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Dear Reader,

As I think back to my younger days, I used to love to take things apart and try to put them back together. That progressed into a hobby as a bike mechanic. Cable replacement, greasing the bearings, wheel trueing...I loved it all. I had minimal tools, but I had the know-how of how to get the job done. When I got my dream job as a shop mechanic, I was amazed that there was actually a proper tool for every job. The wrenches and ratchets were literally the tools of the trade. It occurred to me, the mechanic needed to understand what the tools were for, how to use them and especially how to care for them. I realised and appreciated the importance of the tools, but did not want them to be the limiting factor.

Dentistry is experiencing a truly remarkable period with many ‘tools’ of digital dentistry available to the clinician and technician. These tools are not only providing increased accuracy and improved efficiency, but are also improving the experience for the patient, clinician and technician. Communication has also been expanded with digital dentistry, allowing for easier translation of information to the patient, the insurance company, colleagues and the laboratory. With an open-source approach, the technologies have the opportunity to be merged and shared. Add in the advances in mobile technology, the portability and the utilisation of technology becomes even more appealing. From an academic and research perspective, I can attest that I am truly a tech junkie. I love gadgets. Technology seems to improve every aspect of my day. I find the technological solution to a problem a unique driving force that harnesses limitless passion. It appears to be an exciting time!

The spectrum of digital dentistry has become quite overwhelming. There are technologies that provide numerous approaches for image acquisition, easy-to-use design packages, milling/printing solutions, implant stability assessment and even real-time guided implant surgery. The technologies seem to represent every aspect of diagnoses, treatment planning and treatment delivery. This issue entirely reflects that statement. Whitepeaks Dental Solutions provides insight into their scanners, CNC and CAD/CAM. CAD/CAM is explored in greater detail, as Dr Ferencz reviews its impact on dental practices, while Dr Zamanian discusses its use with implant abutments. Lastly, a clinical guide to Max Align is presented. Max represents a new technology that not only offers a digital alternative to the facebow/facial analyser, but also provides a unique set of patient records. It appears to be a very exciting time!

But let’s not let the excitement overwhelm us.

In dentistry, we have the privilege of improving the oral health of our patients. There can be little comparison to a bike mechanic, as the human body presents a unique set of complex systems. However, the technologies in digital dentistry represent tools. These tools have a purpose and we must be able to understand what the tools are for and how to use them. The tools cannot act as substitutes to fundamental principals. As clinicians and technicians, we must rely on our knowledge, skills and evidence-based experience to act as our guide. From the subjective aspect of patient informed consent, to the rigorous protocols of implant surgery, let us exercise what our comprehensive training has taught us. The tools are merely there to assist us on our mission.

As we, clinicians, technicians, educators and researchers, look to advance dentistry in a modern technological world, let’s keep the digital dentistry toolbox open to more tools. Let’s always pose the question ‘why’ and try to find a solution to ongoing problems. Let us keep the aspect of accessibility in mind, with the development of open-source and affordable technologies. Lastly, let us merge our knowledge, skills and experience with the tools of digital dentistry to propel our profession as leaders in healthcare simulation.

Yours faithfully,

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Introduction

The importance of records cannot be overstated. Records are a legal requirement, are vital in assisting with diagnoses, and facilitate treatment planning, patient comprehension and laboratory communication. The clinician has the choice between virtual or tangible records, which may include casts, a facebow, articulation and photographs. Accurately mounted diagnostic casts provide an immense amount of information for treatment and that information will have an impact on the final prosthodontic plan.

Just as the correct mounting of casts provides valuable information, so too does incorrect mounting provide inaccurate information. In addition, incorrect mounting may result in false diagnoses and possibly even altered treatment plans, based on errors in inter-arch space, occlusal contacts and force directions (Fig. 1).

Laboratory communication with the clinician remains an important aspect, yet this has been
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lacking. Without records, communication with the laboratory can be even more limited. Communication tools must be employed to provide information so that laboratory technicians can satisfy laboratory requisitions. Lack of information results in guesswork, assumptions and incorrect dental work that is ultimately returned to the dental laboratory.

_Beckground: MaxAlign_

The MaxAlign application (Max; Whip Mix) is a communication tool for the clinician that captures essential patient information. It is a tablet-based technology that offers a unique set of records, enabling the accurate mounting of casts complete with a patient image. Max provides a calibrated photograph with clinical information and a novel technique for the mounting of casts. This case report will explore the effective use of Max to acquire clinical information that is vital for the laboratory, third-party insurance, the clinician and the patient.

_Clinical protocol_

A healthy 36-year-old female patient with a non-contributory medical history presented for consultation regarding elective anterior aesthetic treatment. Records consisted of alginate impressions using stock trays, which were poured in JADE STONE (Whip Mix), and utilisation of Max.

The Max app was downloaded onto a Samsung tablet (provided) and launched (Fig. 2). Patient information was input (Fig. 3). The tablet was positioned in the tablet clamps (provided) and the clamps were tightened to ensure a vertical orientation (Fig. 4). The tablet must be placed such that the Samsung logo is on the right, so
that the camera is located to the right. The patient was in the upright position, with the occlusal plane parallel to the floor, while the tablet was placed on the instrument delivery stand (Fig. 5). Max has anatomical guides for positioning: maxillary incisor midline and edge, location of orbits and inferior facial outline. The delivery stand was positioned close enough to the patient for her facial features to line up with the guides on Max (Fig. 6). Cheek retractors were employed to offer a clear view of the dentition (Fig. 6). Once the patient was in the correct position, the "arm auto capture" button was pressed. The tablet then captured a photograph, with a flash, of the patient (Fig. 7). Once the photograph has been taken, the clinician has the ability to maximise patient position by sizing or moving the image. The width of the central incisors can be selected from the boxes (Fig. 7). Once completed, the image is saved.

The next step is to verify occlusion. This was done with standard 8 µ shimstock while the patient is in maximum intercuspation (Fig. 8). The contacts were observed and input into the second Max screen (Fig. 9). This screen represents the quadrants of the dentition, and each box represents a tooth. In order to record occlusion, one touches the box that corresponds to the teeth contacting (Fig. 9).

The image and record of occlusion are saved and the operator has the option to exit the app or proceed with the laboratory component. If the mounting will be delegated to a laboratory, this concludes the clinical component of Max. The clinical information can then be e-mailed to the respective laboratory as a JPEG or PDF file. The laboratory would utilise the information according to the instructions in Max, as well as the peripherals, to mount a set of casts accurately (Fig. 10).
_Discussion_

Based on the records and examination, the following were determined: Class I occlusion, 20% overbite, 0/2 mm overjet, canine guidance and evidence of a parafunctional habit. The diagnosis included mildly discoloured anterior composites and bruxism. The patient was presented with several treatment plans, ranging from preoperative whitening followed by minimally invasive composite replacement to anterior porcelain veneers. An occlusal splint was also recommended. Although she was undecided on the treatment modality, the records obtained with Max provided valuable information for the clinician, the patient and third-party insurance. If treatment is to proceed, important information on occlusion, guidance and aesthetic determinants will be accurately conveyed to the laboratory.

Utilisation of the clinical component of Max provided a very simple approach to capturing the clinical data. The process was straightforward, the anatomical guides proved very useful and the record of occlusion provided additional crucial information that is often omitted. There were no software glitches or errors during operation. The patient also found the process extremely quick and comfortable.

Max has several safeguards to guarantee optimisation. There is a sensor to ensure it is properly positioned when taking the photograph of the patient. If it is not properly positioned, image capture will not occur. Calibration may be required in order to ensure that the sensor is correctly set. This is achieved by positioning the tablet vertically in the stand and then pressing the “calibrate sensor” button. The sensitivity of the positioning sensor may also be adjusted with the “adjust sensitivity” button. If the clinician has become frustrated and must take the image immediately, there is a “force capture” button that will override the sensor and take an image.

Future development may consider the option of saving the image in STL format. This would enable various output options and use with other digital image and design software.

_Conclusion_

Max provides a novel and innovative approach to the mounting of casts using a tablet, reinforcing the anatomical and aesthetic considerations when establishing a simulated patient case. The accurately mounted tangible casts provide substantial information for diagnostic and treatment planning, beneficial to dental students, new graduates and experienced clinicians.

Compared with traditional approaches, such as facebow transfer, Max provides an easy, efficient and accurate method for clinical information acquisition that has benefits for both the clinician and patient. Its ease of use would perhaps encourage clinicians to consider utilising Max as a vehicle for obtaining crucial clinical data. This would enable greater overall communication, improved success in prosthesis fabrication, and a more satisfying experience for the patient and clinician._

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Abutment selection and long-term success

Author: Dr Julia-Gabriela Wittneben, Switzerland

Implant abutment types

Implant abutments can be either standard or customised (Fig. 2). The use of a standard abutment is indicated if the implant is placed in an almost ideal prosthetic position. The advantages of standard abutments are time efficiency in the overall treatment and, therefore, shortened technical manufacturing time. Divergences between implants supporting multi-unit prostheses can be corrected with angled standard abutments. In the aesthetic zone, it is important that the collar height of a prefabricated abutment is not a uniform 360 degrees, as the interproximal position of the crown margin would be placed too far submucosally.

