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The Virtual Facebow

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Aesthetic Digital Smile Design – Part II

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My presentation at the Dental Tribune Study Club Symposium at IDEM Singapore 2014 highlighted some of the advantages and disadvantages of the use of CAD/CAM in dentistry. My goal was to enable clinicians to see how it might become more widely accepted in their daily practice and remove some of their reservations. The next generation of dentists will hopefully come to view traditional methods of manufacturing dental prostheses in the same way as we now view fixed partial dentures as a way to replace missing teeth before implants.

CAD/CAM methods for conventional dental and implant-borne prostheses have gained popularity for a variety of reasons. Despite many advantages in terms of cost and convenience, the uptake of this relatively new technology is slow, hinting at a reluctance to try something new.

Many, if not most, clinicians still choose to have fixed implant-borne multi-unit prostheses fabricated by traditional methods of casting and veneering precious metal alloys. However, the associated high technical and material costs may be prohibitive to the group of patients who need this treatment modality the most. To this end, more cost-effective alloys, including base metal alloys, have been cast and veneered with a variety of tooth-coloured materials with good success. CAD/CAM takes this one step further. In fact, materials such as zirconia, which has revolutionised dental prostheses, would not be in use were it not for CAD/CAM.

There has been much discussion around the problem of achieving passivity of fit, the lack of which, it has been postulated, can contribute to mechanical and biological complications. The multiple steps and materials used in impression taking, casting a working model, producing a wax pattern, casting in metal alloy then veneering in tooth coloured material all lead to a certain degree of misfit.

CAD/CAM can help to address this common problem. The use of digital dentistry is more common than clinicians might think, as the laboratory processes involved have already been widely implemented and dental technicians can take the credit for driving the use of the technology forwards. The next step is to adopt digital technology to replace some of the clinical steps in fabricating a prosthesis, namely the impression stage, which leads to production of a working cast.

These steps can introduce cumulative inaccuracies, as well as consume a variety of materials that are then discarded. In addition, there are time-savings to be made, perhaps not in the initial stages of learning and integrating new technology, but, once familiar with the systems involved, all will benefit from the improved and efficient workflow.

I wish you a pleasant read of this CAD/CAM issue, and I hope you will find various interesting articles in it.

Dr Steven Soo
Dental specialist in prosthodontics at Specialist Dental Group® in Singapore
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The Virtual Facebow
A digital companion to implantology

Author Dr Les Kalman, USA

Abstract

The Virtual Facebow has been developed as an open-source tablet app that provides an alternative to the conventional facebow for the mounting of casts to an articulator.

The Virtual Facebow implements several design features to prevent and minimize errors, provide accurate mounting and reinforce the anatomical considerations associated with articulators. The Virtual Facebow is an effective, efficient and accessible digital companion to dental implant diagnoses and treatment planning.

Introduction

Prior to the delivery of dental treatment, carefully established diagnosis and treatment planning is required. This is particularly important with dental implant therapy.1

To assist the process, the mounting of a patient’s diagnostic casts remains an important step, as it allows the assessment of critical factors such as occlusion, implant position and forces direction.2 It also allows exploration into prosthetic options,3 such as angled abutments (Fig. 1). To support proper mounting of patient casts, a facebow, which aligns the maxilla to relative facial planes, can be utilized. Errors in the utilization of the facebow, or complete lack thereof, create critical errors in diagnoses and treatment planning that become magnified in the design and delivery of implant prosthetics.

The Virtual Facebow has been developed as a digital substitute to the analogue facebow to address the shortcomings.

Background

Analog facebow

The facebow (Fig. 2) facilitates the mounting of the maxillary cast to the articulator. The Whip Mix Quick Mount facebow (Whip Mix, Louisville, KY) is composed of a caliper-type instrument that anchors into the ear canals and is balanced by the bridge of the nose.

A bite fork is utilized, embedded with polyvinylsiloxane, to register the position of the maxillary teeth. The bite fork is then transferred to an articulator, through the use of a transfer jig. The maxillary cast is positioned and mounted to the upper portion of the articulator.
The facebow is a largely omitted during the diagnosis and treatment-planning phase due to its shortcomings. It can prove tedious and uncomfortable for the patient, as the ear canal projections, bite fork and nose bridge can apply pressure and pain. The facebow can prove tedious and frustrating to the clinician, due to the subjective positioning and multiple adjustments\textsuperscript{3,4,5} (Fig. 3).

If utilized incorrectly, the facebow can result in errors, which include:

- facebow application;
- assembly;
- patient position;
- verification;
- in maxillary cast orientation;
- in mandibular cast orientation;
- occlusal relationship.

Errors have direct impact on the assessment of inter-arch space, occlusal contacts and force direction (Figs. 1–4). Errors will then affect the diagnosis, treatment plan, implant type, abutment angle and prosthesis. If inaccurate mounting errors are not recognized early, the outcome may yield a compromised result, poor prosthesis (form and function), timely adjustments and a remake.

As with any compromised result, the ultimate consequence would include inefficient use of time, unnecessary costs, patient unhappiness, stress on the clinician and an unnecessary environmental impact.

Virtual Facebow

To rectify these compounded issues, the Virtual Facebow app (VF) (Research Driven, Komoka, Ontario) was developed as a digital substitute for the analog facebow.

Several safeguards were incorporated to minimize errors in positioning and orientation. The VF has been developed as an app that incorporates patient photos, alignment verification, anatomical relevance and confirmation of occlusion. The open source tablet app has been developed to be accessible through affordable tablet cost, affordable app cost and unlimited use.

Data can be readily shared, used on various devices, requires no specialized software, is simple to open and read and provides an easy-to-email option. The VF was designed to be efficient, effective, economical and educational. The VF's current requirements include:

- any supported tablet device with an Android operating system,
- a back-facing camera and a minimum system update of 4.0.3.

The VF is currently available on the Google Play market.

Although the VF app has been designed to be used as a standalone substitute for the analogue facebow, several peripherals have been developed to offer even more simplicity to the process. A patient positioner verifies patient orientation, a vertical tablet stand simplifies operation and an articulator mount positions the maxillary cast.

Methodology: Case study

Clinical

The following is a step-by-step instruction on the VF utilization. Properly position the patient and confirm orientation. Place the tablet in the stand within 6 to 12 inches of the patient. Launch the VF app (Fig. 5).
CE article _ Virtual Facebow

Position the skull and reference markers over the patient’s image. Confirm alignment of tablet and markers and simply take a photo. Resize and reposition the patient photo if required and save the image. Verify orientation of midlines, incisal edges, occlusal planes and anatomical references by altering the transparency of either the skull or face image (Fig. 6). Clinically assess occlusal contacts (Fig. 7) and input via the touch screen (Fig. 8). Clinical component has been completed.

Laboratory

If the clinician has delegated mounting to the laboratory, then the records phase has been completed. The following applies to those who mount their own casts. Position the tablet in the stand 6 to 12 inches from the cast and launch the VF app. Place the maxillary cast on the articulator mount (Fig. 9). The patient image will appear.

Adjust orientation of cast (tilt) to confirm alignment with the patient markers. Verify orientation of midline, incisal edges, occlusal plane and facial references (Fig. 10).

When the cast is correctly positioned, simply take a photo. Resize and reposition the image if required and save the image. Orientation can be confirmed by altering the transparency of either the face or cast image. Mount the maxillary cast to the upper articulator. The record of occlusal contacts (Fig. 8) will then be displayed. Position the mandibular cast to the maxillary cast, confirming contacts, and mount the mandibular cast. The VF will then generate a composite of the skull, face and cast. The operator has the ability to alter the transparency of any image to reconfirm the position of the skull to the patient’s face and, ultimately, to the cast (Fig. 11). The laboratory component has been completed (Fig. 12).

The files are then saved on the hard drive as a series of PDFs and JPGs, both of manageable size. The user has the option of emailing either the complete series or individual images, in PDF or JPG, to any third party. The user has the ability to refer back to any image but cannot modify any of the images. A series of six screenshots document the VF process.
Discussion

The VF utilizes several proprietary design features that enable a tablet device to have the ability to record, confirm and reproduce the orientation of the maxilla to relative facial landmarks. This enables a simple, efficient and effective technique in the mounting of the maxillary cast to the articulator.

The VF also records the maxillo-mandibular relationship vital to correct mounting, enabling the accurate mounting of complex implant cases (Fig. 13). With exact mounting, the proper position and angulation of dental implants can be achieved (Fig. 14).

A pilot study was recently performed at the Schulich School of Medicine & Dentistry at Western University. Patients with restored dental implants were selected. A practitioner assessed the occlusion. Impressions and required records were taken, and casts were mounted.

