special
Smile analysis and smile design

technique
Team players: efficiency and aesthetics

case report
CAD/CAM custom-milled titanium bar for rehabilitation of an atrophic upper jaw
Digital technology
determines daily routine in modern dental practice

Digital dental procedures are increasingly becoming an essential part of the daily routine in the modern dental practice. They render patient management and treatment planning processes more economical and increase time efficiency. At IDS 2015, digital technologies thus became a core subject, many exhibitors presented their latest product solutions in the field.

At IDS 2015, the digital technology offerings available for dental practices formed a focal point for all visitors in the fields of dentistry and dental technology.

The exhibited product ranges contribute to simplifying workflows and, as a result, to reducing treatment times. They create synergies with the digital range for dental laboratories, yielding positive implications for practice management and therapeutic procedures. That is why the state of the art in digital technology for dental practices was a major topic at IDS 2015, said Dr Martin Rickert, Chairman of the Association of German Dental Manufacturers. Presented products included software for efficient patient management and integrated treatment planning, as well as digital imaging devices, including CBCT and CT, which have been used alongside conventional radiographic techniques in recent years.

IDS 2015 gave also special attention to digital scanners, which offer a wide range of advantages for patient-specific restorations and implant planning. In particular, intraoral scanners were in the spotlight, as they have contributed significantly to making prosthetic treatment workflows simpler and more precise.

Overall, both patients and dentists benefit from the use of digital technologies. They help shorten treatment time and reduce the number of work stages, and enable the dentist to immediately examine and explain preparations on screen. Furthermore, the data gained through digital procedures can be quickly processed in the dental practice and sent to dental laboratories.

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Virtual reality simulation

Indications and perspectives for the technology in the field of dental education

Authors: Dr Susan Bridges, Suzanne Perry & Prof. Michael Burrow, Hong Kong & Australia

Virtual reality (VR) simulation inevitably conjures up images of futuristic technology, imaginary worlds or complex robotic devices. What it may not initially suggest is the use of virtual technology as a means of training dental students and dentists, facilitating the development of skills in a safe and relaxed environment.

An increase in demand for simulation units over the last ten to 10 years has indicated growing interest from dental schools, suggesting a certain confidence that simulation systems have potential as a recognised form of dental skills training in the future. Using technology inspired primarily from the flight simulation industry, dental simulators are now able to create an environment in which users can practise clinical procedures, such as restorative dentistry, endodontics, periodontal assessment, implant placement and even dental extractions.

These systems are a far cry from the first phantom head simulator created in the early 1900s that attempted to represent the oral cavity with a relatively primitive set of upper and lower dental casts mounted on a metal pole (Fig. 1). Although phantom head systems are now the mainstay for undergraduate training, educationalists are becoming more aware of the additional benefits of VR simulation, such as the ability to repeat the same task many times, providing real-time feedback leading to a reduction in supervision, and the benefits of students being able to practise in their free time without laboratory supervisors. Other benefits of VR simulators include the reduction of consumable costs incurred with plastic teeth and the elimination of water system management issues, reducing the possibility of water-borne infections such as Legionella.

Undoubtedly, the initial cost of the VR simulators is a major deterrent and, with additional concerns regarding possible lack of realism to the clinical situation, it is natural that many suggest the need for more evidence-based research prior to committing to such an investment.

In the limited literature on VR dental simulation, studies have been mixed but, in general, are positive about the use of the technology for dental training. Research has shown that procedural learning on VR simulators may be more effective than with the traditional phantom head and may reduce the number of staff—student interactions without a reduction in the quality of the practical work.

In contrast, other research has shown that dental performance may be no better using VR simulation and that some students prefer their training to be on phantom heads. Naturally, further research will be needed to establish the effectiveness of the technology.
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What are haptics?

The addition of haptics to VR technology creates a dimension of sensory feedback for the user. The word itself originates from the Greek work haptikos, which means “to touch or grasp”. There are many examples of haptic simulation in modern-day technology, such as in gaming and the vibration component of a mobile phone. The aim of haptics in many cases, and especially simulation, is to improve the realism of the virtual experience. In dentistry, for example, when carrying out a cavity preparation on a haptic VR simulator, there is a difference in hardness felt when cutting from enamel to dentine, and if the pulp is damaged an instant loss of resistance occurs, producing a realistic sensation of drilling through the roof of the pulp chamber (Figs. 2 & 3).

Initially, the important question is, does the addition of haptic technology really make a difference when learning using VR simulation? To answer this, we have to delve into surgical research for which a stronger evidence base exists, specifically in the area of laparoscopy. A review of the use of haptics in surgery suggested that the addition of haptics to simulation can reduce surgical errors and is especially beneficial in the early stages of learning a new skill task.1 Other studies have shown that the addition of haptics may improve overall performance of surgical skills and may be beneficial when a trainee is first exposed to a clinical situation. In dentistry, small-scale studies of haptic VR simulators suggest that they are at least as good as phantom heads in training undergraduates.

The future of VR simulation in dentistry

Currently, exciting research involving the universities of Hong Kong and Melbourne is looking into gaining solid evidence concerning the use of haptic VR simulation in the dental undergraduate curriculum. By utilising neuroimaging techniques, identification of the traits an expert usually displays can occur, which in turn can be built into training pathways to enhance the effectiveness of procedural learning.

Initial findings have suggested that distinct differences may be apparent in the brains of dental experts and novices during a simulated clinical task when using a dental haptic VR simulator. Further work in this area is to be carried out, with additional investigation into the positioning of haptic VR simulation within a curriculum and considering its effectiveness compared with traditional phantom head training techniques.

Already it can be seen that the area of VR in dentistry and especially that of haptic VR simulation is proving an interesting development, offering encouraging prospects for the future skills-based training of dentists. The evidence is limited, however, so, prior to commending this technology as the mainstay of training in dental undergraduate curricula, there is a compelling need to expand the current research base.

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**Fig. 3** An image of a cut tooth from the Simodont haptic VR simulator.

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**Introduction:**

Smile analysis and aesthetic design

Dental facial aesthetics can be defined in three ways.

Traditionally, dental and facial aesthetics have been defined in terms of macro- and micro-elements. Macro-aesthetics encompasses the interrelationships between the face, lips, gingiva, and teeth and the perception that these relationships are pleasing. Micro-aesthetics involves the aesthetics of an individual tooth and the perception that the colour and form are pleasing.

Historically, accepted smile design concepts and smile parameters have helped to design aesthetic treatments. These specific measurements of form, colour, and tooth/aesthetic elements aid in transferring smile design information between the dentist, ceramist, and patient. Aesthetics in dentistry can encompass a broad area—known as the aesthetic zone.

Rufenacht delineated smile analysis into facial aesthetics, dentofacial aesthetics, and dental aesthetics, encompassing the macro- and micro-elements described in the first definition above. Further classification identifies five levels of aesthetics: facial, orofacial, oral, dentogingival, and dental (Table 1).

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Authors: Prof. Edward A. McLaren & Lee Culp, USA
Special smile analysis and smile design

Initiating smile analysis: Evaluating facial and orofacial aesthetics

The smile analysis/design process begins at the macro level, examining the patient’s face first, progressing to an evaluation of the individual teeth, and finally moving to material selection considerations. Multiple photographic views (e.g., facial and sagittal) facilitate this analysis.

At the macro level, facial elements are evaluated for form and balance, with an emphasis on how they may be affected by dental treatment. During the macro-analysis, the balance of the facial thirds is examined (Fig. 1). If something appears unbalanced in any one of those zones, the face and/or smile will appear unaesthetic.

Such evaluations help determine the extent and type of treatment necessary to affect the aesthetic changes desired. Depending on the complexity and uniqueness of a given case, orthodontics could be considered when restorative treatment alone would not produce the desired results (Fig. 2), such as when facial height is an issue and the lower third is affected. In other cases—but not all—restorative treatment could alter the vertical dimension of occlusion to open the bite and enhance aesthetics when a patient presents with relatively even facial thirds (Fig. 3).

Evaluating oral aesthetics

The dentolabial gingival relationship, which is considered oral aesthetics, has traditionally been the starting point for treatment planning. This process begins by determining the ideal maxillary incisal edge placement (Fig. 4). This is accomplished by understanding the incisal edge position relative to several different landmarks. The following questions can be used to determine the ideal incisal edge position:

- Where in the face should the maxillary incisal edges be placed?
- What is the proper tooth display, both statically and dynamically?
- What is the proper intra- and inter-tooth relationship (e.g., length and size of teeth, arch form)?
- Can the ideal position be achieved with restorative dentistry alone, or is orthodontics needed?

In order to facilitate smile evaluation based on these landmarks, the rule of 4.2.2—which refers to the amount of maxillary central display when the lips are at rest, the amount of gingival tissue revealed, and the proximity of the incisal line to the lower lip—is helpful (Fig. 5). At a time when patients perceive fuller and brighter smiles as most aesthetic, 4 mm of maxillary central incisor display while the lips are at rest may be ideal. In an aesthetic smile, seeing no more than 2 mm of gingiva when the patient is fully smiling is ideal. Finally, the incisal line should come very close to and almost touch the lower lip, being no more than 2 mm away. These guidelines are somewhat subjective and should be used as a starting point for determining proper incisal edge position.
special smile analysis and smile design

Fig. 4. Evaluating the maxillary incisal edge position is the starting point for establishing oral aesthetics.

Fig. 5. According to the 4.2.2 rule, this patient’s smile is deficient in aesthetic elements, having only 1 mm of tooth display at rest (left), minus 3 mm of gingival display, and 4 mm of space between the incisal edge and the lower lip (right).

Fig. 6. Gingival symmetry in relation to the central incisors, lateral incisors and canines is essential to aesthetics. Optimal aesthetics is achieved when the gingival line is relatively horizontal and symmetrical on both sides of the midline in relation to the central incisors and lateral incisors.

Fig. 7. The aesthetic ideal from the gingival scallop to the tip of the papilla is 4–5 mm.