Therefore, the ideal design of a standard abutment should be similar to a tooth preparation, following the contour of the gingival margin (Fig. 1). Clinical limitations exist regarding the position of the implant in a vertical dimension. If the implant is placed too apically, standard abutments are not indicated, especially for screw-retained reconstructions, as they do not provide enough support for the veneering ceramic.
Customising an abutment gives the clinician the freedom to individualise its position and angulation. In the case of a bone level implant, it is also possible to individualise the emergence profile and future crown margin position of the final restoration. It allows abutments to be designed to provide optimal support for the veneering ceramic material, especially for screw-retained reconstructions. Individualisation may be achieved using CAD/CAM technology, gold abutments produced with traditional lost-wax casting methods, or titanium base abutments (Fig. 2).

Customised abutments manufactured via CAD/CAM can be made of titanium or zirconium dioxide for bone- and tissue-level implants. They can be used for cement- or screw-retained single crowns or cement-retained bridges. The benefits of the CAD/CAM abutment include the possibility of using a high-performance ceramic material, which again offers many advantages, especially in aesthetic sites. In patients with a thin tissue biotype, no visible grey will shine through with a white-coloured abutment. However, it is also possible to choose titanium as a material. Another advantage is individualisation regarding the angulation and design of the abutment to support the veneering ceramic.

Traditional cast gold abutments can be used for screw- and cement-retained single crowns and bridges, and are available for implants placed at soft tissue or bone level. Their advantages consist in the facilitation of the screw retention with bridges. Disadvantages, however, are that gold abutments are technique-sensitive, require more time, and generate higher manufacturing costs. An in vivo histological study in dogs has demonstrated that gold alloys also have disadvantages in terms of soft tissue integration. Histologically, an apical shift of the barrier epithelium and the marginal bone around gold alloy abutments has been shown.3

The third group of customised abutments on implants are the titanium base abutments. They are two-piece abutments with a titanium base. Clinicians are sometimes concerned about the handling of complications with a full ceramic
Implant abutment regarding the retrieval of broken-off ceramic fragments in the implant, which can be difficult. The main advantage of this abutment type is that there is no ceramic material inside the titanium implant connection. However, the disadvantage lies in the lack of evidence in published clinical data to date.

In particular, the soft-tissue reaction regarding the bonding gap, especially in bone-level implant cases in the aesthetic zone, remains unknown. In consequence, this type of abutment should be used with this current limitation in mind. However, use with soft tissue-level implants with a microgap above bone level might be less of a concern. An example of a soft tissue-level implant case is presented step-by-step on the following pages (Figs. 3–15).

**Implant abutment material**

Different biomaterials are available for implant abutments. Polymethyl methacrylate (PMMA), titanium, and polyether ether ketone (PEEK) are indicated for abutments supporting provisionals—especially for bone-level-type implants—to customise the emergence profile and individualise the peri-implant mucosa with soft tissue conditioning. The materials of choice for abutments for final restorations are titanium, gold, zirconium dioxide, and aluminum oxide-based ceramic.

Titanium and zirconium dioxide will be discussed in this article regarding clinical and histological performance. Titanium is the biomaterial of choice regarding long-lasting and well-documented behaviour under functional loading for both soft and hard tissues. It has excellent biocompatibility, mechanical strength, and is resistant to corrosion. Therefore, it is the abutment material of choice for posterior sites. However, the expectations of patients in the anterior zone are increasing. In aesthetic sites, mucosal thickness plays an important role. An animal study comparing different dental materials under different mucosal thicknesses showed that titanium induced the most prominent...
colour change. Zirconium dioxide did not induce visible colour changes in 2 and 3 mm thick mucosa.6

With the background of the available clinical evidence and systematic reviews, no differences were found between zirconium dioxide and metal abutments in clinical performance based upon aesthetic, technical, or biological outcomes.2–10 In vitro studies have shown statistically significant greater wear of zirconium dioxide than of titanium abutments inside the titanium implant.11 However, the clinical relevance remains unclear.

In our clinic, we have been using Straumann CARES CAD/CAM fabricated zirconium dioxide abutments since 2009 on a daily basis in aesthetic cases with bone level implants, and have had no issues with abutment fractures so far. The correct CAD/CAM design of a zirconium dioxide abutment and the quality and precision of the connecting part into the implant play a crucial role in long-term success. Focusing on the outcome of histological studies, an in vivo study shows that there were no visible differences in soft tissue health in peri-implant mucosa adjacent to zirconium dioxide and titanium abutment surfaces.12 Another study found that soft tissue around zirconium dioxide heals faster than when in contact with titanium.13

A systematic review14 evaluating the existing literature on zirconium dioxide abutments concludes based on evidence from animal and human histological studies that zirconium dioxide is as suitable a material for dental implant abutments as titanium. Regarding plaque accumulation, zirconium dioxide appears to have a lower tendency for surface-bound bacterial plaque in early stages, which is advantageous.

**Conclusion and clinical recommendation**

**Abutment selection in aesthetic sites**

Implant abutments are located in a transition zone where they are in contact with the implant and the surrounding peri-implant tissues. Therefore, the choice of abutment is of major importance, especially in a sensitive region like the aesthetic zone.

For single-unit reconstructions, zirconium dioxide abutments are indicated, which can be either standard or customised depending on the prosthetic position of the implant. For multi-unit reconstructions, zirconium dioxide abutments are recommended for cement-retained bridges,
Abutment selection in posterior sites

Clinical indication of each implant abutment type depends primarily on the prosthetic position of the implant and whether single or multiple units need to be replaced. Standard and Straumann Variobase abutments are the abutment of choice in posterior sites if the prosthetic position of the implant is ideal. Angled standard abutments, individualised CAD/CAM abutments made of titanium, or cast abutments in gold are indicated in cases where the implant is not placed in an ideal prosthetic position. In multi-unit reconstructions, standard titanium or individualised gold abutments are recommended.

Case report

Restoration of a single edentulous gap with an all-ceramic screw-retained implant crown in a posterior site using the Straumann Variobase Abutment.

A 43-year-old, non-smoking, healthy female patient with a single edentulous tooth gap, region 46 came for treatment. A Straumann Soft Tissue Level Regular Neck Implant with Straumann SLActive surface was placed in a correct three-dimensional position (Fig. 3). Open-tray impression and bite registration followed eight weeks later. Peri-apical radiograph for evaluation of the impression coping position (Fig. 4). Fabrication and articulation of the master casts. Insertion of the scan body. The cast was centralised in the scanning machine (Fig. 5).

Bite registration with the scan body in place (Fig. 6). Verification of digital image and manual modification, matching occlusion of the opposing dentition (Figs. 7 & 8). A Straumann Variobase Abutment was used (Fig. 9). An IPS e.max CAD crown made of lithium disilicate glass ceramic was ordered and delivered to the dental laboratory in a bluish colour (Fig. 10). The crown was cut back with a diamond bur and crystallised in a furnace.

Characterisation and finalisation of the crown followed by the manual addition of veneering ceramic (IPS e.max Ceram) and the use of stain and glaze paste (IPS e.max Ceram Essences and FLUO). Different firing cycles. Cementation of the crown on the Straumann Variobase Abutment with adhesive cement (Multilink Hybrid Abutment Cement). The excess cement was removed and polished (Figs. 11 & 12). The final crown was tried intra- orally and inserted with 35 Ncm inside the implant (Figs. 13 & 14). Evaluation of the crown position (Fig. 15). The occlusion was adjusted and oral hygiene instructions given to the patient.

IPS e.max CAD, IPS e.max Ceram, Essences and FLUO are registered trademarks of Ivoclar Vivadent, Schaan, Liechtenstein.

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

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The case presented in the article was treated in a multidisciplinary approach:

- Prof. Dr med dent Daniel Buser (Surgical)
- Dr med dent Julia-Gabriela Wittneben, MMSC (Prosthetics)
- Thomas Furter, CDT (Lab)
ATLANTIS Conus abutment — Treatment of a fully edentulous maxilla

Authors: Dr Claudia Mrosek & Jan Stöckel, Sweden

Initial situation

The 71-year-old female patient presented at the clinic with two tooth-supported maxillary bridges that required removal due to secondary caries, apical osteitis, and general bone loss.

The patient requested a fixed restoration with high aesthetics and easy hygiene maintenance.

Clinical and radiographic examination showed that sufficient bone was available for placement of six ANKYLOS C/X implants (DENTSPLY Implants).

After treatment planning and discussion, the patient consented to extraction of the seven remaining maxillary teeth followed by a friction-retained prosthesis supported by six ANKYLOS C/X implants and six ATLANTIS Conus abutments (DENTSPLY Implants).
During the healing period, the patient was provided with an immediate temporary denture that was relined several times to minimise soft-tissue trauma.

**Surgical treatment**

Seven weeks after the extractions (Fig. 1), a mucoperiosteal flap was elevated by making a crestal incision from region 16 to 26 with relief incisions buccally in region 16 and 26 as well as buccally and palatally in region 11/21. The six ANKYLOS C/X implants were placed slightly subcrestally in regions 15, 14, 11, 21, 25, and 26, using a conventional drilling protocol (Fig. 2). The placement heads were removed and replaced by cover screws. This first stage of the two-stage surgical protocol was completed with tight...
case report _ treatment of edentulous maxilla

Invasive approach, the cover screws could be replaced by gingiva formers without the need for any suturing (Fig. 4).

