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Dear Reader,

I have great pleasure in presenting to you this year’s first issue of the CAD/CAM international magazine of digital dentistry. The magazine, just like the International Dental Show in Cologne (this year’s show runs from 12 to 16 March), is all about the latest developments in digital dentistry.

Dentists use a great deal of equipment and it is thus not possible to be a good dentist today if we are not updated on the latest methods and technologies relating to dental equipment; knowledge only is not enough. Being updated means keeping up with all the latest technological advances. Such advances apply to many areas of dentistry: CAD/CAM, scanning software, surgical guides, treatment planning. These new technologies, however, though they are excellent and very useful, cannot be used efficiently and successfully without adequate knowledge.

Furthermore, there is the risk that dentists may rely so heavily on these new technologies that they forget about the important human aspect in addition to the significant knowledge and skill required.

As a professor and Vice Regent for Italy of the International College of Dentists, I strongly believe in the importance of sharing knowledge and experience in any way possible. I think that a magazine like CAD/CAM that addresses all of the above topics guides all of us through the recent developments in our profession, and keeps us informed about what is available and how this can improve our offerings to our patients.

This edition of CAD/CAM is concerned particularly with implantology. You will find information on new concepts in computer-guided implantology, using CAD/CAM techniques and facial aesthetic analysis, as well as the latest industry news and information on upcoming meetings.

I hope that you will find the magazine useful and interesting.

Yours faithfully,

Prof. Mauro Labanca, MD, DDS
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Welcome to the “Block Party”

Author: Dr Curtis Jansen, USA

Restorative clinicians have been spoiled in the past regarding materials for direct and indirect restorations. We've had the great luxury of seeing an ad in a journal, getting an offer in the mail or online, or attending a CE course about a new product, technique or service, and then immediately or the next day, we could take action. If we saw a new restorative material for fabricating restorations, we would simply write the request on a lab slip for the new material and expect to get it back in a couple weeks.

Think of the poor laboratory technician on the other end, reading perhaps for the first time, the method you want used to fabricate your restoration or a specific new material or a mix of materials and techniques. Remember, a laboratory slip or prescription is a work authorization, and if you write one, the laboratory technician has to comply. If we change our minds for the next restoration, we simply prescribe something else. I'm sure technicians sometimes feel as if they're chasing their tails with all the new materials, techniques and requests. Consider the investment in materials, systems, training and the learning curve they have to endure every time a new material is prescribed.

To the relief of patients, dentists, team members and technicians comes CAD/CAM dentistry and a little bit of sense and sensibility regarding dental materials. Dental material manufacturers need to invest in the technology, methodology and product design, as well as the material evolution to the restoration (blocks, mandrels, discs), in order to introduce a new material for CAD/CAM dentistry. Then, in collaboration, dental CAD (computer-aided design) and dental CAM (computer-aided manufacturing) developers must work with that material to produce consistent optimized results. This takes time and effort. Only those materials proven through economic evaluation, clinical validity and proven demand will make it to the final stages and into the software of the CAD systems and into the mills of the CAM systems and ultimately into our patients mouths.

CAD/CAM also requires the dentist to take more control of all facets of patient care; it requires more thought than a whim and a handwritten prescription to choose the right material. CAD/CAM requires thinking through the restorative and aesthetic process before proceeding with a restoration, all better things for the dental professional as a whole. As more and more laboratories and dentists invest in digital dentistry, everyone gains.

I'm "all in" for "daily digital dentistry." I have digital impression-only systems and a chairside CAD/CAM System, E4D Dentist (Fig. 1). There still isn't just one system that can complete all of the restorative indications we have in dentistry. It is my preference to select the techniques and materials that excel in a particular area, rather than compromise to have one system that says it does a little of everything. For me and my practice (a prosthetic practice located in Monterey, CA), all of my single-unit restorations are fabricated using the E4D Dentist system. In addition, with the opening of E4D Sky™ Network and the newest version of the E4D’s DentaLogic software, more and more of my total restorative care will be touched by digital technologies on a daily basis.

When you are first introduced to CAD/CAM chairside dentistry, you have the opportunity to refine your thinking on restorative care. You’ll no doubt become a better diagnostician and clinician—because of looking at your preoperative conditions and preparations on a large monitor—but also a better and more confident provider of
when to do what in different clinical situations. Given the number of restorative materials available at your fingertips, you’ll make better-educated decisions with each particular patient situation. Using the E4D Dentist system, you have access to a number of proven materials (blocks), each with either an Ivoclar Vivadent or 3M ESPE logo on it, so you know exactly what you are getting. The abundance of material options allows you to select the best one for the given clinical situation. A quick review of what is available follows.

_Block Party attendees

_Resin

In the category of resin, you have the option to select the Paradigm MZ100 block from 3M ESPE. Complementing the success of the direct restorative Filtek Z100, this block contains ceramic particles with an average size of 0.6 microns with cross-linked monomers that provide the ideal wear resistance, strength and radiopacity necessary for posterior use. I use it primarily for partial coverage restorations as well as some full coverage restorations on implants. The use of this resin for indirect restorations requires placement using an adhesive cementation protocol. I personally have an onlay restored with MZ100 in my own mouth, tooth #3.

When compared to conventional feldspathic porcelain restorations fabricated with chairside CAD/CAM, the Paradigm MZ100 restorations showed better colour match through ten years.\(^1\) This same study also showed no difference in margin finish, surface finish, anatomic form, caries or sensitivity. The authors actually concluded that “the composite inlays performed as well as the porcelain inlays with less bulk inlay fracture.” In an \textit{in vitro} fatigue study on occlusal veneer restorations,\(^2\) Paradigm MZ100 had significantly higher fatigue resistance (100\% survival at 185,000 cycles up to 1,400 N loads) compared to CAD/CAM feldspathic porcelain (0\% survival).

\textit{Resin nano ceramic}

A new category for chairside CAD/CAM dentistry is the resin nano ceramic created with the introduction of the new Lava Ultimate block. This material defines a new category, resin nano ceramic, which provides some unique and beneficial characteristics for us to have for chairside. We all know that 3M ESPE and its Lava brand have become synonymous with zirconia restorations and they’ve expanded this technology to additional digital applications. Lava Ultimate material contains a blend of three fillers: zirconia and silica nanoparticles agglomerated into clusters, individually bonded silica nanoparticles and individually bonded zirconia nanoparticles.\(^3\)

Lava Ultimate contains approximately 79\% (by weight) of this filler blend that reinforces a highly cross-linked polymeric matrix cured using a proprietary manufacturing process. The result is a unique block with indications for chairside fabrication (blocks) and use. It’s indicated for a full range of permanent, adhesive, single-unit restorations including crowns, onlays, inlays and veneers. The material is ideally suited for implant supported restorations (Figs. 2 & 3) because of its high 200 MPa flexural strength (higher than conventional feldspathic blocks and layering ceramic used in metal-ceramics) and relatively low modulus (compared to ceramics).

From a time management standpoint, the use of resin or resin-ceramic system provides faster milling times and no need for an additional step of sintering or firing. As a sign of its full confidence in this new category of material, 3M ESPE is introducing a unique 10-year warranty on the use of the Lava Ultimate block. The 3M ESPE Lava Ultimate block will be offered in eight shades with two translucency options (LT and HT).
Glass ceramic

In the glass ceramic category, with E4D Dentist you have the two most popular ceramics in the history of dentistry right at your fingertips, IPS Empress CAD and IPS e.max CAD in block form. These blocks can be used together or separately depending on the clinical situation to create extremely aesthetic restorations. Here an example is shown milling both IPS Empress (#7–#10) and e.max CAD (#6 and #11) (Figs. 4–6).

Leucite-reinforced ceramics

IPS Empress ushered in the aesthetic revolution, and I’ve had nearly 15 years of clinical utilization of the IPS Empress material, first via the press technique and now through milling of the IPS Empress CAD blocks. IPS Empress CAD blocks are available in two translucencies (LT and HT), as well as the extremely useful IPS Empress CAD Multiblock. The IPS Empress CAD Multiblock has a blend of translucency and colour intensity graduating through the block from the cervical position to the occlusal/incisal.

The coordinated software of the E4D Dentist System (DentaLogic) provides a simple way to position your restoration first virtually then actually within the block in order to customize the shade and translucency of your restoration even before you begin any customization. The clinical documentation, verification and confidence of using IPS Empress have been established via long-term data.

Lithium disilicate ceramic

IPS e.max is a high-strength ceramic with a flexural strength of 360–400 MPa that defines a new level of strength for metal-free restorations. While veneering ceramics (for metal, zirconia or ceramic substructures), it exhibits strengths in the 100–120 MPa range, IPS e.max CAD provides a monolithic full-contour material that was predicted to resist fractures and chipping greater than other layered processes (veneered metals, ceramics or zirconia). In a comparative study of durability and fracture resistance between layered, lab-fabricated zirconia restorations and monolithic IPS e.max restorations, the IPS e.max restorations provided reduced fracture and more durable results.5

IPS e.max CAD blocks have the unique characteristic of being distributed in a partially crystalized stage (blue to violet coloured). This means that after milling, the IPS e.max CAD blocks need

It should be noted that the proper and successful utilization of any of the metal-free types of materials (resin, resin ceramic, glass ceramic) require following approved preparation guidelines. These are simply providing proper clearance for the particular material—typically 1.5–2 mm occlusally (2 mm for implant restorations) and 1 mm axially; heavy chamfer or shoulder; rounded internal angles and butt joint margins—which need to be visible!

All digital capture systems today can only capture what they see and if you clinically can’t see the margins, don’t try and capture them digitally; first gain visualization through proper soft-tissue management. With all these materials, the preparation is of the utmost importance!

Concern has been raised by those without firsthand experience about the aesthetic limitations of mono-block restorations or the limited longevity of surface-characterized (glazed) metal-free restorations. It should be noted that it is often the dental bur that removes the glazed surface and not natural wear; one need only walk on 2,000-year-old tiles in Europe to realize the natural fusion of the glazed material into the base ceramic.

Proper design, record (bite) taking and attention to detail in the use of various software packages along with the replication of the virtual design in ceramic after choosing the correct shade and translucency, quickly relieve any hesitation about aesthetics and reinforce the benefits of doing and more and more chairside restorative treatment.

It’s all about the preparation

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IPS e.max CAD blocks have the unique characteristic of being distributed in a partially crystalized stage (blue to violet coloured). This means that after milling, the IPS e.max CAD blocks need
to be fully crystalized in a two-stage ceramic oven (e.g., Programat CS) prior to final delivery. This provides a major benefit to the entire procedure, with the advantages that the IPS e.max CAD milled restoration can be tried in the mouth and contacts verified before final firing and characterization. This makes the final delivery of the restoration more predictable and consistent.

The introduction of DentaLogic software version 2.0 coincides with the availability of additional shades of IPS e.max for chairside use. IPS e.max Impulse introduces five new shades, three Value and two Opal shades. Because of the different brightness values of the three Value blocks, restorations can be optimally integrated into the surrounding tooth structure in terms of their shade. The two Opal blocks allow clinicians to imitate the lifelike opalescent effect, which is desired in anterior restorations. The Opal blocks are ideally suited for the fabrication of veneers and thin veneers.

IPS e.max CAD blocks can also be seated with adhesive or conventional protocol depending on the retentive characteristics of the preparation following approved guidelines (Table 1).

