A computer vision platform that can identify and measure an array of pathologies, the software highlights potential areas of interest and provides dentists with a second set of eyes.

The FDA cleared the software in early March, and a press release from Pearl explained that the agency's strict efficacy requirements had been exceeded by the clinical studies that formed the basis of the company's application for market approval.

In total, Pearl submitted four clinical studies to the healthcare regulator, and each of the studies featured a dataset of more than 2,000 images that were interpreted by dozens of expert dentists and radiologists. Pearl said that the studies showed clear advantages for the experts using Second Opinion software. Those who had used the AI software had identified 36% more lesions than those who had worked without AI assistance.

The company said that the FDA clearance marked an important step in the adoption of technology-assisted dental care. Tanz commented in the press release: "This clearance is a major milestone not only for our team and for the many dentists, advisors and partners who have contributed to Second Opinion's development, but also for dentistry itself." He explained that AI-assisted technology brought with it a paradigm-shift in dental technology that he said would add value across the entire healthcare sector. "Because X-rays are a regular part of every dental patient's experience, the first place most people will encounter the power of medical AI technology will be in their dentist's chair. Second Opinion's FDA clearance has made that possible," he added.

Prof. Markus Blatz, a key opinion leader in restorative dentistry and digital innovation, said in the press release: "The benefit that Pearl's AI brings to patient communication in the dental operatory—and the trust that follows—cannot be overstated, and it is in that area that Second Opinion's impact will be most immediately felt."

Pearl's co-founder and chief technology officer, Cambron Carter, added: "State of the art algorithms that currently assist in the detection of cancerous lesions can now be applied to detect many more frequently occurring dental diseases. The standard of care in dentistry is about to level up."

Speaking to Dental Tribune International, Tanz predicted that, as dental patients reap the benefits of AI-assisted technology, dentistry itself would become a model for the rapid adoption of AI in other medical fields. "So, at the same time as today we welcome the future of AI-powered dentistry, we also welcome an AI-powered future for all of healthcare," he said.

In October last year, Second Opinion was provided with market authorisation by Australia's Therapeutic Goods Administration and New Zealand's Medicines and Medical Devices Safety Authority. Earlier in 2021, it received the European CE marking, and it is already being used daily by dentists in North America, Europe, Australasia, South America and the Middle East.

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SmileAward recognises patient stories on a world stage

An interview with Dr Anthony Mak

By Franziska Beier, Dental Tribune International

Fig. 1: Dr Anthony Mak at his dental clinic W Dental in Sydney in Australia. *(All images: © Anthony Mak)*

Straumann's mission is to change patient's lives by giving smiles back. Whereas it is the company which produces the dental implants and everything associated with them, it's the numerous dental professionals around the world who, with their treatments, have a positive impact on the patients' quality of life—they enable them to have the confidence to smile again, to laugh freely and to enjoy the foods they love. To shine a light on these dental professionals, last year, Straumann launched the SmileAward contest. Dr Anthony Mak participated in this first edition and was one of the ten winners. In this interview, he explains what he enjoyed most about the contest and how it changed his patient's life.

> "It helped the patients become aware that they were going to go through a life-changing journey."

Dr Mak, what motivated you to participate in the 2021 SmileAward?

A good friend told me about this award and how the competition wanted to connect the world to share what dentistry's impact can have on the lives and well-being of our patients. I thought it was a very thoughtful and gratifying initiative, as it recognises our commitment and passion within the dentistry field. I wanted to participate in the SmileAward competition to support the initiative and to share what we do in our daily practice and the influence we have on our patients, not only aesthetically, but also regarding their health and self-confidence. It's the perfect way to share knowledge about the possibilities of dental implants and their advancements in oral health at a global forum.

Fig. 2: Dr Anthony Mak (left) and Dr Javier Tapia from Spain working on the case together.

What did you enjoy most about the contest?
I most enjoyed having the opportunity to connect with my patients more in-depth. When I was interviewing my patients, hearing their testimonials and checking whether their cases met the criteria for the competition, I found out exactly how the treatment had had an emotional impact on each patient's life. It was a really meaningful and gratifying experience.

Besides the prize, what did you obtain from your participation?
It really gave me the confidence to share realistic cases with my patients who were considering this form of treatment. It helped them become aware that they were going to go through a life-changing journey.

For the upcoming 2022 contest you will be a part of the jury. How does that make you feel?

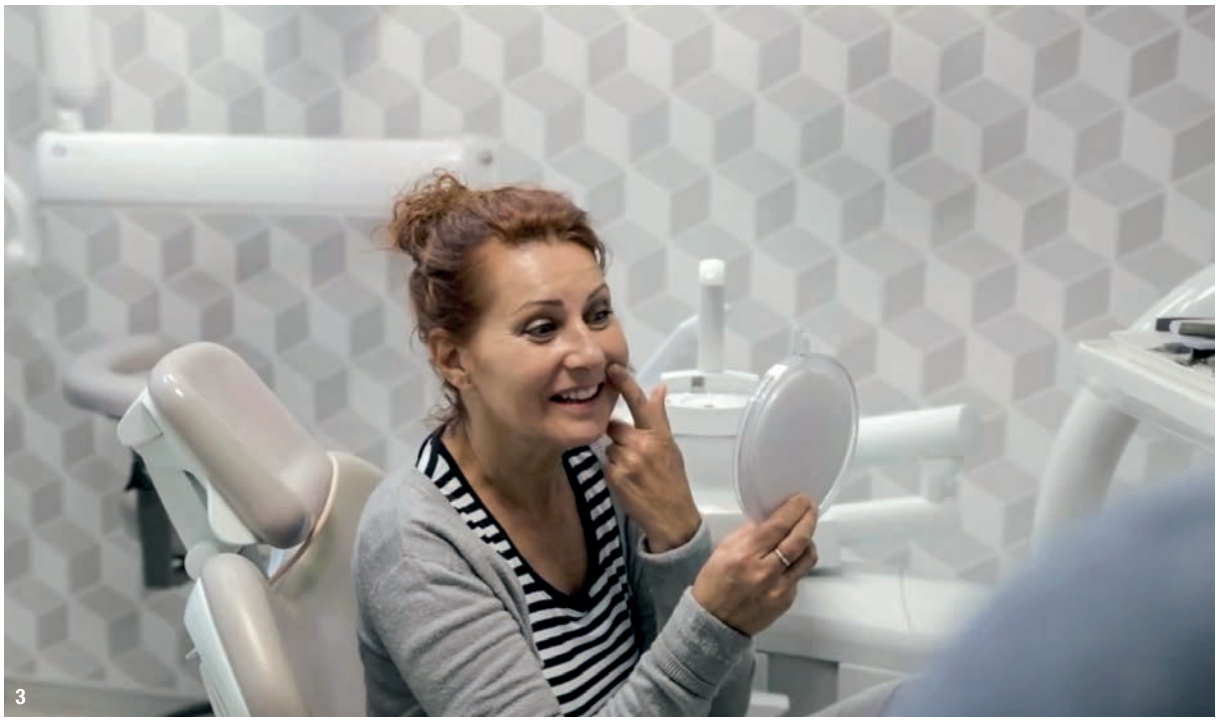

Fig. 3: The patient looking at her final prosthesis immediately after the insertion.

Fig. 4: The patient, almost one year post treatment, talking about how the treatment has changed her life.

> "It's given the patient confidence and satisfaction in the fact that she has had excellent treatment which was recognised on a world stage."

It feels wonderful having the opportunity to continue supporting this very special initiative. I am humbled and honoured to have this opportunity, as I feel that I can bring a new level of understanding to the jury panel regarding the complexity of case submissions and of meeting the requirements for the award.

I will be able to empathise with all of this year's SmileAward entrants and hopefully also make a positive contribution to the work of the jury.

Where do you see the link between the purposes of both the contest and your profession?
It's an amazing contest for our profession. It's the perfect way for professionals to share publicly with the global community how dental implants can change the lives of patients and, ultimately, improve their personal confidence and oral health.

It's something that has never been done before. It's a wonderful initiative that connects dentistry, well-being and the world together.

I truly feel everyone who enters into this contest is already a winner, as they have been able to provide excellent dental care that patients ultimately feel very happy with. The whole experience connects dentists with their patients, and you see the outcome in more ways than just in aesthetics. It's a comforting relief for the patient who may have struggled with concerns for years.

How did the contest change your patient's life?
Obviously, the improvement in the patient's dental health has been a life-changing experience for her. Outside of the dental realm, I feel it's given the patient confidence and satisfaction in the fact that she has had excellent treatment which was recognised on a world stage. That alone had tremendous value for her, and reinforced her trust in our treatment, materials and technique. Her contribution by supporting me through the process of participating in the contest has helped and inspired other dental clinicians around the world to participate as well.

Editorial note: Dr Anthony Mak runs two practices in Sydney in Australia, focusing on quality modern comprehensive care, including aesthetic and implant dentistry. He is a member of the Restorative Advisory Board of GC Europe and also of the executive planning committee for the Graduate Diploma in Clinical Dentistry (Oral Implants) at the University of Sydney and is the Australian team leader of the renowned Bio-Emulation Group, a global group of high-achieving dental practitioners. Dental professionals who are interested in participating in this year's contest may submit their patient story until 20 July. More information concerning participation can be found on the Straumann website, https://www.straumann.com/group/en/discover/smileaward-2022/hero.html.

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MORE INFOS

Precise prosthetic planning and implant placement

Treatment of a complex full-arch case using guided surgery and immediate loading

Dr Sergio Piano, Italy


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Introduction

Oral health plays an important role in quality of life, and even though preventive dentistry has evolved, edentulism remains a prominent public health problem that can affect function, aesthetics and psychosocial health. Thus, the option of replacing teeth with implants is important for patient well-being.

Technological progress, including the proliferation of Internet access worldwide, has given patients access to a wealth of information about their oral health and has raised awareness of the range of available treatments, materials and techniques. As a result, patients' expectations and behaviours have changed and an ever-increasing number are requesting less invasive, affordable, efficient and immediate solutions.

The Straumann Pro Arch concept enables personalised treatment protocols with various treatment options to address specific indications and clinical scenarios. This concept covers all stages of an immediate full-arch treatment and includes the use of implants specifically designed for immediate procedures, offering a flexible prosthetic portfolio that considers patients' aesthetic expectations and financial resources.

The following case report describes a successful functional and aesthetic prosthetic full-arch implant rehabilitation of a patient with a hopeless maxillary dentition and decreased quality of life caused by impaired masticatory function and poor aesthetics. The Pro Arch concept with Straumann Bone Level Tapered (BLT) implants and screw-retained abutments (Straumann) allowed us to address our patient's chief complaints by providing an efficient and predictable solution.

The immediate treatment workflow involved four steps: (1) accurately creating a preoperative dental model; (2) surgical and prosthetic planning with coDiagnostiX software (Dental Wings); (3) placing the dental implants with a computer-guided and flapless technique; and


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(4) performing an immediate loading procedure. This clinical outcome was achieved in a single day with no complications. The patient was highly satisfied with the positive impact the treatment had on her quality of life owing to significantly improved aesthetics and recovery of masticatory function.

Initial situation

A systemically healthy 58-year-old female patient presented to our office with the chief complaint of aesthetic dissatisfaction and impaired masticatory function caused by an unstable removable partial denture (Fig. 1). The initial comprehensive clinical evaluation revealed partial edentulism; a deep overbite, the mandibular incisors impinging upon the palatal gingiva; and increased overjet. The maxillary incisors were buccally tilted and presented tooth wear and mobility. Moreover, there was interference between the lower lip and the anterior teeth in the smile position (Figs. 2–5). Intra-oral periapical radiographs showed approximately 50–75% alveolar bone loss (Fig. 6). In addition, the patient had an uneven smile line (Fig. 7).

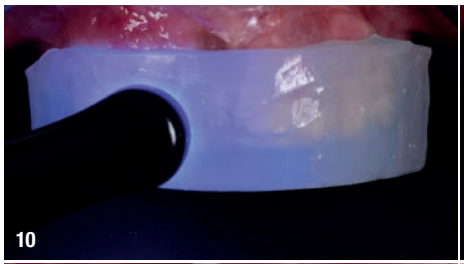
Treatment planning

The benefits, risks and alternative treatment options were discussed with the patient and a decision was then reached in partnership with the patient. This is a fundamental stage in treatment planning to ensure that the patient's needs and wishes are met and to achieve a successful outcome. The treatment workflow included the immediate placement of implants into the extraction sockets and immediate loading using computer-guided surgery and a flapless approach.

A suitable new removable partial denture was planned as a starting point. On the basis of the clinical documentation, a digital smile design preview was created. The dental technician then made a wax-up of the anterior teeth and a model of the posterior area of the future denture. This new set-up increased the vertical dimension to define an optimal vertical position for the anterior teeth (Figs. 8 & 9).

The next step was to transfer this data to the patient's mouth to verify its accuracy. Using a silicone mask created based on the wax-up and filled with flowable composite, a mock-up of the anterior teeth was made (Fig. 10). A model of the posterior teeth was added to the mock-up to complete the previsualisation of the proposed new smile (Fig. 11).

The already created digital smile design drove the proposed shape and position of the teeth (Fig.12) In addition, the deep bite and the overjet were corrected, and the smile was improved. This prosthetic plan was discussed with the patient and then approved (Figs. 13–15).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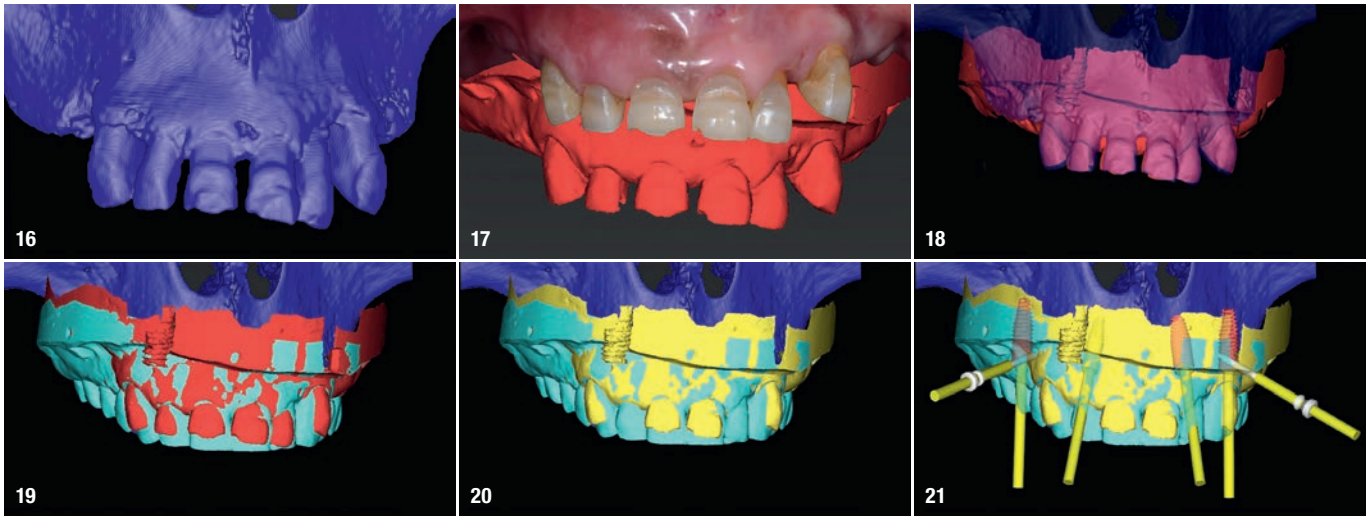
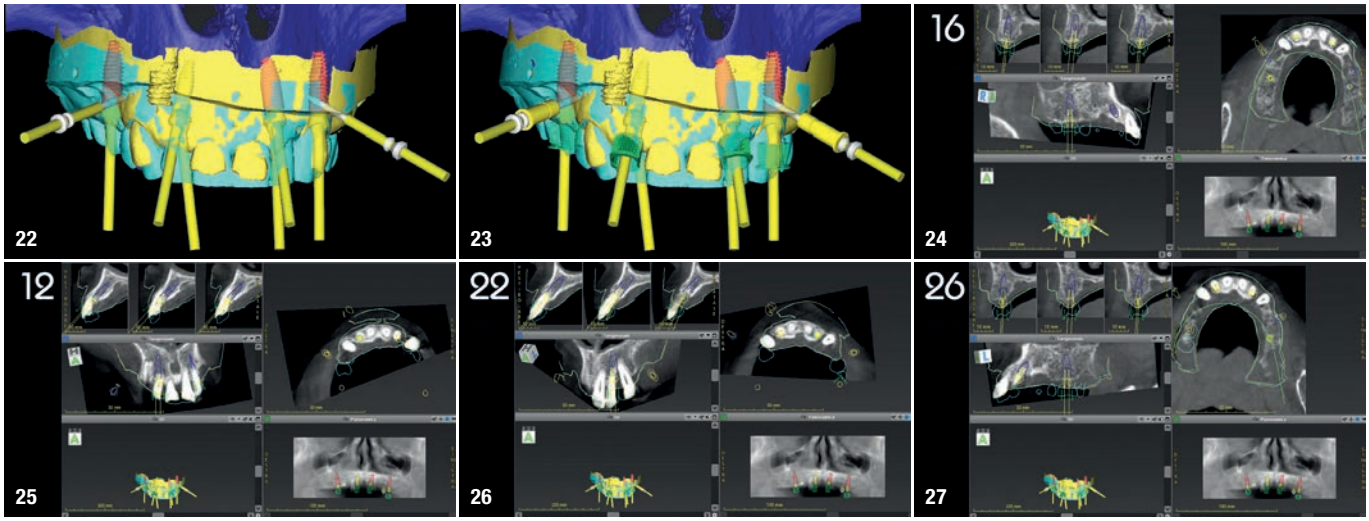


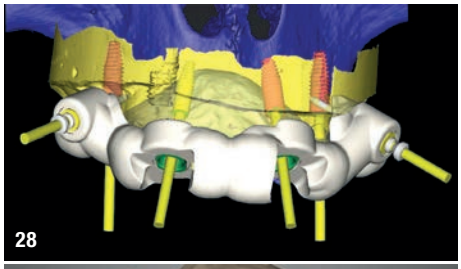
The cast model was scanned and an STL file was generated. Moreover, a CBCT scan was requested for the radiographic assessment. This data, including the DICOM files, was imported into the coDiagnostiX software for the analysis and treatment planning (Fig. 16).

The prosthetic plan is just as important as the surgical plan. For this, the STL file of the initial situation was compared with the DICOM files (Figs. 17 & 18). Furthermore, the STL file related to the proposed prosthetic plan was aligned with the rest of the files (Fig. 19). Finally, the last pairing was performed by superimposing the STL file on to the virtual extraction of the lateral incisors, which were potential sites for implant placement (Fig. 20).

After this preliminary phase, all the data related to the initial situation, bone availability, gingival profiles and prosthetic strategy had been obtained in order to start the planning of the implant positioning. On this basis, four BLT implants were planned: of 4.1 mm in diameter and 12.0 mm in length for tooth #16; 3.3 mm in diameter and 12.0 mm in length for tooth #12; 4.1 mm in diameter and 12.0 mm in length for tooth #22; 4.1 mm in diameter and 12.0 mm in length for tooth #26. The implants were strategically distributed in the maxilla and fixation pins were planned for the stabilisation of the surgical guide (Fig. 21). Furthermore, suitable screw-retained abutments were chosen, and the corresponding sleeves for the implant and pin placement were selected (Figs. 22 & 23). The implants at sites #16, 12, 22 and 26 were planned according to bone volume, soft-tissue position and prosthetic strategy (Figs. 24–27). The surgical guide for implant placement was designed, and the corresponding STL file (Figs. 28 & 29) was sent to the dental laboratory for printing (Fig. 30).

The next step was to prepare the temporary prosthesis for immediate loading. This is the preliminary phase prior to milling and involves replicating the shape of the dental set-up in a resin disc (Figs. 31–33).