_Prosthetic treatment_

Impressions were taken two weeks after the second-stage surgery. The gingiva formers were exchanged for transfer posts, and a closed-tray impression (Fig. 5) was taken with an individual tray and polyether impression material was taken (Fig. 6). In the dental laboratory, the cast model was scanned, and 4-degree-angled conical abutments were designed using ATLANTIS VAD software (DENTSPLY Implants) (Fig. 7). The final abutment designs were sent digitally to DENTSPLY Implants in Mölndal, Sweden, where the six ATLANTIS Conus abutments were produced (Fig. 8). To connect the abutments to the bridge framework, prefabricated tapered ANKYLOS SynCone Caps were used on top of the ATLANTIS Conus abutments (Figs. 9 & 10).

To achieve precise fitting in the mouth, the laboratory provided transfer keys made from light curable composite to connect the ATLANTIS Conus abutments to each other (Fig. 11).

In the next step, the gingiva formers were replaced by the six ATLANTIS Conus abutments with the help of the transfer keys. The abutments were torqued to the implants with 15 Ncm (Fig. 12). After test for perfect fit of the SynCone Caps and framework in the mouth, the SynCone Caps were cemented to the cobalt-chrome framework intraorally using dual-hardening cement (Figs. 13 & 14). This part of the treatment was essential to assure perfect fit; carefully following the instructions for mixing the cement is highly recommended.

After the cement had cured completely, the fit of the framework, including the SynCone
Caps, was checked and the framework then removed from the mouth (Fig. 15). A new impression was taken using an individual tray and polyether impression material to pick up the cobalt-chrome framework (Fig. 16). The six ATLANTIS Conus abutments were not replaced by the gingiva formers again. Therefore the temporary denture had to be largely adjusted to provide space for the abutments, and relined once again.

A new master cast was created in the laboratory. The framework was used to create a bite registration (Fig. 17). After defining the plane of occlusion, the tooth setup was made in the laboratory (Fig. 18). Before finalizing the removable prosthesis, the wax tooth setup was sent by the laboratory for the final clinical try-in (Fig. 19).

To avoid a metallic grey shadow, the cobalt-chrome framework was treated with a pink opaque composite (Fig. 20) before processing the prosthesis in acrylic (Figs. 21 & 22).

Figures 23 and 24 show the removable prosthesis after it was finalised and polished.

The final palate-free restoration was inserted in the patient’s mouth (Figs. 26 & 27) and checked with an OPG (Fig. 25).

**Conclusion**

The treatment described in this case was delivered before the ATLANTIS Conus abutments were officially introduced in the summer of 2014, and the abutments were only available with a 4-degree angle.

Due to the perfect retention with that angulation, the patient had some problems removing the prosthesis for cleaning. Therefore, a decision was made to remove two of the ATLANTIS Conus abutments (14 and 25) and seal those implants with gingiva formers. This made it easier for the patient to remove the prosthesis, but could still provide the comfort of a fixed restoration when chewing.

To avoid this problem, the ATLANTIS Conus abutments are today only available with a 5-degree angle.

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Implant-prosthetic restorations
The challenge of creating an aesthetically pleasing smile in an edentulous patient

Author_ Cristian Petri, Romania

Fig. 1_Aesthetic evaluation prior to treatment: the edentulous upper jaw had been provided with a conventional complete denture. Figs. 2 & 3_After the healing and osseointegration process of the four implants, an impression of the oral situation was taken. The impression posts were splinted together prior to impression taking.

Fig. 4_ Implant model for the reconstruction of the overdenture.

Rehabilitation of the edentulous jaw can be achieved with various treatment modalities. Removable implant-supported overdentures can provide a comfortable, aesthetic and functional option even in cases in which only a limited number of implants can be used. Since the number of patients desiring an alternative to complete dentures is on the rise, this treatment option is becoming a frequent choice.

Patients’ expectations regarding prosthetic tooth replacements are similarly high compared with fixed ceramic veneered restorations. With the emergence of new materials and their combination with CAD/CAM technology, outstanding clinical outcomes can be achieved for this indication. An adequate solution can be found for almost every patient and budget.

Generally, overdentures offer several advantages over conventional removable prostheses, including improved stability, functionality, comfort, confidence in the ability to interact socially, straightforward rehabilitation and easy maintenance for the patient. Quite simply, overdentures result in a significant improvement in the quality of life of the patient.

In our case, a 58-year-old patient presented at the practice with discomfort caused by her complete maxillary denture. When looking at her history, we found a prosthetic restoration retained on six im-
plants in the lower jaw and a complete maxillary denture that was aesthetically and functionally inadequate (Fig. 1). An initial aesthetic evaluation established that the shape and shade of the teeth were inappropriate. In addition, the midline was misaligned and the curvature of the maxillary anterior teeth was shaped incorrectly.

The poor stability of the denture was caused by insufficient prosthetic support and by the method with which it had been produced. Taking the patient’s requirements and financial constraints, as well as the clinical condition of the maxillary prosthetic field, into account, we decided in favour of an implant-supported prosthetic treatment modality. The plan was to insert four maxillary implants to retain an overdenture prosthesis using the double-crown method. This procedure is frequently followed in such cases and has seen constant improvement with the emergence of new technologies and materials.

Our protocol required primary telescope crowns milled from zirconia at an incline of 2 degrees and secondary copings obtained by electroforming. This approach combines the advantages of zirconia (primary telescopes) with those of hydraulic retention (galvanic copings). After a complication-free period of healing and osseointegration, the four implants were uncovered and a preliminary impression was taken. Also, a customised tray was created from the resulting model.

In order to proceed to the next stage of the treatment, we required a functional impression that would transfer the exact position of the implants. For this purpose, the four impression posts were splinted together on a custom tray with composite material (Figs. 2 & 3). After creating the working models (Fig. 4), we determined the patient’s vertical dimension of occlusion, the length of the future teeth, as well as the gingival smile line, by means of an occlusal
I case report _ implant restorations

plate (bite rim). In the upper jaw, the occlusal rim was shaped in such a way that 2 mm of the edge was visible when the upper lip was in rest position. The lower edge of the rim was aligned parallel to the bipupillary plane and smoothly followed the curve of the lower lip when the patient smiled. On the maxillary rim, the midline, the smile line and the line of the canines were outlined. A facebow was used for the transfer of the maxillary position in relation to the base of the skull.

Once all of the relevant ratios had been obtained, the models were mounted on the articulator (Fig. 5). The difficulty of this case was that we had to make allowance for the existing mandibular restoration in the design of the maxillary rehabilitation. The implant axes of the mandibular prosthesis in particular posed some problems. Shade selection was dictated by the mandibular restoration and, consequently, our room for decision-making was reduced to deciding on the shape of the teeth. To this end, a photograph of the patient as a young adult was useful, as it was her wish that the shape and size of her teeth as they were when she was young should be re-established in the prosthetic reconstruction. With the aim to attain as perfect a prosthesis as possible and to make the most of the available space, we created a wax set-up using prefabricated denture teeth (SR Phonares II, Ivoclar Vivadent).

_Figs. 12 & 13_ Detailed view of the completed denture: customised prefabricated teeth and soft-tissue parts.

_Primary structure_

A try-in of the set-up was performed to check the phonetics, aesthetics and occlusion (Fig. 6) and then a silicone key was created over the set-up. This acted as a guide in the subsequent working steps. In order to manufacture the primary structure, the four titanium abutments were customised (Fig. 7), the resulting abutments were scanned together with the model and set-up (double scan), and these datasets were imported into the design software. The CAD program proceeded to suggest the shape, height and angulation of the telescope crowns, which we adjusted and optimised as required (Fig. 8). The primary telescopes were milled from zirconia and sintered to their final density at 1,500 °C. After the accuracy of fit had been checked, the zirconia crowns were permanently bonded to the titanium abutments (Multilink Hybrid Abutment, Ivoclar Vivadent). Finally, the zirconia telescopes were adjusted using a laboratory turbine and parallelograph. The walls of the telescopes were given a 2-degree incline and smoothed using appropriate diamond grinding tools and sufficient water-cooling (Figs. 9 & 10).

_Secondary structure_

The primary crowns could now be prepared for manufacturing the secondary crowns by means of the electroforming technique. For this purpose, the zirconia surfaces were covered in a thin coating of conductive silver using the airbrush method. Upon completion of the process, the galvanised gold crowns were detached from the telescopes and the conductive silver coating was removed with a solution containing nitric acid. In the process, a highly accurate secondary structure was obtained.

_Tertiary structure_

All of the components were repositioned on to the working model. Before the tertiary structure was fabricated, the electroformed crowns were covered
case report implant restorations

in a thin layer of wax to create the space necessary for the cement that would later be used. The tertiary structure was invested, cast in a cobalt-chromium alloy using induction casting technology and then finished. The tertiary structure was intraorally cemented on to the electroformed telescopes (Multi link Hybrid Abutment and Monobond, Ivoclar Vivadent) in order to obtain a tension-free restoration (Fig. 11).

