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Aesthetic Digital Smile Design

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Quest for the perfect restoration

_CAD/CAM_ dental restorations were introduced nearly 30 years ago. It is beyond doubt that this introduction marked an extremely important milestone in our endeavour to achieve the perfect restoration.

Restoring damaged or missing teeth has always been a tough challenge, since ancient Egyptians until the present time. Rapid developments in the field of CAD/CAM systems in the last decade are bringing us ever closer to our goal. Currently, a digital workflow can be implemented with great confidence. Scanners, milling units and 3-D printers are becoming precise to the extent that results can be achieved almost to within the micron.

Although our restorations offer our patients a wide range of benefits, they do not come without disadvantages. More often than not, part of the remaining healthy tooth structure must be sacrificed to accommodate and retain the restoration. Furthermore, regardless of the method of fabrication, whether direct or indirect, the dental materials used usually exhibit dimensional and structural changes during the process, leading to an array of problems.

For perfect results, it is essential to standardise the procedures in fabricating a restoration. Manual fabrication involves numerous errors that are nothing but part of human nature. The human eyes and hands are not predictable in measuring and evaluating dimensions, angles, spaces, and all other calculations needed to achieve a satisfactory result. Computers are, beyond doubt, far superior to humans in determining such critical parameters.

Utilising now very advanced CAD software, we are able to come up with almost perfect restoration designs. CAM software is following suit. What we see on the screen is often what the milling unit or 3-D printer produces. It is the obligation of every one of us to join this fast-moving industry. We owe it to our patients, as well as to ourselves, to become acquainted with and put to use all available technology to offer the best possible treatment.

I believe that digital and CAD/CAM restorations are taking over in setting the standards for dental restorations. They are precise, predictable and much easier to produce. We are certainly coming closer to our goal. The perfect restoration appears to be just around the corner.

In this issue of the _CAD/CAM_ magazine, you will find various clinical articles describing the use of CAD/CAM and 3-D technologies, from digital smile design to guided surgery.

I wish you a pleasant and informative read,

Dr Munir Silwadi
Specialist in Prosthodontics, Implantology and CAD/CAM dentistry
Member of the Royal College of Dental Surgeons of Ontario, Canada
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Aesthetic Digital Smile Design: Software-aided aesthetic dentistry—Part I

Author: Dr Valerio Bini, Italy

**Introduction**

The concept of aesthetics has been explored by various authors and discussed by eminent philosophers. While their definitions are subjective, they all agree on the natural origin of the term. For this reason, I believe that the real objective of aesthetic dentistry must be imitating nature, which is so simple to perceive yet so difficult to copy, particularly as regards the aesthetics of the lower third of the face. The skill and visual perception of the dental team are essential in pursuing this goal, and the dentist acts as architect and artisan of the oral and periodontal tissue by moulding the physiology of the smile.

**Smile designer: A new means of communication**

Dental surgery is increasingly being forced to adopt a multidisciplinary approach to treating the face and smile, in which the dentist plays an influential if not primary role. A balance between the teeth, inter-oral and perioral tissue, face, smile and person creates an aesthetic ideal, and synergises the artistic capacities and the expertise necessary to see the design in the context of the face. Today aesthetics is increasingly linked to measure, proportion and symmetry, which were all already present in ancient civilisations but today have been considerably perfected by the digital age. Modern scientific knowledge puts at the disposal of professionals various therapeutic options. This along with collaboration between different specialists (orthodontists, implantologists, periodontologists, dental technicians, maxillofacial surgeons, plastic and cosmetic surgeons) and the above-mentioned goal enable a treatment plan to be...
developed with ever-greater precision (Fig. 1). Furthermore, images captured at locations far away and viewed via video conferencing using Skype, for example, give the dentist the role of the conductor of an orchestra and provide him or her with a new way of working together with other professionals.

Digital dentistry requires that one follow precise protocols in order to obtain a standard, predictable result that corresponds to an optimal clinical result (virtual planning) in an ergonomic manner and with a high level of quality. Today, the use of 2-D and 3-D software for photograph editing and digital image editing allows us to process data and customise parameters for each specific clinical and aesthetic requirement of the smile makeover. Modern digital technology along with the experience and aesthetic sensitiveness of the dentist, which are fundamental to the success of smile design, offers greater predictability for the patient, as regards both the final aesthetic results and the course of therapy agreed upon.

Figs. 4a–d: Front view and lateral views at 45 and 90 degrees.

Fig. 5a: Face Analogic Transfer Support.

Fig. 5b: Transfer of analogue measurements to digital caliper.
The combination of terms such as “aesthetic dentistry”, “interdisciplinary vision”, “digital dentistry” and “predictability” led me to consider that today a new professional figure might be created: the smile designer, whose fundamental role would be communicating with the patient and the aesthetics medical team, whose members are crucial in virtual planning.

My ideal would be to have at my disposal a single instrument that would serve the purpose of the smile designer.

Using various software platforms, I have pursued the development of a protocol for Aesthetic Digital Smile Design (ADSD) to be used alongside other important diagnostic elements useful for diagnosis and prognosis, ultimately to improve the health and well-being of the patient. Furthermore, it is advisable to obtain prior consent regarding the aesthetic treatment to be undertaken using real clinical models, such as a mock-up, since this is also a predictable method of simulating the aesthetic treatment plan. It is useful to recall here the forensic dentistry provides that the dentist is obliged to comply with three fundamental principles in carrying out his or her profession: prudence, diligence and technical expertise.

**ADSD method and protocol**

Further to what has been said above, ADSD should first be an instrument to improve communication with the patient by showing the patient detailed images. On the monitor, the before and after photographs allow an index of predictability and point of comparison with the patient himself or herself. A milestone is the innovation of aesthetic clinical planning in aesthetic dentistry and prosthetic dentistry relating to dental technical analysis and planning, which, among other things, can be integrated into diagnosis and planning for plastic and maxillofacial surgery (Fig. 2).

The protocol first requires the acquisition of full-frame digital images and videos of the patient. Video especially is capable of capturing the dynamic phases of the smile linked to its physiology (mimicry, phonetics, relationship between the teeth and lips). Importing this vital data into the digital clinical file of the patient is complementary to the anamnesis because it is an integral part of the intra- and extroral objective examination, and will subsequently be the subject of aesthetic analysis according to the main guiding principles. Therefore, we could define this as the third part of the methodology, which we will call analytical processing, during which the aesthetic composition of the smile, the determining morphological features of the face and smile, including the fundamental points of reference to be...
obtained from software such as face makers, will be mapped and processed.

The next phase in digital data processing is virtual planning by means of digital image editing: wax-up, digital and analogue diagnosis, mock-up, and provisional and definitive restorations. The digital methodology used for photograph and image editing is very reliable, especially in communicating through images the ongoing clinical case to dental laboratories concerning functional and morphological adjustments, which is made even easier if accompanied by explanations and verbal comments. Compatibility with other digital systems is very important, for example being able to implement ADSD in digital orthodontic simulations, digitalisation of casts, CAD/CAM, etc., thus adding to the methodology.

**Acquisition and import of digital images**

As stated earlier, the first phase of ADSD entails the acquisition and import of photographs of the patient. If possible, these photographs should be taken with a digital SLR camera with semi-professional features and with a good illumination system (nowadays there are a number of basic dental photography courses and books available dealing with this fascinating subject). We must remember that in the analytical phase the photograph is a clinical and aesthetic diagnostic element that will form part of the patient’s clinical history, which can be consulted by other specialists to establish an interdisciplinary vision. In view of this, the dentist/photographer must capture the photographs with the patient’s head in a position that can be replicated in the future to verify topography in relation to smile design. The
most reliable position in which to photograph the patient's face is that relative to the aesthetic plan (Fig. 3), that is the plane perpendicular (frontal) to the plane that runs at the centre of the angle formed between the Frankfort horizontal plane and Camper's plane. The same position must be projected orthogonally at 45 and 90 degrees (Figs. 4a–d) because photographs of the profile are of great importance in the aesthetic dental and facial analysis of the profile in relation to occlusal class, the relationship between the lips, and aesthetic angles, according to studies in orthodontics, maxillofacial surgery and cosmetic plastic surgery.