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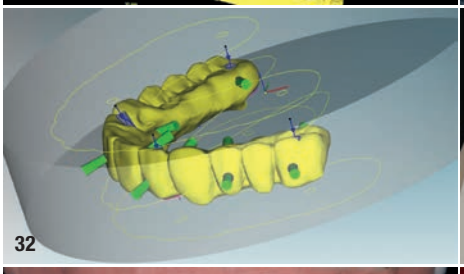
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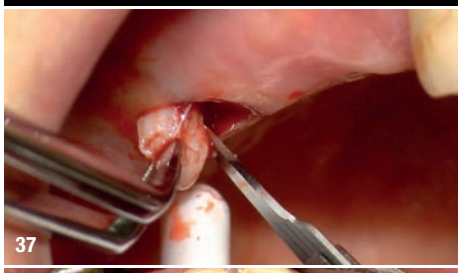
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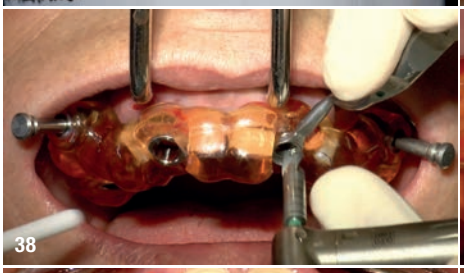
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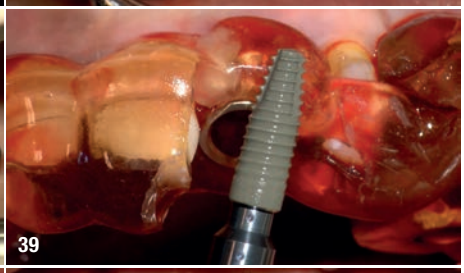
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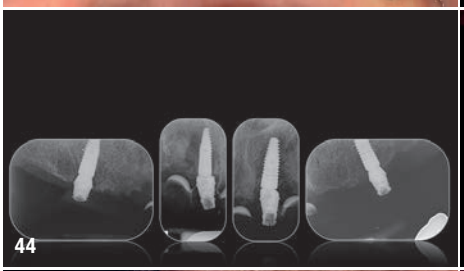
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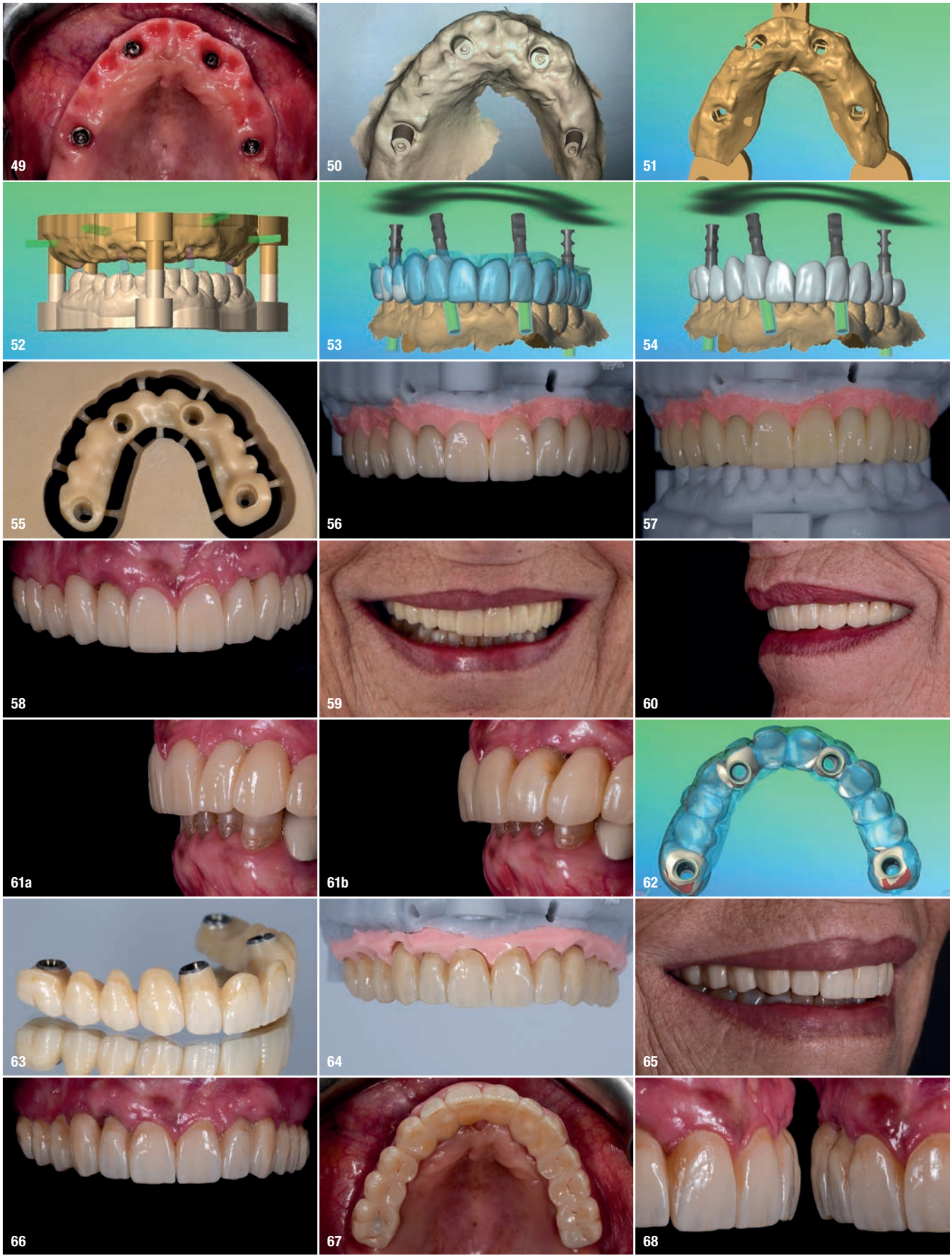
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Once obtained, the temporary prosthesis was seated and adapted on the master model with implant analogues and the corresponding screw-retained abutments (Fig. 34). In the final step, the occlusion was carefully adjusted (Fig. 35).

Surgical procedure

In the first phase, the hopeless teeth located in the planned implant sites were strategically extracted (Fig. 36) and the soft tissue removed with a punch for a flapless approach (Fig. 37). The remaining teeth were used to stabilise the guide with the aid of surgical pins as anchorage (Fig. 38).

After the optimal stabilisation of the guide, the implants were placed (Fig. 39) using the dedicated surgical kit, and the screw-retained abutments were placed on the implants (Fig. 40). The remaining teeth on the arch were then extracted and temporary abutments were placed on the screw-retained abutments (Fig. 41). The temporary prosthesis was screwed on to the copings and bonded with flowable resin (Fig. 42). Once the occlusion had been adjusted, the chimneys were filled with PTFE and covered with temporary composite.

The patient was very satisfied with the functional and aesthetic outcome (Fig. 43). Radiographs were taken at the one-month follow-up visit (Fig. 44).

Prosthetic procedure

At the three-month follow-up visit, the patient reported no mechanical or biological complications. Moreover, the clinical examination showed uneventful healing and complete soft-tissue maturation (Figs. 45–48). At this point, the treatment already met the patient's expectations, providing the desired aesthetic and functional clinical outcomes.

To prepare the final restoration, the temporary prosthesis was removed, and the soft tissue was evaluated (Fig. 49). An optical impression with the Virtuo Vivo intra-oral scanner (Straumann) was taken, and a digital model was obtained and guided into occlusion with the maxilla (Figs. 50–52). The initial dental set-up (represented in blue in Fig. 53) was then matched with the digital model, and minor adjustments were made (shown in white in Fig. 54).

Before milling the zirconia framework, it is important to ensure optimal dental alignment. Therefore, a test drive was performed using a roughly milled resin prosthesis with the exact shape of the designed restoration that was then checked in the patient's mouth (Figs. 55–57). The overall aesthetic outcome, smile line, emergence profiles of the teeth, lip support and occlusion were carefully verified. The zirconia prosthesis was then created accordingly (Figs. 58–62). For this, a full-contour zirconia prosthesis was milled, on to which Variobase copings (Straumann) were cemented (Fig. 63). The model was slightly adjusted and refined before delivery (Fig. 64).

Treatment outcomes

Finally, the prosthesis was screwed into the patient's mouth. The treatment outcome fulfilled the patient's aesthetic expectations in terms of natural appearance, harmony and beauty. Furthermore, she reported an improvement in her quality of life owing to the recovery of her masticatory function and self-esteem (Figs. 65–70).

Acknowledgement
A special thanks to DT Alessandro Giacometti, Genova, Italy, for his great lab work.

about

Dr Sergio Piano graduated with a DMD from the University of Genoa in Italy. He is director of his own private dental clinic in Genoa. He has lectured in more than 30 countries and written several scientific papers in the fields of implantology and aesthetics.
Dr Piano is an active member of the Italian Academy of Osseointegration and Italian Academy of Esthetic Dentistry and an affiliate member of the European Academy of Esthetic Dentistry, as well as an International Team for Implantology fellow and Education Delegate of the Italian section's leadership team.

Production of complete maxillary and mandibular dentures using CAD/CAM technology

Dr Francesco Zingari, Dr Eleonora Carozzi & Salvatore Belvedere, Italy

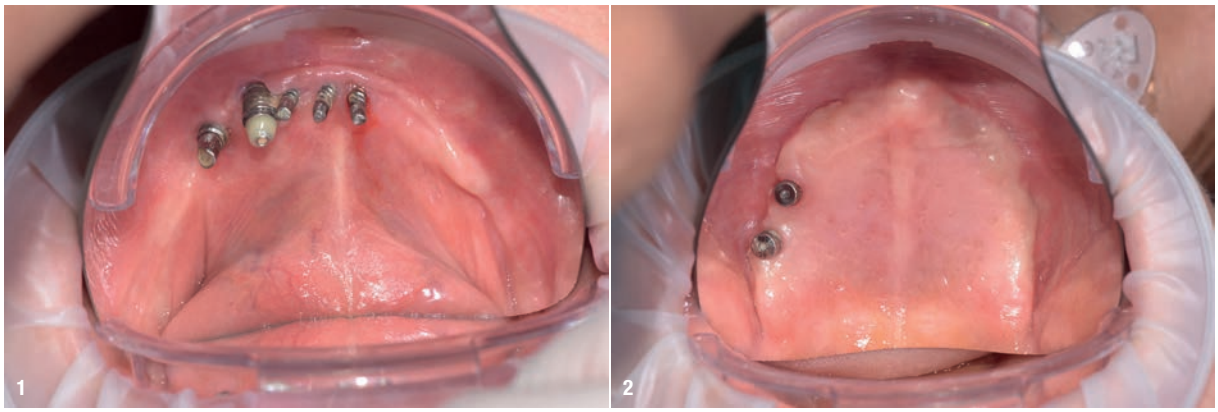


Fig. 1: Situation in the mandible before treatment. **Fig. 2:** Situation in the maxilla before treatment.

Introduction

Digitalisation in the world of dentistry and dental technology is advancing rapidly, and it is now difficult to imagine everyday clinical practice without it. Sophisticated solutions are available in the fields of diagnostics, treatment planning and the production of permanent restorations in particular.[1] Capture of digital radiographs, implant planning and the design of permanent restorations using hardware and software solutions are already well-established procedures in modern dentistry and dental technology. The weak points of solutions available to date included soft tissue and functionally intrinsic structures, which were difficult to integrate into the digital workflow.[2] Furthermore, the production of removable dentures has been widely accepted for many years and is now a firmly established everyday procedure in practices and laboratories alike.[3] Increasingly, however, the production of removable dentures is now also being satisfactorily digitalised thanks to continuous improvement of the system components. This progress brings with it changes for the workflow, especially as far as dental laboratories are

Fig. 3: Taking of the mandibular impression with the existing denture. **Fig. 4:** Taking of the maxillary impression with the existing denture.

concerned, evolving from a predominantly manual into a predominantly digital task.[4] The following case report describes the use of the CediTEC system (VOCO), which allows production of complete dentures in just a few appointments.

Case description

A 62-year-old female patient presented at our practice of her own volition, complaining of serious difficulties when chewing and speaking as a result of poorly fitting maxillary and mandibular dentures. From an aesthetic perspective, the patient also complained that her old dentures bothered her every day and confirmed that she was no longer happy with them at all.

When asked about her medical history, she stated that she was undergoing treatment with bisphosphonates for diagnosed osteoporosis. Many years ago, the patient had also had five implants inserted into her lower jaw and two into her upper jaw, to which the existing removable dentures from her former dentist were attached. The patient's request was for accurately fitting dentures again to improve both her appearance and her ability to chew and speak properly.

Findings

The clinical, instrumental and radiographic findings revealed generalised horizontal and vertical bone loss in the edentulous regions. The mucous membranes did not appear to be irritated. The implant abutments, which had clearly been individualised multiple times, were inadequate for support of the removable dentures. All the implants displayed a degree of loosening and the peri-implant tissue appeared both slightly red and swollen. We found that the complete maxillary and mandibular dentures were inadequate and diagnosed peri-implantitis around all the implants.

Treatment planning

The prognosis for the implants was not predictable at the time the findings were recorded, for which reason the implants were initially left as they were (Figs. 1 & 2). The treatment of the peri-implantitis would be initiated after production of the new complete maxillary and mandibular dentures. With special consideration of the patient's existing condition and medication, replacement of the implants in the upper jaw with zygomatic and pterygoid implants at a later point in time might also have been conceivable. However, this will not be discussed in further detail at this point.

The patient requested that the functional impairments and aesthetic aspects be resolved as quickly as possible. For cost and time reasons, the complete maxillary and mandibular dentures to be produced were designed using CAD/CAM technology. To do so, we decided for the sake of simplicity on the CediTEC system, in which all the necessary components are coordinated.

Fig. 5: Digital maxillomandibular relationship registration and axiography.

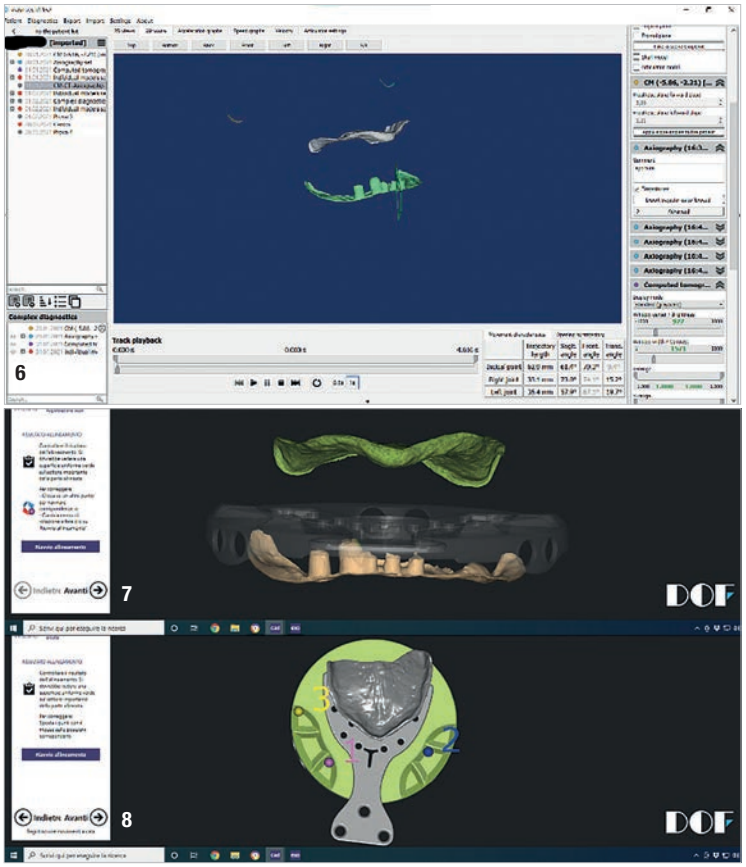
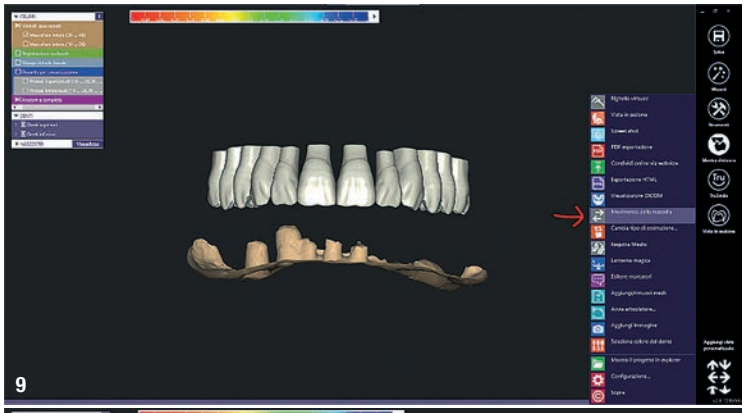
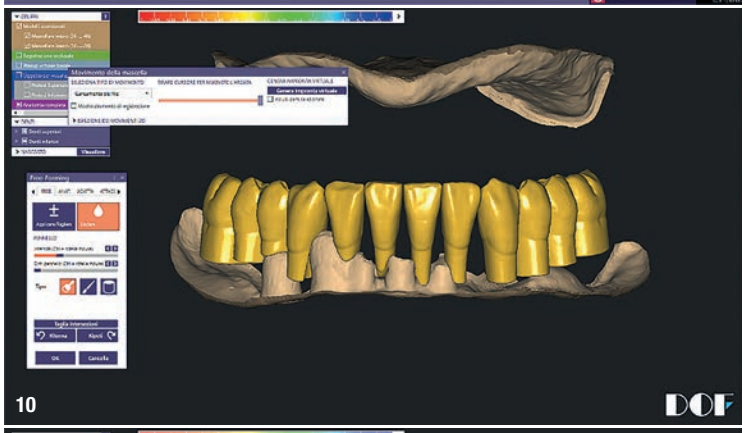


Fig. 6: Visualisation of digital maxillomandibular relationship registration.
Figs. 7 & 8: Import into the exocad software after scanning of the individual impressions and dentures using the laboratory scanner.





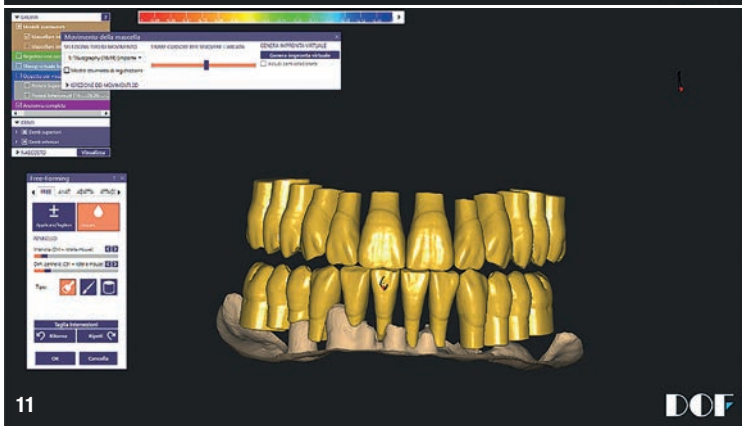


Fig. 9: Diagnostic tooth arrangement in the maxilla. **Fig. 10:** Diagnostic tooth arrangement in the mandible. **Fig. 11:** Digital tooth arrangement with static and dynamic occlusion.

Treatment

Using the existing dentures as customised trays, the situation impressions were taken (Flexitime Monophase Pro Scan, Kulzer; Figs. 3 & 4) and digitalised using a laboratory scanner in the first appointment after the recording of the findings, diagnosis, dental hygiene and treatment planning. At the dental laboratory, the individual impressions and dentures were digitalised with a laboratory scanner (BEGO LabScan, BEGO Medical) and the data was converted to STL format. The individual holders for an intra-oral registration instrument were designed and produced.

In the second treatment appointment, the digital maxillomandibular relationship registration and axiography were performed with Prosystom (SDiMatriX; Fig. 5). At the dental laboratory, data sets were imported into exocad software (Figs. 6–8), diagnostic and digital tooth arrangement was performed (Figs. 9 & 10), and digital modelling of the complete maxillary and mandibular dentures was performed (Fig. 11). The data sets were transferred to nesting software (Netfabb, Autodesk) and the files were exported to a 3D printer (SolFlex 170 HD, VOCO).

The dental laboratory printed modified wax try-ins (V Print Try-In, VOCO; Fig. 12). These were tried in (Fig. 13) and the static and dynamic occlusion, phonation and aesthetics were checked at the third appointment.

Next, the dental laboratory 3D-printed (SolFlex 170 HD) and finished the master models (V-Print model fast, VOCO) and the denture bases on the basis of the existing data sets (V-Print dentbase, VOCO; Figs. 14 & 15). Thereafter, the dental laboratory milled the 24 denture teeth from a disc (CediTEC DT, Shade A2), finished them (Fig. 16), fixed them to the printed denture bases (CediTEC Adhesive) and finished the bases (Figs. 17 & 18). The occlusal surfaces on the complete dentures were then individualised (FinalTouch, VOCO; Figs. 19–22).

In the fourth treatment appointment, the final complete maxillary and mandibular dentures were inserted (Fig. 23) and selective grinding was performed.

Result

The complete dentures were produced using CAD/CAM technology. The finished result is in no way inferior to a manually produced workpiece. The patient was also unable to identify any disadvantages. After insertion, the patient's *en face* profile during phonation and smiling had a natural appearance (Figs. 24 & 25). The soft tissue of the face was harmonious and naturally padded. In a before and after comparison, the nasolabial and peri-labial folds were considerably reduced with the new complete dentures. Clinical aspects such as static and dynamic occlusion were normal.

Discussion

The conventional production of removable dentures and complete dentures in particular may seem somewhat laborious when considering the case described here, as the use of CAD/CAM technology clearly represents an approach which is extremely time-effective and therefore cost-effective. The continuous modification of the clinical approach employing CAD/CAM technologies initiated in recent years, especially with regard to the production of complete dentures, has repeatedly resulted in lower labour costs and fewer clinical treatment steps.[5–7]

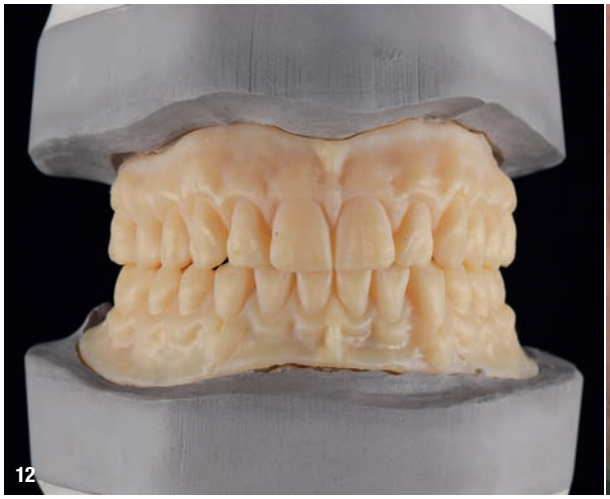
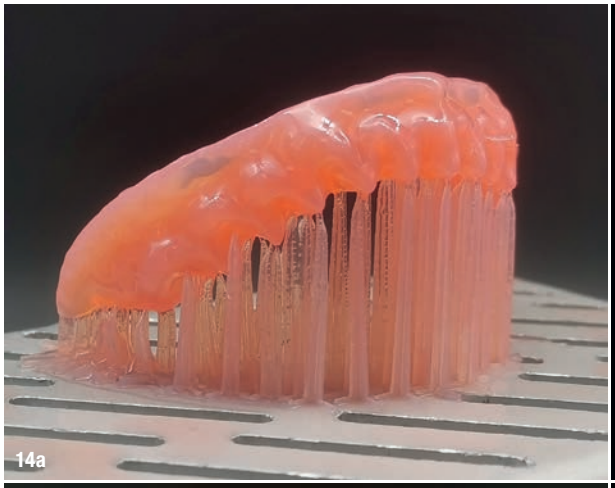
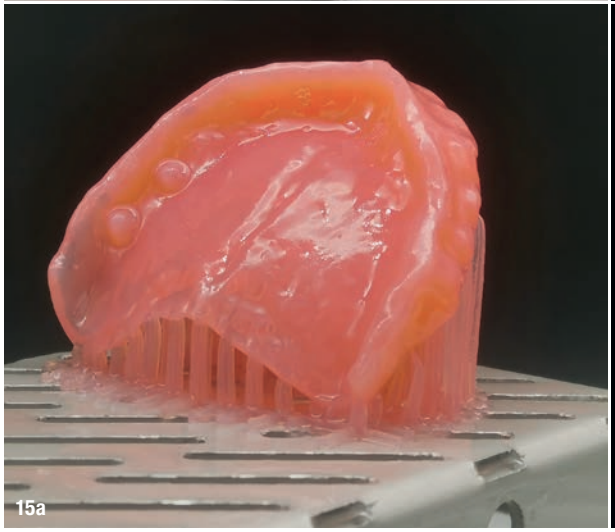


Fig. 12: Modified wax try-ins (V-Print Try-In). **Fig. 13:** Try-in of modified wax try-ins.