_Dentogingival aesthetics_

Gingival margin placement and the scalloped shape, in particular, are well discussed in the literature. As gingival heights are measured, heights relative to the central incisor, lateral incisor, and canine in an up/down/up relationship are considered aesthetic (Fig. 6). However, this may create a false perception that the lateral gingival line is incisal to the central incisor. Rather, in most aesthetic tooth relationships, the gingival line of the four incisors is approximately the same line (Fig. 6), with the lateral incisor perhaps being slightly incisal. The gingival line should be relatively parallel to the horizon for the central incisors and the lateral incisors and symmetric on each side of the midline.9 The gingival contours (i.e., gingival scallop) should follow a radiating arch similar to the incisal line. The gingival scallop shapes the teeth and should be between 4 mm and 5 mm (Fig. 7).

Related to normal gingival form is midline placement. Although usually the first issue addressed in smile design, it is not as significant as tooth form, gingival form, tooth shape, or smile line.

Several rules can be applied when considering modifying the midline to create an aesthetic smile design:

_The midline only should be moved to establish an aesthetic intra- and inter-tooth relationship, with the two central incisors being most important._

_The midline only should be moved restoratively up to the root of the adjacent tooth. If the midline is within 4 mm of the centre of the face, it will be aesthetically pleasing._

_The midline should be vertical when the head is in the postural rest position._

_Evaluating dental aesthetics_

Part of evaluating dental aesthetics for smile design is choosing tooth shapes for patients based on their facial characteristics (e.g., long and dolichocephalic, or squarish and brachycephalic). When patients present with a longer face, a more rectangular tooth within the aesthetic range is appropriate. For someone with a square face, a tooth with an 80% width-to-length ratio would be more appropriate.
The width-to-length ratio most often discussed in the literature is between 75% and 80%, but aesthetic smiles could demonstrate ratios between 70% and 75% or between 80% and 85% (Figs. 8–10).1

The length of teeth also affects aesthetics. Maxillary central incisors average between 10 mm and 11 mm in length. According to Magne, the average length of an unworn maxillary central to the cementoenamel junction is slightly over 11 mm.10 The aesthetic zone for central incisor length, according to the authors, is between 10.5 mm and 12 mm, with 11 mm being a good starting point. Lateral incisors are between 1 mm and a maximum of 2 mm shorter than the central incisors, with the canines slightly shorter than the central incisors by between 0.5 mm and 1 mm (Fig. 11).

The inter-tooth relationship, or arch form, involves the golden proportion and position of tooth width. Although it is a good beginning, it does not reflect natural tooth proportions. Natural portions demonstrate a lateral incisor between 60% and 70% of the width of the central incisor, and this is larger than the golden proportion.11 However, a rule guiding proportions is that the canine and all teeth distal should be perceived to occupy less visual space (Fig. 12). Another rule to help maintain proportions throughout the arch is 1–2–3–4–5; the lateral incisor is two-thirds of the central incisor and the canine is four-fifths of the lateral incisor, with some latitude within those spaces (Fig. 13). Finally, contact areas can be moved restoratively up to the root of the adjacent tooth. Beyond that, orthodontics is required (Fig. 14).

Creating a digital smile designed in Photoshop

Although there are digital smile design services available to dentists for a fee, it is possible to use Photoshop CS5 software (Adobe Systems) to create and demonstrate for patients the proposed smile design treatments. It starts by creating tooth grids—predesigned tooth templates in different width-to-length ratios (e.g., 75% central, 80% central) that can be incorporated into a custom smile design based on patient characteristics. You can create as many different tooth grids as you like with different tooth proportions in the aesthetic zone. Once completed, you

Figs. 8–10. Acceptable width-to-length ratios fall between 70% and 85%, with the ideal range between 80% and 85%.

Fig. 11. An acceptable starting point for central incisors is 11 mm in length, with lateral incisors 1–2 mm shorter than the central incisors, and canines 0.5–1 mm shorter than the central incisors for an aesthetic smile display.

Fig. 12. The canines and other teeth distally located are visually perceived as occupying less space in an aesthetically pleasing smile.

Fig. 13. A general rule for achieving proportionate smile design is that lateral incisors should measure two-thirds of the central incisors and canines four-fifths of the lateral incisors.

Fig. 14. If feasible, the contact areas can be restoratively moved up to the root of the adjacent tooth.
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Fig. 15

Fig. 16

Fig. 17

Fig. 18

Fig. 19

Fig. 20

Fig. 21

Fig. 22

create conversion factor: Divide proposed length by existing length e.g. 1.1 divided by 8.5 equals 1.29
will not have to do this step again, since you will save the created tooth grids and use them to create a new desired outline form for the desired teeth.

Follow these recommended steps:

1. To begin creating a tooth grid, use a cheek-retracted image of an attractive smile as a basis (e.g., one with a 75% width-to-length ratio). Open the image in Photoshop and create a new clear transparent layer on top of the teeth (Fig. 15). This transparent layer will enable the image to be outlined without the work being embedded into the image.

2. Name the layer appropriately and, when prompted to identify your choice of fill, choose “no fill,” since the layer will be transparent, except for the tracing of the tooth grid.

3. To begin tracing the tooth grid, activate a selection tool, move to the tool palette, and select either the polygonal lasso tool or the magnetic lasso tool. In the authors’ opinion, the polygonal works best. Once activated, zoom in (Fig. 16) and trace the teeth with the lasso tool.

4. To create a pencil outline of the tooth, with the transparent layer active, click on the edit menu in the menu bar; in the edit drop-down menu, select "edit > stroke," then use a two-pixel stroke line (with colour set to black) to trace your selection. Make sure the transparent layer is the active working layer.

5. Image of the central incisor with a two-pixel black stroke (tracing).

6. Image of the teeth traced up to the second premolar to create a tooth grid.

7. To determine the digital tooth size, a conversion factor is created by dividing the proposed length by the existing length of the tooth.

8. Select the ruler tool in Photoshop.

9. Measure the digital length of the central incisor using the ruler tool.

10. Create a new transparent layer and mark the new proposed length with the pencil tool.
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“I special smile analysis and smile design

“stroke”; choose black for colour, and select a two-pixel stroke pencil line (Fig. 17), which will create a perfect tracing of your selection. Click “OK” to stroke the selection. Select (trace with the lasso selection tool) one tooth at a time and then stroke it (Fig. 18). Select and stroke (trace) the teeth up to the second premolar (the first molar is acceptable; Fig. 19).

The image should be sized now for easy future use in a smile design. In the authors’ experience, it is best to adjust the size of the image to a height of 720 pixels (Fig. 20) by opening up the image size menu and selecting 720 pixels for the height. The width will adjust proportionately.

At this time, the tooth grid tracing can be saved, without the image of the teeth, by double-clicking on the layer of the tooth image. A dialog box reading “new layer” will appear; click “OK.” This process unlocks the layer of the teeth so it can be removed. Drag the layer of the teeth to the trash, leaving only the layer with the tracing of the teeth (Fig. 21). In the file menu, click “save as” and choose “.png” or “.psd” (Photoshop) as the file type. This will preserve the transparency. You do not want to save it as a JPEG, since this would create a white background around the tracing. Name the file appropriately (e.g., 75% W/L central).

By tracing several patients’ teeth that have tooth size and proportion in the aesthetic zone and saving them, you can create a library of tooth grids to custom design new teeth for your patients who require smile designs.

The Photoshop smile design technique

The Photoshop Smile Design (PSD) technique can be done on any image, and images can be combined to show the full face or the lower third with lips on or lips off. This article demonstrates how to perform the technique on the cheek-retracted view.

The first step in the PSD technique is to create a digital conversion of the actual tooth length and width, and then digitally determine the proposed new length and proportion of the teeth.

Determining digital tooth size

To determine digital tooth size, follow these steps:

Create a conversion factor by dividing the proposed length (developed from the smile analysis) by the existing length of the tooth.

The patient’s tooth can be measured in the mouth or on the cast (Fig. 22). If the length measures 8.5 mm but needs to be at 11 mm for an aesthetic smile, divide 11 by 8.5. The conversion factor equals 1.29, a 29% digital increase lengthwise.

Open the full-arch cheek-retracted view in Photoshop, and zoom in on the central incisor.

Select the eyedropper palette. A new menu will appear. Select the ruler tool (Fig. 23).
Click and drag the ruler tool from the top to the bottom of the tooth to generate a vertical number, in this case 170 pixels (Fig. 24). Multiply the number of pixels by the conversion factor. In this case, $170 \times 1.29 = 219$ pixels; 219 pixels is digitally equivalent to 11 mm (Fig. 25). Determine the digital tooth width using the same formula.

Create a new layer, leave it transparent, and mark the measurement with the pencil tool (Fig. 26).

**Applying a new proposed tooth form**

Next, follow these steps:

- After performing the smile analysis and digital measurements, choose a custom tooth grid appropriate for the patient. Select a tooth grid based on the width-to-length ratio of the planned teeth (e.g., $80/70/90$ or $80/65/80$). Open the image of the chosen tooth grid in Photoshop and drag the grid onto the image of teeth to be smile designed (Fig. 27).
- If the shape or length is deemed inappropriate, press the command button (control button for PCs) and “z” to delete and select a suitable choice.
- Depending on the original image size, the tooth grid may be proportionally too big or too small. To enlarge or shrink the tooth grid created (with the layer activated), press command (or control) and “t” to bring up the free transform function. While holding the shift key (holding the shift key allows you to transform the object proportionally), click and drag a corner left or right to expand or contract the custom tooth grid.
- Adjust the size of the grid so that the outlines of the central incisors have the new proposed length. Move the grid as necessary using the move tool so that the incisal edge of the tooth grid lines up with the new proposed length (Fig. 28).
- Areas of the grid can be individually altered using the liquify tool (Fig. 29).

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**Fig. 31** Use the selection modify tool to expand the selection to better fit the grid shape.