ADSD imports the measurements of the photographed subject standardised and configured to the scale of values expressed in pixels, the ordinary unit of measurement of a digital photograph. In order to do this, it is possible to use technical drawing tools, such as set squares and rulers (made of metal if possible and thus easily cleaned and capable of being sterilised, or other similar material). I have personally built a measuring tool called Face Analogic Transfer Support (Fig. 5a), which consists of a ruler with graduated millimetre and centimetre scales, which the patient can wear like a pair of glasses. Furthermore, for new photographs for the fabrication of mock-ups and PMMA models etc., it is useful to use a device such as a craniostat fixed to the headrest, which is integrated into our dental chair. If more accurate and detailed measurements of the teeth and gingival parameters are required, one can use digital callipers whose tips are placed at the cervical margin and incisal edge (the length of the tooth) or at the mesial and distal margins relative to the dental line (width of the tooth; Fig. 5b). These measurements when transmitted can be very effective in communication between the dentist and dental technician, whose manufacturing skills and expertise will be the most important to the end-result of this innovative method (Fig. 5c). It is necessary to bear in mind that the measurements expressed in millimetres in relation to the digital image produced by the digital processing, as well as the design of the dental contours, are not of much interest to patients, who desire a photograph of the first phase simulation, but
the measurements represented as 3-D wax models and mock-ups tried in and analysed in the patient’s mouth will give you an idea of the delicate psycho-aesthetic approach to the clinical case very important for aesthetic dentistry.

**Aesthetic analysis of a face and a smile**

In relation to the manner in which to portray the patient in a photograph, we should reflect on the aesthetic component of the face and the smile. For the objective aesthetic analysis, the focal length is modified, starting from the first photograph (Fig. 6). For this parameter, the following classification criteria could be applied:

- macro-aesthetics (extra-oral analysis of the face);
- mini-aesthetics (extra-oral analysis of the mouth);
- micro-aesthetics (intra-oral analysis of teeth and gingiva).

As regards the aesthetic analysis of the smile, the specific areas of the objective analysis that are pertinent to dentistry are as follows, based on that provided by a number of many authors:

- **Facial analysis:** Frontal/lateral, determining morphological features, horizontal/vertical reference lines, vertical/horizontal facial proportions, golden ratio, horizontal/vertical dimensions, analysis of the facial profile, and analysis of the lips, nose and eyes as regards position and size (Fig. 7).
- **Dental analysis:** Dental composition, dental arrangement and position, dimensions, proportions, shapes, contours, margins, textures, surfaces, axial inclinations, inter-incisal angles, interproximal contacts and colour (Fig. 8).
- **Dento-labial analysis:** Labial dynamics, smile line, width of smile, labial corridors, occlusal plane, mid-line, and inter-incisal and commissural lines (Fig. 9).
- **Phonetic analysis:** This is complementary to the dento-labial analysis and involves the recording...
special digital smile design

of the phonetics with particular attention to consonants and their combinations. In addition, the analysis of the phonemes "/m/" and "/l/" (sometimes also the phoneme "/n/"") is of great importance for detecting and determining the position of the lips and the maxillary incisors relative to the age and sex of the subject being analysed. Furthermore, it is important to bear in mind the extent to which the central incisors are the visual focal point of the smile architecture.

Gingival analysis: Architecture, shape parallelism, symmetry, zenith, papillae, biotype and colour (Fig. 10).

In general, it can be stated that considering all of these very important values and parameters in detail requires comprehensive planning and competence that cannot be contained in only a few lines. These have been scientifically established by a number of authors and further information can be found in books and scientific articles.

Dental digital image editing

Digital image editing can be performed in various ways (Fig. 2) according to the requirements of the smile designer and with various software packages (both freeware and for purchase) easily obtained from the Web. Their main use includes generic image and photoproduction for both amateur and professional graphic designers. Some of the packages available have been developed by dentists. An important contribution to these packages is offered by some authors, who through the use of Keynote (a presentation application developed by Apple for Mac OS X and iOS) have made smile design easier with results that provide a schematised dental design with real outlines.

In addition to Digital Dental Design (Figs. 11a & b), ADSD offers important processing functions: the import, conversion and editing of dental shapes and types of dentition in the form of real images. In order to carry out these important functions, it is necessary to create a real dental library, which we shall call the Digital Dental Photos Database (DDPD). This might include:

Dental shape library, which might be the best form of database, in which five types of dentition could be captured relative to anatomical form and possibly colour according to the quality and amount of light in the photograph as observed by the operator. The photographs of the teeth in this library should be taken at a frontal projection, and at 45 and 90 degrees laterally, that is a profile, so that they can be

Figs. 14a–c. DDID, vectorial deformation of the length of teeth.
Figs. 15a–e. DDID applied to teeth 12, 11, 21 and 22.
incorporated into the photographs and images of
the patient in ADSD. The dental shapes contained
in the library must correspond to nature itself, such
as triangular, oval or rectangular with variables,
like square or trapezoidal (Fig. 13f).
Libraries of dentition containing aligned and aesthetically ideal complete mouths: There are some
libraries, such as that of Digident, in which the teeth
are already preformed according to the morphology
of the incisal edges (flat, square and round).
Personal case reports database, that is the collection
of our clinical cases concerning the fabrication of
prostheses, aesthetic dentistry, virtual wax-ups,
mock-ups and the healthy dentition of patients
(with their permission). Dental technicians in lab-
oratories could also exchange data thanks to the
goodwill of colleagues who supply them with im-
ages. An ADSD images community would be of
great scientific advantage. This library should con-
sist of images of complete and partial dental arches
eight anterior teeth, six anterior teeth). These might
be single maxillary arches, the primary object of
smile design, or maxillary and mandibular arches
with normal occlusion (useful for partially or totally
edentulous patients). The images might also contain
the gingiva according to photographic requirements;
indeed, they may be integrated as a whole into the
virtual oral cavity or else one might isolate single
teeth (Fig. 12) in order to be able to adapt them
according to shape, alignment, emergence, ideal con-
tour and contact points respecting the aesthetics.
Dental libraries of removable prostheses: These are
available on the Web from leading companies in the
industry, such as Ivoclar Vivadent, Heraeus Kulzer
and Candulor.
Smile library, consisting of photographs with faces
of models smiling, which can be useful if in high
resolution. The teeth can be selected and extra-
polated from the face of the subject, generally
photographed by professional photographers. These
images can be downloaded from stock photography
sites at a fee (such as 123RF.com, Fotolia.com, Shutterstock.com
and Fotosearch.com).

Another very important feature
of this method of smile design is
Digital Dental Image Distortion
(DDID; Figs. 13a–f), which allows
the modification of the morphol-
ogy of the teeth to be processed.
This function is of great utility for
the formation of the teeth in the
DDPD. It must be applied to length
and width (Figs. 14a–c), as well as
in every direction both along the
contours and on the dental sur-
faces, and especially along the lines
of transition. This processing is of-
ten very useful for light reflected
on the dental surfaces characterised
by micro- and macro-textures, and
is effective in the analysis and pro-
cessing of the interproximal con-
tact points and inter-incisal angles.
Moreover, it is effective in the
morphological classification of the
incisal edges, transitional lines, etc.,
often reference points specific to
the age, sex and personality of the
patient (morphopsychology). From
my point of view, this part of dental
digital image editing is the most
important because it is not possible
to give a prefabricated smile to a
patient; while such a smile might
be made up of teeth that are in
themselves perfect, it is necessary to
know how to modify, model, shape,
deform, increase, diminish or elimi-
nate everything in contrast with the
harmony of form (Figs. 15a–e).
In many aesthetic clinical cases, it is useful to perform Digital Dental Calibrated Transposition (DDCT), a transposition of the teeth necessary for the simulation of orthodontic movements, some of which apply to the situation prior to aesthetic treatment, prosthetic treatment, implants, etc. (Figs. 16a & b). The transposition must be calibrated, that is must move the teeth into the desired position and maintain the measurements and anatomical dimensions. This makes it easier to calculate more predictably the future dental composition, not only aesthetically but also functionally, as well as the relative spacing (mesialisation/distalisation) necessary for the insertion of the prosthetic implant. It gives important feedback for the implantologist, prosthetist and orthodontist, with all of whom it is necessary to communicate radiological findings (DICOM and Tac3D—the latter is compatible with ADSD). Only after having decided on the final positioning of the teeth can the smile designer pay greater attention to the improvement of the aesthetic aspects by further modifying the images with DDID. The same is true for the integration of the orthodontic simulation data from sophisticated applications such as ClinCheck (Align Technology), which can be implemented in the virtual planning towards an integrated aesthetic and prosthetic solution to an orthodontic problem (Figs. 17a–d).

