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This year, in addition to the International Dental Show, significant for the entire global dental industry, another important event in digital dentistry is taking place: the CAD/CAM and Digital Dentistry International Conference—celebrating its tenth anniversary—which is to be held in May at the Jumeirah Beach Hotel in Dubai.

Almost 20 years after the first CAD/CAM system was presented on the market, with great enthusiasm and a belief in digitalizing dentistry, the Centre for Advanced Professional Practices (CAPP) held its first CAD/CAM and computerized dentistry conference in the Middle East. CAPP, with a group of passionate leaders, such as Drs Munir Silwadi, Aisha Sultan and Omar Adeeb, supported by 3M ESPE, Sirona, KaVo, etkon and the MOH, UAE, has made possible what we have today, the fruit of ten years of continuous dedication to digital dentistry education. To date, more than 15,000 dentists and dental technicians have been educated in digital dentistry by CAPP.

Our journey over the last decade has been fraught with the many challenges of keeping pace with the incredibly fast growth of the industry and new technologies. Ten years ago, we could not even have imagined the opportunities to change dentistry and improve patient care, covering everything from diagnosis to treatment in terms of precise, improved efficiency, and changing outcomes and aesthetic needs.

What has been accomplished in the past ten years has been significant, and we would like to acknowledge our business partners, industry, sponsors and supporters for helping us make CAPP the success it is today. Thank you to all who have worked with CAPP during this period and who share the challenges and passion. We are grateful to all of the dentists and dental technicians who have followed us in this decade of rapid development in the dental industry and technologies.

In 2015, there is one more anniversary to celebrate: CAD/CAM magazine is now 6 years old! Since 2010, CAD/CAM has served as a platform for education and information exchange, and we all hope it will continue. Inside this issue, you will find clinical articles, as well as reviews of CAD/CAM technology, and industry news.

Yours faithfully,

Dr Dobrina Mollova
Managing Director of CAPP
Dubai, UAE
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We usually associate the term 'brand' with a product that has a unique, consistent and well-recognised character (i.e. Coca-Cola, BMW). These brands conjure up images in the minds of consumers. Large organisations work hard to raise the power and status of their brands and guard them carefully against unlicensed use or unfair imitation.

The American Marketing Association (AMA) defines a brand as a ‘name, term, sign, symbol or design, or a combination of them intended to identify the goods and services of one seller or group of sellers and to differentiate them from those of other sellers’.

Therefore, it makes sense to understand that branding is not about getting your target market to choose you over the competition, but it is about getting your prospects to see you as the only one that provides a solution to their problem. Looking out into the world today, it is easy to see why brands are more important now than at any time in the past 100 years. Brands are psychology and science brought together as a promise mark, as opposed to a trademark. Products have life cycles. Brands outlive products. Brands convey a uniform quality, credibility and experience. Brands are valuable. Many companies put the value of their brand on their balance sheet.

Why? Well you do not have to look very far. In today’s world, branding is more important than ever. But you cannot simply build a brand like they did in the old days. You need a cultural movement strategy to achieve kinetic growth for your brand. With that, only the sky’s the limit. What sells Chanel when it produces a cosmetic? A cream or a dream of beauty? What does the Perugina brand sell when it produces the ‘Bacio’? A chocolate or a feeling? What sells Ferrari when it produces the 458; car or social status? What sells Starbucks when opening its stores? A coffee or a third place between home and work? The list goes on with many examples. Branding is fundamental. Branding is basic. Branding is essential. Building brands builds incredible value for companies and corporations.
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If you are still not convinced, let me give you another example. The dollar is a world brand. In essence it is simply a piece of paper. But branding has made it valuable. All the tools of marketing and brand building have been used to create its value. On the front will find the owner of the brand: the Federal Reserve. There is a testimonial from the first President of the United States, George Washington. There is a simple user’s guide: ‘This note is legal tender for debts public and private’. And if you are still not convinced, the owner has added the all-important emotional message: ‘In God We Trust’. The dollar is a world brand. It confers a uniform value globally. But, as I said, it is really just a piece of paper. Branding has made it worth something.

I mentioned earlier that brands are more important today than in the past. There are a few reasons for this. Firstly, the world has come online and there are many new markets and a growing middle class in places such as India, China, Brazil, Russia, South Africa, Nigeria, Indonesia and in many more places. These consumers buy brands. They buy premium brands. The best branding today is based on a strong idea. The best brands have remarkable creativity in advertising to help them break through people’s wall of indifference to create brand heat and product lust. A case in point is the recent turnaround of Chrysler and its reliance on marketing and advertising. Or look at the reinvention of Levi’s. A final example is a campaign by my own agency, which has helped reenergise one of America’s great iconic brands—Jim Beam.