**Fig. 32** Activate the layer of the teeth by clicking on it. Blue-coloured layers are active.

**Fig. 33** With the layer of the teeth highlighted, choose “liquefy”; a new window will appear with a red background called a “mask”.

**Fig. 34** Shape one tooth at a time as needed by selecting “wand”.

**Fig. 35** Once all of the teeth have been shaped, use the liquify tool.
Digitally creating new aesthetic teeth

Next, follow these suggested steps:

1. With the new tooth grid layer and the magic wand tool both activated, click on each tooth to select all of the teeth in the grid (Fig. 30).
2. Expand the selection by two pixels in the expand menu; click “select > modify > expand” (Fig. 31). Note that the selection better approximates the grid. You can expand the selection or contract as necessary using the same menu.
3. Activate the layer of the teeth (cheek-retracted view) by clicking on it (Fig. 32).
4. Next, activate the liquify filter (you will see a red mask around the shapes of the proposed teeth). The mask creates a digital limit that the teeth cannot be altered beyond. This is similar to creating a mask with tape for painting a shape (Fig. 33).
5. Use the forward warp tool by clicking on an area of the existing tooth and dragging to mold/shape the tooth into the shape of the new proposed outline form (Fig. 34).

Repeat this for each tooth. If you make a mistake or do not like something, click command (or control) and “z” to go back to the previous edit (Fig. 35).

Adjusting tooth brightness

The following steps are recommended next:.

1. Select the whitening tool (dodge tool) to brighten the teeth. In the dodge tool palette, click on “middle tones” and set the exposure to approximately 20%. Click on the areas of the tooth you want brightened (Figs. 36 & 37).
2. Alternatively, with the teeth selected, you can use the brightness adjustment in the brightness/contrast menu; click “image > adjustments > brightness/contrast”.

Performing the changes on only one side of the mouth allows the patient to compare the new smile design to his/her original teeth before agreeing to treatment.

Create a copy

To save the information you have created for presentation to the patient, follow these tips:

1. Go to “file” and select “save as.”
2. When the menu appears, click on the “copy” box.
3. Name the file at that step.
4. Save it as a JPEG file type.
5. Designate where you want it saved.
6. Click “save.”

A file of the current state of the image will be created in the designated area. You can now continue working on the image and save again at any point you want.

Conclusion

Knowledge of smile design, coupled with new and innovative dental technologies, allows dentists to diagnose, plan, create, and deliver aesthetically pleasing new smiles. Simultaneously, digital dentistry is enabling dentists to provide what patients demand: quick, comfortable, and predictable dental restorations that satisfy their aesthetic needs.

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

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Full-contour posterior restorations made with translucent zirconium oxide

Author_ Dieter Knappe, Germany

Introduction

This article is written in celebration of zirconium oxide, a material which has firmly established itself in the dental laboratory over the past 15 years or so. If appropriately used, zirconium oxide restorations produce very strong and durable results. They also satisfy demanding aesthetic requirements due to their translucent properties. The following case study shows how monolithic zirconium oxide is effectively incorporated into the digital manufacturing chain to produce highly cost-effective dental restorations without having to compromise on aesthetics. In the case presented, a wax-up was crafted which served as a basis for fabricating a provisional restoration (TelioR CAD for Zenotec, Wieland Dental) and a permanent restoration (Zenostar Zr Translucent, Wieland Dental) with one digital data set and CAD/CAM milling equipment.

Preoperative situation

The patient presented to the dental practice with a fractured ceramic inlay restoration in tooth 26 which she wished to have replaced. The tooth had been restored many years previously. Since tooth 25 and tooth 35 were discoloured as a result of root canal treatment, they were included in the treatment plan. The existing tooth structure of tooth 26, which had been prepared to accommodate the inlay in the past, was preserved to the best possible extent. The patient had very high aesthetic expectations and wanted the explicit assurance that the crowns would look completely natural. Nonetheless, we decided to use a very efficient fabrication method in which monolithic restorations are produced with translucent zirconium oxide (Zenostar Zr Translucent). Three options are available for fabricating monolithic restorations with this approach:
1. milling, sintering, glazing (efficient, cost-effective);
2. milling, sintering, individualization with ceramic characterization materials, glazing;
3. milling, individualization with infiltration liquids, sintering, glazing (highly aesthetic).

We chose to pursue the third method, which would be very cost-effective as a result of the benefits offered by the digital workflow.

Advanced zirconium oxide

Zirconium oxide is more than twice as strong as other dental ceramics, and it exhibits excellent mechanical properties. Due to its translucent characteristics, the material has been fulfilling highly aesthetic requirements for quite some time now. The material is used to fabricate full-contour (monolithic) restorations and 20 frameworks that provide a base for individualized veneers. The zirconium oxide material Zenostar Zr Translucent shows excellent light transmission. In this system, efficiency teams up with aesthetics to offer impressive results. The wide range of discs, the matching stains and the brush infiltration technique allow lifelike effects to be imparted to restorations in a relatively short time.

Preparation

The following aspects were paramount in preparing teeth 25, 35 and 26 for the ceramic restorations: avoidance of sharp edges and observation of a minimum wall thickness. The benefits of using zirconium oxide include the material’s high strength and as a consequence, the fact that very little tooth structure needs to be removed. The cavity in tooth 26 already showed extensive preparation. However, in order to properly anchor the new restoration, re-preparation was shown to be inevitable. The cavity had to be extended towards the buccal aspect. Despite being very

Figs. 3 & 4. CAD/CAM images of the scanned wax-up and the PMMA-based long-term temporaries (Teilo CAD for Zenotec).
Fabrication of long-term temporaries

According to the treatment plan, the patient would have to wear long-term temporaries for a period of several months. In order to fabricate these restorations, a wax-up was created (Figs. 1 & 2). In this type of situation we prefer to use the manual wax-up technique, because we have found this method to be faster. Alternatively, the restorations could have been virtually designed. Irrespective of the method used, a lasting result can only be achieved if the technician has an in-depth knowledge of the principles of functional occlusion.

The waxed up crowns were transformed into long-term temporaries with CAD/CAM equipment. First, the physical models and wax-ups were digitally scanned (Zenotec D500, Wieland Dental) and the STL file was imported into a corresponding design software [DentalDesigner™, 3Shape] (Fig. 3). Then, all the parameters were suitably adjusted and the construction data was transferred to the milling machine (Zenotec select, Wieland Dental), where the restoration was cut from a PMMA-based disc (Telio CAD for Zenotec) (Figs. 4 & 5).

The milled crowns were re-worked only minimally and then placed on the model. In order to impart the PMMA restorations with a natural-looking appearance, their surface texture was finished in such a way that a natural play of light was achieved. The crowns were subsequently polished with a special polishing medium and goat’s hair brushes (Fig. 6a). Next, the clinician removed the chairside provisional restorations and cemented the long-term temporaries with a suitable luting composite (TelioR CS Link) (Fig. 6b).

Fig. 5 The milled crowns before they were trimmed from the PMMA disc.
Fig. 6a The completed long-term temporaries made of PMMA on the model and...
Fig. 6b … in the mouth.

Fig. 7 Same digital data set: preparation for the fabrication of the zirconium oxide crowns (Zenostar Zr Translucent) with CAD/CAM equipment.
Fabrication of the permanent restorations

Three months later, it was time to focus on the permanent restorations. In an effort to keep the treatment with monolithic restorations as straightforward as possible, the existing data set, which had been validated by means of the long-term temporaries, was used (Fig. 7). We selected the translucent zirconium oxide Zenostar Zt Translucent for the restorations. This material comes in disc form and in six different shades. We decided to use the "sun" variant, which would give the restorations a warm, reddish foundation. Various possibilities of finishing the restoration were available after the milling process (Zenotec select) (Fig. 8). In this case, the unsintered structures were characterized with the colour infiltration method.

Figs. 9a & b. The unsintered structure is carefully ground and smoothed.
Figs. 10a & b. Brush infiltration before sintering: The colouring liquid is applied in the cervical areas.
The charm of this colourless liquid lies in the fact that it can be made visible. For this purpose a drop of colour concentrate (Zenostar VisualiZr, Wieland Dental) is added to the solution. As a result, the individual liquids can be easily distinguished from each other when they are brushed on the restoration. The colouring material is composed of organic pigments which fire without leaving any significant residue. Next, the restorations were sintered at 1,450°C (Zenotec Fire P1, Wieland Dental). After the sintering process, the crowns appeared lifelike and showed a warm and natural glow due to the reddish zirconium oxide used. Only a few minor adjustments had to be made on the basis of the inspection on the model. As a result, this approach not only ensures savings in terms of time and money, but it also heightens quality assurance.

At this stage—before the staining materials were applied—the zirconium oxide crowns were polished and the surfaces were smoothed (Fig. 12). This effectively counteracted the common concern of abrasion.

Before the crowns were fired, a glaze (Zenostar Magic Glaze, Wieland Dental) was sprayed on their surfaces in order to establish an even base for the application of the staining materials. Stains in paste form (Zenostar Art Module Pastes, Wieland Dental) were used to characterize the restorations. The pastes had to be mixed to a soft, smooth consistency before they could be applied. The cervical and incisal areas of the restorations were individualized with the stains (Fig. 13). A film of glaze was sprayed on the restorations (Fig. 14) before they were fired. The combination of the stains and the lightly fluorescent spray glaze produced a three-dimensional effect.
After the final firing, the crowns did not appear any different from layered restorations. On the contrary, they looked very lifelike and showed a natural internal play of colour. In the next step, the occlusal contacts were checked in the articulator and the proximal contacts on the model. Then the crowns were sent to the dental practice for placement.

**Seating of the restorations**

Teeth 25, 35 and 26 were suitably prepared for the permanent restorations. Unfortunately, the attempt to save tooth 26 failed. The buccal crown wall fractured when the long-term temporary was removed. Right from the beginning, we were aware of the fact that the remaining part of this tooth might not be strong enough to withstand the treatment.