One dental student utilized the analogue facebow, the other the virtual facebow. Mounting was assessed in terms of: cast position (anterior/posterior and lateral), quantity of occlusal contacts, required clinical, laboratory and total time and cost. Preliminary analysis suggests that the VF is more accurate, efficient and cost-effective. Data will be presented in the near future.

The use of cone-beam computer tomography remains the gold standard of dental implant treatment planning. However, many clinicians have barriers to the technology either from limited finances, physical access or intimidation. Many implant cases are planned and delivered with little to no clinical records, other than final impressions. The Virtual Facebow provides a digital companion that is accessible, affordable and understandable.

Conclusion

The Virtual Facebow is an open-source tablet app that not only facilitates the mounting of the maxillary
Virtual Facebow cast but offers a record of occlusion. The VF also reinforces the anatomical basis of articulator mounting and supports clinical records through patient photographs.

The VF provides the clinician with a digital alternative to the analog facebow. Although evaluated through a pilot study, a larger research project would provide further validation.

By reducing errors in the diagnosis and treatment phases of implantology, the VF hopes to prevent and minimize errors incurred through incorrect mounting. Dental implant therapy can then be planned and delivered with the affirmation that mounting has not faulted the process of treatment delivery.

**Editorial note:** The Virtual Facebow has been acquired by Whip Mix Corporation. Version 2.0 has been developed to allow a simplified approach. The new version will be available in early summer of 2014.

**References**


**_about the author_**

Dr Les Kalman, DDS, graduated from the University of Western Ontario with a doctor of dental surgery degree in 1999. He then completed a GPR at the London Health Sciences Centre. He has been involved in general dentistry within private practice since 2000. He has served as the chief of dentistry at the Stratford-Middlesex General Hospital. In 2011, he transitioned to full-time academics as an assistant professor at the Schulich School of Medicine and Dentistry. Kalman is also the coordinator of the Dental Outreach Community Services (DOCS) program, which provides free dentistry within the community. Kalman has authored articles on subjects ranging from paediatric Impression to immediate implant surgery in both Canadian and US journals. He has been a product evaluator for several companies, including GC America and Clinician’s Choice. Kalman is the co-owner of Research Driven Inc., a company that deals with intellectual property development. His most recent dental product invention has been featured on the W Network’s “Backyard Inventors” television series. Kalman is a member of the American Society for Forensic Odontology, International Team for Implantology, Academy of Osseointegration, American Academy of Implant Dentistry and the International Congress of Oral Implantology. He can be contacted at lkalman@uwo.ca.
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Aesthetic Digital Smile Design: Software-aided aesthetic dentistry—Part II

Author: Dr Valerio Bini, Italy

Virtual planning and digital wax-up

Having introduced the fundamental tenets of this method in Part I, I move on to a step-by-step description of Aesthetic Digital Smile Design (ADSD) in Part II.

Import and adaptation of images: after having acquired the video frames that statistically capture the dynamic phases of the smile and after having imported all the intra- and extra-oral photographs in the manner described in Part I, the smile designer, as if he or she were an architect, undertakes true and accurate mapping of the face and the smile, observing the peculiarities according to focal length. The aesthetic analysis (macro, mini and micro) to which it makes reference is based on values and parameters derived from Powell, Goldstein, Rufenacht, Lombardi, Arnett and Chiche, Pinault, Ricketts, Fradeani and others, and the aesthetic dentist can use these values and parameters with rulers, set squares and goniometers. The full face images of the patient also involve an analytical observation of the portrait and therefore hair and skin colour, make-up, pose, etc. are important. After being imported, these factors will be processed in the manner described below.

Verification of orientation and exposure of the subject photographed (Fig. 18a): the imported images must be verified on the basis of the quality of the images orientation and analytic focal length.
of the shot, exposure, sharpness, etc., technical factors that most software packages can correct and improve, and some of which the Digital Firmware camera cannot correct itself. Practice to acquire greater familiarity and skill will prove useful to the smile designer.

In addition to the qualitative factors, the correct orientation of the patient's face is absolutely essential. Some software on Mac operating systems allows rotation of the image with a simple movement of the fingers. In general, however, it is possible to trace a bi-pupillary plane that the software will recognise as the horizontal plane to which to make reference for adapting the image.

Another efficient method, with a dual function, is that of using the cropping grid. This offers the possibility of cropping the photograph to centre the image for use in ADSD. It permits us to align the bi-pupillary plane horizontally to check the symmetry in relation to the sagittal plane.

There is another simple but efficient way: increasing the zoom on the photograph. The pupils will be more detailed and thus, by rotating the photograph, it will be possible to take as a reference point the upper edge of the software window, on which to verify the pupillary alignment. Later on, it will be possible by scrolling the image towards the top to examine the mouth and the teeth to verify the occlusal plane.

Mapping of the macro-aesthetics (face): having decided on the correct position of the face for a detailed aesthetic analysis and after a digital analysis, it is indispensable to mark the face and the smile with reference lines and areas, verifying symmetries and asymmetries (Fig. 18b). The first thing to do is to mark the reference points and morphological determinants (face marker); these should be saved in the project from the photograph because they are fixed anatomic topographical points in both the extra-oral and intra-oral soft tissue, obviously bordering on the teeth and gingivae. From now on, it is essential to save the various ADSD projects. In this manner, we shall have immediately at our disposal the cardinal points of the topographic anatomy on which we shall later base the proportions of the face in terms of the other features.

Mapping of the mini- and micro-aesthetics of the mouth and smile (Fig. 18c).

Check of mini-aesthetic virtual planning with opacity and semi-transparency (Fig. 18d).

Comparison of the before and after images in virtual planning (Fig. 18e).
special digital smile design

of vertical and horizontal dimensions and the golden ratio analysis.

Mapping of the mini-aesthetics (mouth and smile): from the macro-aesthetic focal length, we can come closer to select the perioral and intraoral zone where it is necessary to carry out the virtual simulation after a careful dento-labial analysis (Fig. 18c).

The photographs taken statically with closed lips in relaxation, the lips spontaneously half-closed or the lips in a smile while pronouncing the phonemes "[m]" and "[i]" can be compared to video frames: from the recording of this data, we can evaluate movement, the dynamic curvature of the lower lip in relation to the maxillary anterior teeth, the position of the central incisors, their exposure and the breadth of the smile well delimited by the width of the labial corridors.

All of these factors are relevant to the smile design. It is also fundamental to verify the relationship with closed lips between the labial vermilion (analysed both frontally and in profile) and the labial dimensions useful for defining and comparing the vertical dimensions of the face, eventual losses or excesses of substance, bruxism, atrophic jaws, dental alignment, micro- or macrodontia, malocclusion or even simple loss of lip fullness, which is currently of great aesthetic interest not only clinically, but also and above all in the media.

Often the multidisciplinary approach to a clinical case entails a preliminary examination by the plastic surgeon to establish the aesthetics of the labial profile. The plastic surgeon, who has to speak in favour of possible plastic surgery to the profile or the like, sends the patient to the dentist for a clinical evaluation of the dental-skeletal ratios, which is comparable with the aesthetic analysis of the entire profile of the face (Powell’s aesthetic triangle, Ricketts’ aesthetic plane, etc.). A dento-facial aesthetic analysis thus becomes a fundamental pillar for the co-operation between the specialists in the facial aesthetics medical team (Fig. 1 in Part I) to allow a predictable diagnosis and a treatment plan based on a multidisciplinary vision, considering the fact that the soft tissue of the lower third of the face is supported by and moves by sliding on the hard structures (bones and teeth).

In this regard, ADSD can be of help for analysing the lateral thickness of the hard tissue, particularly the position of the anterior teeth, their inclination and their emergence profile. Indeed, it is possible to perform digital image editing analytically on a millimetre grid based on the reference points from the mapping of the facial profile. The simple superimposition of the images and the implementation of protocols or complementary examinations (virtual 3-D orthodontic simulations; vto; cephalometric analysis; dental design related to the thickness of veneers, overlays, prosthetic crowns, recontouring, etc.) can process virtual plans, in which it is possible to pre-
dict the future position of the lips and vestibules (Fig. 19).

Mapping of the micro-aesthetics (intra-oral): the iconography of the analysed face includes the study of photographs taken with lip retractors in place (micro-aesthetics). The focus of this type of image is the close-up of the mouth, the details of which are relative to and parameterised according to the horizontal and vertical lines traced on the patient’s face. Our virtual project will centre on the occlusal plane ideally parallel to the bi-pupillary plane, and the main vertical lines (i.e. the median of the face, inter-incisal of the teeth, subnasal area, etc.).