Another advantage is the uncomplicated and arbitrary reproducibility of the procedure thanks to the data being clinically generated initially and then subsequently digitalised and stored.[8] This allows the repeated production of further, identical dentures on the one hand and the export of the data sets to other software programs, for example for the planning of subsequent implant treatment as in this case, on the other.





Figs. 14a & b: Printing of the denture base for the mandible (SolFlex 170 HD & V-Print dentbase). **Figs. 15a & b:** Printing of the denture base for the maxilla (SolFlex 170 HD & V-Print dentbase).

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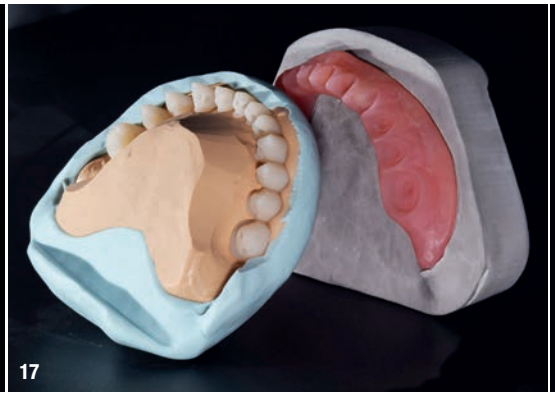
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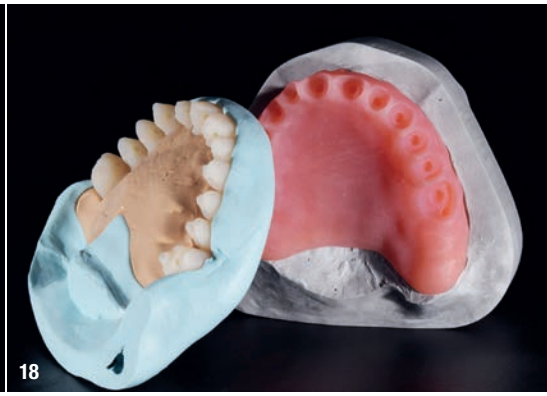
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Fig. 16: Production of denture teeth by milling (CediTEC DT). **Fig. 17:** Silicone wall for fixing the denture teeth in their defined positions in the mandibular denture base (CediTEC Adhesive). **Fig. 18:** Silicone wall for fixing the denture teeth in their defined positions in the maxillary denture base (CediTEC Adhesive).

Owing to the constant and rapid further development of the different components in the scope of the digital workflow over the course of recent years, the progress in the registration and processing of clinical parameters for the production as well as the design of dentures has been enormous.[9, 10] In the case presented here, the computer-assisted production of the denture bases was performed with an additive (rapid prototyping) procedure using a 3D printer and the denture teeth were produced with a subtractive procedure on a milling machine. Subtractive techniques are currently more popular than additive ones in dental laboratories,[11] but the two processes can be used in combination just as easily, as illustrated here using the CediTEC system. Compared with conventional denture production, the use of CAD/CAM technology offers the advantage of better accuracy of fit of the denture


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Fig. 19: Individualisation of the occlusal surfaces of the mandibular denture with composite stains (FinalTouch). **Fig. 20:** Individualisation of the occlusal surfaces of the maxillary denture with composite stains (FinalTouch). **Fig. 21:** Individualised, digitally produced complete maxillary and mandibular dentures in their finished state (CediTEC).

Fig. 22: Individualised, digitally produced complete maxillary and mandibular dentures in their finished state on the 3D-printed master models in the articulator (CediTEC). **Fig. 23:** Individualised, digitally produced complete maxillary and mandibular dentures *in situ* (CediTEC). **Fig. 24:** Individualised, digitally produced complete maxillary and mandibular dentures *in situ*, en face view, habitual bite (CediTEC). **Fig. 25:** Individualised, digitally produced complete maxillary and mandibular dentures *in situ*, smiling (CediTEC).

bases. Using both additive and subtractive processes makes it possible to avoid dimensional changes resulting from polymerisation shrinkage. The reproducibility of the dentures for future replacements as mentioned is another advantage, as the digital data sets are available at all times and any location. The CediTEC system presented here represents a consistent process for both dental practice and dental laboratory. CediTEC stands for CAD/CAM-enabled denture individual TEChnique. In this case, CediTEC DT ("DT" stands for "denture teeth") was used in the scope of the milling technique for the computer-assisted production of the denture teeth. CediTEC DT is a special composite developed specifically for CAD/CAM technology and available in four shades. In the case described here, the denture bases were produced using additive process technology with the aid of a 3D printer and the printing resin V-Print dentbase. The denture bases could alternatively have been manufactured subtractively, in which case they would have been milled from a PMMA disc (CediTEC DB). CediTEC DB is available in three different shades. Both CediTEC DB and CediTEC DT can be subsequently further customised in the scope of aesthetic dentistry with composite stains.

Conclusion

The patient was very satisfied with both the aesthetic and the functional results. In addition, she was surprised that dentures so perfect in every way were possible in so few and such short appointments at that.

In our opinion, nothing has changed in terms of the fundamental principles of the production of complete dentures, even when new and state-of-the-art CAD/CAM systems are utilised. Corresponding expertise in dentistry and dental technology remains the basis for time- and cost-effective treatment with digitally produced dentures. Even in the future, handy software and hardware components will not be able to completely replace the expertise of dentists and dental technicians. Nevertheless, applications in dental practices and dental laboratories will be joined by further new working steps in the interest of the digitalisation of clinical, patient-specific data and virtual planning of dentures.

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

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KATANA AVENCIA Block—making my daily work easier and my patients happy

Dr Cyril Gaillard, France


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Introduction

In the past few years, the number of patients diagnosed with sleep apnoea has increased. Fortunately, we can propose different treatment options today which can provide positive clinical results and improve the quality of life of our patients. This clinical case presents the use of a new CAD/CAM material which offers remarkable mechanical properties, KATANA AVENCIA Block (Kuraray Noritake Dental), produced using Kuraray's unique manufacturing method.

KATANA AVENCIA Block is a new type of hybrid ceramic that brings together the producer's organic and inorganic technology and experience gained over many years of developing and working with restorative materials. It has superior mechanical properties and excellent wear resistance while still being kind to opposing enamel.

Case presentation

This case report presents the rehabilitation of a patient suffering from sleep apnoea, integrating the concept of minimally invasive and adhesive dentistry with, most importantly, functional dentistry by selecting an appropriate occlusal concept and mandibular position for the patient. The 40-year-old


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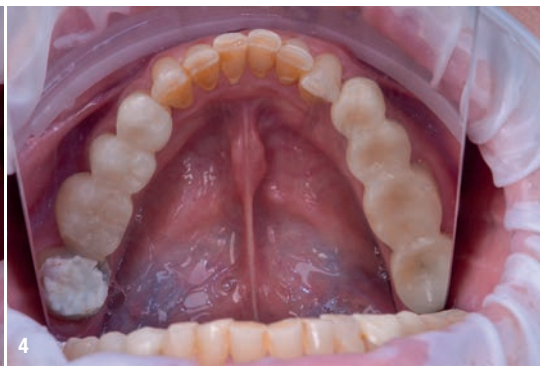
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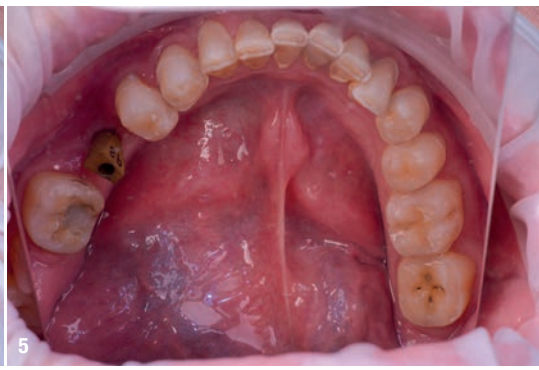
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patient came to the office for his annual check-up, and during initial examination, we discussed his problem of sleep apnoea and the fact that he felt uncomfortable with his occlusion. The patient told us he did not suffer from muscle spasms nor from articular pain, but experienced increasing discomfort during mastication and difficulty placing his mandible correctly.

The extra-oral examination revealed a largely reduced lower face area. We noted the presence of a crown on tooth #46 and amalgam restorations on the molars. Initial evaluation revealed occlusal problems causing discomfort during mastication (Figs. 1 & 2). The crown would have to be removed, the root extracted and an implant placed. Based on the diagnosis, it was judged that treatment with KATANA AVENCIA Block would be within the scope of its indication, since the occlusal problem was a minor issue.

Treatment plan

The goals of the treatment were:

– to use a biological and minimally invasive approach to the teeth (non-invasive), periodontium and occlusion (muscular and articular);
– to maintain health in the long term (ease of hygiene); and
– to re-establish effective function (mastication) without compromising aesthetics.

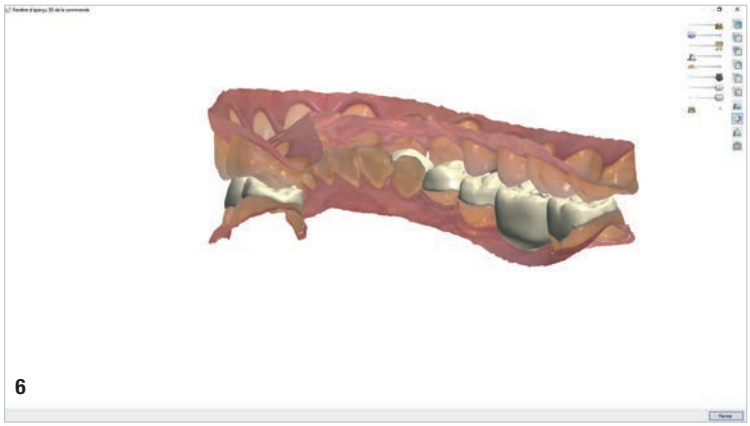
To create the treatment plan, we always follow the same steps:

– discussion with the patient to identify his or her wishes and limitations in terms of treatment;
– occlusal planning and establishing of the appropriate mandibular position in order to determine the quantity of destroyed dental tissue (done using a TENS machine);
– periodontic diagnosis and support teeth.

Treatment procedure

We proceeded in the following manner for the treatment:

– cleaning of all teeth;
– creation of complete in-mouth mock-up for the mandibular arch;
– leaving of the mock-up in the mouth in order to validate the new occlusion;
– use of CAD/CAM technology to create the definitive prostheses, integrating the concept of minimally invasive dentistry—we used KATANA AVENCIA Block as the material for the overlays.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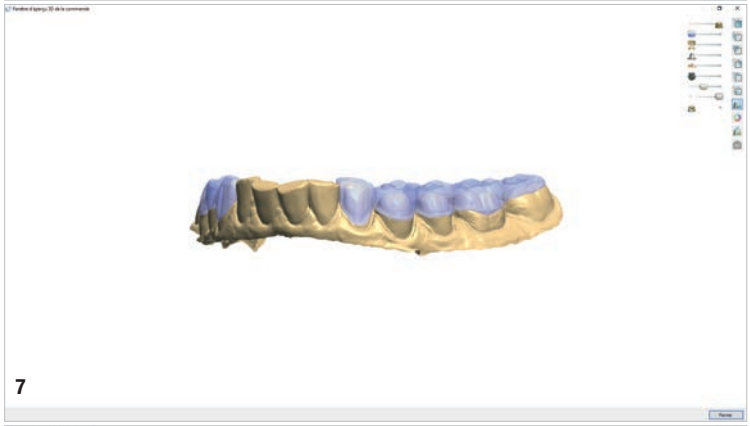
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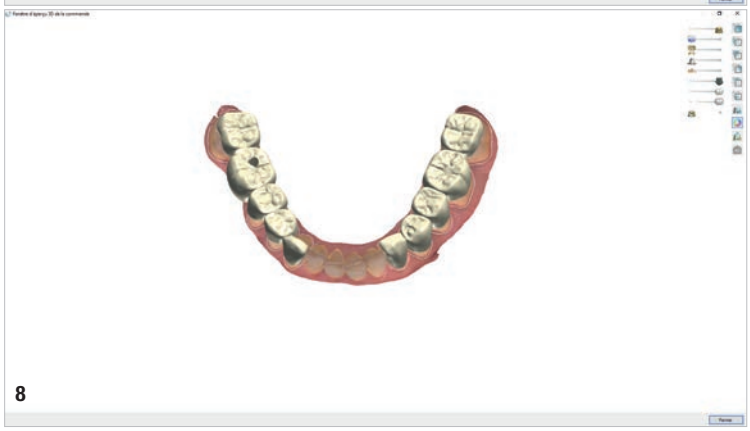
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The mock-up was milled (Roland DG) in PMMA. Once the mock-up had been placed in the mouth, it was necessary to test the new occlusion and adjust if needed (Figs. 3 & 4).

Tooth preparation was performed through the mock-up to be as minimally invasive as possible. The thickness was 1.5 mm for the occlusal and 1.0 mm for the buccal surface (Fig. 5).

The overlays and crown on the implant were designed using 3Shape software and milled (Roland DG). The definitive restorations were created using two digital impressions. On the impression taking of the preparations, the cervical limits were marked (Fig. 6). Next,

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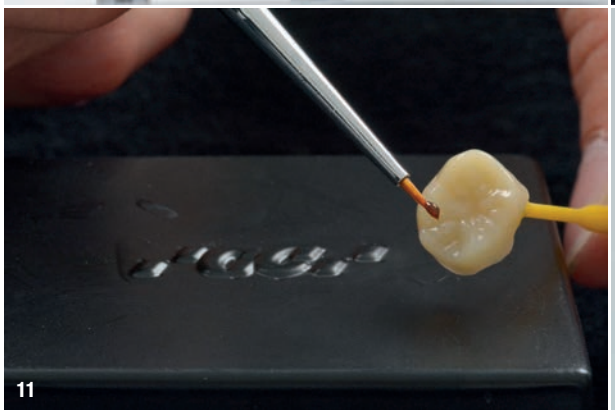
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"All KATANA AVENCIA Block restorations were tried in one by one for validation and adjustment."

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the software matched the two impressions by subtraction and proposed the shape of the restorations to be milled (Fig. 7). These restorations are the exact copy (morphology) of what the patient wore in his mouth for two months. If the work is done by section, it is easier for the computer to match the impressions (Fig. 8).

During the next step, KATANA AVENCIA Block was milled (Fig. 9) and then polished with CLEARFIL TWIST DIA (Kuraray Noritake Dental; Fig. 10). After that, the restorations were stained using a 3D-staining technique (Fig. 11). 3D staining involves a specific sequence in which 3D optical illusions are created. Staining gives excellent results (Fig. 12).

A classic bonding procedure was followed using PANAVIA V5 (Kuraray Noritake Dental; Fig. 13). To begin, all KATANA AVENCIA Block restorations were tried in one by one for validation and adjustment and then all together to check the contact points.

A dental dam was placed on the mandible. The intradoses of the restorations were blasted with alumina power and then K-ETCHANT GEL (Kuraray Noritake Dental) was applied and they were rinsed well and dried. A layer of silane (CLEARFIL CERAMIC PRIMER PLUS, Kuraray Noritake Dental) was applied for 60 seconds and then dried (Fig. 14). K-ETCHANT GEL was then applied for 30 seconds to the enamel (Fig. 15). Afterwards, the surfaces were rinsed and dried, and the adhesive PANAVIA V5 Tooth Primer was applied, left on for 20 seconds and then dried.

The restorations were bonded one by one with PANAVIA V5 Paste. The excess was removed and the final photopolymerisation using glycerine was performed (Fig. 16). The restorations were then polished using CLEARFIL TWIST DIA (Figs. 17 & 18).

The occlusion was verified in static position with cusp–fossa contact, then laterality, propulsion and finally mastication. To conclude, the definitive restorations showed good aesthetic integration (Figs. 19 & 20). As always, long-term follow-up was necessary to confirm the success of the treatment.

about

Dr Cyril Gaillard is a dental surgeon and CEO of GAD Center, a private dental practice in Bordeaux in France.

Surface texture: Using horizontal and vertical lines to simulate natural tooth appearance

Theory and technical procedure of lines

Giuseppe Romeo, Italy

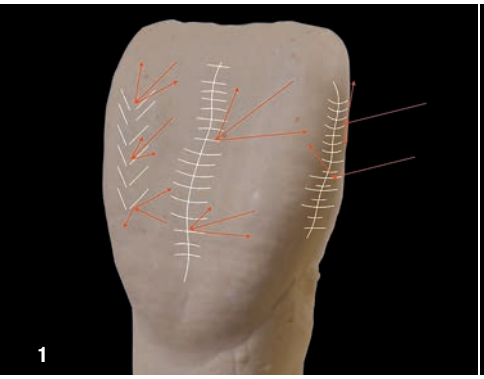
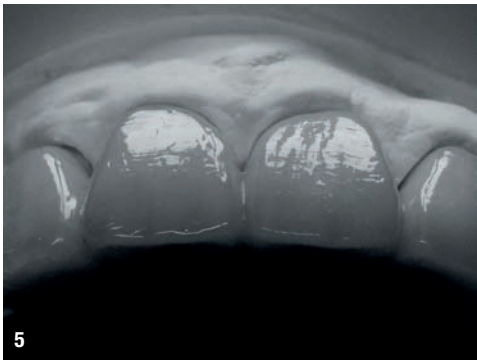


Fig. 1: Directions of the light beam of refraction and reflection phenomena. **Fig. 2:** Teeth of the same shape and different texture have multiple aspects. The concave and convex surfaces of the tooth coupled by lines of different directions allow different combinations of the desired texture.

Introduction

The surfaces of a tooth are always conditioned by the surfaces of the adjacent teeth. A smooth tooth close to a tooth with a more pronounced texture will create a contrast of predominance in which the rougher tooth will appear of lower value than the smoother tooth. The texture of the surface is an integral optical property of ceramic material and has fundamental value in enhancing the aesthetic appearance of prosthetic restorations created with the material. Form therefore contains the function, colour and surface of the ceramic material.

The brightness, roughness and quality of the marks applied to the surface of a tooth affect the refraction of light, which can change according to the arrangement of these characteristics. Weaving lines that traverse the surface of a tooth do not all have the same direction (Fig. 1). They are horizontal, vertical and oblique; sometimes one can have a combination of these characteristics that enhance the vestibular aspect. A tooth that has the same vestibular configuration but that has different weaving lines on the surface is continually changing in aesthetic appearance (Fig. 2).



Figs. 3–5: Same weaving line technique performed on different materials: ceramic and resin teeth.