Editorial note: This is the first of a two-part article based on a paper presented by Dr Valerio Bini to the 15th International Congress of Aesthetic Medicine in Milan in October 2013 during the session titled “Aesthetic dental surgery of the lower third of the face”. Part II of the article will appear in CAD/CAM 2/2014.

Valerio Bini, DDS, graduated from the University of Genoa in Italy. He is a specialist in prosthodontics and aesthetic dentistry. He has presented papers at international conferences on aesthetic dentistry and aesthetic medicine, and is the author of many articles published in national and international journals. Dr Bini is a member of the European Society of Cosmetic Dentistry, a fellow of Società Italiana di Estetica Dentale (Italian society of aesthetic dentistry) and a fellow of the Italian Academy of Esthetic Dentistry. He is Invisalign certified. Dr Bini may be contacted at info@studio-bini.com.

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**Special Digital Smile Design**

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**About the Author**

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“Take CAD/CAM to the next level”

Planmeca’s vice-president on the company’s strategic investment in E4D Technologies

_Finnish dental technology manufacturer_ Planmeca has recently made a significant equity investment in the US-based high-tech medical device company E4D Technologies. In this interview, vice-president at the Planmeca Group and acting CEO for E4D Technologies Tuomas Lokki sheds light on this new venture.

_CAD/CAM: Mr Lokki, why did Planmeca choose to invest in E4D Technologies?
We believe in the tremendous possibilities and future growth of CAD/CAM dentistry. As dentistry will be completely digital in the future, we believe it is vital to invest in the development of new and efficient practices. E4D is a long-term leader in advancing modern CAD/CAM dentistry, so we knew that joining forces with this high-tech medical device company would be a valuable addition to our own leading expertise in 3-D imaging and software solutions. Their special expertise and innovative ideas provide a great foundation for future projects that will combine the know-how of both companies.

_Can you also tell us about the brand new intra-oral scanner that you launched recently?
Our new Planmeca PlanScan intra-oral scanner is an ultra-fast, powder-free and open solution for 3-D digital impressions. Its advanced blue laser technology accurately captures hard and soft tissue of various translucencies, dental restorations, models and impressions. It is the world’s first dental unit-integrated intra-oral scanner and can be used through a laptop as a standalone version. Together with our Planmeca Romexis software, the system supports an ideal digital treatment workflow.

_How will both Planmeca and E4D benefit from this investment?
On the one hand, this investment strengthens Planmeca’s position in the fast-growing CAD/CAM business and Planmeca benefits from E4D’s cutting-edge solutions and long-term CAD/CAM expertise. On the other hand, Planmeca’s extensive distribution network enables E4D Technologies to grow globally and our leading dental imaging solutions will be a valuable addition to the E4D CAD/CAM platform.

_Have this venture created any new needs for your company?
Definitely, as we need to provide extensive CAD/CAM training for our distribution and customer network in over 120 countries. Therefore, we have recently invested in new training, warehouse and production facilities alongside our Helsinki headquarters. These new 10,000 sqm facilities will help us address the growing need for training and education in this new field of dentistry.

We are thrilled to be able to take CAD/CAM to the next level. Our innovations will change the concept of same-day dentistry completely and facilitate the workflow of dental professionals worldwide.

Thank you very much for the interview._
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Utilisation of patient-specific CAD/CAM abutments for long-term soft-tissue management

Authors: Drs Julian Osorio & Robert B. Kerstein, USA

The traditional approach to soft-tissue contouring of an implant-supported restoration is to initially shape the surrounding peri-implant soft tissue of an edentulous site with hand-prepared stock healing abutments, which are later replaced with a custom abutment and final crown, both of which are designed to fit into the space and form created by the stock abutment. However, with the continued advancement of both 3-D imaging and digital abutment design technology, the final abutment can act as both a link between the implant and the crown, and as a tissue shaper that contributes directly to the final surrounding soft-tissue contours. This greatly aids the clinician in obtaining the desired aesthetic outcome.

Regardless of implant or healing cap diameter, the peri-implant sulcus shape often requires additional modelling to obtain more natural and optimised final restoration aesthetics. Traditional methods of tissue contouring include the use of temporary restorations to form the desired soft-tissue anatomy. Provisionals can be retained by bonding them to neighbouring teeth with properly shaped pontic contours that apply pressure to the peri-implant tissue in order to shape the tissue covering the implant.1, 2 An alternative method is to use abutments that support overcontoured provisional crowns, which push out the peri-implant tissue as it heals.3–5 When the tissue matures around these types of provisionals, it takes on the shape of the gingival portion of the tooth, pontic, or temporary crown. The abutment and final crown are then fabricated to match the tissue contours.

A more efficient alternative to the traditional method for soft-tissue management is to employ patient-specific abutments that can effectively provide ideal anatomical formation of the soft tissue. These abutments can be designed with the desired specific profile that passively fills the healing cap-shaped sulcus from the top of the implant up to the sub-crestal tissue, and then expands just below the abutment shoulder region to the dimensions and contour of the tooth to be replaced. The lateral pressure applied induces the peri-implant sulcular tissue to stretch and adopt the abutment’s outer morphology as the shape of the sulcular inner wall.

At insertion, the seating of a larger, more anatomical abutment design results in significant tissue blanching when the tissue is stretched. However, the blanching generally resolves within one to two days after abutment placement. Multiple clinical trials utilising large anatomical abut-
ments followed since 2008 have found that healthy tissue that is absent of inflammation quickly forms as the tissue adapts to the abutment’s base shape. Additionally, over that same two- to three-year period of clinical observation, during which multiple cases of abutment-controlled peri-implant sulcular stretching were monitored, no significant recession around these abutments was noted.

Several important clinical prerequisites should be met when sulcular stretching of the peri-implant tissue using fully anatomical patient-specific abutments is attempted, including the following:

- Any required tissue grafting, bone grafting or ridge distraction should be performed and the area fully healed.
- The top of the implant should be located at least 2.5 mm below the soft-tissue crest, and in the middle or lingual third of the ridge crest.
- The edentulous ridge should be well-formed with a crestal height comparable to the gingival margin heights of the neighbouring teeth.
- The peri-implant sulcus should be significantly smaller than the tooth to be replaced.

**Case presentation**

The patient presented with a fractured maxillary left lateral incisor in need of extraction (Figs. 1–3).

After several months of healing, an impression was taken (Figs. 4 & 5), and sent to the laboratory with a prescription for the fabrication of an ATLANTIS patient-specific abutment in zirconia (DENTSPLY Implants; Fig. 6). The abutment was anatomically designed based on the desired final tooth shape to optimise both function and aesthetics (Fig. 7).

In order to seat an anatomical patient-specific abutment properly, the cover screw is retrieved and any loose granulation tissue found within the sulcus is curetted away (Fig. 8). The peri-implant sulcus is anesthetised circumferentially to minimise the patient discomfort resulting from the pressure the oversized abutment will apply to the soft tissue when it is screwed into place. If epinephrine is used, the peri-implant tissue will likely blanch from vasoconstriction.