_Aesthetic design_

The structure obtained was covered in an opaque light-curing laboratory composite (SR Nexco, Ivoclar Vivadent) in pink and white prior to finishing the prosthesis. Again, the silicone key was used as a guide. The SR Phonares II teeth were repositioned from the wax set-up to the framework. The occlusal parameters were checked again and then we proceeded to complete the restoration. In order to reconstruct the pink gingival portion, we used the IvoBase Injector system (Ivoclar Vivadent). First, the denture was invested in two specially designed flask halves using Type III and IV plaster. After removing the wax and isolating the plaster surfaces, we prepared an IvoBase capsule and placed it together with the flask into the polymerisation chamber. The IvoBase injection and polymerisation process is fully automated and takes about 60 minutes. Users can choose between two programme options. Running the standard programme takes about 40 minutes. If the RMR programme is additionally activated, the pressing time increases, as a result of which the monomer concentration is reduced to less than one per cent. This aspect is beneficial to patients because the risk of allergies and irritation of the mucous membrane is virtually eliminated.

After the injection programme was complete, the flask halves were opened, and the denture divested from the stone core and processed with milling and polishing instruments. To this end, the vestibular surfaces of the anterior teeth and the corresponding pink parts were sand-blasted. SR Connect (Ivoclar Vivadent) was applied and the teeth and prosthetic gingiva were characterised with SR Nexco. The shape was adjusted in accordance with the requirements of the patient. Final polishing was carried out with biaxial brushes and pads. The result proved very lifelike (Figs. 12–15).

_Conclusion_

Many patients are reluctant to be given removable dentures. If dentures are optimised by adding the stability of implants and the effectiveness of telescopes, dental professionals will be able to help patients overcome their reservations and offer them a tooth replacement that provides the level of comfort they expect. Completely edentulous patients have the same high aesthetic expectations as patients requiring fixed restorations. However, some of these requirements are more difficult to satisfy in the edentulous patient, because we have to replace soft tissue in addition to missing teeth. In order to achieve this, we need to find a way to create harmony between the pink and white aspects of the denture.

Today’s patients tend to be well-informed. They have ever higher expectations of the aesthetic and functional aspects of tooth replacements. Therefore, we need to be well trained and know which materials and technologies can aid our work and increase our efficiency. This will enable us to solve any clinical case, regardless of its difficulty._

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The challenge of aesthetic implant restoration

Authors: Dr Jan Spieckermann & Jörg Wildenhain, Germany

The demands of treatment with implants are high, particularly in the aesthetically relevant areas. In the case of difficult morphological conditions, the individual wishes of patients regarding their natural appearance represent a major challenge for the treatment team. A host of materials and techniques for crowns and abutments allow for perfect imitation of the tooth structure. However, aesthetic restoration is only successful if a natural periimplant hard and soft tissue profile can be preserved or reconstructed. The following case study illustrates the complexity of implant treatment for combined horizontal and vertical bone resorption after the traumatic loss of the left central incisor.

Dental history and treatment plan

The most predictable, stable long-term aesthetic results are achieved through a synergistic process for diagnosis and therapy involving the various dental specialties. Science-based therapies need to be implemented with surgical and prosthetic precision and require the active participation of the patient both during and after treatment. A 29-year-old patient was referred to our oral surgery practice with the request for implant therapy in the anterior maxilla. He had lost the upper left incisor in an accident some months before. The gap had been treated with a flipper by the referring dentist. The removable restoration strongly affected the social well-being of the young man.

Examination showed advanced horizontal and vertical bone resorption (Fig. 1). An extended plastic shield on the flipper was to visually compensating for bone loss (Fig. 2). This untoward design of the flipper exerted continuous pressure on the alveolar ridge owing to the rotary freedom around the clamping axis, particularly during removal but also during chewing motions.

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Fig. 1. The X-ray shows progressive horizontal and vertical bone resorption.
Fig. 2. The too long gingiva shield contributes to resorption due to the rotational freedom of the flipper.
Fig. 3. To avoid further traumatisation of the soft tissue, the flipper shield was shortened.
Fig. 4. The occlusal top view shows the horizontal hard and soft tissue deficit in the implant region.
The unphysiological force induction influences the progression of bone resorption. To avoid further traumatisation of the hard and soft tissue, we removed the gingival plate of the flipper and created a pontic-like design for region #21 (Fig. 3). With the exception of the pronounced bone deficit in region 21, there were no negative findings during examination of the anterior tooth region (Fig. 4).

We took impressions of the situation, prepared models and performed articulations. Then all therapeutic options were weighed against each other. We prepared a biological and financial cost-benefit analysis for each solution. We discussed all options in-depth with the patient. The justification for implantation was that both adjacent teeth were free of caries and should not be ground. Knowing that a correctly placed implant would prevent further resorption of the jaw bone, we prepared the most suitable treatment plan for the patient in our view.

The challenge of every treatment is the natural appearance of the restoration. The aesthetic characteristics proposed by Magne and Belser are part of our pre-prosthetic planning and are discussed by the team. The focus is on the condition and colour of the gingiva, achieving closed interdental spaces, a balanced profile of the gingiva, interdental contact points, the shape of the teeth, characterisation of the teeth and their texture, the alignment and position of the teeth, as well as the symmetry of the smile. The design of the convex structure of the alveolar bone ridge and the reshaping of the jugae alveolaris in the “red” area are just as important for a natural appearance as the perfect “white” crown reconstruction. Reconstruction of the bone deficit, both vertically and horizontally, requires a bone block graft. In order to ensure the success of the surgical intervention for the 3-D placement of the implant, we opted for a two-stage procedure. In other words, the planned implant is inserted after regeneration of the bone.

Reconstruction of the bone defect

After administering local anaesthetic in both the donor and the host regions, a mediocrestal incision with vertical relieving incisions was performed in the anterior maxilla, distal to the adjacent teeth. In order to allow sufficient mobilisation of the mucoperiosteal flap and tension-free adaptation of the margins, the relieving incisions were extended over the mucogingival margin. Care was also taken to ensure that the flap edges were positioned on the local bone as this is where the growth factors for marginal regeneration originate. The mucoperiosteum/mucosal flap was prepared. To ensure blood supply to the flap, this was opened 5 mm apical to the mucogingival margin. The degree of bone deficit was demonstrated visually using a thread loop (Fig. 5).

A sufficiently large bone graft was harvested from the Corpus/Ramus mandibulae. This was preserved in physiological solution until the soft tissue at the donor site had been sutured (Figs. 6 & 7). We then adapted the cortical bone block as precisely as possible to the host site. In order to achieve an aesthetic overall outcome, attention was paid to the shaping of the jugae alveolaris in the later implant region. The bone block was fixated with two osteosynthesis screws (Fig. 8). The remaining autologous bone material was ground and then used to fill the spaces between the block graft and the local bone (Fig. 9). Bio Oss® was added around the graft to...
I case report _implant restorations

Fig. 11 Three months post-op: frontal anatomical shaping of the jaw, sufficiently thick attached gingiva.

Fig. 12 Occlusal view: reconstructed hard and soft tissue, ready for implant insertion.

Fig. 13 Two-component sleeve for CT-planning incorporated in the prosthetically correct implant position.

Fig. 14 Full length of the Ø 2.2 mm sleeve was utilised initially.

Fig. 15 Pilot drilling is deepened through the 4 mm high sleeve section.

Fig. 16 Skeletonised implant template creates the largest possible space for the head of the angled handpiece for pilot drilling.

Fig. 17 Exposure of jaw bone and removal of two osteosynthesis screws.

Fig. 18 Insertion of skeletonised implant template.

The dental technician fabricated a skeletonised template. A two-component sleeve for CT-planning was incorporated at the prosthetically correct implant position and the plastic reduced as far as possible between the adjacent teeth. This reduction also enables placing of the template during the surgical procedure with mucoperiosteal flaps and provides maximum space for the angled handpiece during preparation of the implant bed (Figs. 13–16).

_Implantation_

Implantation was performed four months after bone augmentation. Following local anaesthesia, a vestibular flap was prepared, the jaw bone exposed and the two osteosynthesis screws removed (Fig. 17). Pilot drilling was performed with the aid of a drilling template through the two-component CAMLOG sleeve for CT planning (2.2 mm diameter; Fig. 18). All other drilling steps to prepare the implant site for the CAMLOG® SCREW-LINE implant, length 13 mm and diameter 4.3 mm, were performed without a template.

Placement of the implant was performed three-dimensionally following the criteria for the anatomic window according to Gomez and taking into account the biological conversion processes associated with implant restorations. In this patient case the implant shoulder rested 1–2 mm below the cemento-enamel junction of the adjacent teeth. The implant shoulder was placed approximately 2 mm palatal to the dental arch in oro/vestibular direction. Apical placement compensates for differences between the anatomical emergence profile of the crown and the implant diameter. The mesio/distal distance between the outer edge of the implant to the adjacent tooth should be approximately 2 mm (Figs. 19 & 20). The
Implant was sealed with a cover screw, the soft tissue sutured and an radiograph taken for checking purposes (Fig. 21).