At this stage, therefore, it became quite clear that the tooth could not be preserved. Consequently, the long-term temporaries were re-seated and a new treatment plan was presented to the patient for tooth 26 on the basis of a detailed analysis. A few weeks later, the permanent all-ceramic crowns were cemented (SpeedCEM) on tooth 25 and tooth 35. The plan was to replace tooth 26 with an implant-supported restoration at a later date.

**Conclusion**

The monolithic zirconium oxide crowns on tooth 25 and tooth 35 were indiscernible from the other teeth (Figs. 15 & 16). The patient reported that she was able to chew comfortably and naturally. The CAD/CAM fabrication protocol allowed the crowns to be cost-effectively produced. The translucent material (Zenostar Zr Translucent) that was used in this case showed a high level of light transmission. Therefore, it offered the ideal basis for reproducing the optical properties of the natural teeth. The described approach will help to satisfy the rising number of cost-conscious and aesthetically discerning patients, since it offers an attractive alternative to individually layered ceramic crowns and cast crowns made of precious or non-precious metal.

**Fig. 13 & 14** The stains were applied and sprayed with another coating of glaze.

**Fig. 15** The zirconium oxide crown on tooth 25 immediately after it was placed. Tooth 26 was provisionally restored with a PMMA crown.

**Fig. 16** A suitable alternative to a veneered crown and a cast crown – the full-contour zirconium oxide crown on tooth 35. It smoothly blends into the surrounding dentition.

**Contact**

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CAD/CAM custom-milled titanium bar for rehabilitation of an atrophic upper jaw

Author Dr Richard Marcelat, France

_Case presentation_

A 75-year-old non-smoking female patient, whose rheumatoid polyarthritis has been treated with methotrexate for seven years, presented. This patient has been fully edentulous in the upper jaw for 30 years. She wore a removable partial denture in the lower jaw and a removable complete denture in the upper jaw. Stability of the latter was very precarious owing to severe crestal bone resorption. The patient’s motivations were mostly function orientated; she was eager to regain chewing comfort.

There are centrifugal forces in the lower and centripetal forces in the upper jaw, and bone resorption reduces the volume of the latter, causing an offset between the upper and lower jaws. This offset, which was to be compensated for by the overdenture, must be taken into account at implant placement.

_Pre-implantation surgery_

DentaScan (GE Healthcare) allows the evaluation, as a complement to the initial panoramic radiograph, of the residual bone volume available for implant-retained rehabilitation. In the present case, this examination confirmed that the upper jaw was atrophic (Figs. 1 & 2). Therefore, bone reconstruction was necessary prior to implant treatment. A bilateral sinus lift
with lateral access was performed. The space under the sinus floor was filled with allogeneic bone (maxgraft, botiss biomaterials) mixed beforehand with the venous coagulum collected at the beginning of surgery. The following step entailed covering the allogeneic bone with a collagen membrane (Bio-Gide, Geistlich) and a platelet-rich fibrin membrane. The complete denture was then hollowed out and relined periodically with a soft resin.

**Implantation planning**

The case was planned using the SIMPLANT (DENTSPLY) treatment planning software. The radiographic guide, which is a duplicate of the existing prosthesis, allows the prediction of the positioning and orientation of the implants to anticipate the dimensions, locations and axes of the implants and abutments. It also allows maximal exploitation of the available bone volume (Figs. 3a–c).

**Implant surgery**

In order to test the mechanical resistance of the grafted areas on probing, osteogenic stimulation of the sinus filling material was performed with bone matrix Osteotensors (Victory), using the technique described by G. Scortecci and C. Misch. The bone matrix Osteotensors are used in a transparietal technique (flapless procedure). This endosteal stimulation also activates the cells. This easy and minimally invasive technique enables the assessment of the quality of the intended implant sites. These techniques have been successfully used in orthopaedic surgery for a decade. Given the good response to osteogenic stimulation, the implantation was planned after 45 days.

Six months postoperatively, seven Axiom PX implants (Anthogyr) were placed in the upper jaw using the radiographic guide. Self-drilling, self-tapping and featuring a reverse conical neck, the conical, double-threaded implants selected for this rehabilitation (Fig. 4a) allowed us to obtain excellent primary anchoring, as they, along with the drilling protocol, encourage bone condensation in areas with low bone density. Moreover, the osteoconductive potential of their BCP (biphasic calcium phosphate) grit-blasted surfaces promotes osteoblast differentiation in the early stages of osseointegration.

**Restorative phase**

Four months after implantation, preparation for the final restoration began (Fig. 4b). A percussion test on the implants was carried out, and a control radiograph was taken. Straight multi-unit abutments were then placed and definitively torqued to 25 Ncm. Next, a pop-in impression was taken using a polyether impression material (Impregum, 3M ESPE) in a custom tray made by the laboratory technician. For full impressions on multiple implants, we usually prefer to take a pick-up impression, with joined im-

---

**Figs. 3a–c. Implant planning with SIMPLANT after a bilateral sinus lift.**

**Fig. 4a** Axiom PX implant.

**Fig. 4b. Occlusal view showing the multi-unit abutments and protective caps in place.**

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case report _ upper jaw rehabilitation

pression transfers, but this technique could not be used here because of limited mouth opening.

The master cast with abutment analogues and silicone gingiva was fabricated at the laboratory (Figs. 5a & b) and then checked in the dental office using an index made of non-expanding stone in order to ensure absolute precision (Fig. 6). This step is essential to ensure that the master model is perfectly accurate. The maxillomandibular relationship is then transferred to the articulator by relining the existing prosthesis on conical caps of abutments (a bite wax on a hard basis—a technique considered more accurate by some—can be used instead). The interpupillary line was registered by means of an inclinometer (Amann-Girrbach). The aesthetic set-up, maxillomandibular relationship and occlusion were then checked on the patient by means of a denture set-up placed on a thermoformed hard basis. This set-up reflected the patient’s wishes regarding aesthetics too.

The laboratory produced a resin pattern of the substructure (Fig. 7), namely a milled bar as a true anchoring beam, screwed on to the abutments. After approval, the master model and wax-up were sent to Simeda (Anthogyr). This fabrication centre scans the master model and virtually designs the component to be produced (Figs. 8a & b). After approval of this virtual model at the laboratory by means of a 3-D PDF document (Figs. 9a & b), the bar was milled from a block.

Fig. 5a Master cast with silicone gingiva.
Fig. 6 Plaster index for approval.
Fig. 7 The wax pattern fabricated by the laboratory technician.
of titanium, using a five-axis CNC milling machine (Fig. 10). Titanium—four times lighter than semi-precious alloys—is the lightest metal used in dentistry. It offers excellent biocompatibility and very good mechanical properties. The metal is highly reactive to oxygen: when the metal is exposed to air, a protective film, the passivation layer, builds up on its surface and makes it extremely resistant to corrosion and chemical attacks. Titanium offers additional advantages in oral implantology. The density of the materials used is crucial.

The weight of a prosthesis for an upper jaw appears to be a key factor for treatment success.

A few days later, the bar was tried in the patient’s mouth. It was perfectly adjusted and seated passively (Figs. 11a–d). Milled bars exhibit a precision fit better than 10µ. The substructure was sent back to the laboratory technician, who then produced the framework using the silicone indices of the approved functional and aesthetic set-up.
The restoration consisted of two distinct parts:

_ the milled bar screwed on to the multi-unit abutments; and_
_ the removable telescopic part: the prosthesis, friction-retained on the bar (Figs. 12a–c)._

As the seven implants were well distributed over the entire arch, no palatal coverage was needed, meaning enhanced comfort for the patient. Retention of the prosthesis by the bar was enhanced by four CEKA attachments (ALPHADENT; Fig. 13).

A milled bar-retained removable prosthesis can be considered an attractive option for patients presenting with an atrophic upper jaw and/or bruxism because it efficiently compensates for the tissue loss, ensuring a good aesthetic outcome, in addition to excellent stability and retention of the prosthesis. For this reason, this option is classified by some as falling in the category of removable bridges. The prosthesis is nevertheless resilient enough to withstand high mechanical stress, reducing the risk of fracture, especially that of the veneering layer.

_Discussion_

With conventional casting techniques, producing a substructure for an implant-retained prosthesis remains technically difficult. The difficulty of achieving passive fit is proportional to the number of elements and volume of the substructure. Despite the advances in casting technology, in the case of large-span substructures, primary or secondary brazing is often needed to compensate for the dimension variations in order to achieve an absolutely passive fit. Such an accurate, passive fit of the substructure is essential for the bone physiology of implants and long-term reliability of implant-retained rehabilitations.

Owing to its high precision, CAD/CAM is an invaluable tool for evolving the prosthetic workflow technologically. The restoration is designed based on a 3-D CAD image created from the scanned data.

CAD software allows modelling of the prosthesis, taking into account the material selected (such as zirconia; titanium; cobalt–chromium; IPS e.max; Ivoclar Vivadent; and PMMA).

As the subtractive fabrication technique (milling) associated with this CAD ensures that the material structure will not be altered, a metal substructure featuring optimal density and homogeneity is obtained. In addition, the computerized configuration of this process ensures reproducible results and irreproachable passive insertion of these substructures.

Conclusion

Today’s laboratory scanners can digitize the model, wax-up and implant index. CAD/CAM technology offers unmatched work quality, precision and reproducibility compared with conventional procedures. It is certainly the most appropriate technology for producing implant-retained superstructures. This technology also allows improved passive fit of substructures and facilitates the work of the laboratory technician.

Passive fit as a prerequisite for successful implant-retained prostheses ensures long-term reliability of rehabilitation work. Moreover, the fabrication centres can machine biocompatible materials such as titanium and zirconia.

These CAD/CAM techniques, which are already well established in dental laboratories, constitute a major contribution to our daily practice, and will soon be essential in all practices.

The author declares no conflict of interest.

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

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Opening the patient’s eyes

Dr Luc Vrielinck, an oral and maxillofacial surgeon, an expert in computer- and model-based implant planning systems, and a user of NobelClinician Communicator, explains how he walks his patients through the treatment process step by step. In this interview, he provides some valuable insight into the use of the application.