Fig. 4. Six months after hard- and soft-tissue graft procedures, the patient returned for the final impression.
Fig. 5. A radiograph taken to verify proper seating of the transfer impression coping.
Fig. 6. The impression and case materials were sent to the dental laboratory with a request for an ATLANTIS zirconia abutment.
Fig. 7. Fabrication of the final crown.
Fig. 8. The patient returned for placement of the final abutment and crown.
Fig. 9. The fully anatomical abutment was seated to manage and shape the soft tissue. Initial blanching of the surrounding tissue was observed.
The abutment is then set into the implant, aligned properly, held down firmly into place, and the abutment screw is then torqued according to the manufacturer’s guidelines. During the screwing-in process, the anatomical abutment will compress and blanch the surrounding soft tissue (Figs. 9 & 10). Proper seating should be radiographically verified to ensure no soft tissue is trapped underneath the abutment that would keep the abutment from sealing fully with the top of the implant.

When using ATLANTIS patient-specific abutments, a final crown can often be placed during the same appointment in which the abutment is inserted. The final crown can be fabricated before the patient appointment by ordering an identical duplicate abutment made from the same digital abutment file used in designing the intra-oral abutment. The duplicate is an exact master die upon which the final crown can be constructed. It is our clinical observation that at routine follow-up of these stretched-sulcus anatomical abutment cases, a consistent healthy soft-tissue response is visible, with stable maintenance of the hard- and soft-tissue contours over time (Figs. 11 & 12).

**Conclusion**

The utilisation of ATLANTIS patient-specific CAD/CAM abutments can help eliminate the need for prefabricated soft-tissue healing abutments, while providing natural anatomical and optimal aesthetic implant-supported restorative results. Patient-specific abutments with a specific sub-shoulder design and an emergence profile customised to the particular implant placement and site can be utilised to stretch a small, round peri-implant sulcus outwards and induce it to adopt the shape of the abutment, such that both the tissue and final crown contours appear natural.

With this technique, blanching of the soft tissue at the time of abutment placement is common but has minimal impact on the long-term marginal hard- and soft-tissue health, especially when used in combination with an internal conical connection implant.

Lastly, the use of patient-specific abutments both for soft-tissue sculpting and as the permanent abutment solution has significant clinical advantages over the traditional approach, including simplifying tissue contouring around dental implants for the restorative clinician, and reducing the number of procedures and procedural discomfort, and faster healing time for the patient.

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

**Fig. 10** Approximately 30 minutes after the final restoration was in place, the blanching was already significantly reduced.

**Fig. 11** A radiograph of the abutment.

**Fig. 12** The lingual view after placement of the final abutment and crown.

**Fig. 13** Seven months post-implant placement and two weeks after placement of the final abutment and crown, a continued healthy tissue response could be seen.

**Fig. 14** The follow-up at two and a half years showed maintained healthy soft tissue.
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CAD/CAM fixed prosthetics: A case report

Author_Tero Rakkolainen, Finland

CAD/CAM fixed prosthetic implant restorations raise many questions among dental technicians. Unfortunately, if a technician is not familiar with CAD/CAM technology, he or she might have many misconceptions about it. The design and manufacture of fixed prosthetics still requires the professional skills of an experienced technician. Without input, clicking a button on a computer does nothing. This case report demonstrates the multiple phases and challenges of dental technology work even when CAD/CAM technology is used in design and manufacture.

A middle-aged male patient had an old fibre-reinforced anterior bridge. The abutment teeth of the old bridge had severe caries and the structures of the bridge had reached the end of their lifespan. The bridge was removed. Dr Juha-Pekka Lyytikä (Hammas-Pulssi dental clinic) extracted the teeth that could not be saved and placed three XIVE implants (Ø 3.8 mm; DENTSPLY Implants) in positions 14, 12 and 22. When the healing period was over, the construction of the final prosthetic restoration began.

The implants and healing abutments were in place (Fig. 1) and, since the position and direction of the implants were optimal, screw-retained zirconia structures were chosen. Being able to detach screw-retained bridges and crowns when necessary offers significant benefits for both the patient and the entire dental team. Zirconia abutment bridges and crowns are usually very well tolerated by patients and can be cleaned easily, which is a critical factor in the retention of bone and gingival volume.

The work models were fixed in the articulator before the work was started in the laboratory (Fig. 2). It is not necessary to divide the work model into...
sections when using the 3Shape scanner for implants. A normal gingival mask and high-quality plaster models are sufficient.

The starting point for CAD/CAM work is a carefully filled out order form in a software program (Fig. 3). The order form specifies the work in question and the material to be used for manufacture. The form also specifies the milling centre to be used for manufacture, as well as the abutment library to be used. Moreover, the order form links specific design parameters to the work in question.

Next scanning abutments (Turun Teknohammas) were fixed on the model with screws (Fig. 4). This ensured that the position of the implants remained precise during the entire process. The scanning abutments on the model defined the position of the implants in 3-D space. The software compares the scanning results to the files in the abutment library (Fig. 5).

The complete CAD work model with scanning abutments and a separate gingival mask scan was shown on the screen (Fig. 6). The opposing arch was also scanned (Fig. 7). The work model and opposing arch scan are combined at the end of the scanning phase (Fig. 8). At this stage, it is possible to remove unnecessary data from the scans, such as the base of the plaster model.

Next, the software closes the scan and opens the 3Shape Dental Designer program. This software program places the basic units in the correct places (Fig. 9). It also offers many tools for editing the results.

The preparation limit of the abutments can be configured by dragging the dots to the desired location (Fig. 10). This is where you can also change the shape of the subgingival parts of the abutment to, for example, offer support or make more room, depending on the type and volume of the gingiva.

The virtual articulator in Dental Designer. Fig. 11. The completed bridge ready to be sent for milling. Fig. 12. The complete abutment, combining the anatomy from the library files and the created plan. Fig. 13. A zirconia block. Fig. 15. The complete zirconia abutment sits completely passively on the model.
Dental Designer uses a virtual articulator (Fig. 11). The virtual articulator mimics movements the same way as a real articulator does. In addition, you can use the colour-marking feature to detect contact areas. Movements can be simulated automatically or by moving the mouse.

The software also contains preset values for configuring, for example, the strength of pontics and alerts the user if these pre-sets are changed. Figure 12 shows a completed bridge ready to be sent for milling and Figure 13 the complete abutment, combining the anatomy from the library files and the created plan.

The fact that today we can mill custom-made abutments and screw-retained bridges from zirconia is the result of a cross-disciplinary effort between dental technology and engineering. After years of hard work, we are now able to mill parts to tolerances of less than 5 µm. The milling of implant bridges requires a five-axis milling machine. The STL file generated by the CAD system is only one of the steps in creating the final product (Fig. 14).

The completed abutments accurately matched the design (Fig. 16). The veneering work was performed at the laboratory using conventional ceramic methods. The completed screw-retained bridge and the abutment on the model (Fig. 18), the screw-retained zirconia crown (Fig. 19), the completed work ready to be sent to the clinic (Fig. 20), and the final clinical photograph (Fig. 21).

The completed screw-retained bridge and the abutment were tried on the model (Fig. 18), as was the screw-retained zirconia crown (Fig. 19). Then the completed work was ready to be sent to the clinic (Fig. 20). Figure 21 shows the final clinical situation of the completed product, tightened to the desired torque.

The complete zirconia abutment sits completely passively on the model after correctly executed computer-aided design, milling and sintering (Fig. 15). As part of quality control, the completed abutment is test-tightened to the correct torque on the model. The flexural strength of carefully modified custom-made abutments can be up to twice as high as that of standard zirconia abutments. Stress tests conducted at the University of Turku strained the abutments at a 45-degree angle using up to 1,500 N of force.

The completed abutments accurately matched the design, including the opposing arch and the gingival margin. In this particular case, the abutments were coloured using regular colour (Fig. 16).

The veneering work was performed at Turun Teknottomas’s laboratory using conventional methods (Fig. 17). The ceramic used was IPS e.max (Ivoclar Vivadent) and the work was performed by Jaakko Siira, the technician in charge.

The completed screw-retained bridge and the abutment were tried on the model (Fig. 18), as was the screw-retained zirconia crown (Fig. 19). Then the completed work was ready to be sent to the clinic (Fig. 20). Figure 21 shows the final clinical situation of the completed product, tightened to the desired torque.