**Implant exposure with thickening of the soft tissue**

In order to ensure successful restoration with the implant, we paid particular attention to the soft tissue management when exposing the implant. For this purpose we employed the modified roll flap technique for thickening of the soft tissue (Fig. 22). Using a diamond drill, the epithelium layer over the implant was removed and a pedicle flap prepared vestibularly after palatal preparation, surrounding the de-epithelised tissue with cut-outs for the papillae (Fig. 23). The roll flaps were folded, pushed into the prepared tunnel, and after removing the cover screw a 4 mm high healing cap was inserted into the implant (Fig. 24). We thickened the marginal soft tissue as a matter of principle as it could migrate in the apical direction during remodelling. The periimplant tissue restructures itself during insertion of the healing cap or the prosthetic restoration and the biological scope develops anew.² For cost reasons we were unable to utilise the option of shaping the soft tissue using a temporary implant crown.

**The prosthetic restoration**

Four weeks after exposure, the tissue was stable and irritation-free and an impression of the situation was taken. We removed the healing cap and placed the impression post for the closed tray technique into the implant (Fig. 25). The impression cap was attached to the post and an impression of the upper jaw taken with polyether. Once the models had been fabricated and articulated, the dental technician fabricated a customised zirconium dioxide abutment, bonded to a CAMLOG® Titanium base CAD/CAM. The customised shaping of the crown emergence profile is key to the natural appearance of a prosthetic reconstruction.

A zirconium dioxide cap was fabricated over the hybrid abutment, which was veneered with a glass ceramic (Figs. 26–28). On the day of insertion, the healing cap was removed, the implant interface cleaned, and the hybrid abutment inserted (Fig. 29). The surrounding soft tissue was displaced by the customised crown emergence profile into the shape of the planned emergence profile. After approximately 3 minutes the soft tissue had revascularised and was evenly coloured red. The crown was seated and the overall appearance, shape of the tooth, colour and position evaluated critically. The shaping of the papillae was not yet perfect (Fig. 30). Therefore, the positions of the contact points were checked. The vertical distance between the crestal bone and the approximal contact points to the adjacent dental crowns was 4 mm. Here we referred to the investigations on papillae formation by Tarnow et al. for aesthetic interdental papillae that remain stable long-term.¹⁰
The intact surrounding support structure of the adjacent teeth helps in the realisation of a naturally shaped papilla. The zirconium dioxide crown was cemented with Durelon, the cement residue was carefully removed, and the patient left the dental practice with a permanent aesthetic prosthesis (Fig. 31). Twelve months after insertion, the patient presented in our practice for a follow-up. The images show a stable periimplant hard and soft tissue situation (Fig. 32). The migration of the gingiva had led to considerably more natural shaping of the interdental papillae, and the gaps had virtually closed. The aesthetic outcome of the 3-D implant insertion in combination with the intact approximal bone level of the adjacent teeth and adequate height and width of the periimplant hard and soft tissue was again confirmed at the 24-month follow-up (Fig. 33).

_Discussion_

The prospective implant status demonstrated insufficient alveolar ridge tissue. Aesthetic implant restoration was therefore only possible with bone and soft tissue augmentation. As a single-step surgical procedure did not allow for a prosthetically correct placement of the implant, a two-step procedure was indicated. Perfect red-white aesthetics place great demands on the periimplant hard and soft tissue.

_Co nclusion_

In the aesthetically demanding anterior region, implant therapy represents both a valuable and challenging alternative for replacing lost teeth. The surgical treatment plan based on the patient’s wishes, prosthetic analysis and a wax-up, should be compiled on the basis of the existing hard and soft tissue. The individual treatment steps, as well as treatment times and costs should be discussed in depth with the patient._

Editorial note: A list of references is available from the publisher.
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The various countries in the Asia Pacific region are all expected to demonstrate an increasing demand for dental implant treatments as a result of growing consumer awareness, the ageing population, growing accessibility (such as through the National Health Insurance Service coverage in South Korea), as well as greater product availability and other influencing factors. Traditionally, premium implant companies have dominated the dental implant market globally. However, in recent years, discounted implants have become increasingly popular, especially in the Asia Pacific region.

The growth of the discount implant segment will emerge at the expense of the premium segment and as a result is set to limit market growth for dental implant fixtures by lowering the market’s overall average selling price (ASP). In contrast, the final abutment market is set to experience an increasing ASP owing to the growing adoption of CAD/CAM abutments in the place of stock abutments. While commoditisation of stock abutments has greatly depressed the ASP of the final abutment market, growing adoption of CAD/CAM abutments is set to stimulate the final abutment market by pulling the ASP upwards. Therefore, the dental implant market is set to grow in all four countries included in the Asia Pacific region in this report, namely Australia, South Korea, Japan and China, despite varying pricing trends.

In the Asia Pacific dental implant market, consumer awareness, cultural tendencies and domestic regulations vary greatly. South Korea represents the most highly developed dental implant market as a result of being home to a number of global leading dental implant companies. This in turn has led to a high level of consumer awareness and early accessibility to a variety of...
dental implant products. However, the dental implant market in South Korea is also highly discount dominant and led by domestic implant producer OSSTEM IMPLANT and as a result demonstrated the lowest regional dental implant ASP of US$86 in 2014.

In contrast, the Australian market remains highly dominated by leading premium implant companies, which collectively held over 70 per cent of the domestic market. Consequently, Australia demonstrated the highest dental implant fixture ASP in the region at US$345 in 2014. An increasing number of general practitioners are being trained in dental implant procedures in Australia, and general practitioners have been observed to be more cost sensitive relative to specialists. As a result of a growing number of general practitioners in the market, consumer preferences are shifting towards discounted solutions. Discount implant companies from the US and South Korea have recently been gaining market share in Australia. Throughout the forecast period, the premium segment of the market is expected to grow at far lower annual growth rates relative to the discount and value segments in Australia. By 2021, it is expected that discount implants will represent 43 per cent of the overall units in the Australian market.

The Japanese and Chinese markets for dental implants are also dominated by premium companies. In recent years, OSSTEM IMPLANT has had a significant impact on the Chinese market, however, especially as a result of the training programme offered by the company’s Advanced Dental Implant Research and Education Center. All segments of the dental implant market in China are expected to demonstrate double-digit annual growth. However, the discount market is set to grow far more dramatically throughout the forecast period. By 2021, discount implant fixtures are set to represent over 50 per cent of the overall units in the Chinese dental implant market.

The shift towards discount implants in Japan is expected to be far less dramatic, especially owing to

The Japanese and Chinese markets for dental implants are also dominated by premium companies. In recent years, OSSTEM IMPLANT has had a significant impact on the Chinese market, however, especially as a result of the training programme offered by the company’s Advanced Dental Implant Research and Education Center. All segments of the dental implant market in China are expected to demonstrate double-digit annual growth. However, the discount market is set to grow far more dramatically throughout the forecast period. By 2021, discount implant fixtures are set to represent over 50 per cent of the overall units in the Chinese dental implant market.

The shift towards discount implants in Japan is expected to be far less dramatic, especially owing to
cultural barriers that limit the success of Korean dental implant companies. The premium implant segment is expected to remain the dominant dental implant market throughout the forecast period. Unit representation of discount implants is expected to increase slightly from 12.5 per cent currently to 14.6 per cent by 2021.

The growing acceptance of discount implants has been driven by Korean companies. The regional market leader, OSSTEM IMPLANT, held a 21.9 per cent share of the total dental implant market for the Asia Pacific region in 2014. The company has invested significantly in marketing efforts, which has led to the growing popularity of its products. Throughout the forecast period, OSSTEM IMPLANT and other discount implant companies, such as MegaGen, Dentium and Neobiotech, are expected to capitalise on the growing popularity of discount implants. In contrast, premium implant companies, such as Straumann and Nobel Biocare, are expected to face increasing competitive pressures, especially in China and Australia.

_EmpHASIS ON CAD/CAM_

In the dental implant market, the final abutment market is undergoing an opposing pricing trend relative to dental implant fixtures. CAD/CAM abutments are being increasingly utilised in the place of cheaply produced stock abutments. CAD/CAM development has been relatively rapid in the Asia Pacific region in recent years. A growing number of CAD/CAM milling centres have emerged to produce CAD/CAM abutments for the dental implant market. The overall region is set to demonstrate significant growth in the CAD/CAM segment for final abutments. In contrast to the dental implant fixture market, where discount products are gaining share, the overall final abutment market is set to demonstrate an increasing ASP. CAD/CAM final abutments are relatively more expensive than stock abutments, which have traditionally dominated the market. The shift towards CAD/CAM abutments is set to be most significant in China. For the overall region, units of CAD/CAM abutments are set to grow at a compound annual growth rate of 22.1 per cent. By 2021, CAD/CAM abutments are forecast to represent 31.6 per cent of the overall abutment units in Asia Pacific.