The intra-oral mapping is thus a simple magnification of what has already been traced on the face. In practice, on our computer desktop, we will have a map in which there are very distinct regions, including outlines, ridges and depressions characteristic of the dento-facial morphology.

At this point, all we have to do is to start tracing lines (outlines; Figs. 11a & b in Part I) on the intra-oral photographs, passing over the gingival margins, papillae, and interproximal margins of the central incisors, lateral incisors and canines (Digital Dental Design). In order to achieve a symmetrical drawing, the lines and contours of the teeth can be duplicated to create a mirror image. In this way, it is possible to obtain the positioning of the forms on the contralateral teeth. Among the lines used, it is very important to insert a line corresponding to the ideal aesthetic curve, which will have a value directly proportional to the position of the occlusal plane.

Paste or overlay the images taken from the Dental Digital Photo Database or model a filling of the outlines. In many cases, it is not strictly necessary to draw the teeth, since often the images of the teeth are copied, shaped, moved and positioned on the dental arch (Digital Dental Calibrated Transposition).

Position the teeth by reducing the opacity to place them with greater visibility in the desired positions. Opacity enables one to better visualise the underlying images when using tools for the superimposition of images, is an option in all photograph-editing software and can easily be adjusted in percentage.

Adapt and proportion the teeth in space (dimension and alignment) by using the images rendered semi-transparent by adjusting opacity comparable to the previous opacity (Fig. 18d).

Save the images where the transparency level enables us to calculate it as a superimposition (Figs. 20a & b), where the points of departure and
The sublabial dental composition can be seen and where the subnasal or bi-pupillary line. Therefore, remember to indicate and record on the photograph the unit of measurement chosen for the software conversion scale so that the data approximates the clinical reality of the subject photographed.

Verify and modify the gingival architecture concerning the aesthetic component and tissue ratios. The positioning of the zenith, papillae and cervical parabolas represents an absolute value in aesthetic analysis for planning. It is particularly sensitive data useful for deciding on therapy with the periodontist.

After finishing the positioning of the teeth and gingivae, shape them morphologically according to the customised aesthetic "plan", bordering on the aesthetic dental composition (Fig. 18e).

Every image editing step relating to the simulation must be saved in the software format so that no data is lost to allow modification at a later date. The same must be done for JPG and similar formats in the patient’s file, re-naming them in a sequential manner, which permits a more reliable and revisable back-up for the smile designer and the aesthetic dental team, and permits a better method of communicating the various therapeutic possibilities to the patient. It also provides essential information for checking the positioning of the prototypes (Figs. 20c & 21a-c).

At this point, we have at our disposal the digital wax-up, which we can transfer to the dental technician so that he or she can create an actual diagnostic wax-up, which once photographed can be inserted into the oral cavity. Note that, where it is already possible to transfer the ADSD file into CAD, the CAM phase will produce a model that is useful for reducing the time and synchronising the methods implementing the protocols. By decreasing the opacity of the image and working on the transparency, we can check whether the virtual records and indications conform to the analogue model.

If everything corresponds, it is possible to make modifications then to continue with the direct or indirect mock-up, which necessitates the preparation of a silicone key to accommodate provisional material to be adapted to the teeth or a workpiece produced by the dental technician without it being necessary to adapt the material to the teeth, such as composite veneer, resin and PMMA.

Having positioned the aesthetic model in the oral cavity, it is inspected and approved with the patient, correcting any individual or functional details from the point of view of occlusion, facial expressions and the dento-labial relationship,
which can easily be tested using phonetic tests. In this phase, as well as giving the patient the opportunity to look at himself or herself in a mirror, it is very useful to use the camera again, since the recording of the physiology of the smile in relation to the phonetics and facial expressions may become the subject of further live 3-D analysis of the patient. The more information we send to the dental technician, the more it will be possible for him to observe the patient and update himself or herself on the analysis being carried out. While the dentist is in his or her surgery, the technician in the laboratory can watch the video clips, analyse the photographs and communicate via the telephone or video-conferencing on Skype. All this offers many advantages to this protocol. Being able to dispel any doubts will give greater satisfaction to the dental team and result in clinical success, clearly demonstrated by the aesthetic harmony in the smiles of our patients.

Once the mock-up has been approved with the consent of the patient, who will have been the first critical spectator of and commentator on the video clip, one can take another traditional dental impression or take an impression using an intraoral scanner (optical impression). During the video playback, the patient is able to observe peculiarities about himself or herself that he or she would not be able to see using only a mirror, the first being seeing himself or herself in profile through images that are not static and precisely because of their dynamic nature correspond to spontaneity and naturalness.

Carry out digital smile morphing of the images step by step to demonstrate and transmit the actual simulation corresponding to virtual planning. This phase is of great interest and effect for the patient because morphing, being shown sequentially, appears to be like a film. This procedure is carried out as far as the superimposition of the images processed during the first analytical aesthetic phase up to the related functional models inserted into the oral cavity before the definitive restoration.

From the analogue phase of the model, we move on to the digital phase to produce the prosthesis with CAD/CAM procedures (these images can be further analysed in the virtual planning phase; Figs. 22a & b).

In the case of particular work procedures in which software-assisted implantology techniques are used, one may also have at one’s disposal a second model in PMMA, diagnostic or surgical guides especially for implant structures, etc.

The final step in the implementation of ADSD in the CAD/CAM protocol is the placement of the definitive restoration in the oral cavity (Figs. 23a & b). The outcome of the multidisciplinary approach should confirm the predictability concerning the aesthetic and bio-cosmetic integration of the prosthesis.

**Conclusion**

The detailed analysis of the smile and its project, indispensable for the formulation of an aesthetic clinical diagnosis, is a fundamental part of the delicate approach to the patient, the true protagonist of aesthetic dentistry. Today, the operator has at his or her disposal new non-invasive means of formulating the treatment plan; digital dentistry and image-editing software are now part of a dentist’s armamentarium. Furthermore, the entire treating team being advanced in the use of instruments and technologies for diagnosis and communication makes an excellent marketing tool for dental services. ADSD is a simple and economical way of offering the patient a predictable plan that can be visualised immediately or at least at the second appointment to demonstrate the aesthetic and functional changes possible with treatment with the aid of corresponding models. It is also a tool for transmitting all the information necessary to the entire treating team in the multidisciplinary approach. Let us hope that a new professional figure may soon establish himself or herself in the world of dentistry, the smile designer, a new way to communicate.

Editorial note: This is the second 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 I of the article appeared in CAD/CAM 1/2014.

**about the author**

Dr Valerio Bini, DDS, graduated from the University of Genoa in Italy. He is a specialist in prosthetics 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.
“The trend towards the medium-price range has accelerated”

An interview with Straumann executive board member Frank Hemm about the company’s recent investment in MegaGen

Following previous investments in Brazil, Germany and Spain, Straumann recently announced that it has bought convertible bonds worth US$30 million from MegaGen, one of the largest dental implant solution providers in South Korea. At the recent World Symposium of the International Team for Implantology in Geneva in Switzerland, on behalf of CAD/CAM, implants magazine Managing Editor Georg Isbaner had the opportunity to talk with Frank Hemm, a member of Straumann’s executive management board, about the investment and how it will affect his company’s position in the Asia Pacific region.

_CAD/CAM:_ According to analysts, South Korean manufacturers are expected to dominate the market for dental implants in Asia in the years to come. Is this projected development the main reason for your investment in MegaGen?

_Frank Hemm:_ South Korea is one of the largest markets for implants in terms of volume. More than two million implants are placed every year and local manufacturers are looking to expand into other Asian markets with high potential. China is a good example, where the market is still comparatively small but under-penetrated and growing quickly.

In these markets, the premium implant segment, where Straumann has been and is still very active, is growing less dynamically than the medium- and low-price segments are. We see the same trend in other markets, like Brazil, where companies like Neodent sell higher volumes than premium providers do. Two years ago, we had to ask ourselves whether we could address the non-premium segment with our existing brand or whether we needed a second brand. We decided on the latter and purchased a 49 per cent stake in Neodent. As an established brand in the region, MegaGen gives us a foothold in the Asian “value” (medium-price) segment. The convertible bond approach means that we have the option to gain a majority stake in 2016 with a managed low risk.

Straumann has always provided premium dental implants backed by solid scientific evidence and service excellence. These key differentiators make it necessary to use a separate brand strategy to address customers who are willing to accept lower standards and who want to pay less for implants. The value segment is growing exponentially and developing a new brand from scratch would simply take too much time and too many resources, which is the reason we chose to invest in other established companies.