Acrylic

Even though the price of gold has reached an all-time high if nostalgia and/or clinical concern of adequate clearance, margin design or material preference steer you toward metal-based restorations, you can still take advantage of digital scanning and designing benefits while providing you or your laboratory with a simplified fabrication process for metal-based (gold) restorations.

The BOB (Burn Out Block) block from D4D Technologies can be selected for any preparation style and then scanned and milled for presentation to a laboratory for investment, burnout and casting (or pressing), thus providing you with consistency in design, contacts and contour for your skilled design applications (Figs. 7 & 8).

_Collection_

Chairside CAD/CAM systems have provided clinicians with a new level of control in the practice of dentistry. From diagnosis through preparation and material selection, clinicians now have the capability of selecting from a variety of materials with proven clinical performance and to deliver restorations with unmatched efficiency and productivity. The categories of resin, resin ceramic and glass ceramic give today’s modern practices the ability to offer solutions for the majority of crown and bridge indications right in the office._

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

_Figs. 7 & 8_. The B.O.B. (Burn Out Block) provides the opportunity to design cast gold restorations virtually.

_about the author_

Dr Curtis Jansen completed his DDS and his prosthodontic education at the University of Southern California (USC) School of Dentistry. He taught full time at USC and was director of implant dentistry in the Department of Restorative Dentistry. Currently, he has a full-time practice limited to prosthodontics and a dental laboratory in Monterey, California.

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CE article _daily digital dentistry_
Dentofacial aesthetic analysis using 3-D software

Synergy between aesthetic dentistry and aesthetic medicine

Author: Dr Valerio Bini, Italy

_Introduction

Dentofacial abnormalities are alterations in facial proportion and dental relationships, and such abnormalities in dental and facial appearance often lead to societal discrimination. While orthodontic treatment restores correct dental relationships, it is often not sufficient to solve the facial disharmony and certainly cannot resolve the accompanying psychological difficulties in certain patients (Fig. 1a).

For this reason, aesthetic medicine is utilised to harmonise the final result. Owing to virtual dentistry, the expected smile and face of the patient at the end of orthodontic therapy and aesthetic treatment can be shown to the patient. In order to achieve this, a new diagnostic approach is used in the correction of dental malocclusion: capturing and analysing preoperative photographs in conjunction with CT scans and X-rays with the help of 3-D software specifically for aesthetic dentistry. In this way, the final expected result can be shown to the patient.

_Aesthetic analysis

Often the patient is directed to a dental consultant because he or she does not like his or her smile and this has affected him or her psychologically such that aesthetic dentistry is inevitable.

The role of the dentist today should be to ensure that the reasons for intervention will be agreed upon with the patient and to ensure predictability of the aesthetic result.
Many dentofacial disharmonies are caused by malocclusion, classified according to Angle's molar relationships (Fig. 1b). The soft tissue of the vestibule and the lips lies over the dental hard tissue and is therefore influenced by the molar relationships.

In examining the patient, we could consider, for example, his or her profile from the labial view. When a patient comes to my office for examination, in recording his or her medical history I pay much attention to preoperative photographs in seeking to determine the cause of aesthetic disharmony.
In the case presented here, three extra-oral photographs were taken from the front and three extra-oral photographs were taken from the side (Fig. 2). Intra-oral examination found that the patient presented with a Class III/I malocclusion with a pronounced overjet. From the extra-oral photographs, the macroscopic incongruity in the labial relationship is evident because although the patient had her mouth closed and lips soft the lips are not touching. The face is asymmetrical in the inferior third and the smile line is not aligned with the occlusal plane, and is oblique and does not run parallel to the bipupillary line.

**3-D software in aesthetic dentofacial analysis**

Today, we can design smiles more reliably and in a more sophisticated manner to correct the smile of our patients (smile makeover) using 2-D and 3-D dental software (Fig. 3a). ClinCheck 3-D software (Align Technology) for use by dentists to create transparent orthodontic and dental aligners has proven to be an excellent tool in dentofacial aesthetic analysis, not only from an orthodontic perspective but also from an aesthetic perspective.

In this case, orthodontic therapy using Invisalign (Align Technology) was proposed. Impressions taken of the dental arches, X-rays, photographs and diagnosis with a treatment plan were processed by ClinCheck 3-D, which converts everything into 3-D images to allow the dentist to see and change all the therapeutic orthodontic steps necessary to align the teeth.

ClinCheck is sophisticated software that processes data captured by clinicians, allowing high-fidelity 3-D reproduction, where each step corresponds to the action by a single aligner able to perform movements of 0.12 to 0.25 mm (Fig. 3b).

Biomechanical steps ensure greater predictability in orthodontic clinical cases for both the clinician and the patient. The initial phase of aligner movement and the final situation can be superimposed on a photograph of the face of the patient using 2-D software (Fig. 3c). ClinCheck has among its options a millimetre grid that can be superimposed on the photograph and the steps shown according to conventional reference lines (Figs. 4a–c). In this way, one can obtain a predictable dentofacial analysis from both a dentoskeletal perspective (alignment) and a dentolabial perspective (labial/perilabial repositioning).
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The analysis of the clinical case in question demonstrated a drastic closure overjet of about 3 mm as the final post-orthodontic treatment outcome (Fig. 4d). Since the soft tissue of the lips and of the vestibule lie on the skeletal structures, it is possible to predict the future dentolabial relationship (Fig. 4e). At this point, aesthetic predictability for the patient is important because at this stage the combined results of dentistry and aesthetic medicine are shown. In fact it is possible to simulate virtually the new labial dimension following aesthetic dental treatment and cosmetic labial or perialbial surgery.

Clinical case: Orthodontic treatment and hyaluronic acid

A 47-year-old female patient presented with malocclusion with crowded teeth in the maxilla and mandible and an incongruous dentolabial relationship. The clinical case was treated with 28 upper and 20 lower aligners, with interproximal reduction and attachments in both arches. The superior/inferior midline was moved during the process of sagittal correction (Fig. 5a).

In keeping with the protocol described above, and at the explicit request of the patient, it was decided to approach treatment in accordance with the dentofacial aesthetic analysis obtained using ClinCheck 3-D (Fig. 5b). Using software to show the predicted movement on the grid allows the patient to see the expected changes (showing the lips with or without surgical remodelling; Figs. 5c & d). The preoperative analysis can be verified at the end of therapy by superimposing all of the images available (Fig. 6a).

Once the dental treatment had been completed, we decided together with the patient to increase the lip volume using hyaluronic acid (Figs. 6b et c). About two weeks after surgery, it was possible to verify what had been expected in the analytical aesthetic phase (Figs. 7a–c & 8).

Conclusion

Combined aesthetic dentistry and aesthetic medicine can offer optimal and predictable treatment in the majority of clinical aesthetic cases.

Using digital technology, the predicted outcome of such treatment for smile design can be shown to the increasing number of patients presenting for aesthetic treatment.

Editorial note: A complete list of references is available from the publisher.
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The most important years in implantology
A very personal retrospect

Author_Dr Georg Bach, Germany

Introduction

It all started with an inquiry from a well-known professional journal of implantology asking for a contribution to acknowledge their having been in business for 15 years. Then there was the incidental telephone call by an academic teacher who had accompanied and supported me in my first steps in implantology. When I asked him about the upcoming publication project, I received a both spontaneous and surprising reply, "The last 15 years—those were the most important years in implantology"! This from a renowned university professor who was instrumental in establishing implantology—I was impressed. Later on I had to ask myself, "Is this really true?" The result of my tracing this development is this article—a personal retrospective.

Phases of implantology

If one considers oral implantology with regard to its major developments, three phases are evident: (i) the empirical and experimental phase; (ii) the arrival of implantology in universities and science; (iii) the mass phenomenon of implantology. I would like to add that this is a rough and probably superficial division to some extent. Please, however, allow me to apply it within the scope of this personal—and not exhaustive—review.

Looking back at these past fifteen years, I will barely touch on phase II, but will discuss phase III fully. This entails different directions and priority areas that colleagues working in implantology experienced. When I browsed through implantology textbooks and journals from this period, I realised even more that implantology had undergone considerable change in this relatively short period of 15 years. I would like to recount my highlights of implantology from this period in the following paragraphs.

Farewell to the tristesse of papers

A seemingly minor issue to start with: the variety and quality of dentistry-specific print media and of digital media, particularly print layout, has developed substantially during the past 15 years. This holds true not only for implantology, but also for dentistry as a whole. The appearance of some professional journals up until the mid-1990s was reminiscent of an official legal amendment, but amazing things have happened since. The quality of colour printing (which is the norm now, but used to be subject to a surcharge for authors who wanted to include colour images), the accuracy of images, the paper—all of these make for a high quality appearance and leave a lasting impression on the reader. This has clearly been an advantage also for implantology because now highly complex correlations can be more easily conveyed and "sometimes a picture is worth a thousand words". Ideally, e-learning and electronic professional journals supplement the current training needs of the younger generation of dentists especially.
The end of dogmas

While implantology was marked by many dogmas from its beginning and the mid-1990s, this had changed at the time when our 15-year observation period begins. However, implantology was later called into question in its entirety. Whether it was healing times, waiting times after augmentation or prosthetic concepts—everything underwent scrutiny. On the one hand, some of these dogmas did in fact prove to be no longer sustainable because of remarkable developments, especially improvements in implant surfaces. On the other hand, the mark was at times overshot in the elimination of other dogmas, creating the need to back-track. This was a painful experience for both patients and implantologists.

One dogma that we encountered in the observation period was that of a strict refusal of immediate implant placement. There is general consensus today, however, that under suitable conditions an immediate implant placement can be a high quality and sustainable alternative to established procedures. One clinical case shows an immediate implant placement in the maxillary anterior teeth: the extraction and the immediate implant placement of a maxillary anterior tooth that was not worth preserving under the guidance of a drilling template and implant position (Fig. 1), transfer into the oral cavity (Fig. 2), and the condition immediately after insertion of the implant crown (Fig. 3).

The prospering of the implant market

A welcome variety of new implants, implant forms and prosthetic options has become a reality in the past 15 years. Special implants were developed for special indications so that now even a mandibular molar can be replaced by a corresponding sized implant, followed by insertion of a corresponding sized implant crown. Figures 4 to 7 show the clinical and dental appearance of these in a patient. Implantologists who placed several hundred implants annually were considered the big players on the implant market in the 1990s. Achieving the mark of 100,000 implants placed per year in Germany signified that the peak had been reached. This was not the case, since the one-million mark was also reached within the scope of a rapid, almost unimpeded development. While the increase has been slower in recent years and global economic developments even caused a brief decline, today we can assume that the implant market will continue to grow. The maximum growth phase falls into our observed period.

Development in the eyes of implant manufacturers

From manufacturer to global player—this would be an accurate description of the development of some implant manufacturers. The development of some of these companies over the past 15 years, the size of their companies and the number of their employees today are indeed impressive. And these prosperous companies share other characteristics as well: the acquisition of products and entire firms in order to expand or supplement their product portfolio and their pressing on to the field of digital dentistry (CAD/CAM, planning, etc.), into which these global players invest large sums of money. Revenues
must be generated so that these investments can be made—and they are still made, albeit declining owing to the economic crisis.

Still, the implant market is booming. Although the consistently two-digit annual growth rates some implant manufacturers had started to become used to have become more moderate today, a great deal of money can be made with implants. As a result, an ever-increasing number of implant suppliers and systems make it impossible for the individual user to keep track. Aside from new systems, an increasing number of generics are being launched on the market.