_COnCLUSION_

Overall, the dental implant market, including fixtures and abutments, is set to grow at a compound annual growth rate of 11.5 per cent for the Asia Pacific region. The unit growth will far outweigh the ASP effects, and the dental implant market will grow to reach a higher penetration ratio for the overall Asia Pacific region._

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Veneering options for fixed implant-retained restorations

Author Prof. Stefan Holst

The NobelProcera System guarantees unrivalled product quality for almost any patient situation. No other CAD/CAM system has such a celebrated heritage, stemming from decades of experience in producing the highest quality multi-unit frameworks for both natural teeth and implants.

When compared to conventionally fabricated frameworks, CAD/CAM frameworks demonstrate decisively distinctive advantages, including material homogeneity, customised design options, and ease of fabrication. Industrial production also guarantees uniform high quality and consistent cost-efficiency by reducing labour-intensive work in the dental laboratory along with its related costs.

Scientific data confirms that material incompatibilities between cast and machined components can be minimised or eliminated when titanium or zirconia are used. Corrosive phenomena at the interface between dissimilar metal alloys can thus be prevented while facilitating precision fit at the same time. This approach also promotes soft tissue stability and marginal bone maintenance.

Crucial choices

In order to ensure longevity when restoring an edentulous patient with an implant-retained restoration, the selection of proper materials, prepared with appropriate precision, is vital. What the ideal protocol for finishing/veneering CAD/CAM frameworks entails has been
technique_ veneering options

Intensively debated in recent years. Both metal-based and all-ceramic framework materials can withstand intraoral loading; the veneering material is the weak link.

Despite extensive research activities, chipping—or the partial delamination—of ceramic veneering materials is reported as the chief reason.

In addition to the options dental ceramics provide, polymer-based materials should also be taken into consideration as an alternative material when finishing options for frameworks are considered.

Today, polymers are used in dentistry for a wide array of applications, in which their use ranges from impression materials to direct/indirect restorative materials. They are used as denture base materials and for such standard components in implant dentistry as healing caps, impression transfer units, etc.

By modifying their chemical composition and/or adding filler particles to the microstructure, the physical properties and material characteristics of polymers can be adjusted to specifically meet the requirements of a given clinical application.

Advances in material sciences

Extensive research activities in recent years have led to new and improved materials—and entire groups of materials—that reduce unwanted or non-beneficial properties and provide safe, easy-to-use (and easy-to-maintain) solutions.

If combined with high-strength framework materials such as titanium or zirconia, polymer veneering significantly reduces the overall cost of the restoration. Cost control, of course, must always be kept in mind, since patient expectations and financial means differ, clinical situations vary, and virtually every laboratory set-up is unique.

Presentation on state-of-the-art techniques and materials

The following case reports from some of our skilled partner clinicians underline the versatility and display the functional and aesthetic outcomes that can be achieved with the NobelProcera Software.

Case 1

Dr Ferdinando D’Avenia and Master Dental Technician Cesare Ferri of Parma, Italy, utilised a NobelProcera Implant Bridge Titanium veneered with acrylics to accommodate for the clinical situation and the expectations of the patient.

A 55-year-old male patient, suffering from bi-maxillary severe bone atrophy, presented with dis-
technique — veneering options

He was wearing two severely worn, 20-year-old complete dentures and requested implant-supported fixed restorations. Following diagnostic and radiographic examinations, the definitive treatment plan compensated for the extensive resorption of alveolar ridges (hard- and soft-tissue architecture) via prosthetic means.

In addition to functional and aesthetic rehabilitation, the patient needed a cost-efficient solution that would not require high maintenance costs. To meet his needs and expectations, the treatment team decided to go for the following solution: four NobelActive implants were placed in both the maxilla and the mandible according to the All-on-4 concept. Treatment planning and execution were carried out with NobelClinician/NobelGuide technology, and an immediate provisional restoration was provided. To reduce additional costs for the patient, the existing dentures were transformed into an immediate, screw-retained provisional (readapted to a correct VDO). Following a four-month healing period to allow for osseointegration of the fixtures, the provisional was subsequently replaced with definitive restorations, i.e. NobelProcera Implant Bridge Titanium veneered with conventional denture teeth and cold-cure acrylics (Figs. 1–7).

Why this approach?

The team’s rationale for selecting this approach has to do with a number of clinical and technical advantages.

First of all, the titanium framework represents an economical solution, which also demonstrates beneficial biomechanical properties in combination with Nobel Biocare’s Multi-unit Abutments (MUAs).

Not only does this solution provide excellent peri-implant, soft tissue biocompatibility, it is also associated with a straightforward handling protocol for both the clinician and the dental technician.

MUAs provide ease of use through accessibility. At the same time, their use supports biologic stability of the peri-implant tissues, as this critical interface remains undisturbed during the change from a provisional to final restoration (e.g. abutment-level impression and fixation of the definitive framework).

From a technical and longevity perspective, the performance of the chemical bond between titanium and acrylic has ample scientific background, can be easily achieved, and is stronger than a zirconia-ceramic bonding.

What is more, costs for the patient can be significantly reduced through material selection and the choice of prefabricated standard acrylic denture teeth. In fact, there are any number of time- and cost-saving production steps in the dental laboratory when this option is chosen.

Reduced maintenance costs in case of late prosthetic reintervention can be expected and most repairs can be performed intraorally.

Finally, this restorative approach produces highly aesthetic results thanks to an optional outer layer of composite resin that can be added after a cut-back of the denture teeth (depending on the aesthetic needs and expectations of the patient).

Case 2

Drs Mario Imburgia and Giovanni Cricchio, and Ceramicists Angelo Canale and Angela Giordano
Italy chose a NobelProcera Implant Bridge Zirconia, manually veneered with feldspatic ceramics as a solution in their daily routine.

The 64-year-old female patient was affected by generalised severe periodontal disease. She had been wearing an upper partial removable denture for approximately 10 years prior to her first consultation for implant-supported restorative treatment.

Her chief complaint was discomfort and lack of masticatory efficiency and aesthetics. Migration and increased mobility of her teeth had resulted in altered speech and contributed significantly to her sense of insecurity.

She made it clear that aesthetics were as important as the functional outcome. She wanted to regain a natural and aesthetically pleasing appearance without the “Hollywood smile” effect.

The treatment team had to comply with two conditions:
1) The patient did not want to be subjected to invasive surgical procedures.
2) She was unwilling to wear removable dentures during the provisional phase.

To accommodate both needs and stipulations, the treatment team decided to go for the following solution: Implant treatment planning in both the maxilla and mandible was carried out using NobelClinician Software. Post-extraction, immediate flapless implant placement was done with a two-piece radiographic...
Fixed implant-supported zirconia bridges (NobelProcera Implant Bridge Zirconia) were produced for the definitive restoration in order to ensure high comfort, stability and good aesthetics. In the mandible, five implants were placed and restored with screw-retained, single tooth restorations and a screw-retained implant bridge (zirconia) (Figs. 8–13).

Rationale behind the choice

The team chose this combination of zirconia framework and veneering ceramic for a number of reasons. From extensive earlier experience, they knew that this option would allow them to obtain an optimal aesthetic result, achieving natural-looking colour and translucency in the individual dental restorations while elsewhere preserving soft tissue volume and architecture.

With this combination of materials and techniques, they also knew that they would be using a highly biocompatible material to make a prosthetic restoration that would provide excellent integration and stability of the peri-implant tissues. The team also chose this combination in order to obtain an optimal aesthetic result in a fully customisable prosthetic solution; one that would be, at the same time, both simple and retrievable.

From a technical point of view, the team points out, ‘This choice has allowed us to maintain an excellent fit of the framework due to CAD/CAM technology and the high stability of zirconia during the firing of the veneering ceramic.’

Finally—and not least of all—they chose this combination of zirconia and veneering ceramics because of the NobelProcera Software features, which allow for fully customised frameworks, designed to support the veneering materials for stable, long-term results.

Case 3

Professor Alessandro Pozzi and Master Dental Technicians Paolo Paglia and Alberto Bonaca of Rome, Italy, presented a case of the 62-year-old female patient who had been wearing a porcelain-fused-to-metal restoration in the upper jaw since the late 1980s. She presented with a failing dentition in both the maxilla and mandible and a moderate bone resorption pattern.

After some discussion, it became clear that she was looking for full mouth rehabilitation and requested a minimally invasive approach that would...
provide natural-looking, lifelike prosthetic emergence from the gingival tissue. No artificial gingiva was acceptable for the patient.

Because of the daily administration of oral anticoagulant medications, a minimally invasive surgical approach, avoiding any major bone grafting procedures, was medically essential (Figs. 14–20).

Treatment choices

A novel fixed restorative option, comprising single CAD/CAM lithium disilicate crowns cemented onto a precision zirconia framework, was used to rehabilitate the upper and lower jaws.

NobelClinician Software was used to prepare the digital treatment plan—and to communicate that plan with the patient. NobelGuide was employed to allow for ideal implant position and angulation based on available bone in order to reduce the surgical invasiveness and post-operative morbidity, and still ensure ideal framework design._

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All the treatment concepts presented in this article have been evaluated in extensive clinical trials. These concepts meet patient needs and expectations, as well as advanced functional and esthetic criteria. Together, they represent only a few of the many alternatives available when using products from Nobel Biocare.

To view the complete treatment sequences online and to read short biographies of the dentists and technicians whose work is represented in this article, please visit: www.nobelbiocare.com/newsletter.