_Both companies have said that they will continue to operate separately. Still, do you expect any synergies to arise from this partnership?_

It is important to keep both businesses completely separate to ensure that customers do not think that Straumann is MegaGen and vice versa. The only synergies we see are in supporting the value brand companies to enter selective markets, and in sharing back-office functions, like infrastructure, information technology or accounting. Everything else is handled by each company independently. Straumann products are certainly produced in Straumann facilities and this will continue to be the case in the future.
Is there the risk that you might be creating more competition for yourself with this investment?
We would not have taken this step if the market situation had not required it. The trend towards products in the medium-price range has accelerated and there is already strong competition, even without MegaGen. We are not adding more competition; rather, we are competing where we could not compete as Straumann.

What position is your company generally aiming for in the Asia Pacific region?
We aspire to market leadership in the region. We are not there yet, partly because our Roxolid implants with the SLActive surface are not yet available in the larger markets. We recently received approval for SLActive Tissue Level implants in Japan and the sales figures demonstrate the extent of the potential of our innovative technologies. Achieving a leading position in Asia will certainly have a positive influence on our global position.

What requirements will have to be fulfilled for you to exercise the option to convert and acquire a majority stake in MegaGen in 2016?
We are keeping a close eye on the company’s development. MegaGen is a relatively new enterprise. It is growing dynamically and has many ambitions that still have to be realised. We also want to see how the market develops and the extent to which MegaGen can penetrate certain areas. The company’s valuation is another item on our radar. If our expectations are met, we can convert the bonds into shares in 2016 or require repayment with interest. That is the flexibility that this option allows us.

Should you decide to convert the bonds into stock, another large international implant conglomerate would be created. Is it only possible to survive in the long run as a large market player?
The implant market is still very fragmented and the market share of larger corporations is actually declining. There are hundreds and hundreds of smaller providers, often founded by dental clinicians, that come and go because they do not have the capability to expand internationally. Few companies succeed in making this jump and remaining in the market for a longer period.

Unlike in some industries, scale in the dental implant industry does not have inherent returns. What we are seeing is a consolidation in a larger context, as many distributors have started to include implants in their portfolios with the aim of becoming one-stop shops. This development needs careful scrutiny because implants involve other factors that only we as specialists can deliver.

Thank you very much for the interview.
Patient-specific restorations are the focus of state-of-the-art dentistry. A treatment concept tailored to the specific situation has also become indispensable in implant dentistry. Based on the case presented, this article describes how a custom abutment can be used to create an implant-supported crown very similar to the natural tooth in shape and soft-tissue profile.

A leading-edge treatment protocol distinguishes itself by a perfectly coordinated surgical-prosthetic procedure with the goal of harmony and long-term stability of peri-implant bone and keratinized mucosa. The key parameters of the concept are implant positioning in the lingual or palatal third of the alveolar ridge to ensure a buccal bone plate with a minimum thickness of 1.5 mm. In addition, a zone...
of keratinized mucosa of at least 3 mm must be maintained or created. The surgical approach is minimally invasive based on advanced diagnostics with three-dimensional DVT, imaging and virtual surgical planning. Furthermore, the “oneabutment—one-time” concept avoids frequent abutment changes with the consequence of peri-implant tissue loss. Lastly, the treatment concept includes a custom CAD/CAM fabricated abutment with an anatomical contour, so that the crown margin terminates at the same level as the gingiva. This serves to avoid excess cement subgingivally and the occurrence of peri-implant inflammation.

The importance of stable peri-implant soft tissue for an implant-supported restoration is the topic of numerous publications. But how can the dentist achieve this goal in a safe and efficient manner? A well-coordinated treatment concept and optimal interlocking product components are required. The presented case report explains how the interdisciplinary treatment team can combine these aspects. The case report shows how an implant (XIVE) is used in region 36 with a custom abutment (ATLANTIS) fabricated using CAD/CAM technology.

Years of research and development have been invested in the implant design and surface, and the best possible outcome has been achieved in this
The optimum result can be visualized in advance and the treatment sequence precisely defined.

Initial situation and planning

The patient approached the treatment team with a wish for an implant-supported prosthetic restoration in region 36. The patient’s general medical history revealed no anomalies. The oral situation also indicated no significant need for treatment. The maxilla was fully dentulous, but a radicular cyst on tooth 12 was diagnosed radiographically. Surgical treatment of this cyst is scheduled in the near future. A similar picture emerged in the mandible. After closing the gap in region 36 and restoring tooth 12, the treatment will be completed. The initial radiograph (OPG) showed sufficient vertical bone (Fig. 1), but a lack of buccal bone volume from a clinical perspective. This was confirmed in the three-dimensional view (DVT). The implant (XIVE, DENTSPLY Implants) in region 36 was planned virtually in a slightly lingual position using a planning and navigation software and the need for augmentation in the buccal area was evaluated (Figs. 2a–c). The concave profile of the alveolar ridge would not allow for an aesthetically satisfactory result without grafting. The goal was to achieve a buccal plate of approximately 2 mm, and thus a slightly convex ridge in this area. This required systematic treatment planning. All natural structures of hard and soft tissue should be optimally

Figs. 7a–c. Delivery of abutment, transfer guide and a temporary crown.

Fig. 8. After the healing phase, the conditions were stable and the width of the alveolar ridge was sufficient.

Fig. 9. Careful exposure of the implant. The laser ensured a minimally invasive procedure.
preserved and stabilized. This requirement was incorporated into the planning, and the emergence profile of the implant from the soft tissue was considered already at this early stage. The final implant location was based on the existing anatomical parameters and the desired prosthetic restoration (Fig. 3a).

**Initial surgical session**

According to the plan and the drilling protocol, the implant was inserted in region 36 and the bone grafted in the buccal area (Fig. 3b). To fabricate the abutment during the healing phase of the implant, it was necessary to transfer the situation (implant location) from the mouth to the cast model as precisely as possible. The index registration proved successful for this purpose. The implant impression coping was screwed into place in the mouth and the implant location fixed using a plastic index key. After removing the central screw, the key was removed from the mouth with the impression coping and transferred to the dental laboratory with the impression for fabrication of the master cast. A cover screw was used to enable a submerged healing.

**Fabrication of the abutment**

The dental technician used the index key to transfer the exact location of the implant to the cast and to mold a wax-up of the planned prosthetic restoration. Based on this specification, the ideal emergence profile was defined (based on biological width) (Fig. 4). A gingival mask provided the corresponding emergence profile of the basal abutment area. It was important to design the connection between the abutment and the later crown at gingival level to prevent excess cement from compromising the long-term result. A subgingival crown margin significantly increases the risk of overlooked excess cement.

ATLANTIS (DENTSPLY Implants) was chosen to design and fabricate the abutment using CAD/CAM technology. This concept allows custom abutments for cement-retained prosthetic solutions to be created in a simple and efficient manner. After scanning the implant cast (with gingival mask), a detailed three-dimensional image of the intra-oral situation emerged. At the Design & Fabrication Center (ATLANTIS), a virtual abutment was fabricated based on the patient’s specific situation and an image of the situation sent to the treatment team via the web portal (Figs. 5a & b). After assessing the templates and slightly adapting the virtual wax-up in the 3-D editor, the design was released and fabrication of the abutment ordered (Fig. 5c). Zirconium oxide, titanium, and titanium-nitride-coated titanium (GoldHue) are available as materials for implementation. In this case, titanium was the material of choice for the abutment, for reasons of stability. The laboratory received the industrially fabricated abutment just a few days after receiving the ordering information. It fits perfectly on the cast model and required no rework. The instructions were to leave the basal area of the abutment untouched and not polish the abutment in any way. The titanium surface has a certain roughness in the area of the emergence profile, which optimally supports epithelial attachment of the soft tissue (Fig. 6). However, the abutment was not the only component to be fabricated in preparation for the next appointment (Figs. 7a & b). The temporary crown also had to be cemented in the mouth at the appointment for placing the abutment. Therefore, the dental technician fabricated a monolithic crown (CEREC, Sirona) made of lithium disilicate based on the wax-up (Fig. 7c).
The closed healing phase was complication-free and resulted in an osseointegrated implant a few weeks later, as well as a slightly convex profile of the buccal alveolar ridge thanks to the grafting measures. The goal of augmentation was achieved: a 3 mm thick attached gingiva (Fig. 8). In a gentle laser procedure, a small incision was made to expose the implant (Fig. 9). This minimally invasive procedure made it possible to avoid raising the periosteum of the buccal mucosa, which is essential for preserving the grafted bone. The cover screw was removed (Fig. 10) and the abutment inserted. A plastic index key, created in advance in the laboratory, was again used for accurate transfer from the cast to the patient's mouth. With the key attached over the adjacent teeth, the abutment was accurately transferred and screwed onto the implant in the mouth (Figs. 11a & b). A slight anemia in the buccal area confirmed the accuracy of the fit. The contour of the abutment emergence profile blended in well with the intra-oral conditions (Fig. 12). The “preparation margin” was at gingival level as desired (Fig. 13). After ensuring that the abutment met the specifications exactly and that the surface will allow epithelial adhesion in the basal area, the temporary crown fabricated in lithium disilicate using CAD/CAM technology was cemented (Fig. 14). The crown will “train” the bone, and over the coming months, shape the soft tissue profile accordingly before the final restoration is inserted. This way, the healing process and training of the peri-implant gingiva will run undisturbed (one-abutment-one-time).