Dr Luc Vrielinck has learnt from extensive experience how powerful visual information can be when communicating with a patient. NobelClinician Communicator makes it possible to consult with the patient in a relaxed setting. According to him, it serves as a natural and non-intimidating introduction to treatment planning, after which the clinician can easily start discussing success rates, potential complications and treatment alternatives.

Jim Mack, Managing Editor of Nobel Biocare News, recently posed a few questions to Dr Vrielinck, who has extensive experience using the NobelClinician Communicator iPad app to explain the entire treatment sequence to prospective implant patients.

For how long have you been using NobelClinician Software, and why do you use it?

Dr Luc Vrielinck: I have been using NobelClinician Software since it was released. The 3-D analysis of underlying bone structures and the computer simulation of implant placement add a new dimension to the practice of implant dentistry.

Having a view in all directions of the bone anatomy adds to one’s clinical knowledge and augments the experience of the clinician. While classic radiology allows us to see the bone, CBCT analysis and 3-D computer planning allow us to define and understand treatment planning. Knowing and seeing, after all, are two different things.

What has your experience been using NobelClinician as a patient communication tool?

It has always worked very well, but today I prefer to start discussions using an iPad rather than a computer screen. Although using the NobelClinician Communicator app requires a few extra preparation steps before the NobelClinician planning is ready for viewing on the iPad, it is well worth the effort. Patients are always impressed with the beautiful images and rarely hesitate to engage with these images when asking specific questions.

The NobelClinician Communicator app makes it possible for me to explain the general treatment plan to the patient and allows me to demonstrate visually the need for additional procedures, such as bone grafting and the use of membranes for augmenting the thickness of the dentoalveolar ridge. It can also help me to illustrate the need for a sinus lift, or simply depict the patient’s own bone anatomy clearly, which always facilitates a treatment planning conversation.

What changed when you began using the NobelClinician Communicator iPad app?

It serves as a natural and non-intimidating introduction to treatment planning, after which the clini-
...can easily start discussing success rates, potential complications and treatment alternatives in order to obtain the informed consent of the patient.

The NobelClinician Communicator app provides an open invitation to discuss the treatment ahead, including treatment choices that need to be made, and makes it possible to consider much more than the type of implant to be placed.

_Could you explain to us how you use the NobelClinician Communicator app to discuss the treatment plan with your patients?_

Mostly, I start in a cross-sectional view (radiographic cross-sectional image) to explain the bone structure and bone volume. Next, I show a planned implant at its intended location. The virtual implant is depicted in blue and around the implant is a yellow outline (the safety zone). I describe the importance of this safety zone and use it to explain that an actual treatment can never be as precise as depicted on a screen.

I also explain—if relevant—the relation of the implant to the inferior alveolar nerve or the maxillary sinus. If the yellow zones are larger than the thickness of the bone, this can be viewed easily and provides an opening for me to explain the necessity of grafting procedures in such situations to the patient.

When the different individual implant positions are explained, I often show a 3-D bone model of the jaw to the patient, but certainly not in every case. Sometimes the 3-D CBCT images are difficult for patients to interpret, especially in partially edentulous cases.

_NobelClinician can shorten treatment time and increase safety. Could you imagine working without it today?_

To me, whether to use NobelClinician for a case is not in doubt. It is a natural part of the pathway leading to the treatment plan.

For my patients, the use of NobelClinician is very straightforward, and they generally understand it intuitively. Its purpose is to assess the bone volume of the patient, to see if implant treatment is possible, to evaluate whether there is a need for bone augmentation, and to determine the type of implants to be used.

This assessment results in the formulation of the treatment plan. In the practice of implant dentistry, conscientious planning is a necessity for me, like food and water.

_How do your patients perceive the use of such sophisticated technology in their treatment?_

I do not think our patients are surprised to see the team using an iPad these days. An iPad is used by the implantologist for explaining the treatment plan to the patient, by the dental nurse in rehearsing the treatment plan before the surgery actually starts, and by the administrative treatment co-ordinator to establish which implants and components have to be available and eventually ordered.

If a practice is up to date, well organized and professional, patients should not be surprised to see us using this technology. Rather, I think they ought to be surprised if it is not being used!

_Could you explain to us why using the NobelClinician Communicator app helps you gain patient acceptance of your proposed treatment plan?_

The NobelClinician Communicator app is a basic tool used to present an agglomerate of knowledge to the patient. The process may have started with a prosthetic set-up and continued with the CBCT scan and the subsequent treatment planning, but it will always end up with a final presentation of a solution to the patient, and that is where this app excels.

The app is not fancy imaging software; it is a tool used to explain the treatment to the patient. If the patient feels that one step logically follows the other to a good solution, he or she will be inclined to accept the treatment plan proposed via the app in front of him or her. But it does not stop there. The app can also be used to explain alternative treatment modalities, paving the way for informed patient consent.

To read more about the user-friendly solution for diagnostics, treatment planning and patient communication, please visit nobelbiocare.com/nobelclinician.

Editorial note: iPad is a trademark of Apple Inc.
The field of digital dentistry is rapidly evolving, with new dental technologies emerging as part of a more efficient and comprehensive workflow. By pairing Planmeca CAD/CAM solutions with radiographic units in the Planmeca ProMax 3D family, dental professionals can bring together a wide range of detailed information for treatment planning and diagnostic purposes. This seamless combination of CAD/CAM and CBCT technology presents new possibilities in creating a new standard of care for patients, offering high-quality features for different specialities, all available through one software interface.

Planmeca Romexis is the only dental software platform in the world to combine all imaging and the complete CAD/CAM workflow. This powerful solution is at the heart of the Planmeca ecosystem, as it provides dental professionals with the ability to acquire datasets that are more detailed than ever before. Planmeca Romexis includes advanced tools for all specialities, such as implant planning and other restorative treatments. The software presents dental clinics with a superior way to increase their patient flow and improve the level of care offered.

Seeing more than ever before

Bringing together CBCT data and CAD/CAM work provides a comprehensive level of clarity. Planmeca ProMax 3D imaging units reveal intricate information on soft- and hard-tissue structures, including the mandibular nerve canal, while the Planmeca PlanScan intra-oral scanner captures precise data above the gingival margin. This combination of data ensures a complete understanding of any case and makes 3-D prosthetic design quick, accurate and easy. Clinics are able to operate more flexibly, as restorations can either be milled in-house with the Planmeca PlanMill 40 milling unit or easily sent to a dental laboratory in an open STL data format.

The rise of same-day dentistry

A more active role in the manufacture of restorations opens up avenues for dental clinics to significantly increase their patient volume and grow their business. A streamlined digital workflow ensures the full utilization of resources, leading to a more efficient treatment environment. Same-day dentistry is as beneficial for patients as it is for clinics: instead of two visits, patients can be treated in 1 hour—with no temporary crowns or physical dental models required.

Open architecture for maximized efficiency

Standardized data is the driving force behind many of the latest developments in digital dentistry, as it guarantees the interoperability of images and dental data across different hardware platforms—reducing costs, increasing predictability and enhancing patient safety. Bringing Planmeca’s CBCT and CAD/CAM systems together through Planmeca Romexis makes effective chairside dentistry a reality and presents dentists with a streamlined opportunity to grow their practice substantially.

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exocad DentalCAD, the next generation

_exocad_, a company based in Darmstadt in Germany, follows the approach of continuous integration to increase product quality. For this reason, our design software, exocad DentalCAD, has been developed incrementally since its launch. This year, there is an update that is unique in its scope. It represents a major leap forward and as such it presents the next software generation in one fell swoop. Some of the many new and ongoing developments are presented briefly in this article.

_How it all began_

The Fraunhofer Institute for Computer Graphics Research in Darmstadt is one of the world’s leading institutions for applied visual computing. This is where the initial DentalCAD software was developed. It was characterized by its particular ease of operation, rapidly achievable results and open interface for integrating various scanners and milling machines. The first version was completed in 2008. On 1 March 2010, the then newly established spin-off company, exocad, was announced as the exclusive licensee. Even then, the clientele ranged from A for Amann Girrbach of Koblach in Austria to Z for Zirkonzahn of Gais in Italy. Figure 1 provides an image of the software in 2010. A great deal has changed since then and the new version is being launched not only with additional features, but also with a completely redesigned user interface.
New user interface

The basic tried-and-trusted workflow when creating jobs and casting remains essentially unchanged despite the update, so that users of the current version can still find their way around instantly. However, we have implemented closer integration of the exocam scanning software and the exocam CAM software (Fig. 2).

Besides the usual process chains, however, the update provides far more than a mere facelift in terms of the user interface; this has been completely redesigned. Until now, only subtle changes have been made to the design in order to keep the training costs for existing customers to a minimum. However, according to exocad CEO Tillmann Steinbrecher, the time had come to give the software a contemporary look, take account of the current technical findings in software development and match them to a changed user experience. With regard to the graphic conceptual design, this involved implementing a contemporary flat look. In this style of interface design of applications and websites, the use of realistic-looking textures, shadows and ornamentation, as well as 3-D elements, is deliberately avoided. The move away from gradients in favour of flatter space and a rather minimalist design is intended to guide the user’s eye in a more focused manner towards the essentials and support more intuitive menu navigation. The new software’s clear structure is also supported by a bolder use of colour in the design language, such as with group lists (Fig. 3). The demand in the past for realistic icons, based on physical objects as far as possible, is long since obsolete. As (almost) every regular dental technician now has much greater experience in this area owing to tablets, smartphones and the like, increased abstraction is possible. This design also takes into account that with desktops there has been an increasing use of touch screens, which could eventually become the standard. Some newcomers may feel that navigation in a 3-D space with a conventional mouse is certainly a challenge. Operation with three-finger multi-touch is usually easier.