Focus on red–white aesthetics

The President of the German Society for Dental Implantology (Deutsche Gesellschaft für Zahnärztliche Implantologie), Prof. Frank Palm, aptly remarked, “What was celebrated as a triumph for some colleagues 20 years ago is today taken to court.” Dentists who practised implantology were not prepared to find themselves confronted with a debate that had spread from North America to Europe: that of red–white aesthetics. This new focus on achieving the highest possible aesthetics for implant-prosthetic treatments was linked to implantology and distanced itself from surgery, which had been dominant up until that time.

In the early phase of implantology, the main focus was on safe placement and the best possible placement in the bone, sometimes even at the expense of subsequent prosthesis treatment owing to unfavorable placement of the artificial abutment teeth. Now, however, prosthetic standards and issues have become the centre of the discussion. Placement techniques were modified and new techniques were established in order to satisfy these requirements. Patients no longer, or only occasionally, accept demanding and complex cases like the following case.

Both implants in the anterior maxillary region were placed too far buccally, and there was a gap of 5.5 mm between the implant shoulder and the cemento-enamel junction of the adjacent teeth (Figs. 8–10). Treatment with a long-term temporary restoration would only have yielded an unsatisfactory aesthetic result. However, under certain surgical and dental conditions—as shown in our second example—superior results and stability for a period of ten years can be achieved even with challenging initial situations. In 1999, an immediate implant was placed in region 12. The following images show the steps of treatment (Figs. 11–13). The last image shows the condition after ten years (Fig. 14).

This development was made possible mainly by massive improvements in the area of augmentations, which can now be performed with significantly higher predictability. This development was further enhanced by a considerable improvement in the training of implantologists. These improvements are significant for both undergraduate study and postgraduate training. Thus, the universities and professional associations who have contributed immensely in this area deserve much credit in this respect.
The battle of healing times

It was but an episode, yet one that caused an incredible furor at the time: the debate about shortened healing times. Stimulated by a media hype in which the specialised press only played second fiddle and the lay press appeared to be in the lead, the healing times of some implant manufacturers were inflated. Values were corrected downwards almost on a daily basis. Some manufacturers went along with it, while others remained firm. Some participants felt they needed to be at the forefront, others stayed out of it. A short but remarkable ascent was followed by a rapid crash.

A personal highlight for me was an article in a tabloid newspaper that said, "Extraction in the morning; directly followed by augmentation and implantation; a firmly seated supra-construction implemented at lunch time, and then endless servings of spare ribs!" As can be seen from this euphoric statement, some got carried away, while others had to painfully back-track. What remains is the realisation that, owing to improved surfaces and other conditions, the long healing times recommended in the early phase of implantology can in fact be reduced considerably, but not at any cost.

New options for improving the implant site

The afore-mentioned dominance of prosthetic implantology was only possible because many new and safer augmentation procedures were established during the observation period, enabling dentists to design the osseous bed for the implant as desired. Revolutionary augmentation procedures in the area of the maxillary posterior teeth, which had been the focus of discussion in the first year of the period in question, constituted another important approach for real progress.

Thanks to surgical techniques for sinus lifts, which underwent an incredible number of modifications also with regard to less invasive procedures, it was possible to treat areas of the jaw that had previously been considered impossible or that could only be restored for implantation by way of highly invasive orthodontic procedures. While initial sinus-lift procedures were generally reserved for highly specialised centres, they have now become common knowledge in implantology and are offered and performed extensively.

Establishing virtual implantology

It seems easy to figure out what the old-school fraction must have thought about the new planning and placement options for oral implants. This fraction had already had a hard time accepting the development from surgical to prosthetic implantology, and they were strictly against the new digital procedures that were emerging incredibly quickly. With the rapid spread of dental volume tomography, which opened a new dimension to dental image diagnostics, a multitude of planning programs and aids were placed on the market.

The suggestion by some opinion leaders to define validity and establish standards with regard to these new techniques, which are generally based on 3-D X-ray data, was especially frowned upon. I feel that a good compromise has been reached, owing to anticipatory and serious discussions held during consensus conferences and congresses, as well as at universities and within the dental associations.

Of promises and realities

Themes of the congresses during the first decade of the observation period contained generally positive statements and depicted new opportunities in implantology, which exceeded the then current options by far and expressed a belief in boundless growth. This coincided with many positive statements and evaluations by implant manufacturers and distributors. However, all this changed considerably during the past five years.

Suddenly, new topics were given priority, which shaped specialists’ conventions—topics that had previously been partially suppressed if not negated. I remember only too well the implant congress held by a very important American implant manufacturer in Frankfurt/Main in 1998, where I reported on a concept for the treatment of peri-implantitis developed...
implantology at the University of Freiburg and was then rebuked by the main speaker, who was from the USA, during the ensuing panel discussion. He asserted that he had "not seen one case of peri-implantitis in twenty years of implantology—this phenomenon does not exist and, if it occurs, it can only be attributed to a lack in skill on the part of the implantologists." How times have changed. However, trouble-shooting and complications in implantology and even the word "failure" have been mentioned in the themes of many congresses held by leading professional associations of implantology in the past years.

Patients' expectations

While a consistently positive and at times even euphoric tone prevailed regarding the topic of implants for many years, a few critical voices and later increasing criticism emerged at the beginning of the observation period. This was—concurrent with a noticeable increase in the number of implants—based on the considerable increase in implantology failures and complications. The following images depict total implantological failure—the loss of a purely implant-supported complete maxillary restoration caused by an infaust peri-implantitis (Figs. 15–17), leaving profound osseous defects.

However, in line with the consistently positive evaluation of implants and the persisting promise that the use of implants would yield optimum results always—and often publicised by the lay press—our patients' expectations have increased considerably in the past 15 years. Patients assumed that, regardless of the individual situation, he or she would always receive the optimum results. In this regard, it seems reasonable to maintain a self-critical attitude and to concede that we did not always contradict this general assumption vehemently enough.

And then what was bound to happen, happened: at times, the result was not what the patient had expected. An awkward situation arises when the dentist, based on the initial diagnosis, considers the result to be successful and the patient considers it a failure. A long-time legal expert sums up this situation accurately by stating that, "Two-thirds of all pending court proceedings were filed by patients whose expectations were disappointed." Rather unfortunately, the increasing number of court proceedings are mostly related to implantology. It cannot be by chance that the premiums for mandatory professional liability insurance have increased considerably.

Emerging criticism

German periodontists Dr Thomas Kocher referred to implantology as "the red light district of dentistry." Whether this evaluation is justified is a matter to be decided individually. Personally, I do not agree with this evaluation, but a grain of truth might be found in its reference to overtreatment. In this regard, the extraction of teeth in favour of implants, even when not indicated, is a concern voiced increasingly by periodontists and those in favour of conservative treatment.

We have to address this issue by individual evaluation of each patient, as well as through academic
discussion. Implant versus tooth preservation has been a frequent debate at conventions and implant symposia in recent years. In my opinion, this would not have been possible ten years ago.

Trouble-shooting concepts

Unexpected complications, such as implant fracture and failure of implant supra-structure connections [Figs. 18–21], necessitated the development of surgical and prosthetic trouble-shooting concepts and modification of constructions in implant and abutment design. However, these were not readily available and have not yet been finally agreed upon. In other words, they cannot be said to be common knowledge in implantology, at least not in the treatment of peri-implantitis. Similar statements can be made with regard to pre-implantology arguments, where a pleasing variety of surgical techniques and materials is listed, but no generally valid scheme has been agreed upon.

The fact that the need to develop and convey these trouble-shooting concepts is generally recognised today and that these concepts are yet widely supported by the participants on the implant market is gratifying. The specialist press has made a valuable contribution here and continues to do so—numerous articles that received a great deal of attention during the past 15 years are those that dealt with implantology and implant-prosthetic trouble-shooting.

Digital implantology

I consider the establishment of 3-D diagnostic imaging, with all associated possibilities, to be the significant development during the 15-year observation period. It is true that only implantologists used the new 3-D technology during the initial phase of dental volume tomography (because they made up the group of dentists who could actually afford this expensive equipment); nevertheless, 3-D technology constituted a quantum leap for dental diagnostic imaging as a whole.

Today, we have almost unbelievable possibilities at our disposal that even the greatest optimists would not have considered possible 15 years ago: highly complex patient cases can now receive minimally invasive treatment and have implants placed even without the need for augmentation.

Our first case shows a highly atrophied mandible, in which four implants could be placed without any prior augmentation owing to 3-D data and planning [Figs. 22–24]. Three-dimensional diagnostics are sometimes also employed to clarify facts when complications have arisen, for example neural lesions after implantation [Figs. 25 & 26] and bone necrosis after administration of bisphosphonates, and erroneously diagnosed as peri-implantitis [Fig. 27].

My personal conclusions

It is difficult to draw a conclusion regarding the development of implantology over the past 15 years because it has been so multifaceted and rapid. To conclude, I would therefore like to quote my academic teacher and former supervisor, Prof. Wilfried Schilli, who, as a founding member of the International Team for Implantology, was undoubtedly among the pioneers of implantology and has contributed to improving implantology through his university work: “Who would have thought that implantology could develop like it did in less than twenty years.”

This very true statement encompasses many aspects: the admiration and appreciation of what has been achieved, the satisfaction with having initiated a procedure that is considered to be the safest in the entire field of medicine, and some criticism regarding any development in oral implantology that did not turn so well or went off course.

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Single molar restoration — Wide implant versus two conventional

Authors: Prof. Amr Abdel Azim, Dr Amani M. Zaki & Dr Mohamed I. El-Anwar, Egypt

The single-tooth restoration has become one of the most widely used procedures in implant dentistry. In the posterior region of the oral cavity, bone volume and density are often compromised. Occlusal forces are greater in this region and, with or without parafunctional habits, can easily compromise the stability of the restorations (Fig. 1).

The single-molar implant-supported restoration has historically presented a challenge in terms of form and function. The mesiodistal dimensions of a molar exceed that of most standard implants (3.75 to 4.0 mm), creating the possibility of functional overload resulting in the failure of the retaining components or the failure of the implant (Figs. 2 & 3). Wider-diameter implants have a genuine use in smaller molar spaces (8.0 to 11.0 mm) with a crestal width greater than or equal to 8 mm (Fig. 4). Clinical parameters governing the proposed restoration should be carefully assessed in light of the availability of implants and components that provide a myriad of options in diameter, platform configurations and prosthetic connections. Many of the newer systems for these restorations are showing promising results in recent clinical trials.

It has further been suggested by Davarpanah and others, Balshi and others, English and others and Bahat and Handelsman that the use of multiple implants may be the ideal solution for single-molar implant restorations (Figs. 4 b et c).

Most standard implants and their associated prosthetic components, when used to support a double implant molar restoration, will not fit in the space occupied by a molar unless the space has been enlarged (12 mm or larger). Moscovitch suggests that the concept of using 2 implants requires the availability of a strong and stable implant having a minimum diameter of 3.5 mm. Additionally, the associated prosthetic components should ideally not exceed this dimension.