**Conclusion**

In just two surgical treatment sessions, the gap in region 36 was treated using an implant-supported prosthetic restoration. The restoration met all anatomical, prosthetic, functional and aesthetic requirements. With the CAD/CAM method of fabricating the custom abutment (ATLANTIS), a restoration was realized in an efficient manner that meets the demands of state-of-the-art dentistry. Based on the “one-abutment-one-time” concept, the titanium abutment will not be removed again after insertion in the mouth. Preservation of the bone and training of the peri-implant soft tissue are thereby optimally supported. Since the crown margin was precisely determined during the virtual wax-up based on the emergence profile, the risk of excess cement and any resulting peri-implantitis was significantly reduced. The crown margin was at gingival level, which greatly simplifies removal of any excess cement. The procedure described allows long-term stable results and is ideal for referring practices that can realize the prosthetic restoration in a safe manner after implant placement.

**Editorial note:** A complete list of references is available from the publisher.
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Shortening guided surgical implant times based on a combination of CBCT and digital surface scanners

Authors: Drs Alejandro Lanis & Orlando Álvarez del Canto, Chile

The introduction of digital surface scanners to the dental field and the simplicity of data transfer are closing the gap in the creation of a completely "virtual patient" with the optimisation of the digital treatment workflow. Something that a few years ago sounded like science fiction in dentistry, is possible today owing to the technological advances that have been incorporated into our field. The prosthetic, surgical, radiological and laboratory worlds are being fused in sophisticated digital platforms, enabled by the capacity to import the data obtained from digital surface scanners and the DICOM files into surgical and prosthetic planning software. The complete digitalisation of patients’ information and the possibility to combine it offer several advantages to clinicians and are changing the way in which patients perceive invasive dental treatments. Because of their advantages in providing personalised treatment, intra-oral scanners for digital impressions and surgical simulation software will be used as a fundamental technology for diagnosis, planning, treatment and prevention.

Case report

A 55-year-old healthy female patient presented to our practice desiring mandibular molar...
rehabilitation. She complained about the absence of a mandibular left first molar (tooth 36) owing to an extraction performed several years ago because of failed endodontic treatment. After a complete diagnostic evaluation, including clinical and photographic analysis, a CBCT scan of the left mandible was performed using ProMax 3D s (Planmeca; Figs. 1 & 3a). At the same appointment,

Fig. 3a. A CBCT scan of the mandibular left quadrant.
Fig. 3b. Surface scanning of the edentulous zone.
Fig. 3c. Digital reconstruction of the mandibular left quadrant after the surface scanning process.
Fig. 3d. The digitally reconstructed arches in maximum intercuspation.

Fig. 4a. A lateral view of the initial digital crown design.
Fig. 4b. A lateral view of the maxillae and the mandible in maximum intercuspation with the virtual crown design.
Fig. 4c. An occlusal view of the final crown design.
Fig. 4d. A lateral view of the final crown design.
case report _ CBCT and digital surface scanner

![Fig. 5](image1.png) Multiple views of the 3-D digital implant positioning. Note how the designed virtual crown was used as a digital radiographic template.

![Fig. 6a](image2.png) Implant planning performed using an intra-oral surface scan. 

![Fig. 6b](image3.png) Implant planning checked with the cone beam 3-D reconstruction.

A digital surface scan of the left maxilla, left mandible and of both arches in maximum intercuspal contact was done with a TRIOS digital scanner (3Shape; Figs. 2 & 3b–d). Once all the diagnostic information had been gathered, a treatment appointment was made for the next day.

The digital scan files and the DICOM files obtained from the CBCT were imported into the Implant Studio software (3Shape), in which an innovative technique of spacial recognition allows the creation of a 3-D superimposition of the real intra-oral situation and the radiographic images. A restorative design tool included in Implant Studio was utilised to create a functional and aesthetic virtual crown with the ideal prosthetic position on the reconstructed surface image (Figs. 4a–d). After the final crown evaluation, the 3-D digital implant position was defined to obtain the most convenient prosthetic and surgical result, respecting vital structures, such as the inferior alveolar nerve and vascularity. Thus, the designed virtual crown was used as a radiographic template (Fig. 5).

The planning can be performed using an intra-oral surface scan and can be checked with the cone beam 3-D reconstruction at the same time, assuring the optimum implant position and avoiding any bone fenestration or dehiscence (Figs. 6a & b).

The implant selected was a Tapered Internal implant (BioHorizons; D 4.6 mm x L 10.5, platform D 4.5 mm). Once the implant position had been approved, a teeth-supported virtual surgical guide was designed (Figs. 7a–d). The final guide design...
was sent as an STL file (Figs. 8a–c) to the 3-D print manufacturer, where the surgical guide was fabricated in two hours (Objet Eden260V, Stratasys; Fig. 9). Once the guide had been fabricated, a final try-in was performed on the study model to assess any fit inaccuracies or surgical access problems before sterilising the guide and the BioHorizons guided surgery kit (Fig. 10a).
The next day, the patient returned to our practice for the surgical procedure. After a mouth rinse with 0.12% chlorhexidine gluconate (Oralgene, Laboratorios Maver) for 2 minutes and the disinfection and preparation of the surgical field, local anaesthetic was delivered to the edentulous area (tooth 36 region) by buccal, crestal and lingual infiltrations (2% lidocaine hydrochloride and 1:100,000 epinephrine). After a few minutes, the surgical guide was placed in position and the 4.6 mm-diameter guided tissue punch was utilised through the master cylinder placed in the surgical guide at 1,200 rpm. The guide was then removed and the sectioned soft tissue was removed with a tissue elevator and kept in saline solution (Figs. 10b–d).

Fig. 11a. The 2.0 mm guided key in position in the master cylinder in the surgical guide.
Fig. 11b. The 2.0 mm pilot guided drill was used to begin the osteotomy.
Fig. 11c. The 4.1 mm tapered guided drill was used to widen the osteotomy.
Fig. 11d. The surgical site showing the osteotomy without the surgical guide.
Fig. 11e. The guided implant driver and drill stop key with the Tapered internal implant.
Fig. 11f. Guided implant placement.

Fig. 12a. The implant placed in final position.
Fig. 12b. A healing abutment was placed.
Fig. 12c. A small connective tissue graft was placed in a buccal wedge to create denser and thicker keratinised tissue around the implant.
Fig. 12d. A post-op periapical radiograph of the implant.
The surgical guide was repositioned and a 2.0 mm diameter guided key was placed into the master cylinder. A pilot guided drill of 21 mm in length and 2.0 mm in diameter was utilised to start the osteotomy at 1,200 rpm through the guided key cylinder. The surgical guide system compensates 10 mm in actual drill depth so the final osteotomy in this situation was performed at 11 mm depth (Figs. 11a & b). The procedure was sequentially repeated with the 2.5 mm guided key and tapered guided drill of 21 mm in length and 2.5 mm in diameter, the 3.2 mm guided key and tapered guided drill of 21 mm in length and 3.2 mm in diameter, the 3.7 mm guided key and tapered guided drill of 21 mm in length and 3.7 mm in diameter, and finally the 4.1 mm guided key and tapered guided drill of 21 mm in length and 4.1 mm in diameter (Fig. 11c).

The surgical guide was then removed to check the osteotomy site (Fig. 11d). The guide was then repositioned and the implant was mounted in the 4.6 mm guided implant driver (Fig. 11e). The implant was placed through the master cylinder at 15 rpm and 50 Ncm torque (Fig. 11f). Once the implant was at the final depth position (Fig. 12a), the guided implant driver was removed and a healing abutment (BioHorizons; D 4.5 mm x L 3 mm) was screwed into the implant (Fig. 12b). A small connective tissue graft taken from the soft tissue removed by the tissue punch was then placed in a buccal wedge to gain soft-tissue volume and thickness in the remaining keratinised tissue (Fig. 12c). No sutures were indicated. A postoperative radiograph was taken to evaluate the final implant position.