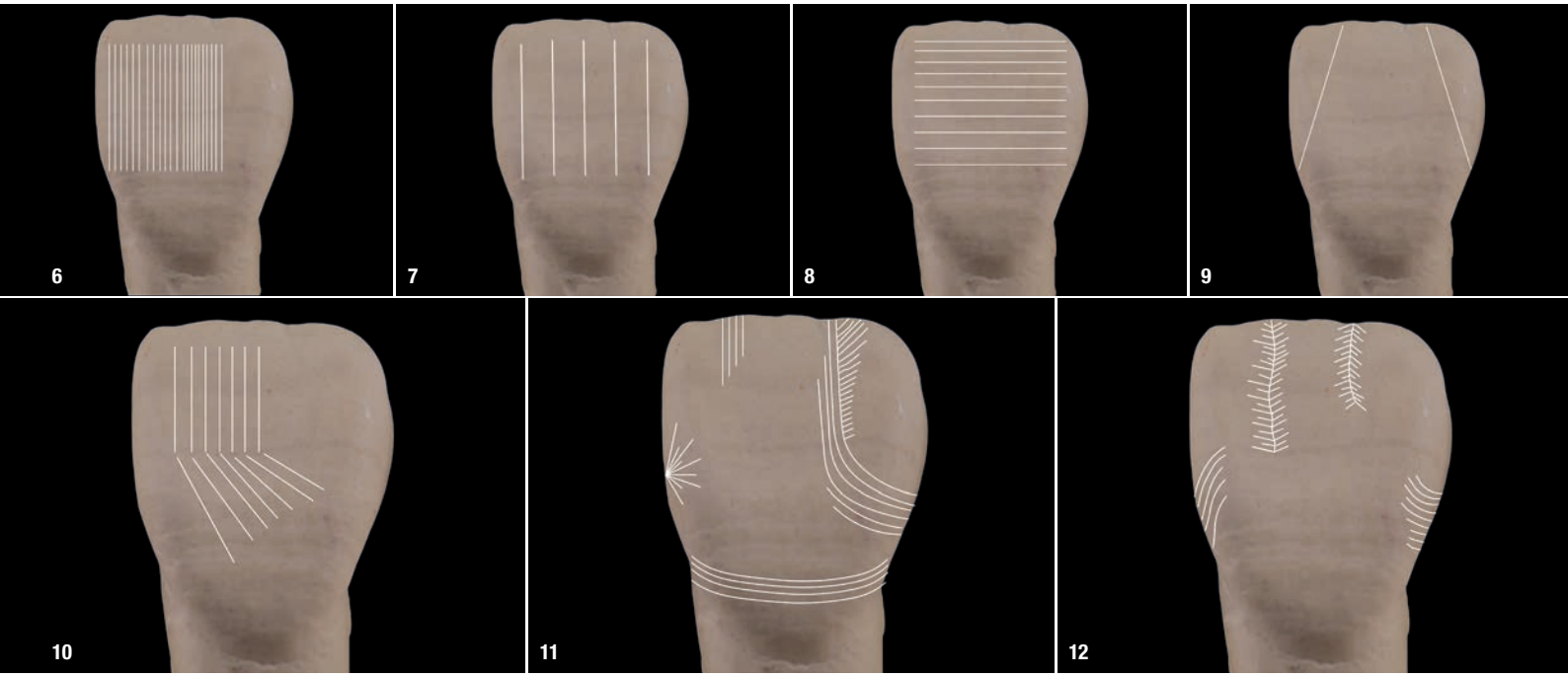


Fig. 6: With long and close vertical lines, the tooth appears longer. **Fig. 7:** Distant vertical lines create a balanced expansion of the configuration of the tooth. **Fig. 8:** The horizontal lines make the tooth appear wider, and there is a progressive expansion of the shape connected to the length of the lines and the distance between them. **Fig. 9:** The oblique lines can change the directions of the texture, lending a narrow perspective to the tooth shape. **Fig. 10:** Combination of vertical and oblique lines: their different positions and design direction change the visual illusion. **Fig. 11:** Rounding the right lobe of the tooth by marking the texture surface with curved lines that become smaller towards the cervical third of the tooth. **Fig. 12:** Marked wavy vertical lines and small oblique segments of different directions create a detailed surface on the facial lobes. From the incisal edge towards the middle third of the tooth, the contrast between the rising and falling marks.

This demonstrates the importance of the manner in which the texture is performed and this feature manually smoothed after glazing of the ceramic in order to obtain a suitable texture for the aesthetic restoration to be performed. Texture can be created with thicker and more subtle marks: the combination of these thicknesses allows for a variable texture result on the entire surface of the tooth (Figs. 3–5).

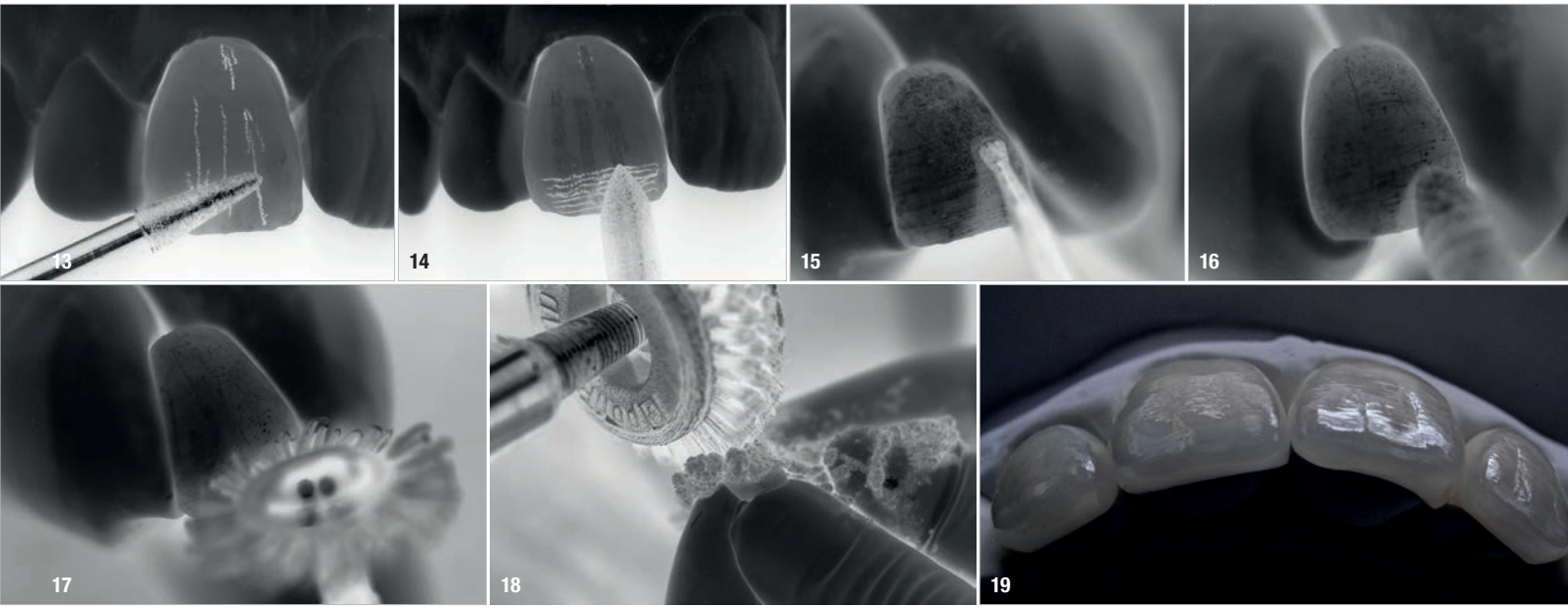


Fig. 13: Creation of vertical lines of different lengths. **Fig. 14:** Weaving horizontal lines. **Fig. 15:** Using an inverted cone to create texture differences. **Fig. 16:** Using a glass-paper cone to smooth the surface. **Fig. 17:** Using a sectioned rubber wheel to create an irregular smooth surface. **Fig. 18:** Polishing of the surface in order to obtain a better-quality texture. **Figs. 19:** Definitive restoration with all the texture details on the plaster model.

Figs. 20–23: Definitive restorations with all the texture details on the restorations in the mouth.

Based on the design of the weaving lines, the illusion of different tooth appearance in size can be created. The extended vertical lines simulate length; the short ones highlight width of the unit. These lines can be very close together or have wider distances between them, changing the appearance of the tooth in a visual illusion (Figs. 6 & 7).

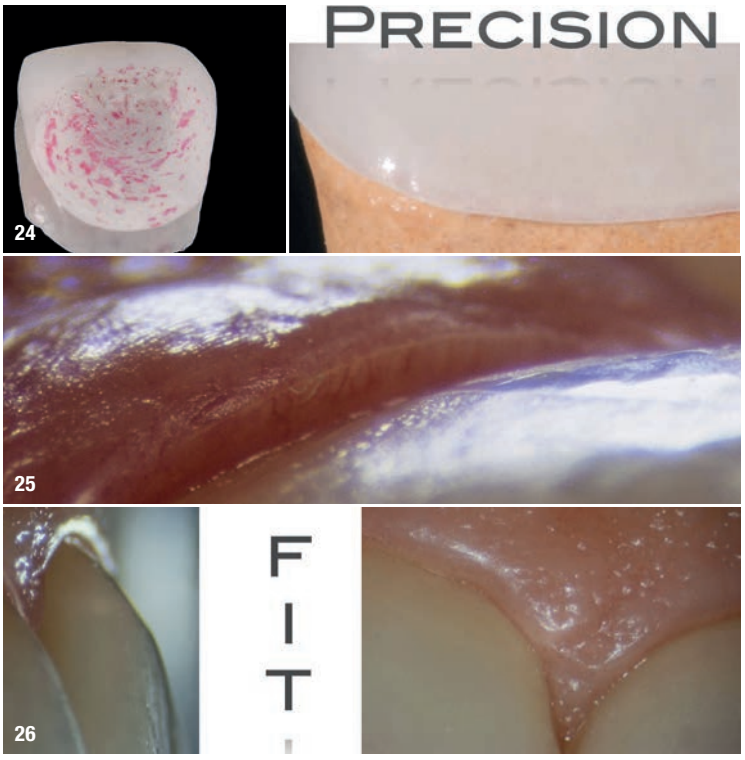


Fig. 24: Marginal precision of the veneer fixed on the master die. **Figs. 25 & 26:** Marginal precision in the mouth.

Horizontal lines simulate progressive variation of distance, whereas oblique lines change the perspective effect of the tooth. Dots on the surface of the tooth create a static effect, and wavy and short vertical lines produce a dynamic visual effect. In the case of a circumferential design, the horizontal line is deeper on the cervical third of the tooth and smoother on the incisal area (Figs. 8–12).

Having considered the various theories of marks on the tooth surface, let us turn our attention to the technical execution. With a laboratory handpiece at low speed, the vertical lines are the first to be performed on the surface of the tooth with a conical bur and then the horizontal lines are immediately delineated with a sintered cylindrical drill. In the next step, the surface of the tooth is marked with an inverted conical bur, making single horizontal lines with a certain distance between them. Other thinner lines are then made on the facial surface with a high-speed piece to create contrast. Subsequently, the entire area of interest is worked first with a glass-paper cone and then with a sectioned rubber wheel to obtain a concave and convex facial surface that lends naturalness to the restoration. After these steps, the ceramic teeth are ready to be glazed and then polished manually to achieve the desired texture to simulate a natural appearance (Figs. 13–23).

All the restoration margins are worked under the stereomicroscope to achieve a precision outcome in order to create a restoration that retains its aesthetics and function long term. The veneers during the adaptation procedure are fitted using a red paste on the master die, finding suitable contact points on the intaglio surface. This allows a better-stabilised position of the veneers once they are seated in the mouth. Furthermore, this marginal precision and veneer stabilisation make it easier

Figs. 27 & 28: Internal texture. **Fig. 29:** Ceramic restorations finished with manual external texture creation procedures. **Fig. 30:** External texture with gold powder and surface details. **Figs. 31a & b:** Pre-op and post-op photographs of restorations #11 and 21.

for the clinician to quickly find the correct position of the restoration in the mouth with no tilt (Figs. 24–26).

Internal texture

The internal texture is created after the first firing of the ceramic unit. The first step of this procedure is realised with a brush during the ceramic layering procedure. Several horizontal and vertical lines with some irregular areas are designed and created on the facial surface of the tooth. The ceramic unit at this point is ready for the first firing, and once the ceramic has been baked, other lines and superficial details are made using a bur to emphasise the quality of the internal texture.

Internal texture has an appearance different from that of external texture. The combination of these two different quality and design textures will allow dynamic refraction and reflection of light when it penetrates the ceramic material. This technique imparts a more natural appearance to the ceramic restoration (Figs. 27–31).

Discussion

Surface texture can improve the appearance of general morphology through the orientation of its characteristics. Vertically and horizontally oriented lines applied to the surface can determine different width details and appearance of tooth size. Both vertical and horizontal lines applied in combination will improve the appearance of the general tooth anatomy by creating a dynamic texture.

Gold or the silver powder facilitates identification of natural superficial characteristics and subsequent mimicking of the surface texture. The combination of internal and external surface texture design directly affects light reflection, refraction and transmission.

Acknowledgements
The author would like to thank Dr Domenico Massironi, Dr Alessandro Conti and Dr Erik Jan Muts for their clinical performance.

about

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BORN IN JAPAN

Digital approach in the anterior area: Management of surgical and prosthetic cases

Dr Roberto Molinari, Italy

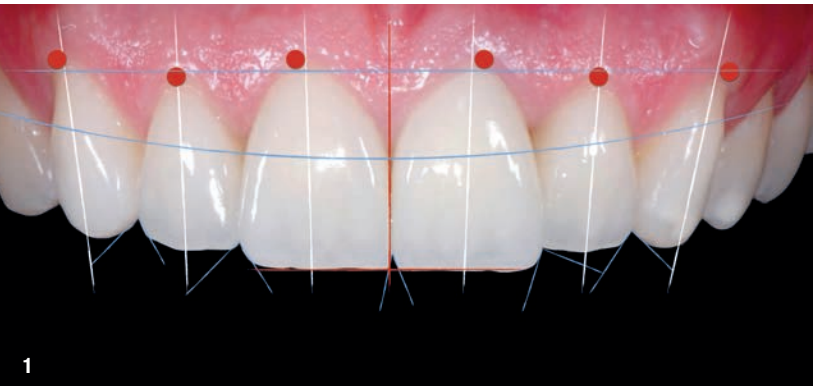

Fig. 1: Ideal anterior aesthetic composition.

Introduction

In this article, I would like to propose a new approach to digital dentistry regarding new surgical and prosthetic work processes on the subject of complex aesthetic rehabilitation in the anterior area, with particular reference to gummy smile patients. More precisely, I would like to introduce the digital process that I apply when I need to preserve the original morphology of the soft tissue (gingival margin and papillae) in the anterior areas, a protocol that involves the use of a customisable collagen matrix and provisional devices created by a digital method.

As is already known, to achieve an optimal result in aesthetic cases, it is necessary for a certain harmony between the soft tissue and prosthetic devices; this means that the interdental papillae, the gingival margin, the dental axes and the dominance of the central incisors must be well balanced (Fig. 1). The digital management of aesthetic cases in which it is essential to perform a surgical procedure in the anterior area, such as the insertion of an implant, requires greater attention to detail, especially if the patient has a gummy smile.

In order to keep the position and thickness of the gingival margin and papillae stable, it is recommended to perform a connective tissue graft in the vestibular area of the implant. The insertion of the connective tissue graft in this area is essential from an aesthetic point of view and in order to maintain the long-term health of the implant.

The most commonly used method is to extract the connective tissue for the graft from the palate or maxillary tuberosity. This type of conventional approach presents some risks, such as the following:

1. bleeding from the donor area;
2. necrosis of the connective tissue graft;
3. neurological damage;
4. aesthetic damage; and
5. pain, swelling and paraesthesia.

Fig. 2a: Initial extra-oral situation. **Fig. 2b:** Initial intra-oral situation.

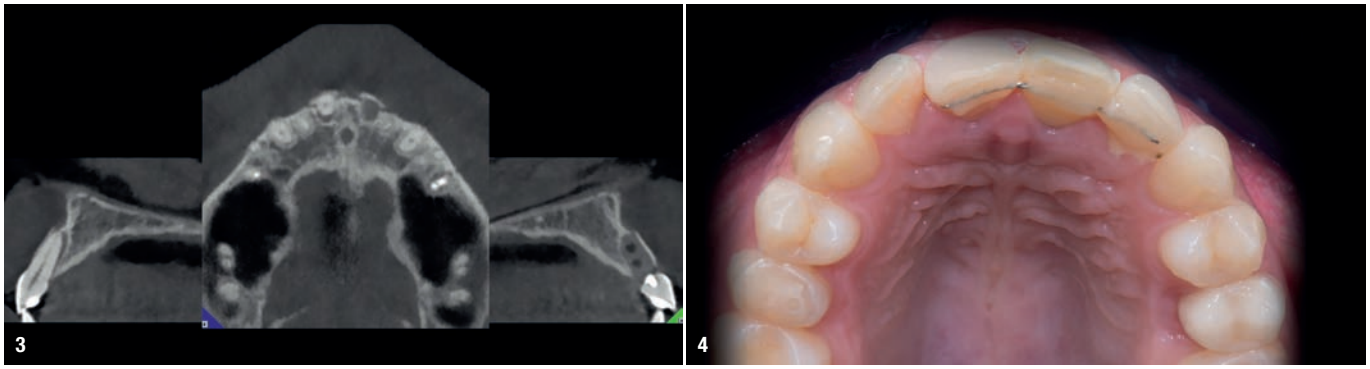

Fig. 3: CBCT scan after the trauma. **Fig. 4:** Emergence solution.

The use of a collagen matrix, as highlighted in the following clinical case, can be a valid alternative to the present gold standard approach.

Case presentation

After an anterior trauma, a 24-year-old gummy smile patient lost tooth #21. Tooth #11 was palatally dislocated, and tooth #12 sustained slight damage to the incisal edge (Figs. 2a & b). The CBCT scan showed a fracture in both buccal bone plates in relation to the two maxillary central incisors (Fig. 3).

Immediate therapy

Because I saw the patient for the first time three days after the trauma, it was not possible to reimplant tooth #21. In order to support the soft tissue of this area (papillae

Fig. 5: Digital Smile Design. **Fig. 6a:** Initial STL model scanned. **Fig. 6b:** Smile Creator (exocad). **Fig. 6c:** Digital wax-up. **Fig. 6d:** STL model with the new morphology. **Fig. 6e:** Prototyped model and silicone index.

Fig. 7: Mock-up of the future restoration and its aesthetic impact on the patient's face.

and gingival margin), as a temporary solution, I removed the root of the lost tooth with a bur and I made a pontic, modifying the crown with some composite on the cervical third. I then bonded the avulsed tooth to the adjacent teeth using a metal wire and flow resin (Fig. 4).

Case analysis and treatment plan

In all cases in which aesthetics is involved, I always carry out an aesthetic analysis of the smile following the Digital Smile Design concept in order to optimise the harmony between the patient's teeth and face (Fig. 5). In this case, in order to test the aesthetic potential of the project, I created a mock-up of the intended final result. In order to reduce treatment time, I used a digital method of prototyping a resin model with the new morphology and creating a silicone index to carry out testing directly in the patient's mouth (Figs. 6a–e). After simulating the patient's new smile and verifying its harmony and proportion-

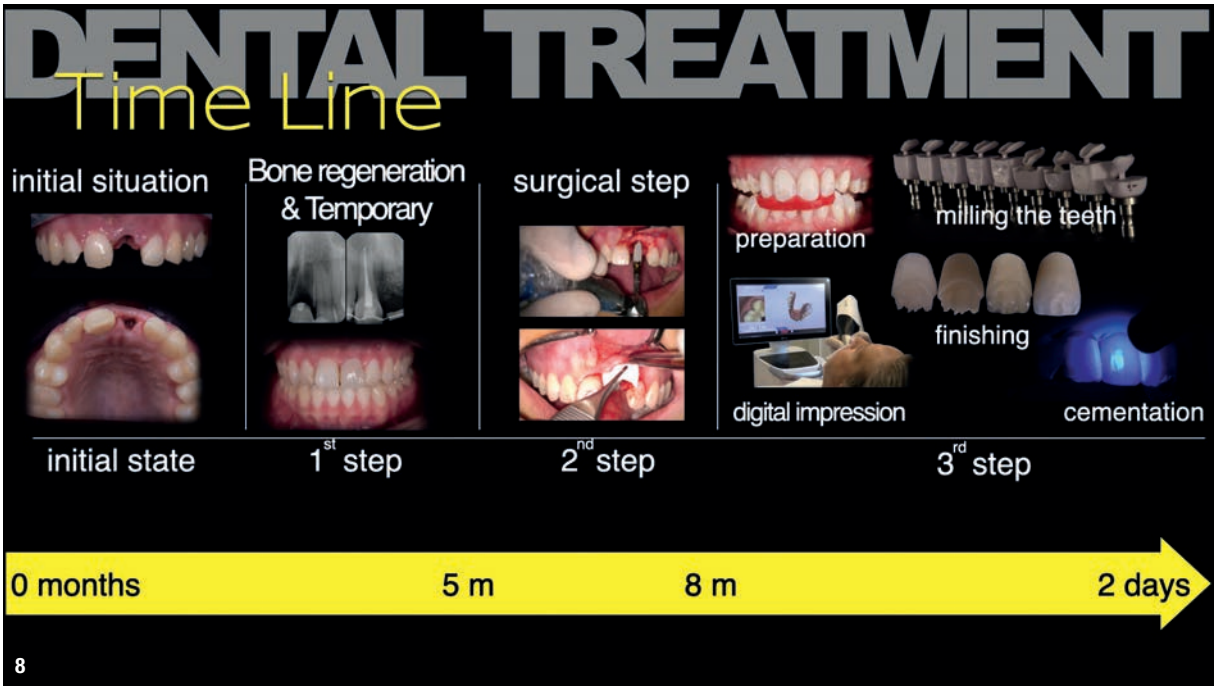

Fig. 8: Definitive treatment plan overview.