**_contact_**

**Tero Rakkolainen**
Käisyöläiskatu 7
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Rehabilitation of an atrophic mandible with 3-D planning

Authors: Drs. Rainer Fangmann & Lars Steinke, Germany

Introduction

Patients with fixed restorations in the form of large-span bridges often wish to retain a fixed solution, even if the distal bridge abutments have been lost. Yet prosthodontists advise a shift in treatment to a removable prosthesis. This is due to a lack of knowledge of current possibilities regarding bone augmentation and implantation. The argument that implant-borne (fixed) restorations promise quality of life, appeal and youthfulness is ignored. As a consequence, removable restorations are only partially accepted and result in patient dissatisfaction in the long term. The desire for permanent rehabilitation remains. The opportunity for immediate placement of an implant and, if necessary, augmentation of the posterior section of the mandible to address resorption is missed.

Initial situation

A 71-year-old female non-smoker in a good general and nutritional state presented with multiple prosthetic restorations in the maxillae, consisting of bridges and single crowns placed at different times. The mandible revealed an insufficient denture. Tooth 43 had been destroyed by caries under the crown and had a treated...
root canal (Fig. 1). The patient requested rehabilitation with a fixed prosthesis. As a result of years of wearing removable prostheses, the mandible revealed an atrophy pattern of resorption Class V–VI on the right and Cawood Class IV on the left.1

Procedure

Treatment planning

Bone augmentation with autologous material from the retromolar region/corpus of the respective sides and delayed implantation was discussed with the patient. She requested a preoperative 3-D image (Fig. 2) to clarify the necessity of augmentation. Three-dimensional planning with coDiagnostiX (Dental Wings) for implant placement and immediate restoration via Multi-Base Abutments (Straumann) was recommended after augmentation.

Surgical procedure

The patient requested general anaesthetic during bone augmentation. This was followed by the typical incision of the gingival margin and appropriate mesial and distal relieving incisions. Once the dimensions of the receiving site had been determined, the corresponding mandibular ramus and/or corpus site was selected.

After determining the dimensions and the morphology of the bone graft, the mono-cortical bone block was harvested from the donor site by piezo-surgery (Fig. 3). Using a SafeScrapper (Meta Advanced Medical Technology), this was thinned down extra-orally to a final thickness of 1 mm. The thinned block served as a biological membrane to stabilise the particulate bone material vestibularly and orally. First, a cortical lamella was fixed occlusally over the osteosynthesis retaining screws in gliding holes (Fig. 4). This lamella was lined with cortical chips.
soaked in autologous venous blood. In order to secure the graft, it was covered with a further lamella vestibularly, which was fixed with osteosynthesis retaining screws (Fig. 5).

This was followed by fully tightening the screws inserted into the gliding holes of the occlusal lamella to compress the particulate graft. This was followed by wound closure with sutures. On the left side, augmentation was performed by applying the tongue-in-groove technique (Figs. 6–8). Clindamycin 600 mg was administered as a short intravenous infusion and continued orally over six days. After coDiagnostiX planning (Figs. 9 & 10), the osteosynthesis retaining screws were removed after four months and the implants placed. Tooth 43, which had been destroyed by caries, was removed on the right. Immediate implantation was performed using a Straumann Bone Level implant (Ø 4.8 mm, L 12 mm).

Straumann Bone Level implants (Ø 4.1 mm, L 10 mm) were inserted in positions 44 and 46 (Fig. 11). On the left, three Straumann Bone Level implants were placed in position 33, a Straumann Bone Level implant made of Roxolid; Ø 3.3 mm, L 14 mm; in positions 34 and 35, Straumann Bone Level implants; Ø 4.1 mm, L 10 mm; Figs. 12–15). All implants had the SLActive surface specification.

Temporary immediate restoration

All implants were fitted with 0 degree Multi-Base Abutments with a gingiva height of 4 mm (Figs. 16 & 17). A Narrow CrossFit Connection Multi-Base Abutment (Ø 4.5 mm) was used for the Narrow CrossFit Connection Roxolid implant. The terminal implants were fitted with Regular CrossFit Connection Multi-Base Abutments (Ø 6.5 mm). Impression taking was performed with a foil technique tray (Fig. 18) with colour-coded impression components (Fig. 19).

The laboratory-made temporary prosthesis (Fig. 20) was screw retained occlusally via integrated temporary copings (Fig. 21). The screw channel was sealed with a foam pellet soaked in 0.1% chlorhexi-
dine gel and a light-curing composite. The temporary restoration remained in place for six months (Fig. 22).

**Final restoration**

The existing metal–ceramic veneer crowns in positions 32 to 42 were removed and the teeth prepared again. For impression taking, the impression posts were laboratory customised to correspond with the gingival emergence profile created by the Multi-Base Abutments. This was followed by a single-session, two-phase impression using the double-mix technique with a polyether impression material [11, 12] (Fig. 23) and corresponding colour and shade selection.

In order to continue support of the ideally shaped soft tissue (Figs. 24 & 25), a decision was made in favour of CAD/CAM customised abutments made of zirconium dioxide. The basal component of the future mesostructures was designed such that the gingiva would be supported optimally and create an ideal transition from the implant connection to the bridge contour. After a pronounced temporary break, one no longer needs to expect changes to the gingival margin.

Thus, the future crown margin was placed only 0.5 mm sub- and epigingivally. The wax model (Fig. 26) on auxiliary parts, which corresponded to the implant connection, was digitalised using the Straumann CARES Scan CS2 scanner. After data transmission, the fabrication of the individual abutments was performed in the Straumann milling centre. In order to ensure the required fit and the stability needed for the molar region, one-piece zirconium dioxide abutments (Figs. 27 & 28) [14, 15] were fabricated.

After a few days, the dental technician received the patient-specific abutment for further processing. In the next step, a zircon veneering framework (Straumann) was designed using CAD/CAM and fabricated after data transmission (Figs. 29 & 30). The zirconium dioxide abutments were inserted at a torque of 35 Ncm (Figs. 31 & 32).
The dental panoramic tomogram shows the situation 18 months after implantation (Fig. 33). The screw channels were filled with non-irritating PEMA16 in a trough-shaped final design. Then the final restorations were inserted (Fig. 34).

Conclusion

The safety of the surgical methods and the augmentation materials used was of the highest priority in the patient information and treatment. The decision was therefore in favour of the body’s own materials. This ruled out the risk of infection for the patient, as well as immunological rejection of the transplant. “In its cancellous form, autologous bone [...] is superior to all other bone substitutes with regard to its biological value, and is still considered [...] today to be the ‘gold standard’ among augmentation materials.”17 In addition, autologous bone is partially osteogenic and osteoconductive.18

When choosing the implant system, the focus was on the greater safety and better predictability in the early treatment phase with immediate loading. As a result, only an implant system with the SLActive surface was an option. Studies have proved 60 per cent more bone–implant contact19 with the SLActive surface after two weeks compared with the SLA surface.20 Immediate loading of Straumann SLActive implants achieves a survival rate in excess of 97 per cent after one year.21

Computer-aided, template-guided surgery via coDiagnostiX was used to place the implants. The procedure shows average horizontal deviations between the final and the planned position to 1 mm.22

Patients nowadays demand minimally invasive surgery, the shortest healing time possible and optimal aesthetic results. Clinicians, however, are not only looking to satisfy their patients’ expectations, but also to obtain predictable long-term results. Both demands can only be achieved through precise planning and appropriate execution with excellent teamwork, as well as an implant product portfolio that offers perfectly matched components, from 3-D planning to the final restoration._

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about the authors

Dr Rainer Fangmann obtained a Doctor of Medicine degree in 1991 and a Doctor of Dental Medicine degree in 1995 from the Hannover Medical School in Germany. In 1999, he was awarded recognition as a specialist in maxillofacial surgery and oral surgery. In 2004, he obtained a Master of Science degree in Implant Dentistry from Danube University Krems in Austria.