Developing a corporate brand is important because a positive brand image will give consumers, and other interested stakeholders, confidence about the full range of products and activities associated with a particular company.

- Essence: A single, energising central idea; it is the heartbeat of the organisation.
- Values: What the organisation believes in and stands for.
- Personality: The traits and qualities that distinguish your organisation as being different.
- Behaviour: The actions associated with values and personality.
- Relationships: The internal and external rules of engagement.
- Value Proposition: The offer that is made to customers, the point of difference and why it matters.

The sophisticated strategy is a cultural movement strategy. I believe that building brands now requires a cultural movement strategy as opposed to simply a brand building strategy. A cultural movement strategy can accelerate your brand’s rise to dominance. Once you have cultural movement, you can do anything in a fragmenting media environment, maximising the power of social media and technology. The world has changed. We are now living in the age of uprisings and movements. I have written about how to build a brand in this new age in my new book Uprising. These days, building brands has become a lot less expensive and smart brands can take advantage of new tools and rocket up there globally, very fast. A common interpretation is that a brand is the promise that is made to customers. Or, the brand is not what you say it is, but what your customers say it is. While these views are legitimate ways of helping to understand a brand, an actively-managed approach makes a brand more tangible and provides it with structure. Company branding is the most efficient way to show potential customers what your business is about. It is reflected visually via the logo and company design elements, as well as through verbiage in marketing materials, slogans and informational copy. According to Fast Company magazine, ‘The brand is a promise of the value you’ll receive’.

In the face of the current economic challenges, it is worth noting that brands do better in tough times compared to unbranded products. Brands outlive product cycles. And in these challenging times, there are still great brands being built. Brand owners still recognise opportunity and their brands will thrive in the years ahead.

No branding, no differentiation. No differentiation, no long-term profitability. People do not have relationships with products, they are loyal to brands. In a movement strategy, brands have a purpose that people can get behind. Brands can inspire millions of people to join a community. Brands can rally people for or against something. Products are one dimensional in a social media enabled world, brands are Russian dolls, with many layers, tenets and beliefs that can create great followings of people who find them relevant. Brands can activate a passionate group of people to do something like changing the world. Products cannot really do that.

Brands have to contain:

- Uniqueness: utilise your branding to set yourself apart from your competitors. To do this, analyse what you do best and consider you target demographic. Use graphics and word choices that clearly reflect your business to your target audience, hence your brand. Use your branding to deliver clear messages.

- Target Audience: done correctly, your brand can assist you in getting a stronger foothold in your
Patients rely on you in order to eat, speak, and smile with confidence. It can be said, you are actually restoring quality of life and happiness.

To succeed, you need technology that is well founded and documented in science. That is why we only deliver premium solutions for all phases of implant therapy, which have been extensively tested and clinically proven to provide lifelong function and esthetics.

Moreover, with an open-minded approach, we partner with our customers and offer services that go beyond products, such as educational opportunities and practice development programs so you can rest assured that you have the support you need.

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niche market. Define your unique selling position and consider methods to communicate key messages to your desired audience. Use specific images or phrases to encourage the feel of inclusivity. Let them know the reason your company exists and how it can fulfill their needs. This can connect you to your target audience, engage them and motivate them to buy.

Emotional Connections: according to a 2010 study conducted by the world’s largest public relations firm, Edelman, the Y Generation, also known as the Millennials, consider brand identification almost as important as religious preference and ethnic background when defining themselves online. The power of branding has successfully melded into that of personal identification and emotional connection.

Message Delivery: having strong branding can evoke trust from your niche market. This can translate to your newsletters, emails and advertisements garnering a greater response, hence increasing sales. As people will already be vested in your brand, they will be confident that they will receive value for time spent reading your messages or researching your product.

Consistency: focus on your long-term branding efforts to keep your business consistent. This consistency should transcend messages, product lines and audience appeal. It should enhance your business, adding depth to your company’s presence. This should allow you to grow and keep a loyal following.

Many small organisations and start-ups neglect spending necessary time thinking about their brand in this broad sense and the impact it has on their business. Let’s look at 10 reasons why digging into your brand is important:

- Branding promotes recognition. People tend to do business with companies they are familiar with. If your branding is consistent and easy to recognize, it can help people feel more at ease purchasing your products or services.