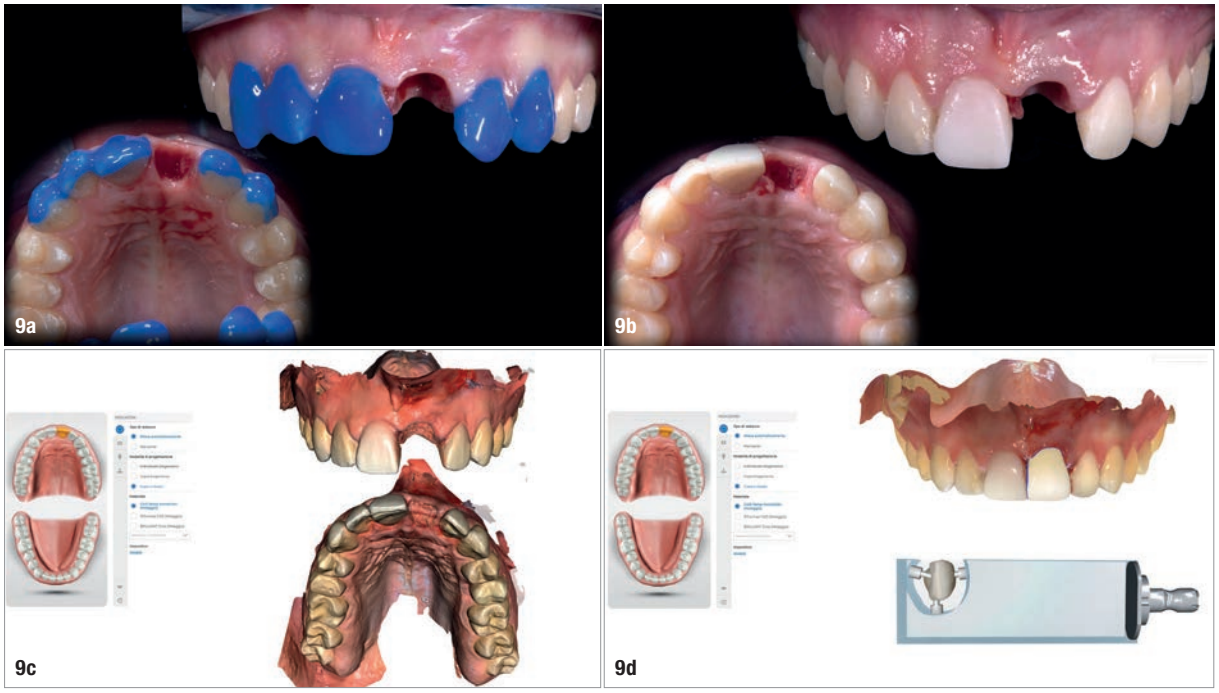

Fig. 9a: Etching of the anterior teeth. **Fig. 9b:** Definitive bonding of the mock-up. **Fig. 9c:** Initial scan and use of the CEREC software to create the first provisional crown. **Fig. 9d:** Digital project of tooth #21.

ality (Fig. 7), it was possible to define a four-step definitive treatment plan lasting eight months (Fig. 8).

The work process

Step 1

Five days after the trauma, the goal was to regenerate the bone volume in area #21. The key to success in this phase is to create a provisional restoration to condition the soft tissue while holding the biomaterial in the socket.

It should be emphasised that the immediate insertion of an implant at this stage in this specific case was not possible, as it would not have allowed optimal primary stability. To obtain the provisional crown, following a digital path, I proceeded as follows:

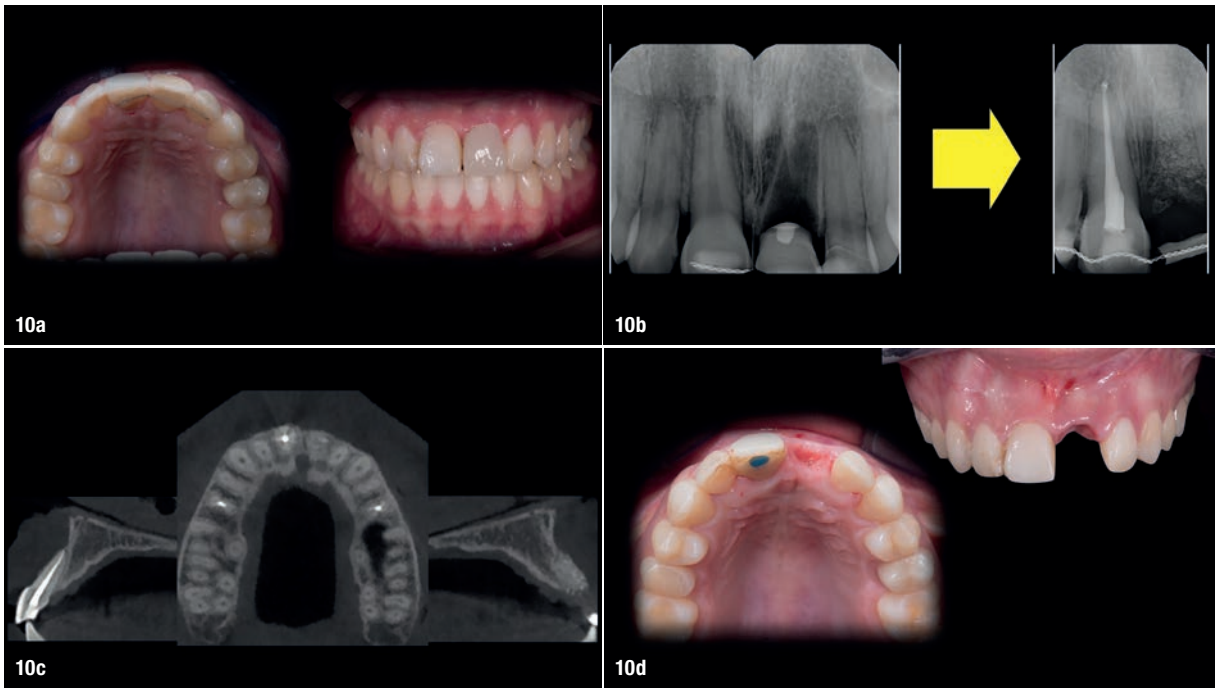

Fig. 10a: Aesthetic result of the first step. **Fig. 10b:** Bone regeneration. **Fig. 10c:** CBCT scan after five months. **Fig. 10d:** Preliminary soft-tissue conditioning.

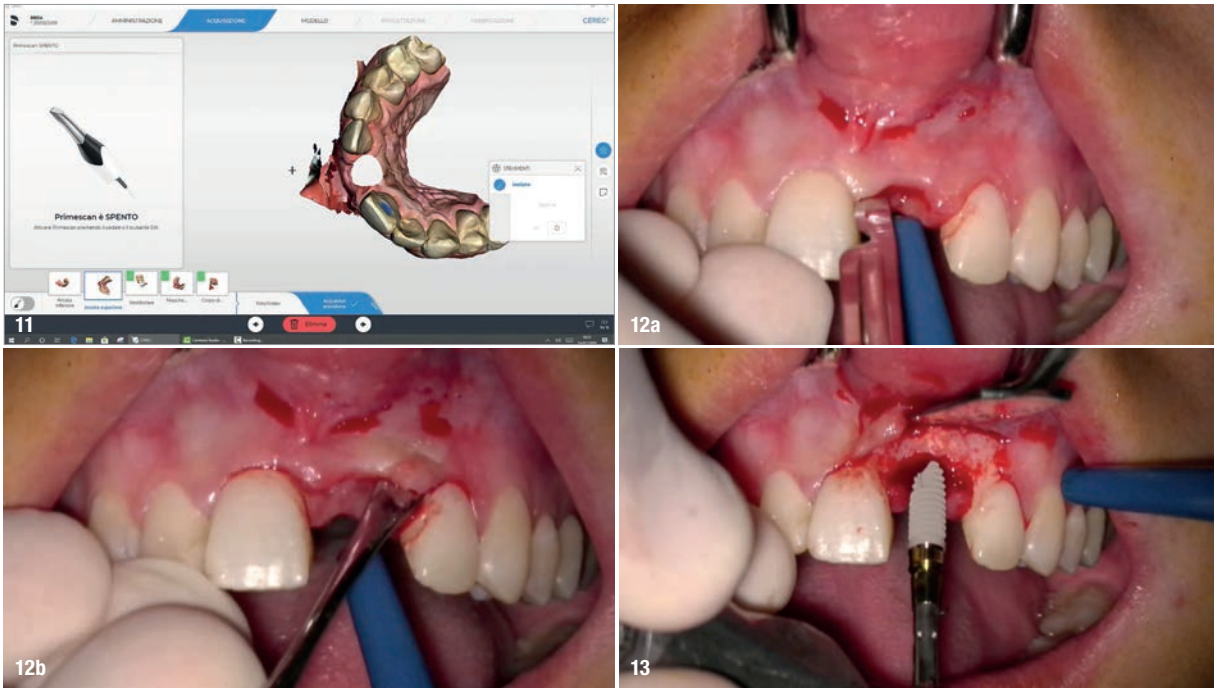

Fig. 11: Digital impression necessary to create the second provisional crown screwed into the implant. **Fig. 12a:** First incision. **Fig. 12b:** Full-thickness flap detachment by 3 mm. **Fig. 13:** Implant placement.

1. I etched teeth #13–23 in order to bond the previously tested mock-up using the adhesive technique. This decision was decisive, as it allowed me to virtually design a provisional crown for area #21 with an adequate cervical shape by copying it with the scanner and then mirroring the new tooth #11 morphology with the CEREC design software (Dentsply Sirona; Figs. 9a–d).

2. I performed bone regeneration of socket #21 using Geistlich Bio-Oss and Geistlich Mucograft (Geistlich Pharma). In this phase, the previously milled provisional crown was bonded to the adjacent teeth with a metal wire and flow resin after etching and applying the adhesive on their palatal surfaces. An adequate compression of the provisional crown protected the biomaterial

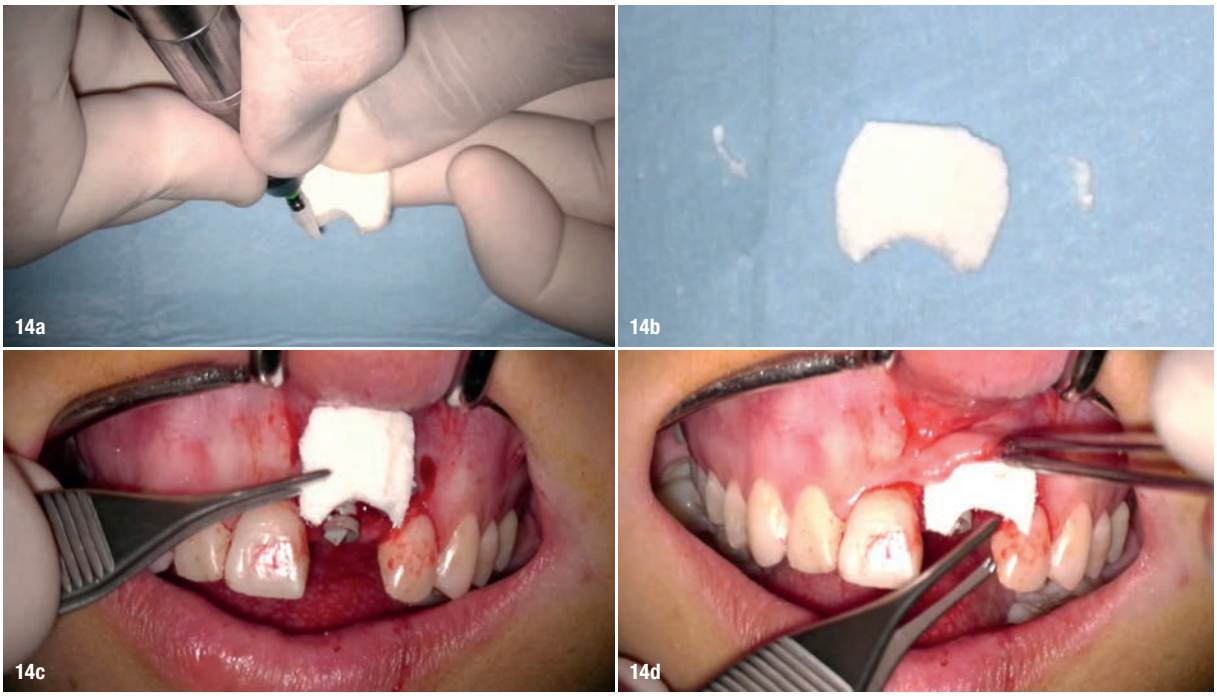

Fig. 14a: Customisation of the collagen matrix with a zirconia bur. **Fig. 14b:** Customised collagen matrix. **Fig. 14c:** Collagen matrix positioning. **Fig. 14d:** Collagen matrix insertion.

graft in the following months, keeping the papillae stable. After five months, I obtained the necessary bone volume to be able to place an implant in the anterior edentulous area (Figs. 10a–d).

Step 2

The objective of this second step was to insert an implant in the regenerated bone ridge and to restore the volume of the keratinised gingival tissue in the vestibular area around it and thus recreate an adequate vestibular gingival profile in harmony with the gingival profile of the adjacent teeth. Even at this stage, the aim was to create a second provisional crown with an appropriate emergence profile in order to further stabilise the soft tissue by conditioning it completely. I performed the following procedures:

1. Taking of a digital impression with an intra-oral scanner. The most important aspect during this first scan was the creation of the gingival mask, which entailed copying the previously conditioned soft tissue. This scan would guide us during the design phase of the emergence profile of the provisional crown. A proper emergence profile was certainly the key to success, and it would allow us to achieve, in a predictable way, correct conditioning of the tissue around the cervical third of the crown screwed into the implant. The maxillary master model would then be digitally cut in the centre of area #21 using a cutter tool (Fig. 11).

2. Design of the flap. The incision did not involve the coronal part of the papillae, as an incision of the bone peaks would inevitably have led to the loss of 1.0–1.5 mm of bone

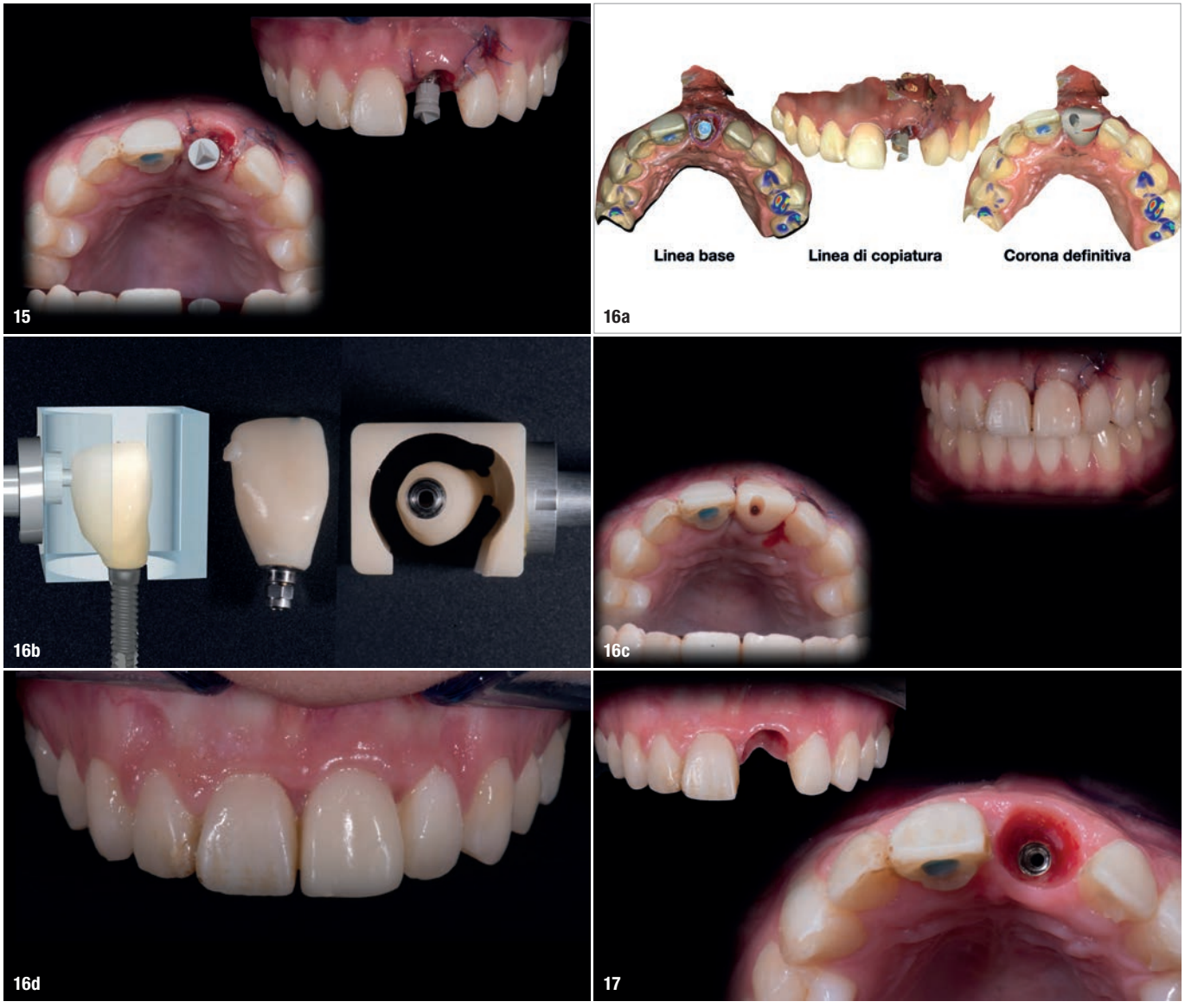

Fig. 15: Suture. **Fig. 16a:** Digital planning of the second provisional crown screwed into the implant. Baseline (left), copy line (middle) and crown (right). **Fig. 16b:** Crown milled in PMMA. **Fig. 16c:** The second provisional crown screwed in. **Fig. 16d:** Healing at three months. **Fig. 17:** Soft-tissue appearance after removal of the provisional crown.

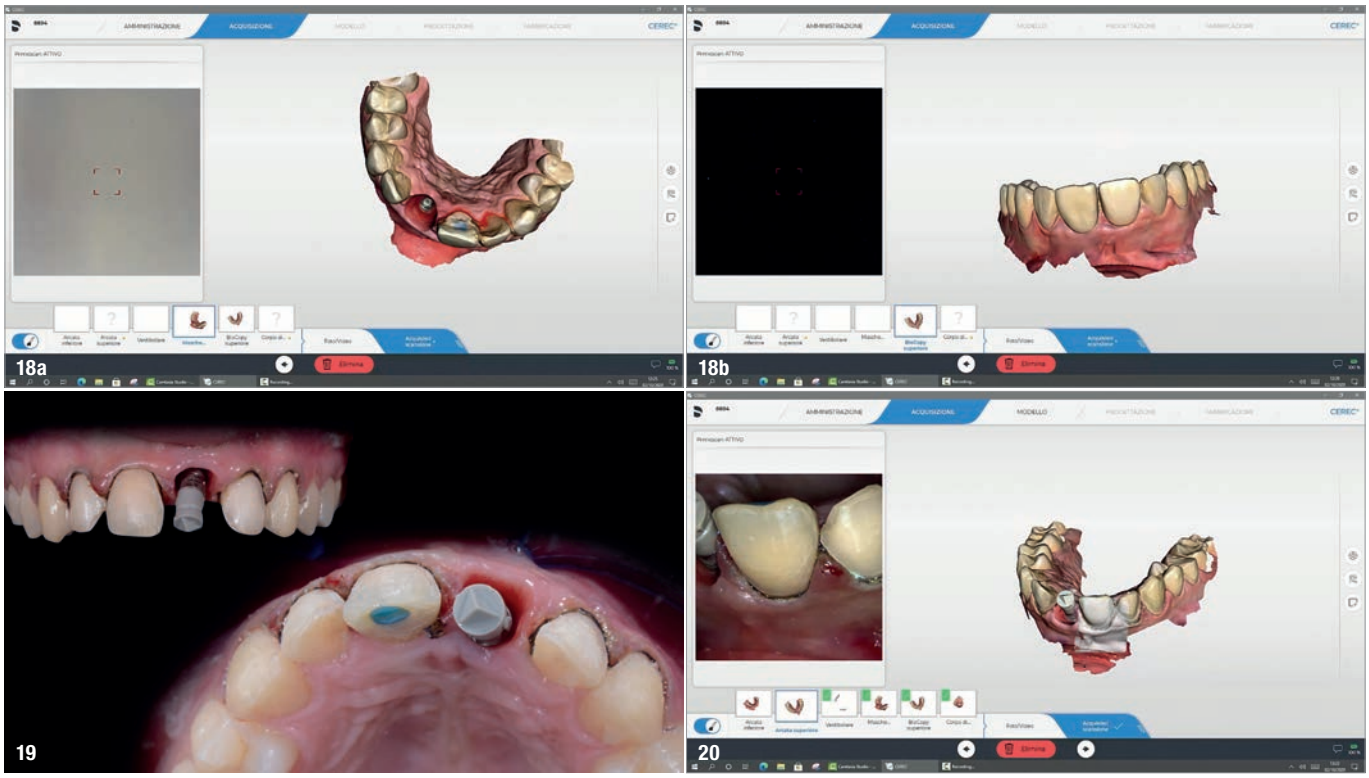

Fig. 18a: Soft-tissue digital impression gingival mask. **Fig. 18b:** Biogeneric copy of the mock-up and the screwed-in provisional crown. **Fig. 19:** Prepared teeth. **Fig. 20:** Definitive digital impression of the prepared teeth.

and thus an impairment of the final aesthetics. Therefore, an intra-sulcular vestibular incision was performed by creating a small mucosa pocket obtained through a further partial-thickness incision of the soft tissue in correspondence with the buccal portion of the edentulous area (Figs. 12a & b).

3. Placement of the implant. The implant was positioned centrally with a palatal inclination in order to prevent the screw access hole from affecting the incisal edge of the provisional crown or its vestibular surface (Fig. 13).

4. Customisation of a Geistlich Fibro-Gide matrix (Geistlich). Fibro-Gide is a porous, resorbable and volumetrically stable collagen matrix of porcine origin, specifically designed for the regeneration of soft tissue in order to avoid removal of autologous connective tissue. This matrix promotes angiogenesis, the formation of new connective tissue and the stability of the collagen network in submerged healing. In an aesthetic case like this, however, the matrix must be customised and adapted to the recipient site. It would then be very stable and maintain its volume in the healing phase, and it would not be oversized, avoiding traction of the flap and/or excessive volume of the soft tissue after healing. As it is a particularly resistant matrix, I always find it difficult to shape it with a scalpel blade. Instead, I suggest the use of a zirconia bur at low speed. In this way, overheating and denaturation of the collagen will be avoided and the structural characteristics will be maintained (Figs. 14a–d).

5. Placement of the collagen matrix and suturing. The collagen matrix was placed in the previously created mucosa pocket. The soft tissue must be hermetically sutured over the matrix so that it is completely submerged (Fig. 15).