Since 2003, he has operated a joint dental practice specialising in oral and maxillofacial surgery and implantology with Dr Helena Fangmann in the Gesundheitszentrum St. Willehad in Wilhelmshaven, Germany. He is a speaker and the author of scientific articles.

Dr Lars Steinke has run his own practice with a focus on aesthetic dentistry in Schortens, Germany since 2004.
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Price pressure and competition are on the rise in the dental industry. In order to maintain their success in the future, manufacturers of dental products and services will have to rethink their current approaches and structures in sales and marketing, for instance.

Influenced by significant changes in the market, business expectations for the dental industry in Europe, for example, are cautiously positive, as leading dental manufacturers there anticipate single-digit revenue and profit growth for the next two years. Under these conditions, rising customer demand and highly innovative manufacturers, which will in turn drive growth from the supply side, are considered to be two main factors for growth.

Demand-driven industry growth has resulted primarily from stronger customer interest in cosmetic treatments and dental implants owing to higher patient awareness and the availability of treatments that are more affordable. The increasing number of qualified and specialised dentists who perform these types of treatments has further driven this growth. Moreover, manufacturers are experiencing higher demand for services and integrated solutions. The reason for this is the shifting service spectrum and higher demand for process optimisation in dental practices and laboratories. An increasing number of manufacturers are therefore seeking to differentiate themselves from competitors by extending their existing portfolio and offering integrated solutions to meet the changing demands of their customers.

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<td><strong>IT integration</strong></td>
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<td>* Higher efficiency in work processes and in cost-effectiveness of practices and labs</td>
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<td>* Greater use and integration of 3D scanners</td>
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)**Author**: Karin Laupheimer & Jan Bordon, Germany
According to leading dental manufacturers, product and service innovations in core competencies and related product areas (synergies) will also play a critical role in achieving sustainable business growth. Ongoing digitalisation in areas such as prosthetics, IT solutions to enhance process efficiency, and new materials are among the main areas of growth and innovation (Table I).

Increasing competition and constant price pressure

Despite solid market growth, businesses are expecting slightly stronger competition saddled with constant price pressure over the next three years. In particular, many regard the competitive pressure from wholesalers that develop and market their own brand and, to some extent, practise vertical integration as a crucial factor of the competitive dynamics in the dental industry.

Wholesalers with their own brands have continuously improved their position in the European dental materials market over the last few years. While they may have considerably lower market share compared with that of manufacturers of dental products, their growth rates are significantly higher than those of the rest of the industry.

Low-cost providers are another source of competitive pressure, especially those from non-European markets such as Asia. Their influence however will remain marginal for the time being owing to their inability to guarantee short turn-around order processing times and to their sometimes suboptimal product quality. As low-cost providers continuously improve their quality, manufacturers assume that the price level, especially for standard segments, will drop further.

Ongoing market price pressure will also be influenced by increased customer price sensitivity. Manufacturers expect stronger price pressure in market segments in which wholesalers offer their own brands than in other segments.

Supply and demand challenges

The market developments yield four primary challenges for manufacturers of dental products (Fig. 1), which require adaptations in their portfolio, as well as in their marketing and sales approaches.

On the supply side, the rising competition from wholesalers at product and service levels presents a considerable challenge. With regard to products, they offer their own brands, as well as an expanding product spectrum. They are also increasingly investing in developing integrated process solutions (IT/workflow integration), and offer sophisticated consulting services and training seminars, placing them in direct competition with manufacturers. While manufacturers are dependent on wholesalers as their main sales channel, they also want to distinguish themselves from them as far as possible. It comes down to creating a balance between efficient wholesaler management and the highest possible level of differentiation.

On the demand side, consolidation and integration of dental practices and laboratories (e.g. dentists joining laboratory chains or practice laboratories) pose new challenges for manufacturers. End-customers’ escalating cost pressure and market competition, but also their increasing levels of digital and international integration are undoubtedly responsible for these developments. In this context, manufacturers will have to deal with the growing negotiating power of providers and their increasing price sensitivity, making the battle over customers increasingly tougher.

Need for action

In order to compete successfully in a changing market environment, manufacturers of dental products have identified the need for action in four main areas (Fig. 2).

Rethink sales structures and push forward integration

Manufacturers of complex products and solutions (e.g. CAD/CAM and imaging) particularly are planning on introducing or strengthening direct sales structures to better meet the demand and supply-side challenges in the dental market. Forward integration, for example taking over laboratory or manufacturing services for dental practices, is another option for manufacturers in innovative product areas to address these challenges.
In market segments with comparatively low service and consulting effort, the wholesaler will retain its importance.

A trend towards direct sales, primarily via the Internet and e-mail, can still be observed in these segments.

Redefine customer segmentation and channel management

In order to adjust to the changing dental practice and laboratory environment, manufacturers are relying mostly on marketing and sales strategies tailored to customer types and needs. This involves, for example, segmenting customer types according to portfolio coverage and potential. It also involves developing innovative offer models that meet specific customer needs (e.g. partnership models and consulting services ensuring individual and targeted customer development). In this context, implementing structured key account management is regarded as another important success factor. Manufacturers that sell primarily through wholesalers are currently being confronted with the question of how to optimise their management of wholesalers, for instance in selecting, steering, developing and incentivising, plus pricing, and controlling cross-channel and cross-border activities.

Expand portfolios and develop solutions for customers

Manufacturers will continue to offer integrated solutions to stand out from competitors. In doing so, they will expand their portfolios from products to IT solutions and from product-related services to IT and process consulting services. Added purchases or co-operation will open up new opportunities here. At the heart of manufacturers’ portfolio strategy considerations are work processes that are more efficient, offering customers added value (e.g. guarantees regarding quality and reproducibility of results), differentiating from competition, reducing simple replaceability, as well as exploiting up-selling and cross-selling potential.

Improve value selling and value communication

Manufacturers are increasingly initiating qualification measures in marketing and sales with the aim of improving value selling and value communication. In parallel, they are developing a new way of thinking, moving from a traditional product sales approach to one that focuses on solutions for customers. Economic value drivers, for example total cost of ownership of integrated solutions versus the cost of individual products or demonstrating cost and time-savings in workflows, are gaining importance. In order to achieve this, manufacturers provide sales with better support by means of case studies and simulation tools.

Recognising what needs to be done and acting on it

Manufacturers of dental products are looking ahead with cautious optimism. In the next few years, they will continue to focus on innovation as their number one growth driver. At the same time, the industry is facing substantial changes in both supply and demand. While most companies already recognise what must be done to overcome these problems, many still lack significant progress in appropriately changing sales and marketing approaches. For sustainable success in the dental industry, it is now time for manufacturers to proactively address growing competitive pressure, increasing customer consolidation and changing customer needs with smart portfolios, sales and price strategies, as well as effective organisational changes.

about the authors

Karin Laupheimer is a director in the Medical Technology Competence Center of global marketing and strategy consultancy Simon-Kucher & Partners. She can be contacted at karin.laupheimer@simon-kucher.com.

Jan Bordon is a senior consultant in Simon-Kucher & Partners’ Medical Technology Competence Center. He specialises in the dental industry.
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The dental implant market, from its clinical and laboratory procedures to its business models, is evolving rapidly. Digitalisation and prosthetically driven implant treatments are the main drivers of this progress, with guided surgery being key to unlocking digital potential. It allows clinicians to deliver implants according to plan, which in turn enables prosthetic results as planned. Following the demands of this fast-developing market, DENTSPLY Implants now offers a brand new solution that, for the first time, combines the advantages of SIMPLANT guided surgery and patient-specific ATLANTIS abutments for time-saving perfect aesthetic results.

A focus session titled “Prosthetically driven treatment planning and execution powered by computer guided surgery” was held in Belgium in early August 2013. Three prosthodontists with profound knowledge of digital dentistry (Dr Marcus Dagnelid, private practice in Gothenburg in Sweden; Dr David Guichet, private practice in Orange in the USA; and Dr Goran Benic, the University of Zurich in Switzerland) met to share their experiences and expectations for digital dentistry in general, and the innovative state-of-the-art solution from DENTSPLY Implants in particular. The clinicians had tried out the new solution in advance and, over the course of the session, they had the opportunity to discuss this new treatment option with their colleagues for the first time.