Finite element analysis (FEA) is an engineering method that allows investigators to assess stresses and strains within a solid body. FEA provides calculation of stresses and deformations of each element alone and the net of all elements. A finite element model is constructed by breaking a solid object into a number of discrete elements that are connected at common nodal points. Each element is assigned appropriate material properties that correspond to the properties of the structure to be modeled. Boundary conditions are applied to the model to simulate interactions with the environment. This model allows simulated force application to specific points in the system, and it provides the resultant forces in the surrounding structures. FEA is particularly useful in the evaluation of dental prostheses supported by implants. Two models were subjected to FEA study to compare between a wide implant restoration versus the two implant restoration of lower first molar.
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Material and Methods

Three different parts were modeled to simulate the studied cases; the jaw bones, implant/abutment assembly, and crown. Two of these parts (jaw bone and implant/abutment) were drawn in three dimensions by commercial general purpose CAD/CAM software “AutoDesk Inventor” version 8.0. These parts are regular, symmetric, and its dimensions can be simply measured with their full details.

On the other hand, crown is too complicated in its geometry therefore it was not possible to draw it in three dimensions with sufficient accuracy. Crown was modeled by using three-dimensional scanner, Roland MDX-15, to produce cloud of points or triangulations to be trimmed before using in any other application.

The second phase of difficulty might appear for solving the engineering problem, is importing and manipulating three parts one scanned and two modeled or drawn parts on a commercial FE package. Most of CAD/CAM and graphics packages deal with parts as shells (outer surface only). On the other hand the stress analysis required in this study is based on volume of different materials. Therefore set of operations like cutting volumes by the imported set of surfaces in addition to adding and subtracting volumes can ensure obtaining three volumes representing the jaw bone, implant/abutment assembly, and crown. Bone was simulated as cylinder that consists of two parts. The inner part represents the spongy bone (diameter 14 mm and height 22 mm) that filling the internal space of the other part (shell of 1 mm thickness) that represents cortical bone (diameter 16 mm and height 24 mm). Two implants were modeled one of 3.7 mm diameter and the other of 6.0 mm. The implants/abutment design and geometry were taken from Zimmer dental catalogue (Fig. 5).

Linear static analysis was performed. The solid modeling and finite element analysis were performed on a personal computer Intel Pentium IV, processor 2.8 GHz, 1.0 GB RAM. The meshing software was ANSYS version 9.0 and the used element in meshing all three dimensional model is eight nodes Brick element (SOLID45), which has three degrees of freedom [translations in the global directions]. Listing of the used materials in this analysis is found in Table 1. The two models were subjected to 120 N vertical load equally distributed (20 N on six points simulate the occlusion; one on each cusp and one in the central fossa). On the other hand, the base of the cortical bone cylinder was fixed in all directions as a boundary condition.

Results and Discussion

Results of FEA showed a lot of details about stresses and deformations in all parts of the two models.
under the scope of this study. Figures 6a & b showed a graphical comparison between the crowns of the two models which are safe under this range of stresses (porcelain coating, gold crown, and implants showed the same ranges of safety). No critical difference can be noticed on these parts of the system. All differences might be found are due to differences in supporting points and each part volume to absorb load energy (equation 2).**

Generally a crown placed on two implants is weaker than the same crown placed on one implant. This fact is directly reflected on porcelain coating and the two implants that have more deflections. Comparing wide implant model with the two implants from the geometrical point of view it is simply noted that cross sectional area was reduced by 43.3 % while the side area increased by 6.5 %. Using one implant results as a reference in a detailed comparison between the two models by using equation (1) resulted in Table 2 for porcelain coating, gold crown, implant(s), spongy and cortical bones respectively.

\[
\text{Difference} = \frac{\text{One implant Result} - \text{Two implants Result}}{\text{One implant Result}} \times 100
\]

Spongy bone deformation and stresses (Table 2) seems to be the same in the two cases. Simple and fast conclusion can be taken that using one wide implant is equivalent to using two conventional implants. On the other hand a very important conclusion can be exerted that, under axial loading, about 10 % increase in implant side area can overcome reduction of implant cross section area by 50 %. In other words, effectiveness of increasing implant side area might be five times higher than the increasing of implant cross section area on spongy bone stress level under axial loading. Starting from Figure 7a & b, slight differences can be noticed on spongy bone between the two models results. The stresses on the spongy bone are less by about 5 % in the two implants model than the one wide diameter implant. The exceptions are the relatively increase in maximum compressive stresses and deformations of order 12 % and 0.3 % respectively. The bone is known to respond the best to compressive and the least to shear stresses[22], so considering the difference in compressive stresses less significant, the two implants were found to have a better effect on spongy bone. Contrarily, Figures 8a & b, showed better performance with cortical bone in case of using one wide implant over using two implants, that, deformations in cortical bone are less by 20 % while the stresses are less by about 40 %. The stresses and displacements were significantly higher in the two implant model due to having two close holes, which results in weak area in-between.

**Conclusions**

This study showed various results between cortical and spongy bone. It was expected that the maximum stresses in the cortical bone was placed in the weak area between the two implants. In addition to be higher than the case of using one wide implant. Although the middle part of spongy bone was stressed to the same level in the two cases, using two implants resulted in more volume of the spongy bone absorbed the load energy** which led to reduction of stress concentration and rate of stress deterioration by moving away from implants. That is considered better distribution of stresses from the mechanics point of view, which may result in longer lifetime. Porcelain coating showed less stress in case of two implants, longer life for the brittle coating material is expected. Contrarily more stresses

<table>
<thead>
<tr>
<th>Differences %</th>
<th>Porcelain coating (1mm)</th>
<th>Gold crown</th>
<th>Implants</th>
<th>Spongy bone</th>
<th>Cortical bone</th>
</tr>
</thead>
<tbody>
<tr>
<td>( U_{xx} )</td>
<td>-17.86</td>
<td>-16.70</td>
<td>-8.18</td>
<td>-0.28</td>
<td>-19.57</td>
</tr>
<tr>
<td>( U_{y} )</td>
<td>-11.10</td>
<td>-11.10</td>
<td>-2.72</td>
<td>-0.03</td>
<td>-19.62</td>
</tr>
<tr>
<td>( S_{1} )</td>
<td>31.59</td>
<td>-179.99</td>
<td>-6.72</td>
<td>5.96</td>
<td>-37.17</td>
</tr>
<tr>
<td>( S_{2} )</td>
<td>0.71</td>
<td>-33.44</td>
<td>-310.74</td>
<td>-11.24</td>
<td>-70.43</td>
</tr>
<tr>
<td>( S_{3} )</td>
<td>-1.26</td>
<td>-18.08</td>
<td>-166.39</td>
<td>4.75</td>
<td>-31.82</td>
</tr>
<tr>
<td>( S_{4} )</td>
<td>0.25</td>
<td>-10.22</td>
<td>-196.86</td>
<td>4.00</td>
<td>-39.17</td>
</tr>
</tbody>
</table>

**Fig. 7a & b** Spongy bone deflection in vertical direction (a) wide implant; (b) two implants. **Fig. 8a & b** Cortical bone deflection in vertical direction (a) wide implant; (b) two implants.

Tab. 2. Results.
were found on the gold crown placed on two implants due to its volume reduction (less material under the same load). This is clearly seen in increasing stresses on the two implants, that more load effect was transferred through the weak crown to the two implants. That showed maximum stresses in the area under the crown, while the wide implant showed maximum stresses at its tip. Looking to energy\(^\ast\) absorption and stress concentration on whole system starting from coating to cortical and spongy bone, although the stress levels found was too low and far from cracking danger, the following conclusions can be pointed out; the total results favourise the two implants in spongy bone and the wide implant in the cortical layer, but the alveolar bone consists of spongy bone surrounded by a layer of cortical bone. It’s also well known that according to the degree of bone density the alveolar bone is classified to \(D_{1,2,3,4}\) in a descending order. So, provided that the edentulous space after the molar extraction permits, it’s recommended in the harder bone quality (\(D_{1,2}\)) to use one wide diameter implant and in the softer bone (\(D_{3,4}\)) quality two average sized implants. Therefore more detailed study to compromise between the two implants size/design and intermediate space can put this stress values in safe, acceptable, and controllable region under higher levels of loading.

\(^\ast\) The area under the \(\epsilon - \sigma\) curve up to a given value of strain is the total mechanical energy per unit volume consumed by the material in straining it to that value (Fig. 9). This is easily shown as follows in equation 2:

\[
U^\ast = \frac{1}{2} \int_0^1 \int_0^1 P \frac{df}{de} + \int_0^1 \int_0^1 \frac{P}{\alpha_0} \frac{df}{de} - \int_0^1 \int_0^1 \frac{df}{de}
\]

**Summary**

Restoration of single molar using implants encounters many problems; mesio-distal cantilever due to very wide occlusal table is the most prominent. An increased occlusal force posteriorly worsens the problem and increases failures. To overcome the overload, the use of wide diameter implants or two regular sized implants were suggested. The aim of this study was to verify the best solution that has the best effect on alveolar bone under distributed vertical loading.

Therefore, a virtual experiment using Finite Element Analysis was done using ANSYS version 9. A simplified simulation of spongy and cortical bones of the jaw as two co-axial cylinders was utilized. Full detailed with high accuracy simulation for implant, crown, and coating was implemented. The comparison included different types of stresses and deformations of both wide implant and two regular implants under the same boundary conditions and load application.

The three main stresses compressive, tensile, shear and the equivalent stresses in addition to the vertical deformation and the total deformities were considered in the comparison between the two models. The results were obtained as percentages using the wide implant as a reference. The spongy bone showed about 5\% less stresses in the two implants model than the one wide diameter implant. The exceptions are the relatively increase in maximum compressive stresses and deformations of order 12\% and 0.3\% respectively.

The stresses and displacements on the cortical bone are higher in the two implant model due to having two close holes, which results in weak area in-between. The spongy bone response to the two implants was found to be better considering the stress distribution (energy absorbed by spongy bone\(^\ast\)\(^\ast\)). Therefore, it was concluded that, using the wide diameter implant or two average ones as a solution depends on the case primarily. Provided that the available bone width is sufficient mesio-distally and bucco-lingually, the choice will depend on the type of bone. The harder \(D_{1,2}\) types having harder bone quality and thicker cortical plates are more convenient to the wide implant choice. The \(D_{3,4}\) types consist of more spongy and less cortical bone, are more suitable to the two implant solution.

Editorial note: A complete list of references is available from the author.
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Impression and registration for full-arch implant dentures

Author: Prof. Gregory-George Zafiropoulos, Germany

Introduction

Usually, a full denture is delivered following tooth extraction or implant insertion of a fully edentulous arch. A denture is usually used until the final restoration is performed. A well-designed full denture should fulfill the following criteria: 1) correct vertical height and maxilla-mandibular relationship; 2) accurate occlusion; 3) appropriate choice of teeth with regard to shape, length, width and position; 4) adequate lip support, and 5) proper function and aesthetics to meet the patient’s expectations. The final restoration should fulfill or surpass these requirements. Obtaining a correct impression and accurately evaluating the interocclusal relationship (e.g., interocclusal distance, occlusal recording and determination of the exact position of the placed implants) are often challenging and time-consuming tasks.²

The aim of the current report is to present an impression and registration technique that allows the transfer of the interocclusal relationship, occlusal recording and esthetics that were initially applied to produce a full denture as a template for the reconstruction of the final full-arch implant.

Materials and Methods

Following multiple extraction of a non-salvageable rest dentition and the placement of six dental implants in positions #4, #5, #6, #11, #12, #13, a full denture was fabricated. After the extraction sites had healed and denture sores were eliminated, the function and esthetics of the denture was optimized. If necessary, angulations, shape and color of the denture teeth and the shape of the denture base were corrected (Fig. 1a). The resulting denture was used by the patient until the final restoration was delivered. For the final restoration of the maxilla, an implant-retained denture with telescopic crowns as attachments was planned.