- Your brand helps set you apart from the competition. In today’s global market, it is critical to stand apart from the crowd. You are no longer competing on a local stage, your organisation now competes in the global economy. How do you stand out from the thousands or millions of similar organisations around the world?
Your brand tells people about your business DNA. Your full brand experience, from the visual elements like the logo to the way that your phones are answered, tell your customer about the kind of company that you are. Are all of these points of entry telling the right story?

Your brand provides motivation and direction for your staff. A clear brand strategy provides the clarity that your staff needs to be successful. It tells them how to act, how to win, and how to meet the organisation’s goals.

A strong brand generates referrals. People love to tell others about the brands they like. People wear brands, eat brands, listen to brands, and they are constantly telling others about the brands they love. On the flip side, you cannot tell someone about a brand you cannot remember. A strong brand is critical to generating referrals or viral traffic.

A strong brand helps customers know what to expect. A brand that is consistent and clear puts the customer at ease, because they know exactly what to expect each and every time they experience the brand.

Your brand represents you and your promise to your customer. It is important to remember that your brand represents you: you are the brand, your staff is the brand, your marketing materials are the brand. What do they say about you, and what do they say about what you are going to deliver (promise) to the customer?

Your brand helps you create clarity and stay focused. It is very easy to wander around from idea to idea with nothing to guide you—it does not take long to be a long way from your original goals or plans. A clear brand strategy helps you stay focused on your mission and vision as an organisation. Your brand can help you be strategic and will guide your marketing efforts saving time and money.

Your brand helps you connect with your customers emotionally. A good brand connects with people at an emotional level, they feel good when they buy the brand. Purchasing is an emotional experience and having a strong brand helps people feel good at an emotional level when they engage with the company.

A strong brand provides your business value. A strong brand will provide value to your organisation well beyond your physical assets. Think about the brands that you purchase from (Coca-Cola, Wrangler, Apple, Perugina, Ferrari)—are these companies really worth their equipment, their products, their warehouses, or factories? No, these companies are worth much more than their physical assets; their brand has created a value that far exceeds their physical value.

Wrapping it up. The best branding is built on a strong idea, an idea that you and your staff can hold on to, can commit to, and can deliver upon. Your brand needs to permeate your entire organisation. When your organisation is clear on the brand and can deliver on the promise of the brand, you will see tremendous fruit while building brand loyalty among your customer base.

But what does a dentist actually sell? Therapies or trust? Improve the management of the dental office by increasing the management control, the Perceived Quality and Value Added, optimising costs, acquiring new patients and increasing the strategic positioning of professional success. Particular attention was dedicated to finding value in being able to offer new therapeutic solutions, especially in this economic, social and cultural ‘time of crisis’.

There are opportunities for growth in the dental business through increased perception of quality in presenting and managing the range of services in the sphere of performance, even aesthetic, not to mention the more traditional therapies. The professionalism of the team of front office and back office generate word of mouth and optimise all investments in communication. To transfer the Perceived Quality, needs new tools of communication personal and professional. Climate Analysis, Applied neuroscience, Web-Marketing and motivational communication, are just some of the methods...
A minimally invasive approach according to biomechanical principles of teeth

Author: Dr. Michael L. Young, USA

Introduction

Traditionally, the practice of dentistry has been a reparative model. We have waited for disease to express itself, and then repaired it. What if we could predict who would express a disease and prevent it from happening in the first place? How would this approach affect the long-term oral and overall health of the dental patient?

Many of our patients tell us, "If it's not broken, don't fix it." Patients are often unaware of the conditions in their mouths because there isn't an associated disability, and they won't accept a solution to a problem they don't have. Thus teeth at risk may remain untreated until a quality of life issue has occurred, such as pain, infection or a fractured tooth.

According to Geurtsen, Schwarze, & Gunay (2003), root fractures are the third leading cause of tooth loss. Cavity preparation or endodontic access destroys the pre-stress state. Teeth can then deform greater and are more susceptible to fracture. Too much flexing makes them crack.

Tooth loss is a quality of life issue. Loss of a tooth ideally requires replacement, which necessitates further expenditures and procedures.

Failure to replace the tooth has consequences, which may lead to further cost and need for treatment or loss of additional teeth. The consequence of the reactive approach to dental care is, at best, a lesser prognosis for the tooth and, at worst, loss of the tooth. This may be avoidable with a paradigm shift to a wellness model of practice. A wellness model is proactive and preventative. If we can identify a dental condition that increases risk to the tooth and patient, and treat the condition prior to its consequence, we're effectively reducing risk. The effect is an improved prognosis. Subsequently, health-care costs will be reduced and quality of life improved.