6. Taking of final digital impressions to fabricate the immediate provisional crown. Once the previously cut impression had been achieved, along with the completion of the 3D position of the implant, the emergence profile was drawn (baseline) on the gingival mask. Subsequently, on selection of the anatomical portion of tooth #11 (copy line), crown #21 was automatically created thanks to the design software. The restoration of tooth #21 milled in PMMA was cemented to the TBase and then screwed into the implant at 20 Ncm. The real advantage of this technique is that the provisional crown would not have to be relined with acrylic resin in the patient's mouth, avoiding the risk of contaminating the collagen matrix. The provisional crown properly designed thanks to a personalised emergence profile would favour the conditioning of the soft tissue by supporting it and, furthermore, by sealing the margins of the surgical gap. This would protect the underlying collagen matrix, ensuring a successful final result (Figs. 16a–d).

Step 3

In this final phase, the case was prosthetically finalised following a chairside digital method. The key to this step is the biogeneric copy function that the prosthetic software makes available and through which it is possible to copy the morphology of the previously bonded mock-up and of the provisional crown screwed into the implant. With this approach, we share with the design software the shapes previously tested in order to create the definitive prosthetic restoration.

1. Creation of the gingival mask and biogeneric copy of the anterior teeth. Proper implant osseointegration was obtained after three months, and the conditioning of the soft tissue appeared to be optimal both in terms of tissue quality and in terms of reconstructed volume. In Figure 17, it is possible to see that the gingival profiles were perfectly harmonious and natural thanks to the provisional crown.

At this point, I performed the biogeneric copy of the anterior teeth, and after having unscrewed the provisional crown from the implant, I scanned the position of the papillae and gingival margin with an intra-oral scanner. And so doing, I created the gingival mask, at the same time, sharing the morphological information of the soft tissue with the CEREC design software which would go to creating the definitive prosthetic devices (Figs. 18a & b).

2. Preparation of the anterior teeth. In the treatment plan, I had planned to create five veneers from tooth #13 to tooth #23, with the exception of area #21, for which I had planned to make a crown to be screwed into the implant (Fig. 19).

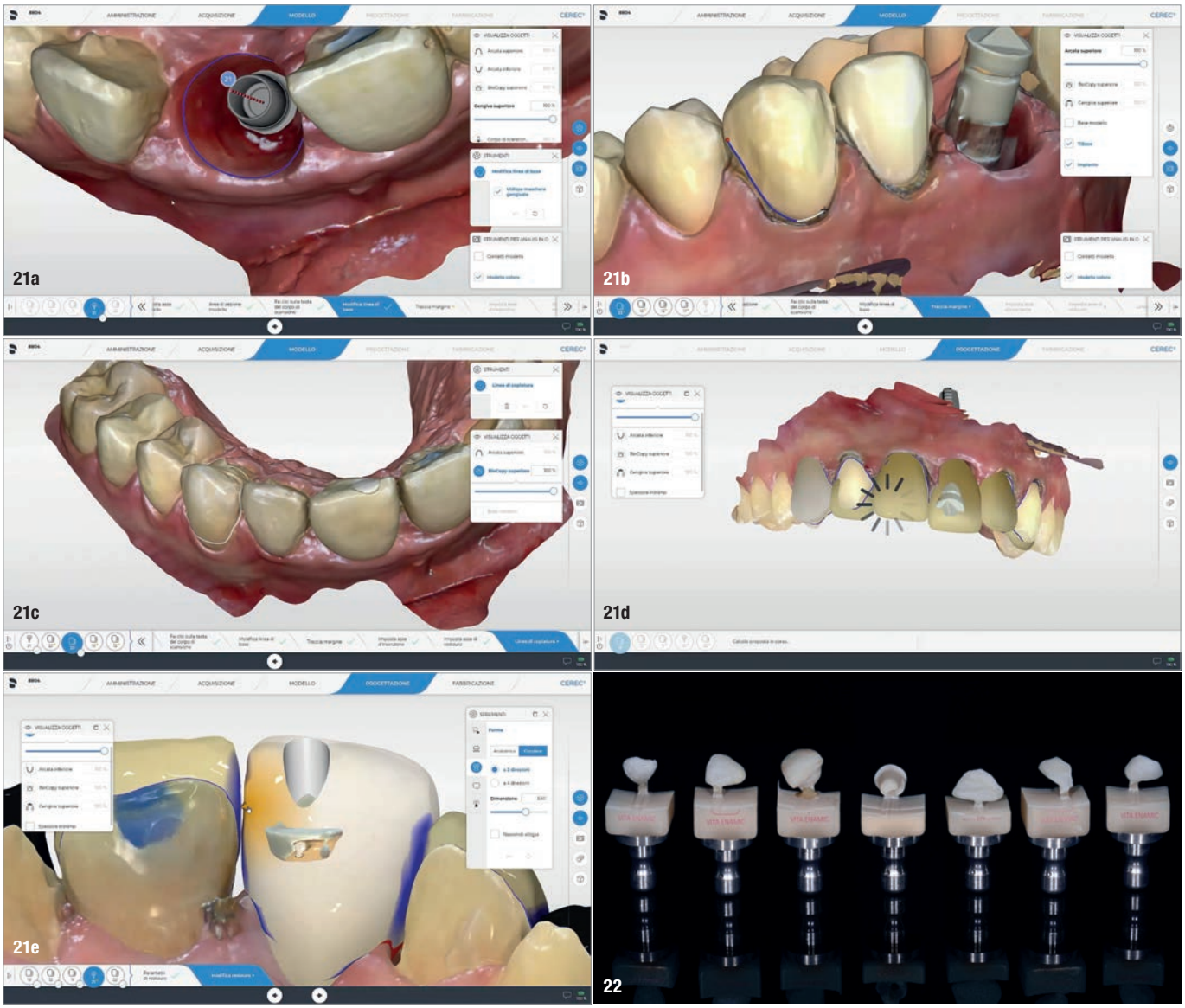

Fig. 21a: Gingival mask and emergence profile crown on implant #21 definition. **Fig. 21b:** Drawing of the baseline, highlighting the finishing line preparation. **Fig. 21c:** Drawing of the copy line. **Fig. 21d:** Automatic project of the definitive restorations by the CEREC software. **Fig. 21e:** Morphological improvement with the digital tools. **Fig. 22:** Definitive prosthetic restorations milled.

Figs. 23a & b: Polished restorations.

3. Taking of final impressions of the prepared teeth. With a scan post positioned on the implant, the prepared maxillary arch was scanned with the intra-oral scanner, capturing every single anatomical detail not only of the prepared teeth but also of the teeth not involved in the preparation. This operation is necessary to match the virtual models, a prerequisite in order to obtain definitive prosthetic devices with the same shape as the mock-up (Fig. 20).

4. Development of the master models and digital design. Once the impression phase had been completed, we would rely on the software in order to design the definitive prosthetic teeth. To begin with, it is necessary to draw the baseline on the soft-tissue profile, highlighting the area within which the software will detect and create a prosthetic crown with a proper emergence profile that will support the previously conditioned papillae and gingival margin. Subsequently, the baseline for each of the prepared teeth must be drawn, highlighting the finishing line preparation. In the following step, the copy line will be drawn, selecting the same teeth from the master model created by copying the mock-up. With this information, the software will create the final virtual prosthetic teeth.

The digital tools that the software makes available are an excellent aid in perfecting the shape of the prosthetic teeth (Figs. 21a–e).

5. Choice of material and milling of prosthetic teeth. The choice of material is another important key point. A dentist who decides to take the digital path must have a good knowledge of the chemical and physical characteristics of materials on the market because they are directly linked to the aesthetic and functional result that will be obtained.

If it is clear to us how natural teeth react to light, considering aspects such as fluorescence, opalescence and translucency, then our goal will be to select the most suitable CAD/CAM block. In general, my first choice is feldspathic ceramics, as they allow me to obtain results that are closest to the aesthetic characteristics of natural teeth. However, in the case that it is necessary to mill prosthetic restorations to a very thin thickness (0.2–0.3 mm), it is necessary to choose a hybrid ceramic containing a variable percentage of resin, which gives greater elasticity and thus avoids fractures during milling and obtains accurate margins.

In addition to chroma and value, it is important to consider translucency when choosing the material to create prosthetic restorations for the anterior area. The multicoloured blocks, or so-called multilayer blocks, have a stratification that goes from opaque to translucent. In the design phase, it is recommended to allocate the translucent area to the incisal edge of the anterior teeth. In this case, having the need to make very thin veneers, I selected a hybrid ceramic. As mentioned, it is a more elastic material than feldspathic ceramic and offers the advantage of being available in industrially drilled CAD/CAM blocks for the production of screw-retained crowns on implants. More specifically in the case described in this article, I milled five multicoloured hybrid ceramic veneers, a multicoloured hybrid ceramic crown for implant #21 and a single-colour hybrid ceramic abutment to mask the grey titanium of the TBase (Fig. 22).

6. Finalisation of the prosthetic teeth. This point is very important, as it will define the final appearance of the prosthetic teeth. In my opinion, we erroneously rely too much on products such as glazes or stains to perform the surface characterisation. The goal we should aim for at this step should not be the creation of mirrors that reflect light evenly, but the creation of a surface texture capable of reflecting light in a different way that gives the prosthetic teeth a more natural appearance. The micro- and macro-texture of each tooth should be sculpted by inserting all the micro-defects that are typical of natural teeth and that help us to camouflage the prostheses. When I use ceramic materials, I do not use stains or glazes, but after sculpting the texture, I just polish them with a series of polishers in order to enhance the anatomy of each individual tooth.

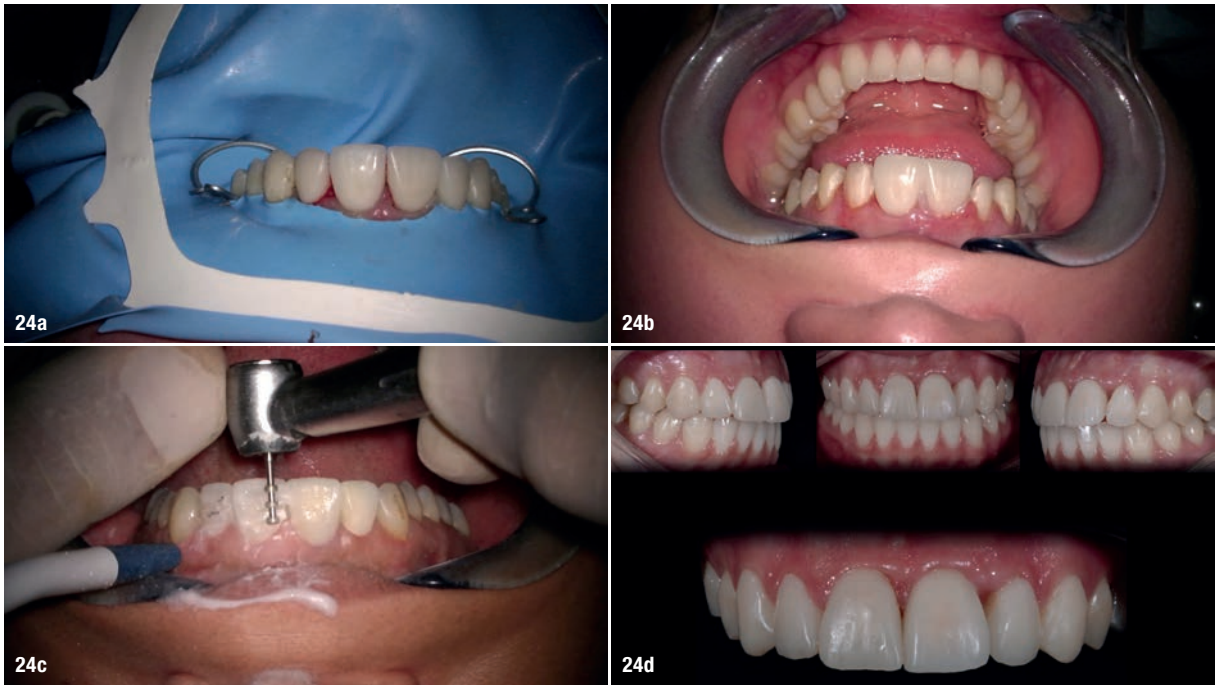

Fig. 24a: Definitive cementation. **Fig. 24b:** Try in paste. **Fig. 24c:** Preparation starting from the mock-up. **Fig. 24d:** Definitive restorations in the patient's mouth.

Another aspect to consider is the fact that the thinner areas, such as the cervical third, after adhesive cementation, transfer the natural colour of the prepared tooth to the surface which, for example in this area of the thinnest enamel, is more chromatic. To remedy this, coloured cements are available on the market with which it is possible to modulate the final colour after cementation (Fig. 23).

7. Adhesive cementation. This last step is very delicate, as if not managed properly, it could nullify the final result from both an aesthetic and functional point of view. Avoiding going into details of the various phases that characterise this step, it is important to remember that the main aspects to be considered in order to obtain optimal stability of the prosthetic devices over time after their cementation are the following:

Fig. 24e: Impact of the new smile on the patient's face.

Figs. 25a–c: Final outcome.

– isolation of the operative site by dental dam (I will not discuss the importance of the dental dam here, as we clinicians know that adhesive cementation must be performed under isolation of the operating site);
– conservative preparation; and
– evaluation of the final colour.

I believe it is essential to emphasise how important conservative preparation of the teeth involved in the treatment is: leaving enamel on the surfaces of the prepared teeth will allow for greater adhesion than would be obtained on dentine. For this reason, I advise you to start the preparation already from the mock-up, creating the guide grooves of 0.5 mm deep with a calibrated bur that allows conservation of the enamel. We must not forget that the dentine must be hybridised immediately if it is uncovered because in this way, by engaging the newly uncovered collagen fibres, the strength of the adhesive bond will also be increased on this tissue. Delay in these cases would lead to deterioration of the fibres, consequently lowering strength of the adhesive bond.

Equally decisive for the final aesthetic result is the third point. Today, there are coloured cements on the market that allow us to modulate the final colour of prosthetic devices by mitigating the possible discoloration of a devitalised tooth or highly chromatic dentine, or to slightly modify the value of the ceramic. These products are sold with the respective full-colour test glycerines, through which it is possible to select the most suitable cement colour for the case (Figs. 24a–e).

Conclusion

I hope that reading this article will be an incentive to see your work differently. Over the years, my vision has led me to change my approach and my work process continuously and to look at what I am doing with a critical eye, in order to improve. After so many years of navigating the digital sea, I must admit that today, compared with 20 years ago, procedures have been simplified and what was considered pioneering at the time is now part of the accepted clinical protocols. Technological innovations and the development of increasingly high-performing materials have allowed me to reduce therapy times and discomfort for my patients and, moreover, to increase my profit margin (Figs. 25a–c).

about

Dr Roberto Molinari obtained his diploma in dental technology in 1986 and his degree in dentistry and dental prosthetics with honours from the University of Bologna in Italy in 1993. After having trained with the most notable experts in modern dentistry, he specialised in periodontics, implantology and aesthetic prosthetics. He holds courses for dentists on the correct use of CAD/CAM techniques for natural teeth and implants. He is an active member of the board of PEERS (the Platform for Exchange of Experience, Research and Science, founded by Dentsply Sirona) and a founder member of the Accademia Italiana di Odontostomatologia Digitale (Italian academy of digital odontostomatology). He is an international key opinion leader for Dentsply Sirona and Zeiss on CAD/CAM and micro-dentistry, respectively. He lives in Mantua in Italy, where he runs his own dental clinic. He can be contacted at r.molinari@sanitasservizi.it.

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"CAD/CAM materials play a key role in our research because they are the future"

An interview with Prof. Bogna Stawarczyk

By Annett Kieschnick, Germany

Fig. 1: Prof. Bogna Stawarczyk is head of materials science research at the Department of Prosthetic Dentistry and and a professor at LMU Munich. She is vice president of the European Association of Dental Technology. *(Image: © Bogna Stawarczyk)*

Differences within material classes in CAD/CAM ceramics are not obvious at first glance. A knowledge of materials science is required in order to classify the ceramics accurately, to use them according to the indication and to process them correctly. In this interview, Prof. Bogna Stawarczyk, whose team at the Ludwig-Maximilians-Universität München (LMU Munich) in Germany is renowned for its groundbreaking work in the field of zirconium dioxide and silicate ceramics, shares insights about lithium disilicates and the features of Initial LiSi Block (GC Europe).

Prof. Stawarczyk, could you please specify to which class of materials lithium disilicate ceramics belong?
In general, dental ceramics can be divided into two groups—oxide ceramics (for example, zirconia) and silicate ceramics. Lithium disilicate is a silicate ceramic that is additionally reinforced with lithium disilicate crystals. The reinforcement crystals result in higher mechanical properties, such as flexural strength or fracture toughness, compared with non-reinforced silicate ceramics (feldspar or leucite ceramics).

The superordinate group of lithium disilicate ceramics is therefore lithium silicate. There are three subgroups here. Lithium disilicate ceramic has been available on the market for a long time. In addition, lithium metasilicate and lithium aluminosilicate ceramics have been around for a few years. The main components of these ceramics are lithium oxide and silicon oxide.

So, there are different lithium silicate ceramics and various products from several manufacturers. How can these be distinguished from a materials science perspective?
For us, the composition of the ceramics and the manufacturing process are interesting and ultimately decisive for the material's properties. The glassy phase of all three lithium silicate ceramics is silicon oxide; the crystalline phase is lithium oxide.

Lithium disilicate and lithium metasilicate ceramics are formed by the crystallisation of lithium oxide and silicon oxide. The molar ratio between lithium oxide and silicon oxide in the glassy phase determines the formation of either lithium metasilicate or lithium disilicate crystals. In lithium aluminosilicate ceramics, a co-crystallisation of lithium disilicate and lithium aluminosilicate takes place.

That sounds very technical. What are the differences in processing in the practice and in the laboratory?
The industrial manufacturing process and the composition of the ceramics determine the application properties. Since the ceramics are reinforced differently, there are certainly deviations in certain properties. For example, all three lithium silicate ceramics are suitable for CAD/CAM milling but, at the moment, only lithium disilicate ceramic is suitable for the pressing technique.

Furthermore, some ceramics are pre-crystallised and others are fully crystallised, which affects the manu-

Fig. 2: The fully crystallised lithium disilicate ceramic Initial LiSi Block is based on GC's proprietary HDM technology, which has already proven itself in the Initial LiSi Press ceramic. *(Image: © GC Europe)*

facturing process. In addition, a lithium aluminosilicate ceramic cannot be individualised by glaze firing in the furnace with conventional ceramics owing to the low coefficient of thermal expansion (CTE). In contrast, lithium disilicate ceramics, for example, can be characterised with ceramic-based paints.

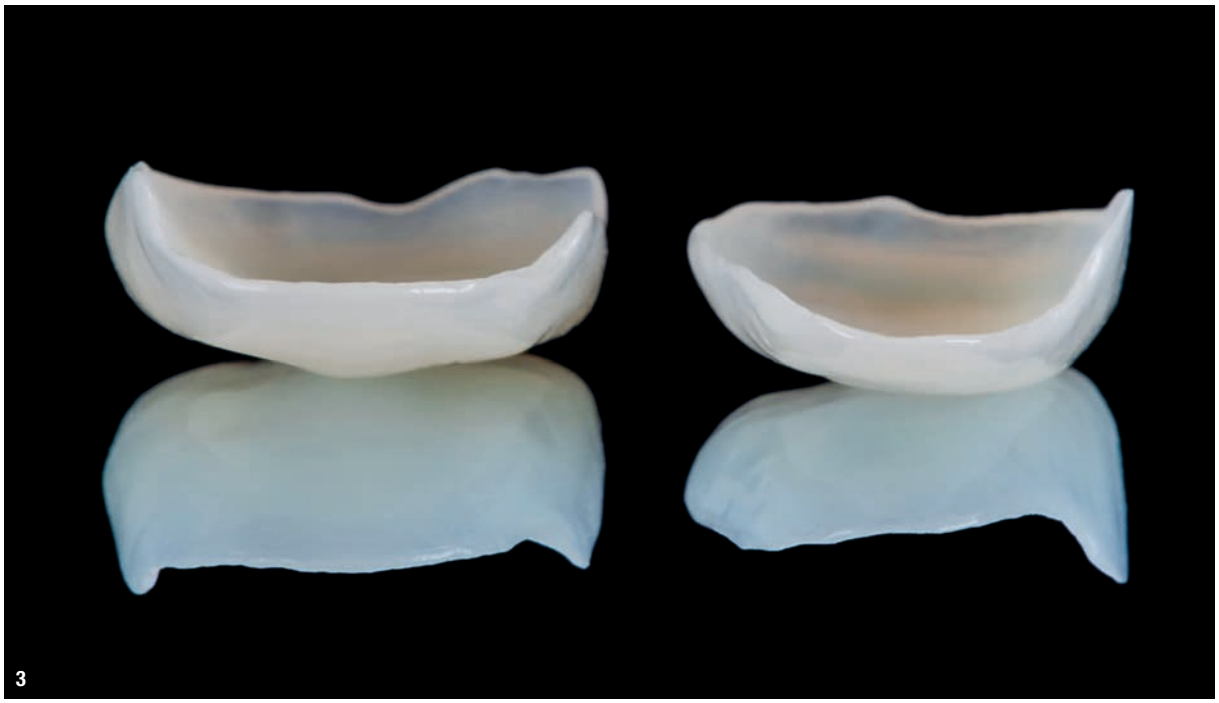


Fig. 3: CAD/CAM-manufactured veneers made of lithium disilicate ceramic Initial LiSi Block (GC Europe).