After the implant was uncovered, the denture was modified to allow sufficient space for the healing abutments. A duplicate of the denture (DentDu) was made out of clear resin (Paladur, Heraeus, Hanau, Germany, Fig. 1b). A trial of the DentDu was performed and minor occlusal discrepancies were corrected (Fig. 1c). Bite records
were taken in centric occlusion with modeling resin (pattern resin®, GC, Alsip, IL; Fig. 1c), using the casts of the original denture. Afterwards, the DentDu was placed in an articulator and a controlling of the occlusion was made (Fig. 2a) with the bite records. A pickup transfer system consisting of a titanium impression post and a plastic impression sleeve was employed (Dentegris, Duisburg, Germany, Fig. 2b). The DentDu was carefully modified by creating internal clearance in the area of the implants so that it could be applied as an individualized custom tray. This permitted it to be fully seated when the impression posts were in place. Impressions were generated by a polyether material (Impregum, 3M ESPE, St. Paul, MI). During this process, the DentDu was kept in centric occlusion using the bite records (Fig. 3a).

The titanium impression posts were connected with the implant analogues and with the plastic impression sleeves (Dentegris), which were embedded in the impression material (Fig. 3b). A master cast was then fabricated and articulated with the help of the bite records (Fig. 3c, Figs. 4a & 4b).

Customizable abutments (Dentegris) were taken to fabricate the implant abutments. Parallelism, angulation, position and shape of the implant abutments were determined using a silicon key fabricated from a matrix of C-silicone (Zeta-labor, Zhermack SpA, Badia Polesine, Italy, Fig. 5). The dentist and the dental technician relied on two alternatives for customized abutments selection:

1. UCLA customizable abutments (UCLA, Dentegris) for casting with a gold alloy (for example, Portadur P4, Au 68.50%, Wieland, Pforzheim, Germany, Fig. 6a) or 2) platinum-iridium customizable abutments (PTIR, Dentegris) for casting with a chromium cobalt (CrCo) alloy (for example, Ankatit, Anka Guss, Waldaschaff, Germany, Fig. 6b).

After casting, the customized implant abutments were ground, polished and served as the basis for the fabrication of electroformed pure-gold copings with a thickness of 0.25 mm (AGC Galvanogold, Au > 99.9%, Wieland, Fig. 6c). The framework was then constructed via CAD/CAM. To ensure proper functioning of the framework, a plastic mock-up and a temporary fixed denture (TFD) were milled (ZENO-PMMA, Wieland). The customized implant abutments, the electroformed copings, the mock-up and the TFD were delivered by the dental laboratory for the next clinical session.

The abutments were transferred, positioned on the implants and torqued to 35 Nm using a resin transfer key (pattern resin, GC; Figs. 7a & b). From this point on, the customized abutments remained fixed in order to avoid any possible inaccuracies. The electroformed copings were placed on the implant abutments (Fig. 7c). The mock-up was placed over the electroformed copings and the occlusion was checked with the bite records (Figs. 8a & b). A final impression with a polyether impression material (Impregum, 3M ESPE) was taken with electroformed copings. The mock-up was further set up and used for the fabrication of a new (final) framework.

The abutments were then constructed via CAD/CAM. To ensure proper functioning of the framework, a plastic mock-up and a temporary fixed denture (TFD) were milled (ZENO-PMMA, Wieland). The customized implant abutments, the electroformed copings, the mock-up and the TFD were delivered by the dental laboratory for the next clinical session.
master cast. After the impression was taken, the TFD was fixed on the implant abutments using temporary cement (TempBond, Kerr, Orange, CA). It was then left in place until the delivery of the final restoration (Fig. 8c).

The new master cast was articulated with the help of the gold copings and the mock-up. The metal framework was milled (here: Titanium Zenotec Ti, Wieland, Fig. 9a). The veneering of the superstructure was made using a light-cured indirect ceramic polymer (Ceramage, SHOFU, Menlo Park, CA, Figs. 9a–d). The electroformed gold copings were fixed in the metal framework using a self-curing compomer cement (AGC Cem, Wieland, Fig. 10).

The above-described procedures can be also performed in cases in which a fixed denture was planned for the rehabilitation of the full-arch (Figs. 11a & b, Figs. 12a–c) and in cases where part of the natural dentition is periodontally stable and can be applied as abutments. In these cases, the immediate full denture can be designed as a cover denture. From this cover denture, a DentDu could be fabricated and further used as described above (Figs. 13a–c).

Porcelain is a possible material for veneering of fixed-denture frameworks. If the angulation of the implants does not allow for taking impressions in the above-described way and an open-tray impression is preferable, fenestrations can be fabricated into the DentDu (Fig. 14).

_**Discussion**_

The reconstruction of the fully edentulous arch with implant-retained dentures necessitates thorough planning and a precise and passive fit of the superstructure. A previous study demonstrated that a passive fit between the implant superstructure and the underlying abutments is essential for the long-term success of the implant prosthesis. To achieve a passive fit, an accurate positioning of the implant replicas in the master cast must be assured. The impression technique and the splinting of the implant copings are factors which may contribute to errors in the final positioning of the implant analogs, thus leading to inaccuracies in the fit of the final superstructure. Furthermore, the angulation or proximity of the implants may inhibit proper seating of the impression copings and/or caps, which may also have a detrimental effect on the registration of the implant position.

The precise recording of the maxillo-mandibular, e.g. interocclusal, relationship is a prerequisite for achieving proper occlusion and a successful treatment outcome. The initially delivered denture allowed for the correction of the interocclusal relationship, tooth shape and color and angulations during the entire healing period. In this way, the patient was able to acclimatize to the function and esthetics of the denture. In the method described in this report, an accurate impression and recording of the full denture was achieved by using a duplicate as a custom tray for the impression. Therefore, it was not necessary to repeat all the
steps usually needed for recording the interocclusal relationship, e.g. wax-up, etc., at the time of the fabrication of the final restoration.

If an open-tray impression is preferred, only minor changes to the procedure are necessary. This method is based on a previous publication. In cases such as this, it is advisable to fabricate two DentDus. The impression can be taken by the first DentDu; the second DentDu is used for the remaining steps. Customized abutments are applied instead of a bar, galvano copings allow a precise transfer coping, and secondary telescopes as well as different technologies are employed for the transfer of implant positions and for the construction of the superstructure.

Customized implant abutments allow for better angulations and shape, for improved occlusal force transmission from the crown to the implant and the bone, and also for facilitating the fabrication of an esthetically pleasing implant-supported denture. Ways in which abutment design contributes to improved esthetics include changes in the location of the crown and changes in the dimension and form of the restorative platform.

Additionally, features of the abutment design contribute to the health and dimensional stability of the soft tissue. Current attempts to objectively define implant–restoration esthetics have focused on periimplant mucosal parameters. The introduction of the UCLA abutment provided a custom solution for implant restorations. This direct-to-implant restoration concept provided adaptability. Through waxing and casting, the height, diameter and angulations can be addressed in order to provide a wide range of clinical solutions for problems associated with limited interocclusal distance, interproximal distance, implant angulations and related soft tissue responses.

The customized implant abutments served as primary telescopes, and the electroformed copings served as secondary telescopes in cases where a removable denture with telescopic crowns was used as the attachment. Electroformed gold copings are associated with several advantages, in conjunction with both removable and fixed restorations. The galvano-forming and electroforming process yielded a precisely-fitted secondary coping for the implant abutment with a gap of only 12–30 µm. The gold electroformed coping saves space and is made of high-quality material. Using gold copings for the impression allows for the exact transfer of the form, angulations and position of the inserted customized implant abutments.

With the help of the milled mock-up, the future fit of the CAD/CAM fabricated framework can be evaluated and necessary changes in the shape of...
the restoration and occlusion can be made. Making these changes on the mock-up was easier and less time consuming than making them on the metal framework itself, and it was then possible to transfer them directly to the final framework. Furthermore, the mock-up almost "splinted" the electroformed gold copings during the impression, allowing for the exact transfer of the abutment position. At the same time, the vertical height and interocclusal relationship were recorded. The delivery of a milled temporary restoration permitted a slow and non-progressive loading of the implants, which then leads to bone remodeling. Abutments were left in place after mounting. Combined with the fabrication of a new cast, this further decreased the risk of inaccuracies during the transfer process.

**Conclusion**

The method described here can be used for full-arch restorations with both fixed and removable implant supported dentures. Accurate impressions can be accomplished and occlusion, vertical dimensions, as well as implant positions can be transferred while facilitating the full-arch restoration process. In addition, this technique resulted in a reduction of the required chair time.

Disadvantages of this technique lie in the fact that the quality of laboratory technician’s work meets higher demands than usual, and that the clinician also needs to acquire some additional skills. Further disadvantages of this method include the need for a highly qualified technical lab and higher technical costs relative to those associated with prefabricated titan implant abutments.

To date, this method has not been applied in conjunction with immediate implant loading. However, dentists and patients have come to expect this level of rehabilitative accuracy, precision, long-term success and aesthetics.

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

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**Fig. 12a–c** A case of fixed-implant retained denture for the maxilla full-arch rehabilitation, right side (a), anterior area (b), left side (c).

**Figs. 13a–c** Impression of a case with natural dentition (teeth #11 and #12) and implants. Master cast in the articulator with a duplicate of the over-denture in place (b). Gold copings fixed on the remaining teeth #11 and #12 and customized implant abutments mounted on the implants (both of them served as primary telescopes (c).

**Fig. 14** DentDu modified for open-tray impression technique.

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**Fixed full arch metal-free prosthesis on four SHORT® implants**

**Authors** Prof. Mauro Marincola, Italy, Dr. Vincent J. Morgan, USA, Angelo Perpetuini & Stefano Lapucci, Italy

**Introduction**

The concept of having only four SHORT® implants for the support of a fixed full arch non-metallic prosthesis (Trinia™), a CAD/CAM fiber reinforced resin, was first executed in 2010. The clinically based results performed in three different implant dentistry centers are showing clinical success because of Trinia’s inherent mechanical and clinical properties. Another factor were the 360 degrees of universal abutment positioning provided by the Implants Locking Taper connection (Bicon®), which gives the opportunity to use the Trinia™ prosthesis to orient and seat the abutments in the well of the implants. The Trinia framework may be covered with either customized poly-ceramic indirect composite material or by conventional denture teeth and resin.

In the following case presentation, we want to show how short implants have been successfully used to restore severely atrophic mandibles without the use of difficult bone augmentation procedures and complicated prosthetic suprastructures in the past decade.

**Material and methods**

Bicon Dental implants (Bicon LLC, Boston, MA, USA) were used for the reconstruction of the case, combined with a CAD/CAM fiber reinforced resin framework (Trinia™) and conventional denture teeth and resin prosthesis. Bicon implants can be characterized by their special macro-structure, including a root-shaped design with wide fins called plateaus, by a sloping shoulder and by a well which holds the abutment post by means of a Locking Taper connection.