So, what is this solution all about? In order to provide dental clinics and laboratories with cutting-edge innovation, DENTSPLY Implants merged its world-recognised digital open solutions SIMPLANT and ATLANTIS to offer a new solution that combines the advantages of SIMPLANT guided surgery and patient-specific ATLANTIS abutments for time-saving perfect aesthetic results.
industry news _ DENTSPLY Implants

The new SIMPLANT 16 software combines the benefits of computer-guided surgery with patient-specific ATLANTIS abutment solutions, advancing surgery and restoration to a new level. It enables a completely digital process that stores all information without having to restart treatment again.

What does this mean for the clinician? The patient’s data only has to be recorded once and can be used for everything, including reliable planning, safe execution of implant surgery, and creation of a patient-specific abutment and a CAD/CAM temporary crown. In other words, a SIMPLANT SAFE Guide, a patient-specific ATLANTIS abutment, and a temporary crown based on the ATLANTIS Abutment Core File can be ordered in one seamless step. This way, the patient can be treated in one treatment session and leave with a perfect temporary restoration.

In collaboration with the laboratory, the clinician gathers the digital data required, including the digital representation of the planned tooth, in the

Fig. 1. Clockwise from left: Dr David Guichet, Dr Marcus Dagnelid and Dr Goran Benic at the meeting in Leuven in Belgium.

Fig. 2. A preview of a SIMPLANT SAFE Guide in SIMPLANT 16. The slot in the guide indicates the correct rotational aspect of the implant.

Fig. 3. The unique SIMPLANT view allows the clinician to review the entire treatment plan digitally. Above is a review of an ATLANTIS abutment in the context of a digital wax-up.

Fig. 4. The alveolus after extraction of a central incisor.

Figs. 5a & b. An initial ATLANTIS abutment in titanium with a temporary crown (a). A final ATLANTIS abutment in gold-shaded titanium with a final crown (b).
SIMPLANT 16 software. The clinician can now plan the treatment and perform that treatment accurately on the patient. Once the planning for the implant has been performed, the data is sent to the design and production units, and the SIMPLANT surgical guide, the ATLANTIS abutment and the ATLANTIS Abutment Core File are designed. The clinician and the laboratory then have the opportunity to review and approve the designs before production starts.

In the hands of the clinician, the planned treatment is realised in an efficient and accurate way. In addition to the advantages offered by the guided surgery protocol and the immediate temporary restoration, the patient-specific abutment provides individualised soft-tissue contouring that starts immediately after surgery.

Ultimately, this goes beyond significant time-saving in treatment planning and implementation for the dental team and the patient. "For immediate loading, this is the highest quality you can get. The shape and strength of an ATLANTIS abutment are of much better quality than a PEEK chairside temporary abutment, thus creating the perfect emergence profile," Dagnelid said during the meeting.

The patient benefit is obvious: performing the implant procedure and the temporary restoration in just one session, as well as creating perfect conditions for individualised aesthetics. After healing, the clinical situation, including soft-tissue response, is evaluated. Based on clinical judgment, the initial ATLANTIS abutment is either retained, making it a final abutment, or changed to a new ATLANTIS abutment.

Great new insights on the new treatment concept for immediate restoration were certainly the highlight of the meeting in Leuven. Yet the meeting delivered much more than that. It was an inspirational forum with impressive exchange of knowledge and ideas about how to advance the product and process developments to provide clinicians and laboratories with the tools they need to perform prosthetically driven implant treatment: a complete digital workflow, starting with the digital scan and utilising digital processes and merged datasets for greater efficacy and accuracy.

Further focus sessions on where digital dentistry will lead us will follow.
3Shape’s new Splint Designer CAD software creates new business opportunities for dental laboratories

3Shape recently released a ground-breaking software tool for CAD of common dental appliances, such as splints, night guards, and protectors, for fabrication using 3-D manufacturing machines and materials. 3Shape is offering this attractive option to Dental System Premium subscribers free.

3Shape, the user-acclaimed leading innovation company for 3-D scanners and CAD/CAM software solutions, has released a unique CAD software tool to the dental market that enables laboratories to provide common dental appliances as part of their range of services. The 3Shape Splint Designer is offered as an add-on module to 3Shape’s Dental System. The new module offers laboratories a cost-efficient getting-started tool, and creates new business opportunities for both dental laboratories and their dentist clients.

“3Shape is continuously seeking ways to help labs compete through new service options and Splint Designer is a prime example,” said Flemming Thorup, President and CEO of 3Shape. “3Shape’s business model provides customers with valuable system upgrades, and this time, we are giving away a complete add-on module with high business potential to our Dental System Premium subscribers as a part of their LABcare package.”

3Shape Splint Designer overview:

- CAD of splints, night guards, protectors and similar dental appliances.
- Splints and appliances can be ordered directly through the Dental System order form.
- An intuitive workflow guides users through the design steps: open the bite with a virtual articulator, create a shell, add a bar profile on top, combine both parts, and optionally “cut” the design with the antagonists in the virtual articulators included.
- Option to engrave ID tags in the appliance for patient identification or branding of the laboratory.
- Included free of charge for all 3Shape Dental System Premium subscriptions.

The new Splint Designer module is a light version of the Appliance Designer which is 3Shape’s complete CAD toolbox for all types of dental and orthodontic appliances.

Splints and appliances can be ordered directly through the Dental System order form. The 3Shape Splint Designer module is included free of charge for all 3Shape Dental System Premium subscriptions and is available with Dental System 2014 through 3Shape resellers.

Availability to end-users is dependent on the specific system configuration.

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Five-axis tabletop milling system with automated eight-fold blank changer

The smart and the smart plus models are the latest in the Tizian Cut CAM family from Schütz Dental (Fig. 3). The newest hardware and software innovations in both simultaneous five-axis machines make them more precise, faster and more comfortable than any other previous Tizian Cut system.

The automatic tool changer can take up to 16 milling and grinding tools. An addition to Tizian Cut 5 smart, the Tizian Cut 5 smart plus model comes with a fully automated eight-fold blank changer (Fig. 1). Together with the tool-changing device, this allows for continuous operation.

Both machines can be fitted with a tool-administration module to ensure that the user will always know when a tool needs replacing.

The Tizian Cut 5 smart milling machine is just 50 cm wide. It can master almost every milling task, almost any undercut and almost any material—even final non-precious metals. With a water-cooling system, which is available separately and retrofitted, this machine becomes a milling machine for glass ceramics. Both CNC versions can be upgraded with water-cooling system and a collecting tank. This means that lithium disilicate and zirconia-reinforced glass ceramics can be milled using the wet-machining feature.

Particularly impressive is that a machine as compact as Tizian Cut 5 smart can be used for dry machining of non-precious metals (Fig. 2). Owing to the sinter-less process, precise fitting and high quality of materials, the machine produces bridges of up to 14 units and is suitable for milling implant-supported bridges with a passive fit. The production of frameworks is precise and time saving with Tizian Creativ RT advanced CAD software: following a virtual design, the Tizian machine mills a framework from a modelling acrylic or wax. Owing to an axis angle of up to 30 degrees, undercuts can be produced seamlessly. This quick, compact all-rounder mills a three-unit metal bridge in just 50 minutes.

Tizian machines do not require licences and import open STL data._

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www.schuetz-dental.de
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Introducing the NobelProcera 2G System

Direct access to unrivalled products and increased productivity

Behind all NobelProcera products is thirty years’ experience in developing leading CAD/CAM dental solutions. It is this extensive expertise that Nobel Biocare utilised to develop the new NobelProcera 2G System.

For busy dental laboratories looking to expand their business, the NobelProcera 2G System is a valuable tool. The new 2G System includes updated software and an exciting new scanner, which provides direct access to high-quality prosthetic solutions through the NobelProcera global production network. Expert engineering provides the next-generation scanner with efficiency and flexibility at a level that will significantly increase a laboratory’s productivity without compromising on precision. While its predecessor was recognised as extremely accurate, the NobelProcera 2G Scanner offers accuracy that surpasses even this high standard.