New features

The cloud-based tool dentalshare (Fig. 4) will in future make process co-ordination easier when working with manufacturing service providers. Their specific material configurations are stored in the cloud and are always kept up to date without further action required by the user. By specifying the recipient when placing a new order, the appropriate design parameters are automatically used.

One change, which users will notice indirectly, is the 3-D engine’s switch to a new development platform. This enabled us in the context of TruSmile tech-
Industry news _ exocad

Technology, for example, to achieve an even more realistic representation of different tooth colours and materials (Fig. 5). In combination with 2-D photographs, this will make it even easier to plan treatment outcomes and an optimized marketing tool is available. It is true that it has been possible to load photographs in exocad DentalCAD for quite some time, but owing to the new webcam integration, it is now especially easy (Fig. 6). Shots can also be imported from several perspectives and each positioned spatially or certain areas can be cropped out and overlayed or blanked out at any time, for example to visualise the lip line.

If required, there is an option to export a 3-D PDF of the plan, including notes in the 3-D space, in order to obtain the dentist’s feedback, for example. In designing, the wizard can now be opened and closed at will without the history being lost. Access to frequently used features has been made easier, so that displaying penetration by the counter bite is achievable with just one click of the mouse.

Plus, new notifications, for example with context-sensitive prompts, ensure that the user is made aware whenever the software notices inefficient working methods. This may be the case, for example, whenever time-saving hot keys, that is, key combinations for specific commands, are not used.

The tools for free forming have been developed with the claim of being able to do everything that is possible in wax. Among other things, any geometrics can be added or subtracted and marked via the new paint and pull features for dynamic reshaping. For example, interlocks can now be designed more flexibly (Fig. 7). Furthermore, the ZRS Wiedmann Dental Library (Manfred Wiedmann Gesicht und Zähne) has been expanded with additional posterior teeth samples (Fig. 8) and our Model Creator now even supports the use of implant libraries (Fig. 9).

For those who like experimenting

In November 2014, exocad announced its purchase of STI’s SensAble Dental Lab System. According to exocad’s executive board, this is the most flexible and high-performance platform for model casting designs currently available. However, its operation is said to be rather complicated and only suitable for power users so far.

The software is now available as a technology preview for exocad users to download free of charge at exocad.com/technology-preview. An integrated and optimised version will appear during the year.

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With over 35 years of experience, a mission to produce quality products and an environment in which the user plays the decisive role, Interdent is now presenting CAD/CAM technology with unlimited possibilities.

The company’s mission has always been to keep track of new trends in dental care. CAD/CAM technology has been on the market for over 20 years; however, despite its initial boom, it developed rather slowly. At the beginning, it was based on processing minor non-metal ceramic restorations, but there were problems concerning precision, speed and the choice of available material at the time. Today, the precision of gingival fit is already extremely fine, although differences remain between the systems. With adequate materials available, it is also possible to mill larger restorations; however, there are many systems on the market that fail to provide comprehensive systems for dental laboratories. Systems are limited to milling only certain materials and, furthermore, many providers charge licence fees, which means an additional cost for the user along with the initial investment.

Every new technology takes time to become complete and to find their way on the market. This year, Interdent paved the way with its new milling units: CC POWER, CC COSMO and CC TRENDY, which are available to users of various profiles. The needs of dental technicians across the world differ greatly, primarily depending on the existing capacities and development of the respective dental laboratory. The needs of a laboratory employing 200 people are significantly different from the needs of a laboratory employing ten people. Since Interdent is focused on the international market, it adopted a broad perspective during development (Figs. 1a–c).

This was the reason for producing CC POWER, which with its immense power of 2.5 kW is suitable for the most demanding of users, as it is able to operate 24/7, maintaining productivity and precision, while the compact CC COSMO and CC TRENDY are intended for medium-sized laboratories that will largely use the device for their own needs. All three units are extremely compact, with all components placed on a seamless cast-iron block not bound to the housing, thus preventing vibrations and providing greater precision. The major difference between the units lies in power, and all of the units allow five-axis simultaneous milling. The axes are driven by alternating current servo-motors made pursuant to the top industrial standards and ensuring very precise movements, a long service life and the accurate processing of all materials.

Both units enable wet and dry milling and include a holder for 18 (CC POWER), 20 (CC COSMO) and eight (CC TRENDY) burs. Hence, the user does not waste time changing burs for the material to be milled. The unit automatically selects the necessary bur and, if required, replaces it during milling (Fig. 2).
CC POWER, CC COSMO and CCTRENDY are manufactured using only the best, as is evident from the spindle produced by Jäger, one of the top makers of spindles for CNC machines. Its pneumatic tool changer and power enable faster milling without affecting precision.

The materials that can be milled by the units come in the form of discs measuring 98 mm in diameter and include cobalt-chromium, titanium, zirconium, PMMA, wax and composite. There is also an adapter for minor blocks, so that CC POWER, CC COSMO and CCTRENDY can also be used to process glass-ceramic and other blocks. These blocks are processed using diamond burs and water-cooling (Figs. 3 & 4).

The milling calculations and the management of movements are controlled by electronic systems that meet the highest industrial standards. The user operates the unit via a tablet computer installed on a special stand and running the Windows 8 operating system.

Our development focused on providing users with an excellent system that will guarantee top quality and precision, be easy to use and protect users from additional costs due to licence fees.

For this reason, we use the Sum 3D CAM software with our CAD/CAM units. It is used to plan for milling and is considered one of the best programs in dentistry. Upon purchasing the program, the user receives a licence for unlimited use, so no subsequent payments of monthly or annual licence fees are required.

Furthermore, our vision guided us to offer a comprehensive CAD/CAM system that would, in addition to the CC POWER, CC COSMO and CCTRENDY milling units with open Sum 3D software, include a scanner. We searched for the best and included the Identica Blue Scanner (Medit) and exocad DentalCAD in our product range (Fig. 5).

Identica Blue convinced us with its reliability, precision (less than 10 µm), scanning speed (e.g. antagonists can be scanned in only 35 seconds), cutting-edge blue light scanning technology, wide area (allowing the scanning of models in an articulator), and, naturally, ability to export files in an open STL format, which provides freedom in CAD/CAM technology.

The logical next step was to upgrade the Identica Blue scanner with the verified, compatible Exocad Dental CAD software, which is noted for its easy handling and wide selection of modules (crowns, links, inlays, veneers, onlays, primary crowns, implants, virtual articulator, shafts, model design, temporary substitutes, TruSmile, etc.). The thing that most impresses every user is the setting of the preparation limit, which is done at the click of a button, offering a major advantage over other available software.

By means of the above, we took a step closer to most users; however, some still find an investment in CAD/CAM technology too expensive with regard to their needs. This mostly applies to small laboratories. Therefore, we came up with the idea to offer such users milling services. As a result, the Interdent Milling Centre was established this year, in which CAD/CAM experts see to it that orders are received and restorations are made to order and delivered in a few working days. This way, laboratories can offer an industry news _interdent_
We are pleased to provide a comprehensive solution in CAD/CAM technology that features ease of use, excellent technology and outstanding material. Since we believe that customer satisfaction depends not only on the quality of the product, but also on correct handling, Interdent offers professional support throughout the process, from your expressing your desire to purchase to training and rapid solutions to any problems encountered during use (Fig. 6).

**Interdent CAD/CAM Training Centre**

Are you deciding on a purchase? Have you recently made a purchase or have you been using a milling unit for a long time? The Interdent CAD/CAM team is at your service!

**I am deciding on a purchase**

Interdent will gladly help you in this very important decision and will advise you on a device suitable for your needs that will optimise your work processes in the laboratory.

**I have just made a purchase**

The first important step is behind you, and now you became a part of the the Interdent CAD/CAM team. Its experienced dental technicians and CAD/CAM specialists will train you to use the unit and materials. With their professional assistance, you will be able to apply your knowledge of dentistry to advanced computer technology and lay the foundations for optimal results and efficient work.

**I have been using a milling unit for a long time**

The CC POWER, CC COSMO or CC TRENDY milling unit has become the centre of your practice. Over time, new questions or unexpected problems can arise, requiring efficient, fast and professional support as provided by the Interdent CAD/CAM team. We are available in person and via various media, such as by telephone or video.

For more information, please do not hesitate to contact us._

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**Fig. 5.** Identica Blue Scanner.

**Fig. 6.** The Interdent CAD/CAM team.

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Multiple new solutions presented at IDS 2015 bring Straumann closer to being a total solution provider of choice

At Europe’s leading dental trade fair, the International Dental Show (IDS) in Cologne in Germany, Straumann presented a number of new products and solutions that—together with new partnerships—bring the group closer to its goal of becoming a complete solution provider and, thus, the partner of choice in tooth replacement for both dentists and dental laboratories.

Further advances in implants

Since the 2013 IDS, Straumann has launched its fully ceramic implant (Straumann PURE) and has successfully upgraded the majority of its surgical customers to the unique high performance implant material Roxolid, which has been extended throughout the Straumann implant range. Owing to its excellent biocompatibility and strength (greater than pure titanium), Roxolid makes it possible to use smaller implants, which in turn can avoid the need for bone augmentation, reducing treatment invasiveness.

New-generation Bone Level Tapered Implant

Roxolid is a key feature of Straumann’s new Bone Level Tapered Implant, which offers high surgical flexibility and primary stability. With the controlled market release having been completed, the new implant is now available in various endosteal diameters (3.3, 4.1 and 4.8 mm) and lengths (8–16 mm), and offers a broad range of prosthetic options. Its design offers high primary stability for immediate or early loading and, with Straumann’s SLActive surface to enhance osseointegration, implant healing time is significantly reduced—making this a new-generation bone level tapered implant.

A complete family of restorative solutions

Straumann is placing significant emphasis on enhanced products, technologies and workflows for dental laboratories—from simple Variobase Abutments and milling blanks with original Straumann connections to new high-tech ceramics, state-of-the-art in-laboratory milling machines, scanners, advanced CAD/CAM functionality and centralized milling services. Together with the partners in its technology platform, the group is able to offer total solutions to dental laboratories around the world. More information on these and other new launches was shared at a dedicated Lunch and Learn session for dental laboratory professionals during IDS.