The plateaus are of particular importance for the biomechanical performance, allowing SHORT® implants with a wide diameter to be used in any position in the oral cavity. Their insertion into the osteotomy, which has been prepared using atraumatic drills rotating at 50 rpm, is executed by using mechanical pressure. The countless micro-retentions created on the surface of the fin edges with the walls of the osteotomy ensure primary stability of the implant in the implant site. Furthermore, the wide spaces between the plateaus avoid vertical compression on the bone walls and rapidly collect the clotted blood, allowing rapid bone formation without the classic macrophagic and osteoclastic actions.
processes of bone resorption taking place. Thus well defined bone is formed, with haversian canals and blood vessels which enable continuous bone remodelling around the implant/bone contact surface. This ensures stability of the implant in any situation involving biomechanical stimulus.

The sloping shoulder is vitally important for the preservation of crestal bone after implant osseo-integration and for implant function. The Bicon implant design offers platform switching with a neck which converges from the widest diameter of the first plateau, to 2 or 3 mm towards the crestal zone (converting crest module). In our patient, we used implants 5 mm in diameter, but the space taken up at crestal level is only 3 mm. This ensures bone augmentation above the neck, also because the implant is seated at least 1 mm below the crest during the first surgical stage. This allows the above structures, such as the crestal bone, periosteum and epithelium, to grow around the hemispherical base of the abutment and to give sufficient space for maintenance and the growth of the papillae.

Another important factor for obtaining long-term crestal bone stability is the bacterial seal within the connection between implant and abutment. If crestal bone maintenance and the formation of papillae can only be achieved when the implant is placed in a sub-crestal position and by platform switching at the level of the implant neck, it is also true that this situation can only be accomplished if the connection is hermetically sealed from bacterial infiltration. Without this feature, the placement of a sub-crestal implant without a bacterial seal would result in the rapid spread of pathogens around vital structures, crestal bone, periosteum and epithelium. The result would be bone resorption well below the original crestal bone level.

Bicon’s locking taper is a design feature ensuring crestal bone level maintenance around an implant with a convergent sloping shoulder placed sub-crestally. The Locking Taper is a precise connection formed by cold welding out of two surfaces of the same material which are brought into close contact with pressure. In this way, the oxidation layers—formed both on the abutment post and on the surface of the implant well—are detached.

The prosthetic components (one-piece titanium abutments made from the same surgical grade titanium alloy as the implants) ensure maximum mechanical resistance and optimum biocompatibility. The subgingival hemispheric base geometry is ideal for the stability of periimplant connective tissues.

The abutments are connected to the implant well by means of a post, which is 2 mm, 2.5 mm or 3 mm in diameter. Implants which are 3.0 mm and 3.5 mm in diameter are suitable for 2 mm posts, while implants of a diameter of 4.5 mm, 5 mm or 6 mm match with abutments with a 3 mm post. All of the abutment posts have diameters or emergence profiles of 3.5, 4.0, 5.0 or 6.5 mm, suitable for allowing a natural anatomical shape of the soft tissues. Abutment diameters are therefore independent of implant diameters, which means that any implant may host the four different abutment emergence profiles.
The different emergence profiles start from the 2 mm, 2.5 mm or 3 mm posts, placed at crestal bone level. The geometry of the abutments provides for platform switching even at a prosthetic level, which is of vital importance in the organization of the connecting tissue and the epithelial layer.

The supraperiosteal space involved in the shift from the connecting post diameter (2–3 mm) to the diameter of the abutment hemisphere (3–6.5 mm), allows a thicker and denser connecting tissue to form, resulting in the optimal preservation of the papilla. In the following case, all the selected abutments have a 3 mm post, as they must connect to the 3 mm wells of the 5.0 x 6.0 mm implants. Abutment post heights, inclinations and diameters are selected in the laboratory in accordance with the position of the implants relative to the anatomy of the alveolar ridge.

Trinia is a CAD/CAM multidirectional fiber reinforced resin material, which despite its light weight is capable of withstanding occlusal forces.

Case report

A 52-year-old male patient, presenting a severely compromised mandibular bone, was treated with the placement of four short implants. Two SHORT® implants (4.5 x 8 mm) were placed bilaterally at the canine region and two ULTRA SHORT® implants (4 x 5 mm) were bilaterally located at the first molar region (Fig. 1). The implants were placed in a two-stage surgery and they were uncovered after a healing period of three months (Figs. 2 & 3).

Clinically, the prosthetic treatment began with an implant level transfer impression by inserting with only finger pressure a green impression post with its corresponding acrylic sleeve into the 3.0 mm implant well, prior to recording their position by making an implant level impression with any conventional impression material (Fig 4). Upon the removal of the full arch impression, green impression posts were removed from the implant wells and inserted into an implant analog of the same color before inserting them into their corresponding acrylic sleeves within the impression.

Prior to the pouring of a stone model, a resilient acrylic was applied around the impression posts to simulate a soft tissue contour in the stone model. The stone model was used for the fabrication of a wax bite rim to record the occlusal registrations. After articulation of the models, appropriate abutments with the largest practical hemispherical base were selected and inserted into their corresponding implant analogs within the stone model. Their prosthetic posts were then milled parallel to one another (Fig. 5). The model with the milled abutments was used to fabricate a light cured resin bar and denture tooth set up for an intra-oral confirmation of the arranged teeth. Once the denture set up had been clinically approved, a facial occlusal silicone mask was ini-

![Image](Fig. 11)  ![Image](Fig. 12)  ![Image](Fig. 13)
wax or by reducing it with a bur. Prior to its being sprayed and digitally scanned, the space between the resin bar and the ridge area between the pencil lines on the model is filled with a putty material, so that the milled framework can be in contact with the soft tissue of the edentulous ridge (Fig. 6).

After the model with the milled abutments and the resin bar were separately sprayed and scanned, the Trinia fiber resin bar was digitally designed on the computer with a minimum thickness of 7.0 mm throughout, an abutment clearance of 30 microns for cement and with a maximum cantilever extension of 21.0 mm. If necessary, the milled Trinia framework may have been judiciously reduced manually.

After cleaning the milled Trinia framework with alcohol, it was placed onto the milled abutments to evaluate and, if necessary, modify the marginal adaptation of the framework to the abutments and to the alveolar ridge of the model. The ridge side of the framework should be convex without any concavities. Additionally, the Trinia framework was used to confirm both the path of insertion of the prosthesis and the sequence of insertion of the milled abutments on the model. After the sequence and path of insertion were confirmed, the facial, occlusal and lingual masks were repositioned on the model and attached together with cyanoacrylate glue (Fig. 7).

A thin mix of denture resin was poured into the silicone flask through the anterior cutaway or aperture in the lingual mask. Final polymerization was achieved while the silicone flask and models were under hot water, with an air pressure of 3 bars. After polymerization, the Trinia prosthesis was removed from its silicone flask, then finished and polished in a conventional manner. Clinically, after the removal of the temporary abutments from the implant wells, at least two milled abutments were incompletely inserted into the prosthesis. If necessary, they were stabilized with an application of Vaseline, prior to their being transported to the mouth and inserted into the well of their implant (Fig. 8). The loosely fitting abutment facilitated its insertion into the well of the implant (Fig. 9). Once the abutment was initially seated, the prosthesis was removed for the definitive seating by tapping directly onto the titanium abutment. This seating process was continued until all of the abutments were definitively seated (Figs. 10 to 12).

Alternatively, an abutment could have been initially loosely seated in the well of the implant, prior to the prosthesis being used to orient and seat the abutment in the well of the implant. Final or temporary cementation was achieved by first applying Vaseline over the ridge area of the prosthesis to facilitate the removal of any extraneous cement. Only a minimum of cement was applied to the bores in the Trinia framework before inserting the prosthesis in the mouth. The extraneous cement was blown away with an application of air under the prosthesis. The occlusion was evaluated and adjusted (Figs. 13 & 14).

Conclusion

Regardless of which type of material will ultimately be used to cover the Trinia framework, it was essential to have an anterior diagnostic positioning, wax rim, or arrangement of the intended teeth prior to the fabrication of the Trinia CAD/CAM framework.

In our clinical case, Meyor composite denture teeth were used for the final prosthetic to assure a good biomechanical force distribution around the four SHORT® implants. The follow-ups of our patients treated with the described technique was showing a good gingival response and no marginal bone loss around the platform switched implant neck of the SHORT® or ULTRA SHORT® implants (Bicon Dental Implants) used in our case presentation and in 60 other cases treated in three different Implant Dentistry Centers.

This technique of a fixed prosthesis on only four short implants deserves a clinical, long term, evidence-based study because of its low costs and reduced treatment time with minimum morbidity and good patient response.

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

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Guided implant surgical placement with CAD/CAM CEREC crown

Author: Dr Nilesh Parmar, UK

Guided surgery has been around for a long time. However, very few dentists in the United Kingdom place implants using surgical guides. The reasons for this are multiple, ranging from dentists not wanting to follow the procedure, or not having confidence in the procedure, the increased costs of guide fabrication, and the time delay and extra appointments needed to obtain a fully functional and reliable surgical guide.
In this case report, I shall demonstrate a surgical guide manufactured in-house using the CEREC Bluecam (Sirona). These guides do not require any impressions to be sent to a third party and can be made rather cheaply in the surgery within around 30 minutes. The guide can then be used in conjunction with specific drill keys, which are compatible with the guided surgery drill sets from all leading implant manufacturers.

In this particular case, Facilitate (Astra Tech/DENTSPLY Implants) was used to place the implant. Once the implant was osseointegrated, the final restoration was fabricated chairside using the CEREC MCXL milling machine (Sirona) and an IPS e.max CAD block (Ivoclar Vivadent).

Case report

A young female patient had lost tooth 36 a few years ago and wanted an implant solution. Her medical history was clear and she had a mildly restored dentition with no current dental pathology. Her BPE scores were low, with excellent oral hygiene.

The patient was scanned using the CEREC Bluecam and a proposal for the missing tooth was created. A collimated CBCT scan of the lower jaw was taken using GALILEOS (Sirona) with a CEREC Guide reference body set in thermoplastic over the edentulous area.

The reference body is identified by the software and a virtual implant placement along with the CEREC crown proposal is imported into the software. This allows the clinician to place the implant virtually, with reference to the ideal final crown position. In this case, it was deemed that a screw-retained restoration would be desirable; hence, the screw-access hole was positioned through the centre of the crown.

Once the implant position had been decided, the information was ported to the CEREC software and using a CEREC Guide Bloc a drill body was milled by the CEREC MCXL milling machine.

The reference body and thermoplastic surgical guide. Fig. 4. Reference body and thermoplastic guide in-situ prior to CBCT scan.

CBCT with reference body and CEREC proposal overlay. Fig. 5. CEREC Guide in-situ.

AstraTech (DENTSPLY Implants) facilitate biopsy punch used through CEREC Guide.

Soft tissue removed. Fig. 8.

Directional indicator to assess osteotomy position. Fig. 9.

Implant placement. Fig. 10.

Placement of a 4 mm healing abutment at stage 1. Fig. 11a.

Post-op RTG view. Fig. 11b.

Fixture level open-tray impression. Fig. 12.

Standard abutment with 3 mm of occlusal clearance. Fig. 13.

Soft tissue profile after two months healing. Fig. 14.
Once this has been milled, it will lock tightly into the thermoplastic drilling template. At this point, the surgical guide is complete and can be used on the patient.