With the NobelProcera 2G System, users benefit from direct access to prosthetic solutions that achieve an excellent functional and aesthetic outcome, whether for a single coping or an advanced full-arch implant case. Plus, with direct local product support providing training for both dental laboratories and their restorative dentist customers, the NobelProcera 2G System helps facilitate stronger relationships between professionals, enabling them to grow their business by offering improved treatment to more patients.

Ease of use was a priority in developing the 2G System, which took into account valuable feedback from first-generation NobelProcera Scanner users. While the new system may resemble the original in appearance, the efficiency of the 2G version is noticeably superior. Existing NobelProcera Scanner users can also benefit from improved ease of operation through Nobel Biocare’s exchange programme, which makes it easy to upgrade to the 2G System.


**Smarter positioning: greater productivity**

Vital to increasing productivity is the introduction of the Smart Motorized Holder, with which objects to be scanned are easily secured using magnets. Moving independently, the holder automatically positions each object on the model at the ideal height, tilt and rotation.

Efficiency is increased by reducing the need for user interaction while improving the scanning range. Additional new workflow options, such as articulated model scanning, have therefore also been introduced. The result is optimal scan data that enables consistency with less manual operation. This is the case even for difficult scanning situations, such as undercuts, freeing up technicians to focus on tasks that offer the most value to their laboratory.

**Predictably precise results**

The NobelProcera 2G System makes it easier for dental professionals to process larger and more complex cases with confidence. The user is also offered the flexibility to control scanning and to add additional scan data at any stage of the process. This means predictably high-quality prostheses for every customer.

**A next-generation scanner for the workflow of the future**

The NobelProcera 2G System will play a crucial role in Nobel Biocare’s new seamlessly integrated treatment workflow, which will be introduced this year. This digital workflow brings together the latest innovations at each stage of the treatment process over the secure online NobelConnect network and is supported by leading diagnostics and treatment planning software NobelClinician.

The current standard procedure is for a clinician to take an initial impression, which is sent to a laboratory for the creation of a radiographic guide. With the NobelProcera 2G System, the radiographic guide is no longer needed, lowering the cost for the clinician and increasing flexibility. Instead, the laboratory can add further value as a treatment partner by providing intra-oral model surface information that assists with the clinician’s diagnostic treatment plan. Thanks to its solid model scanning capability, the 2G Scanner delivers a model scan with intra-oral surface information, such as soft tissue and diagnostic tooth set-up. This can be combined with a patient’s CBCT scan via smart fusion technology in NobelClinician. The result is an accurate diagnostic picture displaying both soft- and hard-tissue information for the clinician without a radiographic guide, saving precious time for both dental professional and patient.

With vital diagnostic information directly from the laboratory, dental technicians are able to discuss their restorative considerations with the clinician at an early stage. Such a collaborative approach improves implant diagnostics and therefore the overall treatment outcome, reducing the likelihood of prosthetic challenges.

In the next step, based on the post-operative situation, individualised CAD/CAM prostheses are easily designed in the NobelProcera software and then ordered digitally from NobelProcera’s integrated global production network. The end-product is a precisely manufactured restoration of outstanding quality that comes with a certificate of authenticity and an extensive warranty.

In summary, the NobelProcera 2G System offers an evolutionary scanner that provides next-generation results. It offers laboratories increased productivity, precision and collaboration with clinicians. The benefits of the system enable laboratories to build their business and make the investment worthwhile.

**References**


**Contact**

Nobel Biocare
Balsberg, Balz-Zimmermann-Str. 7
8302 Kloten, Switzerland

www.nobelbiocare.com/2G
IMAGINA Dental: Digital dentistry experts meet in Monaco

Fig. 1. At the congress, Dr Scott Ganz introduced cone beam, international magazine of cone beam dentistry. (Photo courtesy of Dr Scott Ganz)

Fig. 2. Dr Scott Ganz during his presentation at IMAGINA Dental 2014. (Photo courtesy of MONACO MEDIAX)

In the middle of February, over 500 dental professionals from all over the world gathered at the Grimaldi Forum in Monaco for the third IMAGINA Dental congress. IMAGINA Dental is a prestigious international dental meeting entirely dedicated to 3-D and CAD/CAM technologies in dentistry and organised by MONACO MEDIAX, one of the world’s most highly regarded event organisers.

The rapid development of 3-D and CAD/CAM technologies has necessitated essential changes for all dental practices and laboratories. The challenge is to keep up to date with this growing industry and implement this digital workflow in dental practices.

According to the organisers, the three-day conference featured educational content on digital dentistry relevant to every dental professional. Internationally well-known speakers, experts and trainers in the fields of implantology, CAD/CAM, prosthetic dentistry and laser shared their knowledge and experience with passion and enthusiasm. Participants learnt about the latest digital oral scanners, 3-D printers, 3-D diagnosis tools, treatment planning, guided surgery and aesthetic restoration in dentistry.

Parallel to the lectures, numerous workshops were organised, which offered dentists answers to many practical questions, clinical knowledge and tips on the latest technologies in dentistry.

According to the organisers, IMAGINA Dental is one of the few industry events to apply a policy of fairness towards all brands and thus does not favour one over another.

At the congress, Dental Tribune International launched cone beam, international magazine of cone beam dentistry, a quarterly continuing education publication devoted entirely to CBCT in dentistry. Editor-in-Chief Dr Scott Ganz presented the first issue of the high-gloss English-language magazine.

The new magazine covers the most significant developments in the field and is targeted at experts who use CBCT, such as implantologists, orthodontists, prosthodontists and endodontists. It presents the latest research and case studies in the field,
meetings _ IMAGINA Dental

as well as pertinent industry news, trends in procedures and techniques, and the newest education and events.

cone beam, which is the official publication of the International Cone Beam Institute and several other education providers in the field, will be distributed at all major international congresses, exhibitions and many specialty-specific events.

"The evolution of CBCT, which started with the introduction of 3-D imaging for dental applications in the 1980s, continues within the pages of the new cone beam international magazine. We will do our best to provide our readers with useful information by presenting a variety of clinical applications and state-of-the-art concepts that showcase CBCT technology and related applications. It is time to realise that there is a real danger when we are bound by 2-D concepts, when clearly today we live in a 3-D world," Ganz said.

The first issue is available for free download in the e-paper archive of the Dental Tribune website (www.dental-tribune.com).

Press releases and videos from IMAGINA Dental, as well as interviews with the organisers, are already available online at www.youtube.com/user/IMAGINADental and www.imaginadental.org.

Fig. 3. During the breaks participants could see newest 3-D and CAD/CAM technologies. (Photo courtesy of MONACO MEDIAX)

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EAED 28th Annual Meeting
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Athens, Greece
www.eaed.org

ISRRT World Congress
12–15 June 2014
Helsinki, Finland
www.isrrt2014.fi

APDC 36th Asia Pacific Dental Congress
17–19 June 2014
Dubai, UAE
www.apdentalcongress.org

18th World Congress on Dental Traumatology
19–21 June 2014
Istanbul, Turkey
www.iadt-dentaltrauma.org

IACA 2014 Annual Meeting
24–26 July 2014
Bahamas
www.theiaca.com

AAED 39th Annual Meeting
5–8 August 2014
Santa Barbara, USA
www.estheticacademy.org

FDI Annual World Dental Congress
11–14 September 2014
New Delhi, India
www.fdi2014.org.in

EAO 2014
25–27 September 2014
Rome, Italy
www.eao.org

EPA Annual Conference
25–27 September 2014
Istanbul, Turkey
www.epa2014.org

ICOI World Congress
3–5 October 2014
Tokyo, Japan
www.icoi.org

155th ADA Annual Session
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We can run an unusually long article in multiple parts, but this usually entails a topic for which each part can stand alone because it contains so much information.

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Questions?

Magda Wojtkiewicz (Managing Editor)
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