Conclusion

The combination of digital surface scans and CBCT images for virtual planning for implant surgery can be used for safe and effective non-invasive computer-guided implant placement. Implant Studio is a user-friendly realisation of this innovative technology and can significantly reduce the preoperative preparation procedures and treatment times while maintaining surgical accuracy. In this specific clinical situation, the computer-guided surgical preparation and surgery took no longer than two days, improving the waiting times associated with conventional CBCT guided surgical systems.

We invite anyone interested in this innovative technology to visit our clinic and specialist CAD/CAM training centre in Santiago in Chile, where participants will be involved in practical clinical cases, be given live surgery demonstrations, and attend lectures about guided surgery procedures and CAD/CAM surgical and restorative technologies.

Readers can find a video of the procedure at the following link: https://www.youtube.com/watch?v=2gNwAtWEOUk&feature=youtu.be

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

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The concept of digital study models has often been talked about, particularly in orthodontic circles, as a solution to the considerable physical space required to store plaster models. If a model could be scanned in three dimensions to a high degree of accuracy, stored electronically and then reconstituted should the need arise some time in the future, then the need for physical storage of models could potentially be eliminated.

While there has been talk of this, little in the way of real solutions have been available. Study model scanning services exist but often if you look at the fine print in their terms and conditions, you may not even own the scans of your own models! A more practical alternative is to be able to scan study models in your own laboratory rather than sending them out to be scanned by a third party.

Digital models have many advantages. They are easy to make, inexpensive, very accurate, cost very little to store and transportation is a breeze. Amazingly, you can store over 800 sets of models on one DVD-R disc or an average 500 GB hard drive could hold a staggering 100,000 sets of models! Much better than rooms and rooms full of study models.
I have been working with digital models for some time and have examined several systems on the market today. I have recently found a great new digital study model system with a host of very "useable" features and the best news of all is that it is very affordable.

The Maestro Scanner system consists of a digital 3-D scanner and various software programs so you can easily scan dental models, manipulate the data in various ways and then easily share this data so anyone anywhere with the viewing software can visualise the digital models.

The Maestro Scanner is a smartly designed state-of-the-art structured light 3-D scanner. It uses patterns of light and two digital cameras to measure the surface of the model in three-dimensions. Projecting a narrow band of light onto a three-dimensionally shaped surface produces a line of illumination that appears distorted from other perspectives than that of the projector, and can be used for an exact geometric reconstruction of the surface shape. This is the basis of structured light scanning and in this case, uses no lasers so it's completely safe for anyone to use. It also has great accuracy and is quite speedy in operation. This type of scanning is used by many dental CAD/CAM manufacturers so the technology is well proven for our market.

The Maestro System comes with the Maestro Easy Dental Scan program and I have to say, the name says it all. Put your model into the scanner, click a button or two and you are on your way to a scanned model. However, diving deeper into the program allows you to uncover more complex features if you wish. It even allows you to scan crown and bridge models and acquire multiple dies (up to 8) in one scan. Some of the more advanced C&B scanners are not able to do this. Remember, digital study models are not just for orthodontic purposes but can be used for all dental models. It's a great way to diagnose, discuss and store models.

The quality of the scans is more than impressive with a great amount of detail once the scans are processed. Once you scan the upper and lower models and do a quick occlusal scan, the registering of the scanned models into the correct bite relationship is completely automatic. This is a feature I really like. You can also register the models in various relationships—centric relation; centric occlusion; protrusive or construction bite to name a few. There are also various editing and measuring tools provided and you can do adjustments to the scans if need be. You can save the finished files in industry standard STL or a proprietary ORTHO and ORTHO IPAD file format. File sizes are quite small and easily emailed to clients.

One of the additional notable features of Easy Dental Scan is the option to batch scan.
In many systems, immediately after the scan is completed, it is processed which can take quite a bit of time. With the batch scan, you can quickly scan several models and then complete the processing of the scans at a later time. You simply walk away and the computer does all the work while you get on with something else.

There is also an Ortho Studio program. This starts with a powerful and cleverly thought out database section. Sets of models are sorted by Dental Practice–Dentist–Patient and this is great because it’s very easy to find what you are looking for. It only takes a few minutes to master this section. It is just so easy to use.

When a set of models are loaded, all the information from the database accompanies it so you know exactly what you are looking at. In this section of the program, you will find tools for adding virtual orthodontic bases using various popular angles including ABO 2013, measuring tooth and arch width, occlusal mapping, multiple views, snapshot, printing and much more. It’s extremely easy to use and you are guided through each step in a wizard-like interface. The latest version of Ortho Studio has the ability to perform complex digital diagnostic set-ups and the ability to create files ready for aligner therapy as well as orthodontic bracket placement. This is a powerful system and a valuable tool for any practice or laboratory.

A real bonus of the package has to be the free Ortho Studio Viewer. This program is a cut down version of Ortho Studio but is still feature rich enough for using digital models for diagnosis on an everyday basis. The viewer includes tools for measuring tooth and arch width, occlusal mapping, multiple views, snapshot, printing and more. Of course it’s very easy to use so people will actually use it! This is a great program to give away to people you want to share your digital files with. For example, you may be a lab scanning models for various clients. You can distribute the free viewer to these clients so they can use it to view and diagnose direct from the scans.

Terry Whitty lectures nationally and internationally on a variety of dental technology and material science subjects and runs a busy laboratory in Sydney’s Eastern Suburbs, specialising in high tech dental manufacturing. Using the latest advances in intra- and extra oral scanning, CAD/CAM and 3-D printing technologies, most specialties are covered including fixed and removable prosthetics, orthodontics and computer implant planning and guidance. He also specialises in the latest injection systems for traditional and CAD designed removable prosthetics and various associated dental appliances. His articles appear in various international journals. He can be contacted at www.trulinedental.com.au.
Planmeca makes CAD/CAM easier than ever

Planmeca's open-interface CAD/CAM solutions introduce, above all, quality, cost efficiency and precision to the daily workflow at dental clinics or laboratories. Petri Kajander, product manager of Planmeca’s CAD/CAM solutions, explains the revolutionary features of these new products in this article.

State-of-the-art solutions for dentists: Superfast Planmeca PlanScan

The new Planmeca PlanScan is a digital and powder-free intra-oral scanner that scans the patient's dentition quickly and accurately. The scanner produces real-time digital impressions from one-tooth to full arch scans. Thanks to the open STL data, the scanned files can be sent to any dental laboratory for design work. This is the world's first dental unit-integrated intra-oral scanner that can also be connected to a laptop.

"The scanner has only one cable, so it is extremely easy to move from one place to another, for example between different treatment rooms or clinics," said Kajander. "In addition, the scanner is delivered with a laptop, so the device can be flexibly shared between different users. In other words, Planmeca PlanScan offers value for your investment: it is not a device for just one dentist but can be used by the entire clinic."

The scanner uses the blue-laser technique. It projects a pattern on the surface of the teeth and then analyses it from different directions to calculate distances. In this way, the device is able to calculate a model that is extremely accurate. "You can view the result as a real-time video image. The video recording and the dental surface identification algorithm make the device extremely flexible to use. Thanks to these features, you can pause the scanning at any time and continue later on at any point from where data is already available."

Planmeca PlanCAD Easy, an efficient design tool for prostheses

Planmeca also offers dentists a new kind of open software solution for 3-D design. Planmeca PlanCAD Easy is seamlessly integrated into Planmeca Romexis software, and it is a user-friendly design tool for the design of inlays, onlays, veneers, crowns and bridges.

"The software runs on a floating licence basis. This means that it is not tied to just one computer or workstation, but the work is saved on the Planmeca Romexis server. In this way, the scanning station can be used only for scanning, while another workstation is used for the actual design work. This is a truly unique feature, which allows work to be continued straight away on another computer, while the scanner is freed for more productive operation," said Kajander.

Every dentist who designs his or her own prostheses will also face cases that require assistance from a dental laboratory. For this reason, Planmeca’s system utilises an open STL file format that allows the work to be sent immediately to a partner via the Planmeca Romexis Cloud service.

Since Planmeca PlanCAD Easy is integrated into Planmeca Romexis software, soft-tissue scans can also be conveniently paired with CBCT scans of the patient. This combined data provides valuable information for implant planning, for example, because it visualises the soft tissue and the crown that is designed for the occlusion. This facilitates the planning of the implant screw’s location.