In this particular case, an OsseoSpeed TX implant (DENTSPLY Implants) (4.0 × 11 mm) was placed using the surgical guide. The patient was prepared in accordance with a standard sterile protocol and the area anaesthetised as one would for a regular implant placement. The surgical guide snaps firmly over the existing teeth, expanding over- and undercuts, becoming a very stable platform through which to drill. The Facilitate soft-tissue punch was used to remove the overlying soft tissue, and a standard drilling protocol using the Sirona drill keys was followed. A high primary stability of 40 Ncm was obtained and a 4 mm healing abutment was placed immediately. The patient healed with no pain, no swelling and no discomfort. The post-operative long-cone periapical radiograph corresponded well with the preoperative planning with an ideal angulation for a screw-retained crown. After two months of healing, a fixture-level open-tray impression was taken and cast up using an Astra Tech replica. A standard metal abutment was inserted into the replica and cut back by 3 mm from the occlusal table. This was then powdered and scanned using the CEREC Bluecam, and an IPS e.max CAD C 14 block was milled.

The CEREC 4.2 software was instructed to mill a hole that corresponded to the screw-insertion path on the abutment. This was finished using a high-speed diamond bur with copious irrigation. The crown was glazed and sintered, allowed to cool and bonded to the abutment using Variolink II (Ivoclar Vivadent). The final crown was screwed directly onto the implant and a final check for contacts and occlusion was done.

This process shows just how far CAD/CAM technology has come. An implant can be planned, inserted and restored all in-house, using the current available technology. The final result is equal to any laboratory-based restoration, albeit for simple units. The process does have its limits in terms of multiple-span bridges and placement of multiple implants, especially in edentulous areas. As the technology develops, with further advances being made, the scope of what is possible for the implant dentist is always expanding._

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**Case Report: Implant Therapy**

Fig. 15. CEREC image of the abutment.

Fig. 16. CEREC image of final restoration.

Fig. 17. CEREC image of the block.

Fig. 18. E-max crown glazed, stained and ready for sintering.

Fig. 19. Milled E-max CAD/CAM crown with screw hole.

Fig. 20. Screw retained E-max crown.

Figs. 21 & 22. Final restoration in-situ.

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**About the Author**

Dr Nilesh R. Parmar, BDS (Lond.), M.Sc. (Prosth. Dent.), MSc (Imp. Dent.), Cert. Ortho., was voted Best Young Dentist in the East of England in 2009 and runner-up in 2010. He was short-listed for the Private Dentistry Awards in 2011 in the category of Outstanding Individual. He has a master’s degree in Prosthetic Dentistry from the Eastman Dental Institute and a master’s degree in Clinical Implantology from King’s College London. He is one of the few dentists in the UK to hold a degree from all three London dental schools and recently obtained his Certificate in Orthodontics from the University of Warwick. His main area of interest is dental implants and CEREC CAD/CAM technology.

Nilesh runs a successful five-surgery practice close to London and is a visiting implant dentist at two Central London practices. Nilesh has a never-ending passion for his work and is well known for his attention to detail and his belief that every patient he sees should become a patient for life. He offers training and mentoring to dentists starting out in implant dentistry. More information can be found on his website, www.drnileshparmar.com; Twitter: @NileshRParmar; or Facebook: Dr Nilesh R. Parmar.
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Digital technology and CAD/CAM determine market development in Europe

Author_Daniel Zimmermann, Germany

Supported by growth in major markets like Germany, sales of dental equipment in Europe have proven relatively stable since the last IDS took place in 2011. CAD/CAM had the opportunity to speak with Arseus Lab CEO and the President of the Association of Dental Dealers in Europe (ADDE), Dominique Deschietere, Belgium, about the current state of the industry, and the challenges that lie ahead.

CAD/CAM: Last year, the European Union announced the revision of its medical device regulations. Is this going to affect the dental industry?

Dominique Deschietere: The diversity and potential for innovation in our industry contribute to improved dental procedures and prosthetics, from which the patient can only benefit. As the dental industry and the health-care sector in general produce a wide range of products, from extremely sophisticated devices to consumables, we as distributors need to be vigilant regarding medical device regulations. The regulatory framework provided by the EU for market access, international business relations and legal agreements is in the patient’s best interest. However, we also think that these matters should be adapted to the dental distributor market.

Why do the current regulations need to be changed at all?

The main reason for the revision is that current EU legislation dates from the late 1990s and is considered insufficient by many for our rapidly changing market. In addition, some member states of the EU have tended to interpret some of these rules broadly, which is not necessarily to the benefit of the patient. It also makes competition uneven for those distributors who adhere to the regulations. Therefore, it is essential to impose new regulations in order to increase traceability of dental products within and beyond the borders of the EU.

According to a 2011 survey by your organisation, sales of dental materials and equipment in Europe remained relatively stable. What is the current state of the industry on the continent?

Preliminary figures from our latest survey of the industry show that, except for a few countries, the market has achieved good sales. There might be a slight decrease in traditional product segments, as old technologies are replaced by new ones, but it is still too early to provide a clear picture on the current market situation. Unfortunately, not all figures from our 2012 industry survey to be discussed during the IDS are available yet. However, we would like to invite everyone to our presentation to be held on Wednesday, 13 March, at 16:00 in the Blue Room at the Koelnmesse fairground.

While sales of sundries and technical services increased slightly in 2011, equipment sales decreased by over 2 per cent. Have dentists become more wary of investments?

Socio-demographic developments and changing patterns of reimbursements by public health services and insurers have had an impact on patients’ health-care spending. As a result of the financial crisis, people have had difficulty accessing capital through bank loans, renting, etc., which means they have less money available for medical and dental care. Consequently, dental practitioners and laboratories throughout the continent have become rather reluctant to make large investments.
During a press conference in December in Cologne, the Chairman of the Association of German Dental Manufacturers, Dr Martin Rickert, said that the outlook for markets in Southern Europe is rather negative owing to the financial constraints the health-care sector is facing at the moment. What is the situation really like there?

It is no secret that some countries in Southern Europe that suffered most from the financial crisis are showing a negative trend with regard to dental investments. It is likely that this will be reflected in the sales figures from last year.

Where do you see the industry heading, and what segments are the most likely to grow in the next few years?

We will definitely see significant growth in digital dentistry as new technologies like intraoral scanners, as well as digital imaging and planning instruments, find their way into dental practices. Dental laboratories too are increasingly making use of CAD/CAM technology. Both these developments will determine how the market and the dental business models will develop in the future.

Europe has traditionally been one of the largest markets for dental material and equipment, rivalled only by North America. How important have markets overseas become?

“...it is essential to impose new regulations in order to increase traceability of dental products within and beyond the borders of the EU.”

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It goes without saying that in terms of economic growth, spending ability and other factors, the BRIC countries hold great potential. Dental distributors in Europe will be involved in this process as we gain access to other products and technologies from around the world. From this, competition will only increase within the EU. Our members will have to follow these changes carefully and learn to respond to them in a professional and transparent manner.

Thank you for the interview.
The right CAD/CAM system for every requirement

During IDS 2013, which will take place in Cologne from 12 to 16 March, DATRON, a specialist machine manufacturer and CAD/CAM expert, will be introducing two new products based on the proven DATRON D5 CAD/CAM system: D5 Linear Scales and D5 Entry.

D5 Linear Scales— for maximum precision

D5 Linear Scales is equipped with high-precision linear scales and has been designed especially for applications with high accuracy demands, for example for large-span work in the field of implantology. Owing to its increased thermal stability, it provides consistent quality, even with temperature fluctuations. With a repeatability of < 2 μm and an absolute accuracy of ± 5 μm, D5 Linear Scales is the ideal machine for milling centres wishing to create particularly demanding restorations with the utmost precision.

D5 Entry—entry-level model for machining soft materials

D5 Entry is a cost-effective entry-level model that has been specifically designed to machine soft materials such as zirconium oxide. The machine is ideal for smaller laboratories initially wishing to process only soft materials and not requiring eight-fold automation without compromising the accuracy and versatility of a high-precision five-axis simultaneous machine. When required, for example owing to the laboratory’s growth or the need to machine metals in the future, D5 Entry can easily be expanded to the full version.

Validated manufacturing processes

In addition to the new machine models, DATRON will present the latest machining techniques in the field of implantology and the milling of models based on intra-oral scanning data. Working jointly with selected scanner manufacturers and software partners, DATRON offers machinery for the entire CAD/CAM process from a single source, adapted precisely to the individual needs of each customer. This way, our customers can acquire the best system for their specific needs.

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_about the company

DATRON AG is a publicly traded and internationally active specialised machine construction company from Mühlthal-Traisa near Darmstadt.

Its core products are dental milling machines for the efficient processing of all common denture materials in dental laboratories, CNC milling machines for high-speed cutting (HSC) and 3-D engraving, dosing machines for accurate and quick bonding and sealing, tools for high-speed machining, and after-sales services such as training, service and sale of accessories and spare parts.

The company founded in 1969 currently employs around 200 people, and with more than 20 representative offices and agents worldwide, generated around €32 million in sales in 2011.

DATRON AG
In den Gänsäckern 5
64367 Mühlthal, Germany

www.datron.de
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3Shape releases its new Dental System

3Shape's Dental System 2013 introduces new major indications, a variety of powerful design tools, optimised order creation, improved scanning and design workflows, and a new and highly intuitive user interface. At the end of 2012, 3Shape, a user-acclaimed world-wide leader in 3-D scanners and CAD/CAM software solutions, released its next generation Dental System to the market. “We are keenly focused on helping laboratories stay competitive in an industry driven by technology changes, escalating globalisation and increasing regulatory demands,” said Flemming Thorup, President and CEO of 3Shape. “By enhancing ease of use in our Dental System 2013 and adding even more major indications for digital design, we believe that we can significantly increase the productivity of laboratories and the range of services they can offer at competitive prices.”

New features of Dental System 2013

New user interface for maximum ease of use and simplified design workflows

A new intuitive workflow progress bar guides users through each design step. The new interface introduces an impressive full-screen design window that maximises the 3-D design space.

Advanced implant bridges with gingiva (Prettau style)

Advanced bridges, complete with gingiva, teeth and implant interfaces, can be designed in a single smooth workflow. Designs can be milled directly in zirconia, titanium, PMMA or other materials.

New post-and-core design software

This completely new post-and-core solution with unique scanning and design workflows and specially designed scan posts captures post positions and depth from the model. All layers are designed in a single workflow, starting with the anatomy layer. The software uses scans from both TRIOS and 3Shape desktop scanners.

New Abutment Designer workflow for screw-retained crowns and anatomical abutments

3Shape introduces a new workflow for designing screw-retained restorations in Abutment Designer. All types of abutments—standard customised abutments, screw-retained crowns and anatomical abutments—are selected directly in the order form, followed by the new Anatomy-First workflow.

Ground-breaking digital Denture Design

3Shape’s new Denture Design software brings digital precision and efficiency to a traditionally technique-demanding process. Technicians can use 3Shape’s Smile Composer and the unique Gingiva Creation Tool to model highly aesthetic and functional dentures efficiently.

TRIOS Inbox—Laboratories can connect to any open TRIOS digital impression system in the world

The new TRIOS Inbox enables laboratories to receive scans from TRIOS digital impression systems in dental clinics and discuss cases with dentists online. Incoming cases can be accepted or rejected with a single click and a notification is immediately sent back to the dentist.