We can do better.

Biomechanical principles

Tidmarsh said in 1979 that teeth are like pre-stressed laminates. They flex but can return to their natural state. However, under prolonged loading, teeth can permanently deform.

Grimaldi said in 1979 that there is a relationship between how much tooth structure has been lost and deformation.

Cavity preparation or endodontic access destroys the pre-stress state. Teeth can then deform greater and are more susceptible to fracture. Too much flexing makes them crack.

Larson, Douglas and Geistfield (1981) showed that a restoration that takes up just one-third of the intercuspal distance is less than one-half of the strength of an unrestored tooth. The load required...
to fracture a tooth was the same if the restoration involved only the occlusal surface or included the mesial and distal surfaces as well.

Geurtsen, Schwarze and Gunay (2003) agreed that the risk of cuspal fracture increases considerably when the isthmus width of a restoration is 50 per cent of the intercuspal distance. They stated that amalgam or resin composite restorations should not exceed one-fourth to one-third of the intercuspal distance. The more tooth structure that is removed in cavity preparations, the more the tooth flexes under increasing loads.1

Teeth with cuspal fractures may still be restored; however, the prognosis will be lower and less than ideal because there is less remaining natural structure to retain a crown and withstand the flexing from functional and non-functional forces. These teeth may last for years. However, they may eventually fracture at the gingival crest or below, because of further cracks and propagation of those cracks.

Teeth with history of endodontic treatment are at an increased risk of subgingival fracture, rendering the tooth non-restorable or with a poor prognosis. Therefore, it’s important to prevent these cracks from forming at all.
How do we prevent too much flexing in these teeth and prevent cracking? Some have wondered whether a bonded inlay restoration would strengthen the tooth and prevent cuspal fracture. A study of bonded inlay restorations under static load testing in maxillary premolars with large MOD preparations concluded that bonding ceramic or composite will not strengthen the tooth. A bonded resin or ceramic inlay will not prevent cuspal deformation and fracture. However, bonded ceramic onlays have been shown to be an effective answer in restoring posterior teeth.

Bakeman and Kois (2009) stated that all porcelain, adhesively retained restorations offered the possibility of limited or no removal of tooth structure on the axial wall, while covering the cusps. The result is a tooth with more remaining original structure, less flexure under force and thus less risk of permanent deformation and fracture.

It is important to preserve as much enamel as possible, as failure rates of adhesively retained restorations increase the more the tooth preparation involves the dentin. In addition, the size of the remaining enamel ring after occlusal reduction is an important determinant between an adhesively or cohesively retained approach in tooth preparation.

Increased occlusal reduction, or occlusal reduction on a worn tooth, results in a preparation with...
a reduced enamel ring width. A decrease in the size of the enamel ring thickness from 1.5 mm to 1 mm increased the failure rate dramatically. An enamel ring of less than 1 mm in width would be a contraindication for an adhesively retained restoration, and a cohesively retained restoration would then be required. A restoration bonded to enamel also provides a margin with reduced or no microleakage.

_Summary_

Aminian and Brunton (2003) stated: "The removal of sound tooth structure is an unfortunate biological compromise. The conservation of sound tooth structure, therefore, represents an appropriate strategy to minimize biologic risk."
Adhesively retained restorations offer the possibility to be more minimally invasive while restoring a tooth to natural appearance and function. More conservative removal of tooth structure also means there is less risk to the pulp.

The converse is true in that cohesively retained restorations are more invasive. Removal of more structure increases pulpal risk, decreases strength and increases tooth flexure, which may lead to fracture.

Tooth preparation is also more important as retention and resistance form is essential to retain the crown.

A laboratory can fabricate minimally invasive, adhesively retained restorations. However, chairside CAD/CAM technology can fabricate excellent restorations of the same quality in the same visit. This means the challenge of fabricating a provisional for a tooth preparation that
lacks retention and resistance form is eliminated.

In addition, it has been shown that patients prefer a digital impression technique in lieu of the traditional impression method.\textsuperscript{9–13} Yuzbasioglu, et al (2014), also determined that the digital impression method was faster than the traditional method. This finding was also verified by Patzelt, Lamprinos, Stampft and Att (2014), who indicated that workflow efficiency was improved using a digital impression technique.

\textbf{Case report}

This patient presented for restorations of teeth #3 and #4 (Fig. 1a). Because of the size of the existing restorations, these teeth were diagnosed as structurally compromised (Figs. 1b, c). The prognosis without treatment was fair.