Fig. 18. In the lower jaw the screw access holes did not impact the aesthetic area of the restoration and thus all the crowns have been cemented in the lab. Furthermore, the biomechanical strength of the CAD/CAM lithium disilicate allowed the perforation of the units in order to deliver a screw-retained, easy-to-retrieve restoration.

Fig. 19. The post-operative smile of the patient combines a pleasant prosthetic design with a natural soft tissue framework.

Fig. 20. The RX orthopantomograph at just under three-year follow-up. The bone level around the six NobelActive implants and the four NobelReplace Conical Connection implants in the upper and lower jaw, respectively, demonstrate the success of the implant-supported restorations.

Pro. Stefan Holst graduated from the Medical University of Hanover, Dental School in 1999 followed by a postgraduate education at the Louisiana State University Dept. of Prosthodontics (Head: Gerard Chiche), New Orleans, USA before becoming full time faculty at the University of Erlangen, Department of Prosthodontics where he held a position as Professor for clinical education and headed the CAD/CAM research laboratories for 11 years prior to joining Nobel Biocare as Global Head of Research and Science in 2013. In 2012 Professor Holst was appointed Adjunct Professor for Restorative Dentistry at the University of Pennsylvania, USA. From 2009 to 2011 Prof. Holst served as Associate Editor of the Quintessence International journal and since 2011 he is member of the editorial review board of the International Journal of Prosthodontics.
A system like natural teeth: Elastic inside, harder outside

Author: Dr Christian Jerecinski, Reinhild Schmidt & Manuela Bandl, Germany

To date, no material has been able to imitate natural teeth precisely. However, in the course of the CAD/CAM revolution, we are moving one step closer to this target. The restorations presented in this article emulate the physics of the natural tooth through a material system with a buffer effect.

Case report

A 48-year-old patient was no longer satisfied with his telescopic restoration in the maxillae. This involved a framework with veneers from tooth #14–24. Removing it in the evening was difficult. Furthermore, there were gaps visible in his dentition at regions #15, 35 and 45, and these were making him increasingly unhappy. He had finally decided to call his dentist’s office with the request for implants and correction of his old restoration. The clinical findings showed that periodontitis had developed owing to the old restoration sitting badly and the difficult hygiene. This was initially treated and brought to a halt before further measures were begun. The telescopic bridge was readjusted so that the patient could continue to use it. The mandible showed abrasions and overlapping of the anterior teeth, which was to remain untreated for the time being.

Therapy decision after patient briefing and consultation

After the periodontitis had healed and instruction in personal oral hygiene had been given, implants were recommended to the patient during a consultation. Such a restoration would prevent tooth migration, stabilise the current situation, and ensure a permanent fit of the present maxillary restoration. The bone available for the implants was sufficient in regions #15, 35 and 45. This condition could alter with time and could both complicate and raise the cost of a future implantation necessitating augmentation meas-
ures; the timing was therefore ideal for implantation.

When selecting the material, it is important to determine whether the patient already has a metal restoration. Additionally, it should be taken into consideration that implants greatly increase the resulting masticatory pressure owing to the lack of Sharpey’s fibres and the restricted transmission of stimuli. Hämmerle et al. have shown that the threshold of tactile sensitivity perceived with implants is on average nine times greater than with natural teeth.¹

In order not to increase the amount of metal in the mouth, on the one hand, and to protect the bones, joints and antagonists through the buffer effect, on the other hand, the bionic restoration

Figs. 9a & b. Transfer to the CAM software for nesting (a). The zirconium dioxide blank with the abutments milled from it (b).

Fig. 10. Fitting the abutments on the plaster model.

Figs. 11a & b. Attaching the abutments to the implant abutments using Sebond Implant (Schütz Dental).
Industry report: composite restorations

Composite restorations (Schütz Dental) came into consideration. This material system consists of a framework made of Tizian Zirconia Reinforced Composite and the dialog Occlusal veneering composite (see the discussion section). A restoration made from these materials is slightly elastic, as well as abrasion resistant, and it mimics the physical properties of the natural tooth with flexible dentine and hard enamel. Chipping, as seen with hard zirconium dioxide with layered ceramic veneers, is minimised with restoration using Tizian Zirconia Reinforced Composite.

Furthermore, the patient can be offered bionic restoration at a more favourable price than a fully ceramic restoration. This was relevant in the case presented in this article.

The initial steps: Implant placement, impression taking and scanning

Implant placement in regions #15, 35 and 45 (IMPLA implant system, Schütz Dental) using cortical and extension drills proceeded without problems, as was expected. All three implants were placed during the same appointment.

After healing, conventional impressions were taken, frameworks were cast (Fig. 1) and gingival masks created (Fig. 2), and the necessary scans taken (Figs. 3 & 4a & b).

Virtual construction of abutments and finishing in zirconium dioxide

Individual abutments provided a clean emergence profile and good hygiene capability without undercuts. Abutments made of zirconium dioxide provided the appropriate colour base for the dental prosthesis. Owing to the sparsity of the teeth in the molar region, tooth #15 was considered as tooth #16 for the reconstruction (Fig. 5) and tooth #35 as tooth #36 (Fig. 6). This measure allowed for terminal occlusion (Fig. 7) to be achieved.

The CAD software (Tizian Creativ RT, Schütz Dental) matched all of the scans and made suggestions for three abutment models in the Tizian Creativ RT Abutment Designer module (Fig. 8). These were adjusted slightly and transferred to the CAM software for nesting (Fig. 9a). The framework was milled on a Tizian Cut 5 smart tabletop.
milling machine from Tizian Blank zirconium dioxide (Fig. 9b). Trying on the plaster model showed a perfect fit (Fig. 10). Thus, try-in in the patient’s mouth was not necessary, and the abutments were permanently attached (Figs. 11a & b).

_The way to definitive crowns_

In order to prepare for fabrication of the definitive crowns, the plaster models were scanned with the mounted titanium adhesive bases and abutments (Figs. 12a & b). The software again generated the design suggestion for the three crowns (Figs. 13a & b). These were viewed and measured from every angle. This applied particularly to the occlusal relief and the basal side (Fig. 14). For later finishing with veneer composite, the crown constructions were slightly reduced cervically and occlusally. After this adjustment and approval, the next, fully automated, step was the creation of the STL datasets and the nesting of the crowns (Fig. 15). The milling procedure was then performed using a Tizian Zirconia Reinforced Composite blank in the A3 shade (Fig. 16). It was dry milled, without water-cooling.

The blank received a code for patient identification. This means that several jobs can be performed at the same time without confusion. As the data for nesting are archived, it is possible to use the same blank again later.

The fit of the milled crown fully satisfied expectations. Finally, a razor-thin layer of dialog Occlusal was applied in order to give the restoration the bionic function (Figs. 17 & 18). Cervical, dentine and incisal masses were used to give the restoration a certain vivacity. This should be discrete, and the obtained shade was to mirror the colour of the natural teeth. The patient did not want the fissures to be coloured (Figs. 19a & b). Integration in the patient’s mouth took place to the satisfaction of everyone involved; the implant restoration was harmoniously incorporated into the remaining dentition (Fig. 20).

_Discussion_

The bionic restoration material system, made of Tizian Zirconia Reinforced Composite framework material and dialog Occlusal veneering composite, counters in particular the chipping problem of veneered zirconium dioxide. This especially becomes a factor for implants, as the masticatory forces are particularly high and the restoration is accordingly placed under high strain. Furthermore, the questions of increased wear of natural antagonists and of the effect on the jawbone and the temporomandibular joint remain. In this case, it appears to be appropriate to select implant restorations from materials that can create a buffer effect; this is the case for Tizian Zirconia Reinforced Composite in combination with dialog Occlusal. In comparison with zirconium dioxide, the modulus of elasticity of Tizian Zirconia Reinforced Composite is low at 3,050 MPa, meaning the material is comparatively elastic, and the Vickers hardness is 196 MPa. It takes on the function of natural dentine in the restoration. In contrast, the veneer composite is harder—just like natural enamel. The system of bionic restoration achieves a Vickers hardness of 560 MPa, whereas the Vickers hardness of natural enamel is around 450 MPa.
550 MPa. The total elasticity of the dental prosthesis helps to distribute the selective masticatory strain and to reduce the stress on the implant, bones, joints and antagonists. The physics of the natural tooth are mimicked. This is of benefit for patients with temporomandibular joint dysfunction or bruxism, as well as any other patient.

Additionally, the cost factor has proven favourable for the patient, the office and the laboratory. Should it be necessary to make an adjustment or repair, this can be done in the patient’s mouth. The veneer composite is light cured. This has shown to be positive for the laboratory, as it means that there are no additional outlay costs after acquiring a CAD/CAM system. Furthermore, there is no shrinkage, unlike with zirconium dioxide, and this means it is easier to achieve a perfect fit. The colour also reflects the final result right from the start: unlike with ceramic restorations, the colour does not change during the manufacturing process. However, the tooth surface appears like ceramic and solid, very similar to the natural tooth. All these properties make the bionic restoration a straightforward, reproducible, aesthetic and economical application.

_concluding remark: “It doesn’t rattle anymore!”