The Planmeca PlanCAD Easy workflow, from preparation to the finished result, includes just five easy stages: work description, scanning, marking of the margin line, automatic design, and sending the work...
to the mill. "Once the work has been sent to the mill, it is transferred there in its entirety and the mill’s computer finishes the work. In this way, the software and scanner are immediately freed for a new assignment."

The software is very user-friendly. All design phases are saved automatically and previous phases can be returned to flexibly if further impressions are needed. The design software automatically takes into account the cusps and marginal ridges of the adjacent teeth, in addition to the contact strengths defined by the user. This creates a design that blends into its surroundings well.

**Planmeca PlanMill 40, a fast and precise milling unit for dental clinics**

Planmeca PlanMill 40 is an extremely precise four-axis milling unit controlled by its own computer. The device is suitable for all single-tooth indications, in other words for the milling of crowns, inlays, onlays and veneers. The mill can manage bridges of up to five units in the posterior area and three units in the anterior area.

Since the mill handles the milled pieces completely independently, as many as several dozen pieces can be sent to the mill at a time. In addition, the device determines which block size, colour and material should be used, so any member of the staff can place the block in the mill. "This saves everyone working time. The dentist does not need to put the block in himself," said Kajander.

Planmeca PlanMill 40 has a six-tool exchange mechanism, and it changes tools independently according to different job requirements. In addition, the device mills different materials according to their properties. For example, it knows how to handle delicate ceramics gently in work phases that require precision. "If you force the material, it may break prematurely. Even the smallest hairline crack in the material can lead to a cemented piece breaking when pressure is applied to it."

Also, the maintenance of the device is easy. The mill’s computer calculates the service life of the tools, monitors wear and reports on these via the user interface. It also calculates the time that milling will take and lets the user know when the tools or water should be replaced. "Similar to a car, a mill requires maintenance at certain intervals and notifies the user of this."

**An ideal solution for laboratories too**

For dental laboratories, Planmeca offers a comprehensive solution that utilises the open STL file format. Planmeca PlanScan Lab is an accurate desktop scanner that uses blue light for scanning gypsum models and impressions. The device scans gypsum models quickly and effortlessly with an accuracy of 15 µm.

Design takes place in the open Planmeca PlanCAD Premium laboratory software, which can be used for the design of all prostheses, ranging from one-tooth units to full arch structures. The software can also be used to design for example individual abutments, night guards, different crowns and bridge work and implant bridges and bars for cement-retained and screw-retained solutions.

The software has an order manager page that lends efficiency to the workflow by reporting each stage of work. In this way, several work orders can be entered into the software in one go. The last phase is always saved in the memory so that work can be continued freely at the most convenient time. In addition, precise values can be set for each workpiece to allow for cement space and the milling unit’s blade.

An open STL file is created from the design, and the design can be manufactured with any milling unit that supports the open file format, including Planmeca PlanMill 50. This milling unit can mill any soft, wet and dry materials and for example glass ceramics. In addition, the file can be sent to a milling centre, such as Planmeca’s own PlanEasyMill milling centre, for manufacture.

**Contact**

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00880 Helsinki, Finland

www.planmeca.com
Inspired by nature: Zirconia Reinforced Composite

Schütz Dental presents a new material combining high performance acrylics and zirconium dioxide. Tizian Zirconia Reinforced Composite blanks enables you to produce final restorations of up to 3 units and temporary restorations of up to 16 units.

These restorations stand out thanks to their outstanding antagonist and TMJ friendly properties. These bionic qualities derive from the moderate Vickers hardness and corresponding elasticity module. Chipping and breakage is reduced. Milling blanks (available in two heights) fit in the 98 millimetre open system holder (Fig. 1) and are suited to dry-milling.

This material is suitable to produce final restorations up to three-unit bridges (Fig. 2). This bridges might even expand to the posterior region. This adds to its suitability for final crown structures as well as fully anatomical crowns, inlays, onlays and veneers. This material can also be used for long-term temporaries for up to a whole arch and lasting for up to two years of wear.

The Tizian Zirconia Reinforced Composite is slightly elastic like the natural tooth and adopts a kind of "buffer function". Chewing forces are spread out in the jaw which reduces the selective stress on the bone. The bone remain intact. Thanks to the excellent physical properties, this material is ideal for implant restorations (Fig. 3) and for use on patients with CMD or Bruxism.

In combination with the veneering composite dialog Occlusal, you can rebuild the physics of the natural tooth as authentically as possible (Fig. 4).

Due to its hardness, the dialog Occlusal applied to the framework of Tizian Zirconia Reinforced Composite creates an accurate likeness to the natural enamel. Together, the two materials recreate the physics of the natural tooth. This is also referred to as the "bionic principle". The system is wear-resistant and abrasion-resistant whilst being gentle on the jaw joint and the antagonists.

Tizian Zirconia Reinforced Composite blanks come in a range of five tooth colours.

Find more information here: http://sdent.eu/bionicprinciple

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3Shape launches Implant Studio for implant planning and surgical guide design

_3Shape, a leading innovation_ company for 3-D scanners and CAD/CAM software solutions, has released its new Implant Studio software to the European market. The solution is designed for use in both clinics and laboratories, and 3Shape is offering Implant Studio in various configuration packages to match the different needs of both.

**_All-in-one solution_**

A solution that finally brings together the latest technologies in implant planning into a single smooth workflow is now available to the market. 3Shape’s solution offers the following:

- a complete digital workflow for dentists and for laboratories;
- all the restorative components provided to the dentist before surgery;
- easy implant planning with intuitive tools that merge the benefits of planning in both 3-D and 2-D;
- virtual crown functionality, offering optimal implant placement in combination with the intended prosthetic design;
- the design of cost-efficient surgical guides ready for local manufacture;
- 3Shape Communicate integration, which makes it easy to receive 3-D surface scans from TRIOS and from 3Shape desktop scanners, and to send approved implant positions for designing abutments and crowns in Dental System; and
- an open software platform: Implant Studio supports open DICOM CT scans and STL surface scans, as well as implant systems (libraries) from major implant manufacturers.

"Implant Studio represents the accumulation of our dental technology expertise and industry knowledge, and that is what makes it stand out among existing solutions," said Flemming Thorup, President and CEO of 3Shape. "We have brought together digital impressions, CBCT scans, and intuitive CAD workflows to form a unique solution. Implant Studio provides optimal results for implant placement and prostheses with high aesthetics, while opening new service options for both clinics and labs that include the provision of full treatment packages to patients."

**_3Shape Dental System integration_**

After planning has been completed, laboratories can directly manufacture restorations and implant components (temporaries, crowns, abutments, and more) in a smooth and integrated workflow, providing dentists with a complete treatment package.

**_Released to the European market_**

Implant Studio has recently passed the strict regulatory process required for market launch in Europe. 3Shape expects to obtain regulatory clearance in the US and other selected markets during 2014.

Implant Studio will be available through 3Shape resellers. Actual availability to end-users will depend on the specific system configuration. Please contact your local 3Shape supplier, or visit www.3shapedental.com regarding reseller information.

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Straumann abutments now available to 3Shape software users

"In addition, 3Shape customers are now able to connect with Straumann dentists and, thus expand their business opportunities," Frank Hemm, Executive Vice-President of Customer Solutions and Education at Straumann, added.

3Shape users who wish to benefit from this opportunity may contact Straumann for information on obtaining the libraries. However, availability will depend on the specific system configurations, the companies stated.

"Many laboratories are steadfast users of both the 3Shape Dental System and Straumann abutments. Now, they can design highly aesthetic and functional customised abutments and send them directly for manufacturing at Straumann—thereby introducing a wider range of choices for dentists and their patients," explained Flemming Thorup, President and CEO of 3Shape.
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**It is time to look at aesthetics from a new angle**

**Fig. 1** A new angle for aesthetics: the ASC abutment from NobelProcera allows the screw channel to be set at an angle between 0 and 25 degrees within a full 360-degree radius. In the anterior region, this makes screw-retained restorations possible where aesthetic considerations would previously have ruled them out. In the posterior region, it offers greater accessibility and retrievability.

**Fig. 2** The unique pick-up function of the Omnigrip screwdriver must be experienced to be fully appreciated. The extraordinary level of grip improves handling and is designed to reduce the risk of the screw detaching in the patient’s mouth.

**Fig. 3** The Omnigrip system is instantly distinguishable from other tooling by blue markings on both the screwdriver and screws.

**True innovation** is about finding new and improved ways to do things. At Nobel Biocare, this means developing new products and solutions to help dental professionals treat more patients better. “Innovation” is a term that is used often, but at Nobel Biocare it is much more than just a word; it is a mission. The company’s Designing for Life strategy has innovation at its heart.