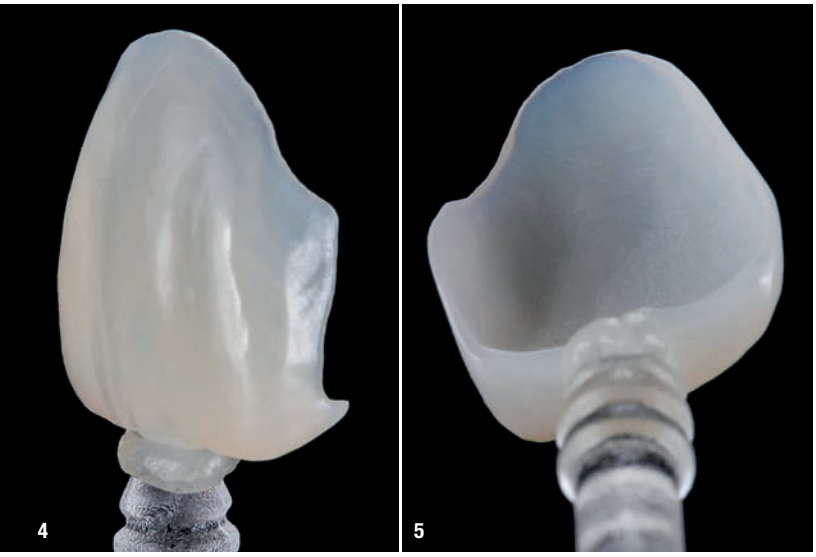


Fig. 4: CAD/CAM-manufactured veneer for an anterior tooth made of lithium disilicate ceramic (Initial LiSi Block; GC Europe) after the grinding process. **Fig. 5:** Posterior crown milled from fully crystallised lithium disilicate (Initial LiSi Block; GC Europe). The picture illustrates the high edge stability, which is owing to a slightly reduced Martens hardness. *(Images 3–5: © Christian von Bukowski)*

In general, lithium disilicate ceramics have a CTE comparable with that of zirconia. So, it is easy to remember that, if a ceramic's CTE value is comparable with that of zirconia, it also bonds to a lithium disilicate ceramic. Hence, the practitioner should be aware of important differences between the different lithium silicate ceramics.

Nowadays, new optimised ceramics are constantly coming onto the market. Some time ago, GC launched a fully crystallised CAD/CAM block, Initial LiSi Block. What is so particular about it?
Basically, Initial LiSi Block is a lithium disilicate ceramic. A special feature is that the material is already in the definitive crystallised state and thus already has its maximum density and final flexural strength. Therefore, the ceramic does not have to be recrystallised in the furnace after the grinding process.

Another positive aspect is that the Martens hardness parameters (Martens hardness and penetration modulus) are slightly lower compared with other lithium silicate ceramics, which means that the edge stability is very high. The ceramic is easy to mill. The risk of edge breakouts or brittleness is reduced because of these Martens hardness parameters. The light-optical properties also appear very good.

From a processing point of view, the fast production time should also be mentioned as a special feature; additional crystallisation firing is omitted. Nevertheless, individualisation is still possible on request. After a short time, ceramic-based paints can be used to individualise the restorations made from the monochromatic block. To individualise the milled restorations, a system could be used such as the paintable colour-and-form ceramic Initial IQ ONE SQIN (GC Europe).

You have subjected the ceramic to some laboratory tests for preliminary research. What were your first findings?
Compared with other lithium silicate ceramics for milling, there was a lower Martens hardness, which correlates with the good edge stability Initial LiSi Block has. In addition, the penetration modulus (indentation modulus/elasticity modulus) is slightly lower than that of comparable lithium silicate ceramics. Therefore, even finely tapered and sharp edges can be precisely implemented. We've tested various mechanical properties and found that the reliability (Weibull modulus) of Initial LiSi Block is high. From this it can be concluded that the material does not fracture spontaneously and unexpectedly.

In summary, a clear trend can be drawn from our first preliminary tests: the material has positive Martens hardness parameters, which indicate that the edge stability of the milled restoration is high.

At LMU Munich, you do a great deal of research on CAD/CAM materials and pay attention to the very practical questions arising from practice and laboratory. Are there any questions that are brought to your attention repeatedly?
CAD/CAM materials play a key role in our research because they are the future. The material quality is high and standardised owing to industrial production. Questions from the practice and the laboratory usually concern processing: "How can the materials be ground and polished?", "How much rework is necessary?", "Are the materials compatible, for example, with paints?", and so on.

Very often, the focus is also on questions relating to intraoral luting. Here, I come back to the lithium disilicate ceramic Initial LiSi Block. From my point of view, restorations made of this ceramic should be cemented adhesively. The milled restoration is etched for 20 to 30 seconds and, after conditioning with a silane-containing primer, seated according to the protocol with a conventional resin composite cement or, according to the manufacturer's instructions, with a self-adhesive resin composite cement, such as G-CEM ONE from GC Europe. Since cementation is a sensitive step, materials science knowledge is especially important.

What material trends do you foresee for prosthetic dentistry in the near future and later?
In general, we try to copy the properties of the natural hard tooth substance in dental restorative materials. This

is not possible with the currently available materials. For example, the elasticity modulus of ceramic materials is too high and that of polymer-based materials too low. Compromises lead to other disadvantages. So, it's always a balancing act.

It is conceivable that thermoplastics will gain a higher priority in the future, but currently, the aesthetic properties are limited. As far as aesthetics are concerned, ceramic materials are convincing and will remain so for years to come. If these ceramic materials could then be implemented in the 3D-printing process at some point, we would work much more economically in terms of material consumption and quick achievement of long-lasting restorations. The printing of dental ceramics is certainly not foreseeable in the near future in prosthetic dentistry, but it is a very conceivable scenario.

Editorial note: Prof. Bogna Stawarczyk studied dental technology at the Osnabrück University of Applied Sciences in Germany after completing her dental technician training. She completed her bachelor thesis at the clinic for dental prosthetics at the University of Bern in Switzerland and later her MSc in dental technology at the University for Continuing Education Krems (formerly Danube University Krems) in Austria. She is the former head of materials science research of the clinic for fixed and removable prosthodontics and dental materials science at the University of Zurich in Switzerland. Prof. Stawarczyk completed her doctorate and her post-doctoral qualification (Habilitation) at LMU Munich, where she was appointed head of materials science research in 2015 and extracurricular professor in 2020. She is also the vice president of the European Association of Dental Technology and teaches materials science at several dental technology master schools. She has over 350 publications to her name. In addition to applied research related to tooth-coloured materials, she takes time to continue researching the optimisation and new development of innovative dental materials and their manufacturing technologies.

about

Annett Kieschnick trained as a dental technician and journalist. Today, she works as a freelance copywriter and journalist specialising in dental topics. Kieschnick lives in Berlin in Germany.

"At age 37, CEREC advances the restorative capabilities of dentists as never before"

An interview with Prof. Werner H. Mörmann and Dr Cord F. Ståhler

By Jeremy Booth, Dental Tribune International

Fig. 1: CEREC pioneer Prof. Werner H. Mörmann. **Fig. 2:** Dr Cord F. Ståhler is chief technology officer at Dentsply Sirona. *(Images: © Dentsply Sirona)*

CEREC was launched in 1985 as the first complete CAD/CAM system for the fabrication of dental restorations. Astoundingly, nearly four decades later, CEREC remains the sole solution of its kind and is used by dentists the world over, including by the youngest professionals, who would be hard pressed to swap their iPads for Macintosh Xls. CEREC founders, Prof. Werner H. Mörmann and electrical engineer Dr Marco Brandestini, unveiled the system to a bewildered profession, and many dentists insisted that digital technology had no place in oral healthcare. Dentsply Sirona, however, quickly recognised its potential, partnered with the inventors and became instrumental in the system's development. Dental Tribune International had the honour of speaking with Prof. Mörmann, who recently celebrated his 80th birthday, and with Dr Cord F. Ståhler, chief technology officer at Dentsply Sirona, about the history and future of the one-and-only CEREC.

Thank you for speaking with us, Prof. Mörmann. Could you tell us how you came up with the idea for CEREC?

Prof. Mörmann: In 1979, a very intense discussion in dentistry arose about a possible health risk from the mercury component of amalgam, the then standard material for treating carious defects in molar teeth. Dentists began to systematically replace amalgam fillings with composites, and patients liked the more aesthetic tooth-coloured fillings. However, these caused new problems: the large resin-based posterior fillings leaked from the beginning because of polymerisation shrinkage, causing pain and secondary caries. As a lecturer and researcher, I felt compelled to seek a solution.

The solution was to have the filling fabricated quickly outside the mouth and to bond it to the tooth as an inlay. However, conventional inlay procedures using ceramic or metal were laborious and time-consuming, and it was clear that new technology would be needed to solve the problem. Around this time, the accessibility of computers was increasing, and their potential fascinated me. That was when the idea came to me that dentists could produce inlays by themselves using digital technology: 3D-scanning the tooth, for example, and designing the inlay and having it formed quickly from a block of aesthetic material directly in the practice. This brought ceramics to the forefront of interest because the material was very similar to tooth structure physically, biologically and aesthetically. Using ceramics, however, required a completely new manufacturing technique as well as a new clinical concept. The rest is history!

The development of the CEREC system was not quite straightforward. What setbacks did you experience and how were they overcome?

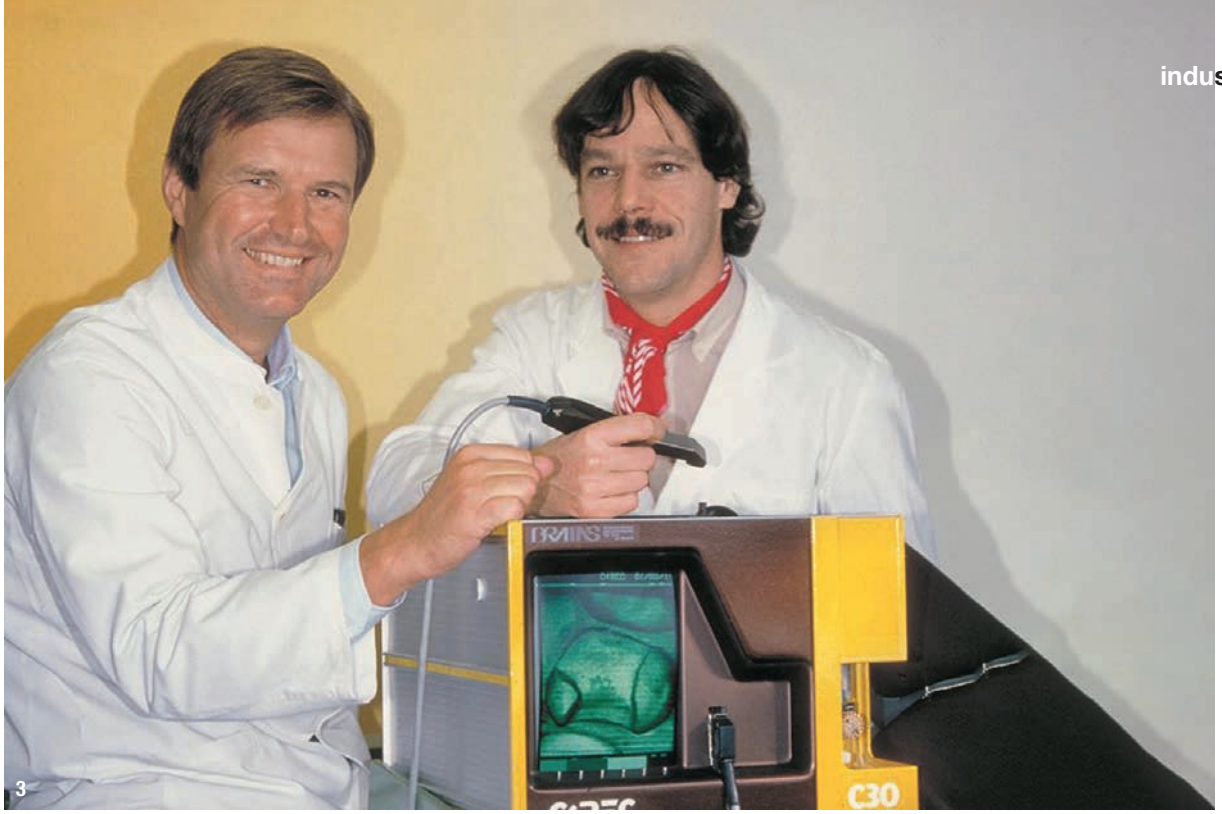


Fig. 3: Prof. Werner H. Mörmann (left) developed the CEREC system in the early 1980s together with electrical engineer and close friend, Dr Marco Brandestini.

Prof. Mörmann: I had a technical solution in mind that would integrate data acquisition, design and form grinding into a small mobile unit. The solution needed a monitor and had to be a practical device that could be used chairside by the dentist. Dr Marco Brandestini, an electrical engineer and a good friend of mine, was also enthusiastic about the idea and saw it as a technical challenge for himself. Our first functional model of a form grinding machine actually self-destructed when the grinder sank into the ceramic!

The solution was to use cylindrical plunge grinding along the mesiodistal inlay axis with a diamond-coated grinding wheel and a water turbine as the drive. This worked quickly at the chairside, but the occlusal surface was flat and dentists had to shape the fissures and cusps manually by themselves after bonding. I am extremely pleased that inlays made in this way still work after 25 years or more. This solution—together with many clinical studies—confirmed that the clinical concept was viable. The full story of the technical and clinical emergence of the CEREC method is rather long, but those who are interested can download it free of charge from moermanncerecstory.com, in English or German.

Dr Stähler, as CTO at Dentsply Sirona you are well versed in all matters relating to CEREC. How important has the system become for the company?
Dr Stähler: Dentsply Sirona and CEREC have been inseparably linked for many years. In 1985, when CEREC was launched, digitalisation in dentistry was still in its infancy, and scepticism and reservations about it were prevalent.

As a company, however, Dentsply Sirona always believed in this idea and demonstrated its perseverance from the very beginning. Engineers from our company were in constant exchange with Prof. Mörmann and Dr Brandestini, and with CEREC users. Together, the parties continued to develop the system and to set new standards in digital dentistry.

Today, the system is mature, and the quality of the clinical results are unquestionable. CEREC has had a huge impact on us as a company and continues to do so. Digital is now part of our DNA: we think, we act, and we live digitally.

How would you describe the current significance of CEREC in dentistry?
Dr Stähler: CEREC, as a system, is a fixed force in the market. The all-new CEREC includes Primescan and the CEREC Primemill, and it is now easier for an even wider circle of practitioners to decide how this modern digital technology can be used quickly and economically in individual dental practices.

The individual components of CEREC, including the scan, the software, the milling and grinding machine and the material block, are optimally coordinated to provide a seamless workflow. Digital chairside dentistry is now faster, easier and more reliable than ever before. It has reached a new level of quality, and this provides for a noticeably more comfortable treatment experience for the patient.

The use of 3D scanners is increasing dramatically. Where does the Primescan fit into the CEREC system?
Dr Stähler: We developed intra-oral scanning in the context of CEREC and, by doing so, established a market for the technology. Today, we see the use of intra-oral

Fig. 4: Innovative and fully integrated CEREC system.

scanning and digital impressions growing beyond chairside and encompassing all areas of dental treatment; first and foremost with clear aligners, but also in the daily interaction with laboratories. Here, we see our market-leading and patient-benefiting precision and speed as key advantages. We will continue to drive single-visit dentistry, but we will also use our experience of dozens of years in chairside for all other applications, especially in the cooperation with dental laboratories.

Prof. Mörmann, are you surprised that new applications for CEREC are still being discovered?
Prof. Mörmann: Not at all! I said a few years ago that the intra-oral scanner has the potential to scan the complete oral situation for diagnosis during practically any dental examination. To name just one example, scans can also be done by dental assistants. In any case, as a treatment method, CEREC still offers plenty of scope for further developments. These could relate to any of the steps, including data acquisition, form grinding, milling technology and materials.

While we are on the topic of new developments, Dr Stähler, what can you tell us about the latest upgrades of the Connect and CEREC software?
Dr Stähler: The latest upgrade of the Connect and CEREC software is upgrade 5.2, and it has provided users with new functionalities and even better performance. Patient communication has also been improved through a new visualisation step in the model phase. It is now possible to view the model directly without restoration selection. Primescan users also benefit from these updates, and new firmware makes the intra-oral scanner faster and extremely stable while giving users access to new workflows and even better usability.

How do these developments benefit dentists?
Dr Stähler: Owing to its improved firmware, Primescan can now generate more 3D data points per second than ever before. With software generation 5.2, the scanning speed and scan stability have doubled. For clinicians working with Primescan in their practices, these improvements in firm- and software result in more efficient workflows and even greater reliability and they also provide a more comfortable patient experience.

CEREC is the best example of Dentsply Sirona's pioneering of digital dentistry. Using CEREC, we are building a digital platform that brings together all stakeholders and devices and the intention is that new technologies and existing equipment can be seamlessly integrated into the workflow. By doing that, we can help dentists to focus on providing patient care and we can give patients a much better and smoother experience.

What drives upgrades to CEREC? Is it advancements in technology or changes in dental treatment and patient preferences?

Prof. Mörmann: Foremost are the expectations of the patient. Whether he or she needs the perfectly aesthetic blending in of a single anterior tooth or a full rehabilitation of the dentition, the patient wants to have the treatment done with efficiency and the results of the restoration need to be pleasing and clinically and aesthetically durable. Upgrades have led to the perfection and expansion of the application of the CEREC method, and the system itself has also benefited from advancements in technology. These developments go hand in hand. For example, I expect that the large number of digital CEREC restoration designs worldwide could be analysed using artificial intelligence in order to develop assistance systems that would further improve restorative work.

Dr Stähler: I agree, and I would add that the driving force behind innovation is the sum of many factors. Dentists and dental technicians wish to treat and care for patients in the best possible way, and our goal is to support them. Our focus on digital technologies has made dental treatment more accurate and more pleasant for patients, and it has resulted in workflows in laboratories being safer, more cost-efficient and more predictable.

Our success in developing solutions that meet the needs of dentists worldwide is the result of a competitive spirit and talented employees who are committed to product innovation and high-quality service and training. Improving clinical outcomes, workflows and patient satisfaction is a driving force in our daily efforts, and we are continually investigating ways in which we can redefine the limits of what is possible. As you see, it is not just about technology; it is also about attitudes and emotions.

What do you think the future holds for digital dentistry and how will CEREC compete with other advancements, such as 3D printing?
Dr Stähler: Digital technologies will always offer benefits. Diagnostics and planning can be implemented in a time-saving manner, and the patient can find out very quickly which treatment options are available and what the results will be. The treatment itself is also faster. The keyword here is single-visit dentistry and, ultimately, this will lead to even greater cost-efficiency for dental practices. The CEREC procedure, which includes digital impressions and chairside manufacturing of restorations, plays an important role in this.

A 3D printer could be a useful addition to the portfolio for use in applications in which milling and grinding machines do not always provide an optimum result—such as in the use of composites. I believe that 3D printing is ready to take centre stage; it is ready to become a part of the daily workflow for clinics and laboratories alike. So, watch this space!

However, CEREC and 3D-printing technology are not mutually exclusive. They complement each other perfectly in digital practices and laboratories. I am certain that 3D printing will be used alongside CEREC for a long time to come and that both technologies will have their specific use cases.

Prof. Mörmann: Anyone who is involved with digital technology knows: never say never. Forty years ago, we would never have dreamed of all the things that are now possible with CEREC. In this respect, as we consider the future, all dental professionals can look forward to being part of a very exciting process of development.

> “Forty years ago, we would never have dreamed of all the things that are now possible with CEREC.”

Finally, Prof. Mörmann, what gives you the most satisfaction as the inventor of CEREC?
Prof. Mörmann: For me, it is the fact that the method, as it is today, is more fascinating than ever. It has increased the enjoyment of restoring teeth, be it with single inlays, onlays, overlays of any form and size, half and full crowns, endocrowns, veneers, anterior and posterior crowns, tabletops, implant crowns, quadrant treatments, three- and four-unit bridges or complex full-mouth rehabilitations. Restorations are automatically generated with individual biogeneric occlusal morphology using habitual bite or virtual functional registration. Drilling templates can be fabricated. To sum up, CEREC provides dentists with a vast choice of high-tech, highly aesthetic ceramic, hybrid ceramic and composite restorative block materials with suitable strength.

Everything runs smoothly, quickly, easily and with high precision: the scanning, the restoration design and the machining. And the result is first fit, at the margins as well as at proximal and occlusal contacts. We are talking about a system that was launched in 1985. To me, this represents an awesome and truly fantastic success, and for this, I would like to thank the developers at Dentsply Sirona! It is wonderful to realise how many colleagues around the world are successfully using CEREC in their practices and providing patients with excellent clinical care. Without a doubt, at age 37, CEREC advances the restorative capabilities of dentists as never before.

Editorial note: The name CEREC is derived from Chairside Economical Restoration of Esthetic Ceramics and also from the initial letters of ceramic reconstruction.

SCANTIST 3D—discover the first 3D scan spray that evaporates automatically after 20 minutes

An interview with Dr Sebastian Gell, co-owner of Scanningspray, the company that developed SCANTIST 3D

By Claudia Duschek, Dental Tribune International

When using even the most modern extra-oral scanners, it is usually necessary to use matting sprays to achieve great accuracy in digital models. With the aim of improving scan quality, a German company has developed SCANTIST 3D, a new 3D scan spray that was specifically developed for extra-oral CAD/CAM applications in dentistry. In this interview, Dr Sebastian Gell explains the main features and advantages of the spray, which allows, for example, accurate scans of transparent objects.

Dr Sebastian Gell is a professor of business administration at FH Aachen University of Applied Sciences in Aachen in Germany. He is also a co-founder of Scanningspray, the company specialising in surface matting for optical 3D scanning that developed SCANTIST 3D. *(Image: © Sebastian Gell)*

Dr Gell, could you please tell us more about the need for digitisation in dental laboratories?
Nowadays, the number of dental restorations such as prostheses produced by conventional means is continuously decreasing. The desire for restorations made of high-performance ceramics, which increases aesthetic demands and high-precision requirements, has led to the development of digital manufacturing processes using computer-aided design (CAD) and computer-aided manufacturing (CAM). Digitisation has therefore become an essential process in the fabrication of dental restorations in modern dental laboratories.