Straumann ProArch, a comprehensive combination

The Bone Level Tapered Implant is an important component in Straumann’s Pro Arch solution, which was first exhibited at this year’s IDS. Pro Arch is a comprehensive combination of implants, abutments, CAD/CAM frameworks, auxiliary components and educational support that enable clinicians and dental laboratories to provide accelerated fixed full-arch rehabilitation. This approach reduces the number of treatment sessions and thus minimizes disruption to patients’ daily lives. Most importantly, it offers fixed full-arch replacements rather than removable dentures, which many patients view as artificial and inconvenient.

The Pro Arch solution includes a selection of sleek new abutments and auxiliary components that offer a wide range of prosthetic options for screw-retained restorations. The low abutment profile, varied angulations (17 and 30 degrees) and gingival heights give dentists exceptional flexibility to provide individual solutions, including tilted posterior implants.

CARES Basic and Advanced Fixed Bars

CARES Visual 9.0, the latest software for Straumann’s CAD/CAM system, adds the functionality for custom-milled bar options and designs to support the final restoration. This means that clinicians can now provide custom-milled frameworks—both at implant and abutment levels. In addition to titanium and coro (the company’s cobalt-chromium alloy) options, Straumann will be introducing zirconium dioxide frameworks this year.

Straumann Variobase becomes a family

At the 2013 IDS, Straumann introduced the CARES Variobase Abutment, the basis for a cost-effective hybrid solution consisting of a titanium bonding base and a zirconium dioxide coping. This was to complement its existing range of customized abutments and to offer laboratories the combined benefit of a metal–metal implant–abutment interface with an original Straumann connection and a variety of aesthetic shades. The pop-
ularity of this solution has prompted several developments, which made their debut at this year’s IDS.

New heights
For additional flexibility, for example to support larger crowns, the Variobase Abutment now comes with an increased (5.5 mm) chimney height, which can be customized and is available for all Straumann implant platforms.

Variobase for bridges and bars
Straumann has also developed a new Variobase Abutment for screw- and cement-retained bridge and bar restorations, offering highly flexible and cost-effective solutions for multiple-tooth restorations. Its conical design features special helix threads and a minimum plateau for long-term stability and passive fit of the bridge or bar.

Variobase for CEREC®
Dentists using Sirona Dental Systems’ CEREC chairside workflow to produce implant-retained restorations now have the option of a Straumann Variobase Abutment with an original connection and a concave collar design for an optimized emergence profile. This Variobase Abutment is compatible with available material blocks and two-piece scan bodies.

CARES X-Stream for bridges and bars
CARES X-Stream was launched at the 2013 IDS and streamlines the prosthetic workflow so that all the components are manufactured from only one scan and one design procedure. The digital functionality has been developed further and now includes the processing steps for bridges and bars on the new Variobase Abutment.

Lava Plus High Translucency Zirconia for CARES
Straumann also announced the availability of CARES restorations in 3M ESPE’s Lava Plus High Translucency Zirconia, a material engineered for excellent translucency with uncompromising strength. It is the only CAD/CAM material system that matches the 16 VITA classical A1–D4 shades and two bleached shades.

Pre-milled abutment blanks
To help dental laboratories build their business and maintain implant–abutment precision and reliability, Straumann is now offering titanium blanks with pre-fabricated implant connections. The blanks are compatible with a wide range of milling machines (e.g. Medentika; imes-icore; D5, D ATRON; GAMMA 202, Wissner; RXD, Röders; DC5, Dental Concept Systems; COBRA Mill, MB Maschinen; and vhf manufacture) and enable laboratories to fabricate one-piece customized titanium abutments with original Straumann connections in-house.

Technology platform strengthened
Straumann heralded the arrival of the CARES M Series in-laboratory milling machine developed by Amann Girrbach to operate with the CARES CAD/CAM system. The new machine will be offered by Straumann together with the latest CARES 3Series and 7Series in-laboratory CAD/CAM scanners, which have been co-developed with Dental Wings and were also launched in Cologne. At Straumann’s press conference, Dental Wings presented the scanners together with its new intra-oral scanner and revolutionary laser ablation in-laboratory milling machine.

Furthermore, Straumann announced its investment in Valoc, a developer and manufacturer of innovative overdenture attachment systems.

N!ce developed by Straumann, manufactured by etkon, distributed through Instradent
Straumann has developed an exciting new glass-ceramic material (lithium disilicate-reinforced lithium alumino-silicate) for high-end restorations, including crowns, inlays, onlays and veneers. Under the brand name etkon nice, the new material will be manufactured by etkon and supplied in ready-to-mill blocks in the common C14 format. Its key advantages include high flexural strength, short milling times and easy finishing.

It is available in two stages of crystallization. The partially crystallized version is easy to mill and can be stained and glazed, making it attractive to laboratories. The fully crystallized form requires no firing and can be milled, finished and seated directly, making it the ideal chairside solution. Straumann plans to release nice through its Instradent platform in May in Europe, with other regions and distribution channels to follow.

Value-adding support
Straumann Patient Pro, a new tool for comprehensive information
Research suggests that every other patient consults the Internet before, after and sometimes even during the consultation. A patient’s choice of treatment and/or dental professional is based on the information found. Straumann Patient Pro is a new comprehensive platform that provides dental professionals with digital information to educate patients and to promote their practices. It supports them with materials and tools for the Internet and social media, as well as for use in their dental practices.

For more information, please visit the Straumann website.
The crown that rules them all: NobelProcera FCZ Implant Crown

Patients, clinicians and dental laboratories all want restorations they can rely on

Author: Michael Stuart, Nobel Biocare, Switzerland

The NobelProcera FCZ (full-contour zirconia)Implant Crown combines full-contour strength that is sufficiently robust for the posterior region with superb restorative flexibility—and all with no cement in sight.

The NobelProcera FCZ Implant Crown is designed for use with Nobel Biocare’s extensive range of conical connection implants. Combining Nobel Biocare components means that all the elements can be trusted to work together seamlessly for the perfect treatment outcome.

No cement, no chipping, no problems

The strength of the FCZ Implant Crown makes it suitable for all tooth positions, ensuring predictability even under the high occlusal forces of the posterior region, which makes it an ideal restoration for molars. There is no need to worry about veneer chipping either, as the full-contour characteristics of the NobelProcera FCZ Implant Crown eliminate the need for veneering.

The biocompatibility of the materials used represents an additional benefit by supporting biological stability in the areas where it matters most. Plus, being screw retained, the FCZ Implant Crown is completely cement free, eliminating the risks associated with excess cement. Even the titanium adapter is mechanically retained.

As it can be placed in the posterior region, the FCZ Implant Crown gives clinicians the opportunity to increase the number of screw-retained restorations they place. This means more patients treated with a restorative solution that is easier to maintain and retrieve—and all without cement.

Natural-looking tooth colour is another benefit offered by the FCZ Implant Crown. Whichever of the eight available shades is used, the colour will be uniform throughout the material. This means adjustments can be made without having to worry about discolouration. Furthermore, cut-backs or staining can be used to achieve the desired aesthetic effect.

For patients, clinicians and dental laboratories looking for restorations they can rely on, the NobelProcera FCZ Implant Crown provides extraordinary strength for long-term predictability and delivers restorative flexibility too. As a result, it is well on its way to becoming the crown that rules them all!
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A dental implant system consists of hundreds of components. It includes everything from the highly advanced implant to simple tweezers. For an optimal function of a system, all parts must interplay. They must fit together like cogwheels and create a smooth and well-functioning totality. If just one cog is misaligned, the entire system will suffer. And this may cause unnecessary problems for the dental team and ultimately the patient.

Mission started

Per Aringskog, R&D Director at DENTSPLY Implants, and his team were well aware of this. To start their development work, they had one of the most thoroughly documented dental implant systems in the business. Decades of research in areas as diverse as mechanical loading and osseous integration had created a product that functioned perfectly, with minimal bone loss and healthy soft tissue. With this as a foundation, the mission now was to create an implant system that was in every detail intuitive for the users. The set target was that the new ASTRA TECH Implant System EV should be the user-friendliest system on the market. Early on, the team realised that no matter how much they thought and tested on their own, there would always be a gap between what worked well on paper and in the laboratory compared to what worked in the everyday clinical reality. In the real world, one had to add unpredictable situations, users with different knowledge levels and the various needs of patients.

A smart solution

The solution was obvious—let the users take part in the development work. That way you get a product that already at launch is tested and adapted to tackle the unpredictable. A product that has its origin where it will be used—the clinics.

The solution is not unique, but it is smart and it works. The method of letting users take part in the development work exists in other businesses. In the software world they have worked with open source code for a long time. Some software developers even publish their software on the Internet. Users and other interested parties can then suggest improvements and further developments. In earlier development projects at the company, there have been smaller focus groups involved. This time however, the team took the idea to a whole new level—a group of 47 clinicians that work with dental implants on an everyday basis was formed. They became known as ambassadors.

“The response to our initial contacts was very positive. Everyone we asked was enthusiastic about taking part,” says Agneta Broberg Jansson, responsible at Global Product Management for the ASTRA TECH Implant System at DENTSPLY Implants.
A smaller group whose members had long professional experience with dental implants, was contacted first. The R&D and Product Management team had by then developed a system. Now, it was time for their efforts in the laboratory to face reality. The group was asked to evaluate the core system and contribute to the further development and refinement of the system.

“The input given at this stage contributed to changes in parts of the system. Some designs were improved in ways we could never have imagined if we had not been open about our work,” says Per Aringskog.

Even if openness and participation turned out to be the key to success, the contents of the project had to be kept secret. The company operates in a highly competitive market where many smaller players are very interested in using smart solutions, preferably without having to invest in the development work. Secrecy was of the utmost importance for this and similar future projects if they were to bear the expenses. Investing in research and development and constantly challenging and improving is part of the company philosophy.