With the new NobelProcera Angulated Screw Channel (ASC) abutment and Nobel Biocare’s unique new Omnigrip tooling, true innovation has been achieved. These products allow clinicians to offer screw-retained restorations in a practical and aesthetic way that would previously have been impossible in some cases.

**Increased restorative flexibility with no cement: It is as easy as A-S-C**

With the NobelProcera ASC abutment, the screw channel can be placed with an angle of up to 25 degrees from the axis of the implant anywhere within a 360-degree radius. In the anterior aesthetic region, this makes it possible to use screw-retained restorations where a buccal screw access hole would previously have ruled them out. When designing the ASC abutment in the NobelProcera Software, the screw access hole can instead be positioned on the lingual side of the restoration. The patient therefore benefits from an optimally aesthetic result without any risk of the issues that can arise with excess cement. Using a screw-retained rather than a cement-retained solution also makes the restoration easier to retrieve.

**Leading restorations now available for a leading implant connection**

In the posterior region, the NobelProcera ASC comes into its own. When used for molars or premolars, the ability to tilt the screw channel into the most convenient position makes it easier for the clinician to place, and access, the restoration.

As a one-piece restoration, the NobelProcera ASC abutment requires less labour from the dental laboratory and so is produced more quickly, reducing costs. This, together with benefits such as improved aesthetics and easier maintenance, can increase the likelihood of patient acceptance. Moreover, once the patient is in the chair, placing just a single piece makes for a more comfortable experience.

The ASC option is available for zirconia abutments on narrow-platform and regular-platform implants with Nobel Biocare’s internal conical connection. This advanced connection is available for Nobel Biocare’s award-winning NobelActive family, as well as on NobelReplace Conical Connec-
tion and NobelReplace Conical Connection PMC (partially machined collar) implants. The conical connection offers a hexagonal internal locking mechanism for a tight seal and high mechanical strength.²

It also allows for platform shifting. This shift moves the implant–abutment junction on to the implant platform, thereby making room for the maximum volume of soft tissue to come up on to the platform edge safely. Platform shifting therefore encourages more natural-looking gingivae for an even better aesthetic result. Moving the junction further away from the bone has also been shown to reduce radiographically detectable crestal bone loss.³–⁵

Given that individualised abutments from NobelProcera allow the optimal emergence profile to be defined, the combined effect is designed to give an unrivalled soft-tissue result. Owing to a titanium adapter, this zirconia option can also be utilised in the posterior region, providing the clinician with an entirely new option for delivering the best possible restoration.

_Come to grips with better handling:
Introducing Omnigrip tooling

The benefits of the ASC abutment are only possible owing to the introduction of the associated Omnigrip tooling. Designed in-house by Nobel Biocare’s product development team, it is more than just a screwdriver; it is a driver of increased clinical success.

The unique tip of the Omnigrip screwdriver allows the screw to be tightened and loosened within the angulated channel with the same accessibility and torque as if the channel were straight. It allows easy handling from multiple angles, even in the posterior region.

The pick-up feature of the special tip is an outstanding feature. The Omnigrip screwdriver grips and holds the screw equally tightly at any angle within the available range. Clinicians will not have experienced tooling like this before. Such is the level of grip that it has to be experienced to be believed. This capability offers convenience and, most importantly, safety. The Omnigrip screwdriver is designed to hold the screw firmly when it matters most: when the clinician is working in the patient’s mouth.

_A new channel of opportunity

Together, the NobelProcera ASC abutment and the Omnigrip tooling offer clinicians not just new treatment possibilities, but opportunities to increase the number of screw-retained restorations they place. Being just one piece, the abutment represents an option that is efficient to produce, but with unique features and benefits that increase patient acceptance. Additionally, overcoming barriers to optimal aesthetics is also likely to improve patient satisfaction. Nobel Biocare innovates to help its customers treat more patients and to treat them better. These new products do just that.

Editorial note: A complete list of references is available from the publisher.
The Academy of Osseointegration is recognized as the premier association for professionals interested in implant dentistry. It has always been at the forefront of scientific advances in dental implant and tissue replacement therapy. In an interview, Annual Meeting chairmen Lyndon Cooper, DDS, PhD, and Donald Clem III, DDS, discuss this year’s meeting, which was held recently, and plans for the 2015 event.

Sierra Rendon: How many people attended AO Annual Meeting 2014?

Dr Lyndon Cooper: More than 2,000 clinicians joined us for the 29th annual meeting of the Academy of Osseointegration (6–8 March 2014, Seattle, USA), which recorded the fourth largest attendance in its history. We had 624 international attendees representing 45 countries and more than 1,100 exhibitors who showcased products and services to support implant dentistry.

Why did AO choose the theme “Real Problems, Real Solutions”?

We have seen that implants are widely applicable and generally successful, and we recognize that clinician education is critical to success among our patients. This year, we sought to inform clinicians that a segment of our population will experience implant complications and failure, but emerging strategies can help them recover success. We encouraged the clinical team to examine implants carefully, address issues promptly and recognize when—and learn how to—intervene to preserve dental implant and patient health.

What were some highlights of the clinical sessions?

Leading experts led the program with insights on who experiences complications, why they occur and what evidence says about how well we address these complications. Consistent with the plan, a broad range of data was presented. The early focus on periimplantitis opened the minds of the audience, while the closing futuristic presentations certainly left everyone feeling inspired. Our clinical presentations anchored the meeting by demonstrating what good science offers great clinicians who adopt an evidence-based approach to caring for people.

Was research a big focus of the meeting?

Yes, presentations ranged from digital planning, new aesthetic techniques and prevention strategies to molecular strategies and stem cell biology. Abstract presentations explored original scientific and clinical research, clinical innovations and case presentations that could help shape the future of implant dentistry. We had a record number of more than 250 Scientific Posters as well.

The new board of directors was also announced in Seattle. How does the AO enjoy such a seamless transition in leadership?

Approaching its 30th year, the AO is fortunate to have organization leadership and leadership development that are very carefully managed. We are all very excited to announce that Dr. Joseph Gian-Grasso, a periodontist from Philadelphia, was elected to serve as the 2014–2015 president of AO. He will follow in the footsteps of a very successful president, Stephen Wheeler, DDS. Dr. Gian-Grasso—along with the rest of us—will remain committed to establishing a nexus where specialists and generalists from around the world can come together to learn and stay up-to-date on the rapidly advancing clinical research and innovations in the dental implant and tissue engineering industries.

Have you already started planning for AO 2015?

Yes, because it’s AO’s 30th anniversary, we’re all very excited about it. Mark the calendar now to join us in San Francisco from 12 to 14 March 2015,
where we plan to on the power of collaboration to advance the art and science of dental implant therapy.

_Can you give us a few glimpses at what’s in store for next year?_

The opening symposium will feature teams of doctors presenting on how they manage patients together for optimal results. The keynote speaker will be Dr Daniel Alam, who was a member of the multi-disciplinary team of doctors and surgeons at Cleveland Clinic who performed the first near-total face transplant in the United States. He will speak to the critical importance of different disciplines coming together to support a patient’s medical, surgical and emotional needs to make them whole again.

AO also will take a look at what the academy has learned throughout its 30-year history and summarize current recommendations to address the most challenging conditions in implant dentistry. AO has enlisted some of the foremost authorities in both surgical and restorative dentistry to share their knowledge and views to support this initiative.

Keeping with AO tradition, we also want to ensure the closing symposium doesn’t disappoint. It will be an interactive session where attendees can vote on keypads to give their opinion on various treatment options for presented cases. A panel of experts will also discuss and debate the options.

_What are you most excited about for the meeting?_

At the annual meeting, we are excited to build on AO’s past and chart the way for its future. This will be done via top-notch surgical and restorative tracks, as well as a “Morning with the Masters,” for which AO has put together an outstanding group of experts to give attendees pearls that can be used in the office on Monday morning. Ultimately, patient safety and benefit must be based on sound evidence—that’s what the academy is all about and our annual meetings are as well. To learn more about AO membership, please visit our website (www.osseo.org/NEWmembership.html).

_Thank you very much for the interview._

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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, CA, USA
www.estheticacademy.org

ICOI Summer Implant Prosthetic Symposium
21–23 August 2014
Chicago, USA
www.icoichicago2014.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

ESCD Annual Meeting
9–11 October 2014
Rome, Italy
www.escdonline.eu

155th ADA Annual Session
9–12 October 2014
San Antonio, USA
www.ada.org

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

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

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Questions?

Magda Wojtkiewicz (Managing Editor)
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