Get Dental System 2013 as a part of your 3Shape LABcare

All Dental System subscriptions include 3Shape LABcare, 3Shape’s customer-centric package that gives users new technologies through annual releases such as this Dental System 2013 software. In addition to upgrades, 3Shape LABcare gives laboratories access to an efficient support network with multiple-language assistance, and access to training and learning channels such as webinars, videos, etc. Dental System 2013 is available through 3Shape resellers. Actual availability to end-users depends on the specific system configuration. Please contact your local 3Shape supplier, or visit www.3shapedental.com to contact a reseller.
Welcome to the 46th Scandinavian Dental Fair
The leading annual dental fair in Scandinavia

Scandefa 2013

The 46th Scandefa invites you to exquisitely meet the Scandinavian dental market and sales partners from all over the world in springtime in wonderful Copenhagen

Scandefa 2013
Is organized by Bella Center and is being held in conjunction with the Annual Scientific Meeting, organized by the Danish Dental Association (www.tandlaegeforeningen.dk).

183 exhibitors and 10,562 visitors participated at Scandefa 2012 at approx. 14,000 m² of exhibition space.

Exhibit at Scandefa
Book online at www.scandefa.dk
Account Manager Tommy Louens
tlo@bellacenter.dk, T +45 32 47 21 33

Travel information
Bella Center is located just a 10 minute taxi drive from Copenhagen Airport. A regional train runs from the airport to Orestad Station, only 15 minutes drive.

Check in at Bella Center’s newly built hotel
Bella Sky Comwell is Scandinavia’s largest design hotel. The hotel is an integral part of Bella Center and has direct access to Scandefa. Book your stay on www.bellasky.dk

www.scandefa.dk
Straumann introduces the new CARES System 8.0

At IDS 2013 in Cologne, Straumann will announce and present new products and services in the field of prosthetic digital solutions.

The essence of dental digitalisation lies in the streamlining of the prosthetic workflow in order to minimise the necessary process steps. Straumann introduces CARES X-Stream, a new solution-driven service that provides a one-step single-tooth implant-based prosthetic restoration process, needing only one scan, one design and one delivery.

The new Straumann CARES System 8.0 enhances operational efficiency thanks to the new, innovative prosthetic solutions that are designed to optimise digital workflows and to increase the productivity and profitability of dental laboratories.

CARES X-Stream—one-step prosthetic solution (Fig. 1)

Fig. 1. CARES X-Stream—the complete implant-based single-prosthetic restoration in one step: one scan, one design and one delivery.

Fig. 2. Straumann CARES Variobase Abutment. The new hybrid abutments come with zircon coping in four different ceramic shades and with original connection.

Fig. 3

Fig. 4

Fig. 2

Fig. 1
Straumann CARES Variobase Abutment

Straumann CARES Variobase Abutments provide high design flexibility and the advantage of adapting the treatment to the patient’s individual oral situation. The new hybrid abutments come with zircon coping in four different ceramic shades and with original connection.

Straumann screw-retained bridges and bars and new bar designs (Figs. 3 & 4)

Straumann CARES System 8.0 now offers an extension to screw-retained bridges and bars for the Straumann Bone Level Implant and introduces Dolder-Bar U-shape (regular and mini-size), Dolder-Bar egg-shape (mini-size), Round-Bar with a diameter of 1.8 mm/Ackermann-Bar with a diameter of 1.9 mm, and MP-Clip Bar.

Full-contour zirconia restorations for crowns and bridges (Figs. 5a & b)

Straumann has extended its already versatile portfolio with zircon HT, a highly translucent zirconium dioxide ceramic for efficient full-contour crown and bridge restorations up to three units. It requires minimal processing (only polishing required, no layering needed) and is a high-strength material designed for reliability and the achievement of outstanding aesthetics. CARES System 8.0 has fully integrated all Dental Wings functionalities with regard to abutment and full-contour crown designs into the CARES Validated Workflow. The latest software version includes more functions, such as mirroring natural anatomy in the desired restoration in easy steps, allowing simultaneous scanning and design, and intuitive design of screw-retained bars to finalise the restoration faster and work more efficiently.

_Contact_ CAD/CAM

Institut Straumann AG
Peter Merian-Weg 12
4002 Basel, Switzerland
www.straumann.com

Dolder is a registered trademark of Prof. Eugen Dolder, former director of the dental school of the University of Zurich. Ackermann-Bar and MP-Clip are registered trademarks of Cendres+Métaux Holding SA, Switzerland.
Registration is open and the preliminary programme is now available for the Nobel Biocare Global Symposium 2013 in New York City. The symposium will be held from 20 to 23 June at one of the Big Apple’s landmarks, the famous Waldorf Astoria. Participants will join the leading experts in implant dentistry for an exciting four-day event. In keeping with Nobel Biocare’s mission, the symposium theme is "Designing for life: Today and in the future" and the scientific programme will offer a comprehensive perspective on how to treat more patients with better results and highlight the latest in implant-based treatment.

Over 100 world-renowned leaders and pioneers

An impressive selection of over 100 well-known researchers, scientists, clinicians and academics will share their insights and perspectives, as well as explore the possibilities of quality care today and in the future. The innovative programme is guided by a scientific committee chaired by George Zarb, with highly respected members from various countries: William Becker, Charles J. Goodacre, Burton Langer, Jay Malmquist, Shohei Kasugai, Ye Lin, Friedrich W. Neukam, Eric Rompen, Massimo Simion, Daniel van Steenberghe and Bernard Touati.

For more information, visit www.nobelbiocare.com.
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The organiser of DenTech China has announced a forum solely dedicated to dental CAD/CAM to be held at its upcoming show in October this year. It will feature internationally renowned experts and cover several fields related to digital dentistry, including digital imaging, digital impression-taking and image-guided implant surgery, representatives of Shanghai UBM ShowStar Exhibition said.

The forum will be held alongside the industry exhibition and other specialty forums on topics like implantology. In addition to leading providers of dental CAD/CAM, International Dental Products for China, a Chinese dental technology magazine published by German publisher Röser, is supporting the event.

While the penetration of dental CAD/CAM is still considered to be low in China, industry sources estimate that the market will grow by double digits in the next five years owing to a large influx of outsourced lab work from other countries and a higher demand for all-ceramic CAD/CAM-manufactured prosthetics by the rising Chinese middle class. According to the Canadian market research provider idata Research, this segment is currently the fastest growing in the country, with an annual growth rate of approximately 4.2 per cent each year.

Major market players offering dental CAD/CAM systems and solutions in China include Sirona Dental Systems, KaVo and AmannGirrbach.

First held in 1994, DenTech China has become the second-largest dental showcase in China, after Sino-Dental in Beijing, having attracted more than 65,000 visitors last year. Since March 2012, the show has been organised by Shanghai UBM ShowStar Exhibition, a joint venture between UK-based B2B communications provider UBM and the previous owner of DenTech, Shanghai ShowStar Exhibition Services. The 17th exhibition is scheduled for 23 to 26 October 2013.
The International Osteology Symposium will be held in Monaco from 2 to 4 May and will once again be highlighting innovations in oral tissue regeneration. At the symposium the Osteology Foundation will also be marking the 10th anniversary of their establishment. Prof. Christoph Hämmerle, Foundation President sheds light on its objectives and projects in an interview.

Verena Vermeulen: The Osteology Foundation is celebrating its 10th anniversary at the International Symposium in Monaco under the banner “Linking Science with Practice in Regeneration”. Why is “linking” important?

Prof. Christoph Hämmerle: Research basically sets out to affect everyday practice. But there is no seamless transition from one to the other. At the Osteology Foundation we aim to shrink the gap between research and clinical practice in our field. We want to bring the two “sides” closer together. We primarily want to see knowledge gained from research being translated into clinical concepts.

What sets the series of congresses apart?

Osteology organizes symposia on oral tissue regeneration at a national and international level; this is what the Foundation is best-known for among practitioners. In recent years the congress series has consolidated itself as a brand in more and more countries on virtually every continent.

From a practitioner’s perspective: What is the Foundation’s most important output?

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Does research play a part in the symposia too?
Yes, in many a respect. The lectures always deal with the state of current research. Furthermore, we also organize a poster exhibition, a research forum presenting current studies and special workshops for researchers. All this raises the appeal of the congress to scientists. You can see what impact your own research makes, if it is relevant to topics other people are conducting research into. An International Osteology Symposium provides a very good picture of what research is currently being performed in the field of tissue regeneration.

Besides organizing training initiatives, sponsoring research is a key objective of the Osteology Foundation. What is in the Foundation for researchers?

Anyone planning a study in the field of oral tissue regeneration can request funding from the Osteology Foundation. We have arranged the application procedure to make the effort for applicants as slight as possible. Initially they only need to submit a brief description of their project; a detailed application does not follow until they are invited into the main round. This can save applicants a great deal of time.

Osteology has thus far sponsored 40 studies from 13 countries. What now?

We are not only concerned with funding specific projects. We also wish to do something about improving the quality of research in oral regeneration.

We set up the Osteology Research Academy for this reason in 2011. It is a 1-week intensive course in research methodology held in Lucerne each September. The idea for this course arose out of there being otherwise virtually no structured grounding in research methodology. Young researchers have often had to learn by “trial and error” how to plan and conduct a study, how to go about raising funding and how to write a paper. The course thus bridges a gap in the academic curriculum.

Furthermore, since 2011 in Volume 1 of the Osteology Research Guidelines there has now been a research book for anyone conducting preclinical studies in the field of oral tissue regeneration. The book features helpful examples of study protocols on many research issues and therefore helps to prevent errors in planning and evaluating studies. If only I’d had such a book when I set out on my scientific career.

Looking back as Foundation President on 10 years of Osteology what gives you the greatest pride?

I enjoy seeing researchers funded by Osteology being awarded prizes. This shows that we support key research. But I also take pride in the development of the Foundation as a whole. Osteology has developed into an institution in regenerative dentistry with world-wide rapport. We have been intent on high quality and integrity from the outset, and that is also how our output is perceived by others. Many dedicated experts that stand for what they are doing and want to benefit the field have made crucial contributions here. We are going to celebrate this at the congress.

Looking ahead—what do you see as the Foundation’s key objectives in the next five years?

We want to continue both training initiatives and research funding. We, however, value spreading our message to more and more people and not just within our events and funding initiatives. Digital media will play an ever greater role in this.

Thank you very much for this interview.
International Events

2013

International Dental Show
12–16 March 2013
Cologne, Germany
www.ids-cologne.de

ITI Congress North America
4–6 April 2013
Chicago, USA
www.iti.org

8th CAD/CAM & Digital Dentistry
International Conference
2 & 3 May 2013
Dubai, UAE
www.cappmea.com

International Osteology Symposium
2–4 May 2013
Monaco
www.osteology.org

ITI Congress South East Asia
16 & 17 May 2013
Bangkok, Thailand
www.iti.org

MIS' 2nd Global Conference
6–9 June 2013
Cannes, France
www.mis-implants.com

Nobel Biocare Global Symposium
20–23 June 2013
New York, USA
www.nobelbiocare.com

FDI Annual World Dental Congress
28–31 August 2013
Istanbul, Turkey
www.fdiworlddental.org

2nd Asia-Pacific Edition
9th CAD/CAM & Digital Dentistry
International Conference
5 & 6 October 2013
Singapore
www.cappmea.com

EAO 2013
16–19 October 2013
Dublin, Ireland
www.eao.org

AAID Annual Meeting
23–26 October 2013
Phoenix, USA
www.aaid-implant.org
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- 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.

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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.

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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.

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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:

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- 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.)

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Questions?

Magda Wojtkiewicz (Managing Editor)
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