_One big project_

Following the initial phase, the more basic parts started to fall into place. Now it was time to expand the group of ambassadors and to gather broader and more detailed feedback. But, allowing the group to grow was risky seen from a secrecy perspective. From the initial single-digit group of clinicians, the group now grew to almost 50 ambassadors on three continents. But, the saying “Confide in one, never in two; confide in three and the whole world knows” was refuted once and for all.

“It is amazing that we managed to keep the contents of the project secret. But, the participants were so dedicated that they saw this as their own project. We became one big project team with a great internal loyalty,” says Per Aringskog.

By now, the work intensified. Six employees visited the ambassadors in their everyday business and held concept handling sessions. The ambassadors also gathered a few times to exchange experiences and thoughts in the early project phase, and the feedback kept coming in.

As the project progressed, Per Aringskog and his colleagues adjusted the system and new tests took place. After five years of work, only fine-tuning of details remained and eventually everything was ready to be launched.

“Each individual point of view might seem tiny, but put together everyone has contributed to the final result,” says Agneta Broberg Jansson, one of those who worked closest to the ambassadors.
MIS implants stand out in comparative implant surface study

Israel manufacturer MIS Implants Technologies has announced that its products have achieved favourable results in an extensive qualitative and quantitative elemental analysis using scanning electron microscopy. The study was conducted on behalf of the Quality and Research Committee of the European Association of Dental Implantologists. It included 65 systems of sterile-packaged implants from 37 manufacturers and ten countries.

According to the intermediate study report, the C1 implant and the SEVEN implant manufactured by MIS achieved noteworthy results. Although the SEVEN implant exhibited blasting material on up to 7 per cent of the surface in earlier studies by the committee in 2011 and 2012, the researchers did not find even isolated spots with residue on the two MIS implant types of Grade 23 titanium in the current study.

MIS Materials Discipline Manager Dr Tal Reiner explained the surface treatment processes applied by MIS that led to the results: “We monitor the surface roughness, uniformity and purity of our implants on a daily basis, taking samples from selected batches, and using our own in-house scanning electron microscope. Because the analysis is done in our own labs, on-site, there’s no holding up production for repairs.”

“MIS adheres to strict procedures, adding any steps necessary to ensure the lowest percentage of contaminants, including blasting residue or remnants from various stages of production,” Reiner added. “Because the scanning electron microscope analysis is done on samples only, a trained technician also does a 100 per cent visual inspection on each and every implant. Any flawed implants are unconditionally rejected.”

The intermediate report, titled “Surface analysis of sterile-packaged implants”, was published in the 01/2015 issue of the European Journal for Dental Implantologists.

This is the second time within the past 12 months that a study has verified MIS’s implant quality claims. The first study, titled “Identification card and codification of the chemical and morphological characteristics of 62 dental implant surfaces. Part 3: Sand-blasted/acid-etched (SLA type) and related surfaces (Group 2A, main subtractive process)”, was published in the June 2014 issue of the POSEIDO journal. According to the study, which included 18 different implants, MIS’s SEVEN implant was among the three implants that showed no pollution and no chemical modification of the surface.
CROIXTURE

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After achieving a record result, the 36th International Dental Show (IDS) that was characterised by an excellent atmosphere closed its doors in Cologne after five days. Around 138,500 trade visitors from 151 countries attended the world’s leading trade fair of the dental industry, which corresponded to an increase of almost eleven per cent compared to the previous event. IDS also achieved new records in terms of the number of exhibitors and the exhibition space sold.

2,201 companies (+6.9 per cent) from 56 countries presented a wealth of innovations, product developments and services on exhibition space covering 157,000 square meters (+6.2 per cent). With an over 70 per cent share of foreign exhibitors (2013:

Biggest IDS of all time in Cologne

Growth in the number of visitors, exhibitors and exhibition space

Author: Koelnmesse
meetings

68 per cent) and a 17 per cent increase in the number of trade visitors from abroad the level of internationality of the event was once again significantly increased. At the same time, the number of trade visitors from Germany also increased markedly in comparison to 2013 (+4.3 per cent).

“We succeeded in making the International Dental Show in Cologne even more attractive, on both a national and international basis. It is thus the most successful IDS of all time,” summed up Dr Martin Rickert, Chairman of the Association of German Dental Manufacturers (VDDI). “The quality of the business contacts between the industry and the trade as well as between the industry, dentists and dental technicians was extremely high. The number of orders placed at IDS rose once again and we are reckoning with sustainable impulses for the post-fair follow-up business,” added Katharina C. Hamma, Chief Operating Officer of Koelnmesse GmbH.

Furthermore she said: “In addition to the growth in the number of German trade visitors, the high international response once again underlines the character of IDS as the world’s leading trade fair of the dental industry. The International Dental Show particularly recorded strong growth in the number of visitors from the Near and Middle East, the United States and Canada, Brazil as well as from China, Japan and Korea. The business in the South East European market, especially Italy and Spain, has also increased noticeably.”

_Fantastic outcome of the trade fair and excellent mood_

The hustle and bustle in the halls made the high attendance at IDS very apparent. By all accounts, representatives from all relevant professional groups—from dentists’ surgeries, dental laboratories, from the dental trade, but also from the higher education sector—from all over the world had visited the exhibition stands. The exhibitors were especially pleased about the high level of internationality of the trade visitors. In terms of business, IDS was very successful for many companies, because orders were placed—by both national and international customers.

Numerous companies were pleased to announce full order books. Aspects such as grooming contacts, customer bonding, winning over new customers or penetrating new foreign markets were at least equally important for the exhibitors. These goals were also achieved to complete satisfaction at the 36th International Dental Show. The exhibitors evaluated the quality of the visitors very positively. This finding is confirmed by the initial results of an independent visitor survey: 83 per cent of all of the visitors are involved in purchasing decisions at their company.

“The world meets up at IDS in Cologne,” summed up Sebastian Voss, managing partner of Hager &
Meetings

More international customer contacts visited our stand this year than in 2013. Visitors from Latin America were particularly well represented, but also from Asia. “We were able to establish countless new contacts at IDS and also met up with our existing customers.” Martin Dürrstein, Chairman of Dürr Dental AG, was also extremely satisfied: “The trade fair went very well for us, it was fantastic. We received a high number of particularly qualified trade visitors. We are totally satisfied with the fair, because we were able to welcome many new customers from Asia, Arabia, Latin America and South Africa.”

Christian Scheu, Executive Director of Scheu-Dental GmbH also praised the further increased internationality of IDS: “In comparison to 2013, we were able to further increase the number of visitors at our stand, in particular visitors from abroad. The Asiatic region, for instance China and Korea, were especially well represented, but we also registered an increase in the number of customers from Southern Europe.” As well as the high frequency of visitors at his stand, Axel Klarmeyer, Executive Director of BEGO, also reported, “that the customers were well informed and that they showed great interest in new technologies.”

Walter Petersohn, Vice President Sales of Sirona Dental Systems, was also pleased “about the vast numbers of international visitors, the buying interest and as always about the large number of attending German dentists and dental technicians.” Michael Tuber, Executive Director of A. Titan also awarded IDS 2015 top marks. “This is the seventh time we have exhibited at IDS and we have optimally achieved the goal we set ourselves, namely further expanding our international sales network. The trade fair offers us the perfect platform for meeting up with our existing customers from all over the world, but at the same time, we were able to establish many new customer contacts. This is why the International Dental Show is an absolute must for every American manufacturer from the dental industry.”

IDS 2015 was also a success for Andrew Parker, CEO of Mydent International: “We met up with our international customers here in Cologne and were additionally able to make over 100 interesting new contacts to dental dealers. No other event in the world has such international appeal.”

Satisfied visitors all round

The visitor survey revealed that over 75 per cent of the respondents were (very) satisfied with IDS. The fair’s comprehensive spectrum of products and new products ensured that 81 per cent of visitors rated the product range as being (very) good. 74 per cent of the exhibitors were (very) satisfied in terms of reaching the goals they had set themselves for the fair. Overall, 95 per cent of the visitors questioned would recommend visiting IDS to business partners and 77 per cent also intend to visit IDS 2017.

The International Dental Show (IDS) takes place in Cologne every two years and is organised by the GFDI Gesellschaft zur Förderung der Dental-Industrie mbH, the commercial enterprise of the Association of German Dental Manufacturers (VDDI) and is staged by Koelnmesse GmbH, Cologne.

The next IDS—the 37th International Dental Show—is scheduled to take place from 21 to 25 March 2017.

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24–26 September 2015
Stockholm, Sweden
www.eao-congress.com

SCAD 2015 Annual Conference
24–26 September 2015
Chicago, USA
www.scadent.org

ICOI World Congress
15–17 October 2015
Berlin, Germany
www.icoi.org

AAED Annual Meeting
5–7 August 2015
Telluride, USA
www.estheticacademy.org

AAID Annual Educational Conference
21–24 October 2015
Las Vegas, USA
www.aid.com

DENTECH CHINA
21–24 October 2015
Shanghai, China
www.dentech.com.cn

12th International CAD/CAM Expo & Symposium
20–22 November 2015
Los Angeles, USA
www.dloac.org/symposium

ADF
24–28 November 2015
Paris, France
www.adf.asso.fr

Greater New York Dental Meeting
27 November–2 December 2015
New York, USA
www.gnydm.com

CAD/CAM International Conference 2015
4–5 December 2015
Suntec, Singapore
www.capp-asia.com
submission guidelines:

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

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

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

Text length

Article lengths can vary greatly—from 1,500 to 5,500 words—depending on the subject matter. Our approach is that if you need more or 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.

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

Text formatting

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

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

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

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

Image requirements

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

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

In addition, please note:

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

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

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

You may submit images via e-mail, via our FTP server or post a CD containing your images directly to us (please contact us for the mailing address, as this will depend upon the country from which you will be mailing).

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

Abstracts

An abstract of your article is not required.

Author or contact information

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

Questions?

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