Patients greatly appreciate the natural appearance without the masticatory feeling of ceramic and specifically of zirconium dioxide. In the following final example, a zirconium dioxide piece in the mandible was extended using a bionic restoration: a full restoration of the mandible with 13 crowns on eight implants and five natural stumps (Figs. 21 & 22). In this case, chipping had been a problem before. The patient felt comfortable with the bionic restoration. He reported that the new restorations were not as hard and instead felt like his own teeth. The restorations have a "nice soft feel" and "It doesn’t rattle anymore!" he summed up happily.

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Reference


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In what way has CAD/CAM made a major difference to your dental practice and patients?

The first time I really experienced the difference CAD/CAM has made for my patients was with one patient, a very successful partner at a well-known architectural firm. He came in on a Friday afternoon around 2 p.m. and said, “John, I’m very sorry to bother you but the crown on my front tooth just cracked. I’ve got a really important dinner tonight with clients and I’m going away on a 14-day ski trip with my family. If I don’t make the trip, I’m in trouble. If you made me a temporary, I would be most appreciative.”

His crown was in two pieces. I told him that I believed that we could do more than just make him a temporary. I thought we could make him a new crown with CAD/CAM and the laboratory. Of course, he did not think this was possible.

I took the broken piece and slipped it back into his mouth; it fitted perfectly, like a jigsaw puzzle. I then had my assistant take a pre-preparation scan. I next took the broken piece off, administered a little Novocain to the patient and ground away the piece that was still cemented. I placed a cord and scanned the preparation with our TRIO S scanner (3Shape). The technician in the laboratory then designed and milled the patient a new crown. Ninety minutes later, the patient left with a final crown and not a temporary.

As a follow-up, he later told me that he must have really bored his clients at dinner that night, because the only thing he talked about was the crown we made in that one visit.

If you look at this case and compare it with what used to happen in the old days, that same procedure would have taken three visits.

Now, whenever I see an emergency in our schedule that involves something broken, I think that we can turn it into a definitive solution and not just a stopgap of placing a temporary and the patient returning the next week. I know that now we can fit a crown using a TRIO S digital impression and our laboratory. For patients like the one in this example, digital is a lifesaver.

Is there not a financial loss by not having the follow-up visits?

No, not at all. One charges the same fee regardless of the number of visits because the patient is charged for the procedure and not per visit. So for us, we actually save time and money. In addition, not having to wear a temporary crown is of great benefit for patients. They do not have to come back to our office.

Are there more advantages of this technology?

Another important advantage of digital technology is its potential for patient education. For example, I had a patient with a lateral incisor that was perfect from the facial aspect, but from the lingual, there was an amalgam restoration, a composite restoration and a vertical crack from the incisal edge.
to the gingiva. But how can you show that to the patient when it is on the lingual side?

In the old days, I would have tried with a mirror or taken a photograph and loaded it on the computer or an iPad. This would have taken 20 minutes. The patient would have been looking at his or her watch, thinking about getting out of the office. The key in situations like these is speed. So, now what I have started doing is taking a scan and obtaining a color digital impression in 3-D.

If I scan the patient, I can take the image of the lateral incisor, flip it and point out to the patient what I see that he or she cannot. The scan shows the crack. The patient would ask me to suggest treatment and I would recommend scheduling a crown. The patient would agree because it is such a convincing demonstration. We are helping patients to codiagnose.

So the scan serves to educate and, in a way, empower the patient?

The best patient is an educated patient, but the communication or educational process has to be quick and intuitive. It cannot entail capturing an image, loading it on to the computer, locating the image, etc. So now, rather than taking out the camera and iPad, I reach for the TRIOS. The idea of having a scanner in every room and having a hygienist pick up the scanner is becoming a reality in our practice.

Do you envision scanning being a routine part of a patient visit?

There is so much information that I can now see from looking at the enlarged scan. It is like looking through my loupes that give four and a half times the magnification. With a scan, I can expand the image on my screen to be as large as I like.

Basically, I can imagine us using a scanner for not just some patients, but EVERY patient. I definitely see a day when we scan each patient as part of our routine.

Do you think that one day decisions on treatment could be made by just reviewing digital scans?

Do you mean do I imagine a day when I could be sitting in my beach house in the Bahamas leafing through scans on my laptop? It would be nice, but it will not happen because so much of our success is based on relationships and personal contact.

So the scan serves to educate and, in a way, empower the patient?

Dr. Jonathan L. Ferencz is a diplomate of the American Board of Prosthodontics and Clinical Professor of Prosthodontics and Occlusion in the Department of Prosthodontics at the New York University College of Dentistry, where he has taught since 1972. He is also Adjunct Professor of Restorative Dentistry at the University of Pennsylvania School of Dental Medicine.
New VCONCEPT by MIS delivers true innovation to implant dentistry

MIS Implants Technologies recently launched the new V3, a multi-use implant suitable for a wide range of surgical scenarios that is part of the company’s VCONCEPT. “MIS Implants is now a frontrunner of innovation in implant dentistry”—this was the powerful message delivered by MIS at the product launch at EuroPerio8 in London.

“The V3 is set to change the future by offering unprecedented biological advancements not previously known in the dental implants industry—specifically, the significant gain of bone- and soft-tissue volume where it matters most,” said Elad Ginat, Product Manager at MIS Implants Technologies.

He pointed out that this claim is supported by the placement of over 2,000 V3 implants in clinical cases performed and reported by some of implant dentistry’s most highly respected experts. The cases date back to 2012 and were treated in collaboration with numerous well-respected research institutes and universities around the world.

“The triangular coronal portion of the V3 is completely new in concept,” said Ginat. Its unique shape allows the formation of gaps between the sides of the implant and the osteotomy, creating open, compression-free zones that immediately fill with blood to form a stable blood clot and accelerating osseointegration for more rapid bone regeneration, he explained.

The triangular shape further allows secure anchorage at three points and provides doctors with more flexibility in positioning the implant, either facing the flat side buccally or towards an adjacent implant as needed, to gain more bone. It is important to note that a wider V3 implant can be used in clinical situations in which a traditional circular implant would require a smaller diameter.

“It’s all part of the innovative VCONCEPT, as a three-point universal approach to implant dentistry,” stated Ginat. The first point is the innovative V3 implant itself that comes with a single-use final drill for an exact osteotomy, shaped to provide optimal primary stability in all bone types. The triangular head of the implant reduces cortical bone compression without compromising crestal anchorage.

The second point is aesthetics. The extra bone volume affects soft-tissue volume, which is further enhanced by the tulip-shaped prosthetic components, realising sustainable and healthy results. With more bone and soft tissue to work with from the start, clinicians can attain much higher aesthetic outcomes and reduced healing times.

The third point is simplicity, part of the MIS “Make it Simple” philosophy. Doctors can enjoy all the impressive VCONCEPT benefits of greater bone- and soft-tissue volume without learning new protocols or procedures. In addition, a dedicated V3 surgical kit makes procedures simple, safe and accurate.

“The VCONCEPT is an innovation MIS is very proud of, especially since it directly benefits our customers. It helps dental professionals all over the world simplify procedures, improve success rates, reduce chair time and achieve better aesthetic results,” he concluded.
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The power of Planmeca FIT

The open Planmeca FIT system for chairside CAD/CAM provides dental clinics with a completely digital workflow. It seamlessly integrates intraoral scanning, 3-D designing and chairside milling into one system, allowing clinics to treat patients in a single appointment. Planmeca FIT offers all the necessary tools for designing perfectly fitting restorations within the first patient visit.

The Planmeca FIT system is comprised of three integrated steps—precise intraoral scanning, sophisticated 3-D designing, and efficient chairside milling. The powerful system combines all workflow phases under one software platform, enabling seamless access to all imaging and CAD/CAM work through the same interface.

The accurate Planmeca PlanScan intraoral scanner can be integrated with any digital Planmeca dental unit. It can be used just like any other instrument and easily shared between different users. The scanner is conveniently controlled from a wireless dental unit foot control, leaving the user’s hands free for scanning and patient treatment at all times. Live scanning data can be constantly accessed from a dental unit’s tablet device, while sound guidance further ensures optimal data capture.

The Planmeca PlanCAD Easy design software is ideal for a wide range of prosthetics planning. It provides the perfect tools for sophisticated 3-D designing at dental clinics, ensuring the precise placement of restorations. Completed designs can either be sent to a lab in an open STL file format, or manufactured on-site with the Planmeca PlanMill 40 milling unit. Packed with refined power, the unit produces restorations from a large selection of materials, exactly according to the design.

All steps of the Planmeca FIT workflow are easily controlled and accessed through the Planmeca Romexis software platform. The brains behind the Planmeca ecosystem, Planmeca Romexis assures that the Planmeca FIT system always runs seamlessly. In addition, the software provides remote real-time usage information on the Planmeca PlanMill 40 milling unit, allowing clinics to locate resources and monitor ongoing milling processes.

Planmeca FIT is a completely streamlined and integrated approach to high-quality dental care. It helps clinics utilise their resources to the fullest and treat more patients in a shorter period of time. Instead of two visits, patients can be treated in one hour—without requiring temporary crowns or physical dental models.

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