The surface of the scan object is digitised with the help of a 3D scanner, and a 3D model is created from the data obtained. The digital model can then be compared with actual parameters and, in the event of deviations, changes can be made to the physical model. In the additive manufacturing process, digital models also serve as input data for a 3D print.

In order to ensure exact 3D scan results, it is often necessary to apply a coating to the scan object. How can optimal scanning conditions be achieved with SCANTIST 3D?
Three-dimensional scanning requires that light emitted by the scanner is reflected from the scan object back into the sensor of the scanner. In the case of a transparent or translucent surface, for example, the light passes through the surface instead of being reflected from it. As a result, the scanner is not able to capture the surface structure. For this reason, it is often necessary to apply a coating before scanning objects that are transparent, translucent, reflective, shiny or highly structured with deep pockets. SCANTIST 3D forms a thin layer of white, homogeneous coating which eliminates reflections and other inhomogeneities and thus provides ideal conditions for optical scanning.

The handling is extremely simple and comfortable. SCANTIST 3D is applied evenly to the surface of the scan object at a distance of 5 to 10 cm. The spray cans are equipped with a special valve with a very fine nozzle. This makes handling easy and efficient, as the spray is applied with pinpoint accuracy and precision. The coating has a layer thickness of about 2 µm and adheres to all materials, even to very smooth surfaces.

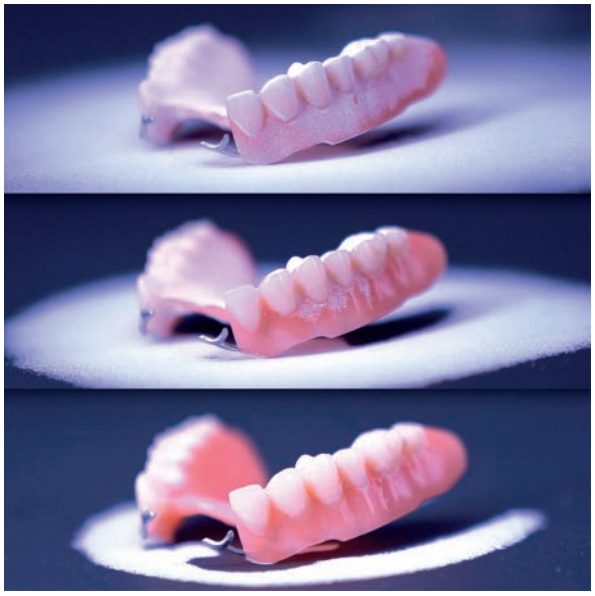
> "SCANTIST 3D eliminates the fundamental application problems of conventional 3D scan sprays and thus greatly increases efficiency and productivity within the digitising process."

SCANTIST 3D is the first evaporating extra-oral 3D scan spray. Why is this a crucial advantage for dental laboratories?

Conventional extra-oral 3D scan sprays are based on ground white colour pigments. The disadvantage is that the applied coating must be removed again after scanning. The cleaning process is very tedious, costly and time-consuming. Unlike conventional sprays, the coating of SCANTIST 3D VANISHING evaporates about 20 minutes after application. The spray does not contain pigments and thus avoids the pigment-contamination of sensitive areas, such as laboratories, equipment and users. You can even apply SCANTIST 3D VANISHING directly, on the spot, without taking any costly precautions to avoid pigment-contamination. Overall, SCANTIST 3D eliminates the fundamental application problems of conventional 3D scan sprays and thus greatly increases efficiency and productivity within the digitising process.

This new scanning spray is free from titanium dioxide. Why is this important?

In a scientific opinion issued on 14 September 2017, the Committee for Risk Assessment of the European Chemicals Agency proposed the classification of titanium dioxide as a Category 2 carcinogen by inhalation. Based on this opinion, titanium dioxide has now officially received its carcinogenicity classification according to the EU Classification, Labelling and Packaging Regulation. The classification as a carcinogen by inhalation applies to mixtures in powder form containing 1% or more of titanium dioxide which is in the form of, or incorporated in, particles with an aerodynamic diameter ≤ 10 µm. This criterion is met by many of the sprays used for scanning containing titanium dioxide. Based on this drastic change, I expect that many dental laboratories will be looking for less harmful spray alternatives.



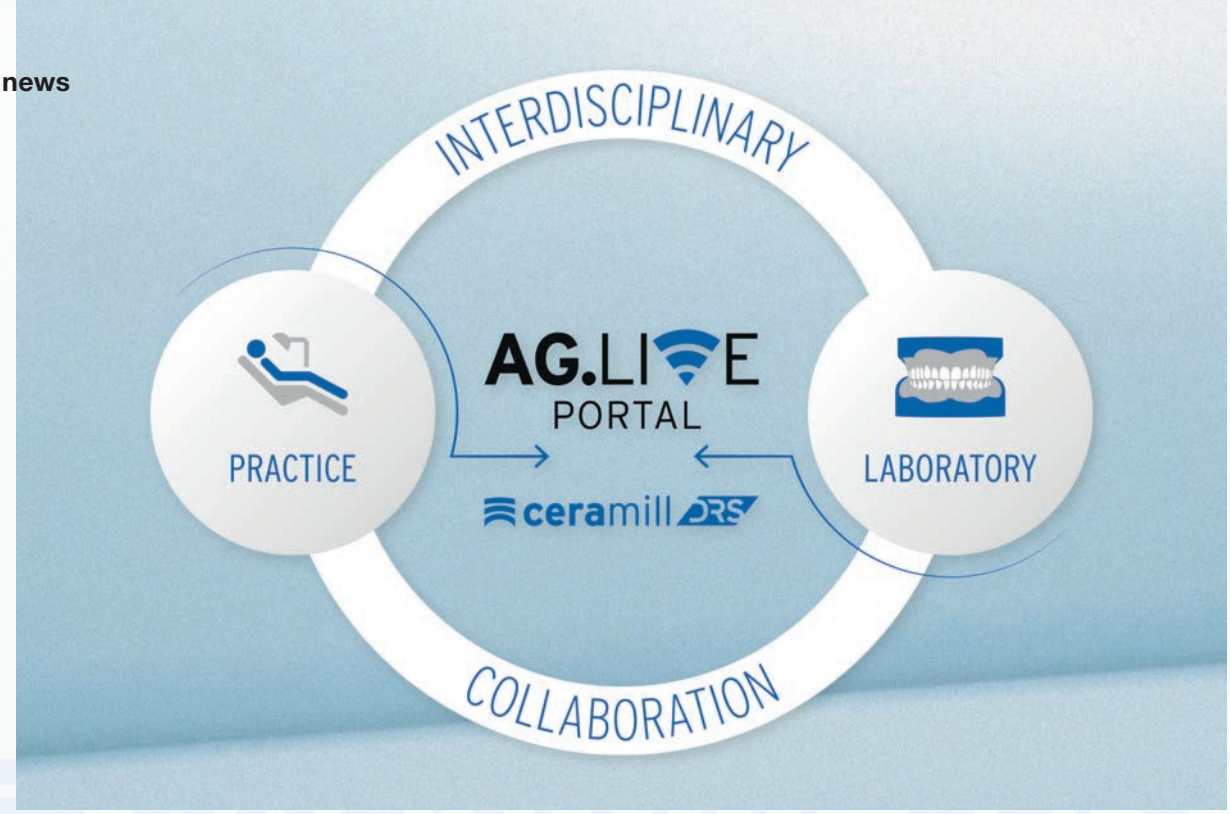
Dental 3D scan sprays form a matt, white and homogeneous coating when applied. This reduces reflections and other inhomogeneities and thus creates excellent scanning conditions. *(Image: © SCANTIST 3D)*

Is the product globally available, and how can technicians order it?

We are currently building our global reseller network and are therefore very happy about dealer inquiries. Dental technicians can contact their usual sources and dental retailers and make them aware of SCANTIST 3D.

Editorial note: More information about SCANTIST 3D can be found online at www.scantist3D.com.

New 3D scan spray developed for extra-oral CAD/CAM applications in dentistry. *(Image: © SCANTIST 3D)*



Ceramill Direct Restoration Solution (DRS). The new digital workflow from Amann Girrbach has been designed to enable interdisciplinary future-oriented collaboration and streamlined production processes that enable same-day dentistry. *(All images: © Amann Girrbach)*

Extension of Ceramill CAD/CAM workflow—digital solutions lead the way into the dental practice

By Amann Girrbach, Austria

With its Ceramill Direct Restoration Solution (DRS), Amann Girrbach has extended its integrated digital workflow to the dentist and thus closed the communication gap that existed between the dental practice and the laboratory. The new digital workflow from Amann Girrbach has been designed to enable interdisciplinary future-oriented collaboration and streamlined production processes that enable same-day dentistry.

In this process, both partners contribute their core competencies in order to provide patients with definitive and functional prostheses in a more timely and less complicated way. The delivery of smaller units is possible on the same day, depending on the local distance between the two partners.

Depending on the type of collaboration that is desired, three team workflows are available in combination with the corresponding Ceramill DRS Kits. In each case, the central basis of these workflows is AG.Live, a new digital platform that provides the infrastructure and patient case management procedures to support a level of consistency and efficiency that was previously unattainable. As such, AG.Live takes communication and collaboration between the practice and the laboratory to an entirely new level.

Virtual platform AG.Live creates freedom, more efficient processes and greater customer proximity

With AG.Live, Amann Girrbach has started the largest digitisation offensive in the company's history. This web-based portal for collaboration between laboratories and dentists offers comprehensive digital services at all levels. For example, AG.Live is a central tool for digital case management, networking, infrastructure, material management and support services. It is also a knowledge database that will gradually replace the company's previous C3 customer portal.

On the one hand, the platform networks machines and materials in the laboratory, thereby simplifying processes and increasing quality and reproducibility. On the other

hand, the greatest advancement is that AG.Live connects the growing global network of dental professionals who are operating digitally. This bridges the interdisciplinary gap between dentists and dental technicians and facilitates future-oriented cooperation. Furthermore, within this network of optimised and new partnerships, participants can focus on their strengths and better position themselves on the market.

Extending the digital Ceramill CAD/CAM workflow to the dentist

The Ceramill DRS Connection Kit is the basic entry-level option, with which dentists and laboratories can already take full advantage of digitisation. It consists of a Ceramill Map DRS intra-oral scanner, the associated scan software and the connection to AG.Live. Any order data, including all the required information, can therefore be shared with the laboratory seamlessly and in real time via AG.Live. This eliminates the need for handwritten job sheets and conventional impressions. All that is necessary is the physical delivery of the restoration to the dental practice, and this is possible on the same day in cases of simple restorations. Such timely delivery can lead to a better dental experience for the patient and could ultimately attract new patients to the practice and generate more orders for the laboratory.

If the preferred material is zirconia, the High-Speed Zirconia Kit, consisting of Zolid DRS zirconia and a corresponding Ceramill Therm DRS sintering furnace, can optimally support the laboratory in fabricating straightforward zirconia restorations on the same day.

In an additional step—which can provide patients with their prostheses even faster—the system in the dental practice can be upgraded at any time with the Ceramill DRS Production Kit. This allows simple restorations to be fabricated in the practice and placed in the patient's mouth in a single session.

All Ceramill DRS Kits are currently available for pre-ordering within Germany, and the High-Speed Zirconia Kit is already available to laboratories. Early bird DRS users benefit from particularly close support from the DRS specialists at Amann Girrbach. For further information and to pre-order, visit www.ceramill-drs.com.

Free online presentation about the innovative Ceramill DRS

In this online presentation, Amann Girrbach explains why it places the dental laboratory at the centre of the prosthetic workflow and ensures the highest possible quality and patient satisfaction through close integration and digital exchange with the dentist. Even with the basic version, the Ceramill DRS Connection Kit and the link to the AG.Live digital platform, the practice and laboratory can connect in a unique manner and take full advantage of the benefits of digitisation. The presentation also explains interdisciplinary collaboration for restorations in a single session or on the same day, using the upgrades to the Ceramill DRS Production Kit and the DRS High-Speed Zirconia Kit.

The full presentation can be accessed, free of charge, in various languages from Amann Grirrbach website, https://academy.amanngirrbach.com/en/webinar/ceramilldrs-the-roi-of-digital-transformation/3606.

The Ceramill Direct Restoration Solution enables dental practitioners and technicians to work as an interdisciplinary and future-oriented team and makes same-day prosthesis fabrication possible.

Innovation and seamless workflow

Digitising and scaling up traditional laboratories

UP3D will soon be releasing its new five-axis fully automatic dental milling machine (720 × 875 × 630 mm; 130 kg), enabling intelligent unattended milling and large-scale production. With P53-DC, laboratories can scale up their production, using one interface to control multiple dental milling machines via UPCNC software.

Boasting an automatic disc changer, P53-DC improves user efficiency, expands laboratory production and profits, and permits a more efficient workflow. The machine employs an intelligent monitoring system for the high-speed milling process and automatically continues milling from the last interrupted step, avoiding repeated work and improving work efficiency by 80%.

P53-DC features a LED light progress bar, reducing staff inspection time, and automatically calculates tool lifetime, allowing planning for reasonable tool life cycles and reducing the risk of zirconia fracture and milling failure with UPCAM.

The machine is easy to operate and can start milling after file import with a single click. P53-DC holds 12 blanks, has 11 tools and supports multiple restorative materials, such as zirconia blocks, wax, PMMA and PEEK.

www.up3ds.com

3Shape

Dental System 2021.2 released

For your laboratory, being a strong digital partner means more than designing great restorations. It is about customer service, transparency and being there when your customers need you.

The new 3Shape Dental System 2021.2 along with the recently launched 3Shape Unite platform for dental practices delivers a best-in-class workflow and transparent connection between your laboratory and dental practices. It offers new communication and workflow tools that will allow you to provide not only terrific restorations but also first-class customer service.

We have optimised the workflows and added exciting new tools like real-time communication with chat, an auto case status update timeline, and a do-it-yourself profile builder for your laboratory on the 3Shape Unite platform.

Now you can market your laboratory directly to the over 30,000 dentists who will come to use the 3Shape Unite platform. You can enrich your Unite profile with a business logo, photos, videos and a detailed description of your laboratory including the products and services you offer.

By building your profile, you make your laboratory instantly searchable in the Unite Store. Clinics will now be able to find your laboratory with ease, and your presence on Unite ensures exceptionally easy communication for the design, production and order tracking of treatments. Receiving case files is no longer fragmented, and there is no longer any need to switch platforms for separate workflows. Building your profile so clinics can find you in our Unite Store is as easy as it can be. You simply log on to Communicate and fill in the desired fields.

Another new functionality in the Dental System 2021.2 notifies you when practices request permission to connect with your laboratory. When you accept, all relevant practice details are automatically populated in your 3Shape Communicate.

The new 3Shape Dental System 2021.2 is about much more than unleashing your laboratory's creative potential with our industry-leading CAD design software. It allows you to provide first-class service as a strong and seamlessly connected digital laboratory partner.

Dental System 2021.2 key features include:

– increased productivity and aesthetics with improved implant bridge design;
– options for complete and partial denture design using the same workflow and tools in order to boost productivity;
– artificial intelligence technology to eliminate workflow steps like tooth segmentation and the preset of the occlusal plane;
– pre-installed integration with 3Shape Automate, which facilitates uploading and downloading 3Shape Automate designs and making changes to them; and
– significantly sharper imaging with the "enhance detail" setting in the E4 laboratory scanner.

www.3shape.com

2022 British Dental Conference and Dentistry Show: An event not to be missed

By Brendan Day, Dental Tribune International

The British Dental Conference and Dentistry Show (BDCDS), the UK's leading two-day exhibition and conference for dental professionals, is finally set to return to an in-person event after a lengthy COVID-19-enforced postponement. To address the unique challenges brought about by working through a pandemic, the organisers are promising an event that will enable dental teams to learn practical solutions to adapt to the "new normal", to set goals to accelerate dental treatments and to thrive in a post-vaccine world.

The 2022 BDCDS will take place from 13 to 14 May in Hall 5 of the National Exhibition Centre in Birmingham. The event generally attracts more than 9,000 attendees and over 400 exhibitors and is free to attend for all registered dental professionals. According to event convenors CloserStill Media, the 2022 show will feature over 100 hours of continuing professional development (CPD) opportunities and more than 200 speakers across 13 specific conference streams and 12 clinical theatres. Included on the programme will be the British Academy of Cosmetic Dentistry's BACD Aesthetic and Digital Dentist Theatre, the Dental Hygienist and Therapist Symposium, and the Dental Business Theatre, which will have a series of engaging and relevant presentations designed to help dentists build a successful and profitable practice.

"The British Dental Conference and Dentistry Show is a great event. It's got all the major players across the industry here exhibiting and some really good clinical content," said Martin Woodrow, chief executive of the British Dental Association.

He added: "There's everything you need. Buy equipment that you want. You can get your CPD all in one place, mix with the professions and do some good networking!"

https://birmingham.dentistryshow.co.uk

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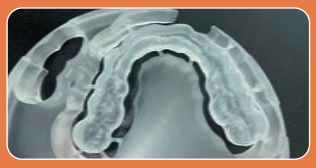

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COME AND JOIN US!

British Dental Conference & dentistry show

Date:
MAY 13th-14th

Booth:
D20

EXPO DENTAL MEETING

Date:
MAY 19th-21th

Booth:
Pending

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info@up3d.cn
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Jen@up3d.cn
+86-755-26983202

UP3D

International events

British Dental Conference & Dentistry Show

13–14 May 2022
Birmingham, UK
https://birmingham.dentistryshow.co.uk

SIDEX Seoul International Dental Exhibition & Scientific Congress 2022

27–29 May 2022
Seoul, South Korea
https://eng.sidex.or.kr

Expodental Meeting

19–21 May 2022
Rimini, Italy
www.expodental.it/en

Dental Bern 2022

9–11 June 2022
Bern, Switzerland
https://dental2022.ch

The 11th IAOCI World Congress

19–21 May 2022
Washington, DC, US
www.iaoci.com/iaoci-2022/general-information

EuroPerio10

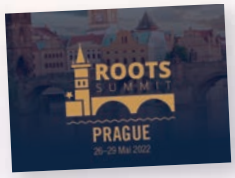
15–18 June 2022
Copenhagen, Denmark
www.efp.org/europerio

17th IDEX Istanbul 2022

26–29 May 2022
Istanbul, Turkey
https://cnridex.com

AAID Annual Conference 2022

21–24 September 2022
Dallas, USA
www.aaid.com



ROOTS SUMMIT 2022

26–29 May 2022
Prague, Czech Republic
www.roots-summit.com

Dental World Budapest 2022

13–15 October 2022
Budapest, Hungary
https://dentalworld.hu/dental-world-2022-en

How to send us your work

Please note that all the textual components of your submission must be combined into one MS Word document. Please do not submit multiple files for each of these items:

- the complete article;
- all the image (tables, charts, photographs, etc.) captions;
- the complete list of sources consulted and
- the author or contact information (biographical sketch, mailing address, e-mail address, etc.).

In addition, images must not be embedded into the MS Word document. All images must be submitted separately, and details about such submission follow below under image requirements.

Text length

Article lengths can vary greatly—from 1,500 to 5,500 words—depending on the subject matter. Our approach is that if you need more or fewer words to do the topic justice, then please make the article as long or as short as necessary.

We can run an unusually long article in multiple parts, but this usually entails a topic for which each part can stand alone because it contains so much information.

In short, we do not want to limit you in terms of article length, so please use the word count above as a general guideline and if you have specific questions, please do not hesitate to contact us.

Text formatting

We also ask that you forego any special formatting beyond the use of italics and boldface. If you would like to emphasise certain words within the text, please only use italics (do not use underlining or a larger font size). Boldface is reserved for article headers. Please do not use underlining.

Please use single spacing and make sure that the text is left justified. Please do not centre text on the page. Do not indent paragraphs, rather place a blank line between paragraphs. Please do not add tab stops.

Should you require a special layout, please let the word processing programme you are using help you do this formatting automatically. Similarly, should you need to make a list, or add footnotes or endnotes, please let the word processing programme do it for you automatically. There are menus in every programme that will enable you to do so. The fact is that no matter how carefully done, errors can creep in when you try to number footnotes yourself.

Any formatting contrary to stated above will require us to remove such formatting before layout, which is very time-consuming. Please consider this when formatting your document.

Image requirements

Please number images consecutively throughout the article by using a new number for each image. If it is imperative that certain images are grouped together, then use lowercase letters to designate these in a group (for example, 2a, 2b, 2c).

Please place image references in your article wherever they are appropriate, whether in the middle or at the end of a sentence. If you do not directly refer to the image, place the reference at the end of the sentence to which it relates enclosed within brackets and before the period.

In addition, please note:

- We require images in TIF or JPEG format.
- These images must be no smaller than 6 x 6 cm in size at 300 DPI.
- These image files must be no smaller than 80 KB in size (or they will print the size of a postage stamp!).

Larger image files are always better, and those approximately the size of 1 MB are best. Thus, do not size large image files down to meet our requirements but send us the largest files available. (The larger the starting image is in terms of bytes, the more leeway the designer has for resizing the image in order to fill up more space should there be room available.)

Also, please remember that images must not be embedded into the body of the article submitted. Images must be submitted separately to the textual submission.

You may submit images via e-mail or share the files in our cloud storage (please contact us for the link).

Please also send us a head shot of yourself that is in accordance with the requirements stated above so that it can be printed with your article.

Abstracts

An abstract of your article is not required.

Author or contact information

The author's contact information and a head shot of the author are included at the end of every article. Please note the exact information you would like to appear in this section and format it according to the requirements stated above. A short biographical sketch may precede the contact information if you provide us with the necessary information (60 words or less).

Questions?

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