The restorations were to be completed with PlanScan chairside CAD/CAM technology in the same visit.

Local anesthesia was achieved with 1.7 cc 2 per cent Lidocaine with 1:100,000 epi, buffered with Onset sodium bicarbonate inj., 8.4 per cent, USP neutralizing additive solution.

Depth guide cuts were made using a 330 bur, which has a 2 mm cutting surface (Figs. 2a–3b). This ensures 2 mm of occlusal reduction to accommodate 2 mm of material thickness on the occlusal surface of the restoration.

Gross occlusal reduction was completed using a KS7 bur to the depth cuts (Figs. 4–8b, 9c). Adequate Fig. 26k Checking material thickness of #4 in facial view. Fig. 26l Using rubber tooth tool to adjust the anatomy of #4. Fig. 26m Using rubber tooth tool to adjust the distofacial cusp height of #3. Fig. 26n Using rubber tooth tool to adjust the distal marginal ridge height of #4. Fig. 26o Using smooth tool to smooth the facial of #3. Fig. 26p Using smooth tool to smooth the facial of #3. Fig. 26q Checking occlusal contacts, location and strength, #3. Fig. 26r Checking interproximal contact strength #4. Fig. 26s Final restorations, occlusal view in PlanScan.
clearance was verified with a 2 mm prep check from Common Sense Dental Products.

After gross occlusal reduction was completed, the remaining enamel ring was measured (Figs. 9a, b). The enamel rings were noted to be 1.5 mm, and the teeth were prepared for adhesively retained restorations. If the enamel rings were less than 1 mm, the teeth would have been prepared on the axial walls to create retention for cohesively retained crowns.

The remainder of the existing composite resin in #3 and the amalgam in #4 were removed. The occlusal surfaces of the preparations were blended into the interproximal areas using a KS2 bur to create smooth preparations (Figs. 10–15c). There was no retention or resistance form prepared to retain the restorations.

Tissue management was obtained with ViscoStat Clear, gingival haemostatic gel, 25 percent (m/m) aluminum chloride (Figs. 16 & 17). Gingival retraction was obtained using a two-cord system. First, a #00 size cord from Ultradent was placed on the mesial and distal of both preparations (Figs. 18 & 19).

Additional haemostatic gel was used prior to the second cord. The second cord was #2 size cord from Ultradent (Figs. 20 & 21a). A minimum of four minutes with both cords in place is needed for adequate retraction of the soft tissue (Fig. 21b).

While waiting four minutes for gingival retraction, the opposing teeth were scanned with the PlanScan wand to create a digital model (Figs. 22a–24c). The buccal surfaces were then scanned...
with the teeth fully occluded in maximum intercuspal position. This scan was used along with the scan of the preparations and the opposing teeth to create a model for the occlusion (Figs. 25a–26c).

Prior to scanning the prepared teeth, the second cords were rinsed and removed. The cords were left wet to lower the risk of disturbing the tissue upon removal.

The #00 cords were left in place during the scanning of the preparations, and the teeth were dried to allow accurate scanning.

The preparation model was examined in data density view to verify adequate data was obtained during the scanning of the preparations (Fig. 26c).

Any areas lacking adequate data were scanned further until adequate data was obtained. Next,

Fig. 27 Isolation for seating of restorations using Isolite.
Figs. 28 & 29 Application of Multilink Automix Primer.
Figs. 30 & 31 Application of Liquid Strip.

Fig. 32 Curing restorations.
Figs. 33a–c Checking occlusion.
orientation of the preparation model was performed (Fig. 26d). Orientation is for optimal design, not path of insertion. The margins were then traced and viewed in ICE mode, which provides a rendering of the scanned images for a clear view of the margins, teeth and tissues (Figs. 26e, f).

The initial proposals for the restorations were made using Library A and autogenesis, which is morphogenesis of the library tooth with the neighbouring teeth (Figs. 26g–i).

Material thickness of the proposed restorations was checked (Fig. 26j, k). Tools were then utilized to improve the initial proposal to the desired result. The rubber tooth tool was used to make minor adjustments to the anatomy (Figs. 26l–n). The smooth surface tool was used to smooth the surfaces (Figs. 26o, p).

The location and strength of the occlusal contacts were checked and adjusted (Fig. 26l). Interproximal contact strength and location was then verified and adjusted as needed (Fig. 26l).

The final proposals were then verified prior to milling (Figs. 26u, v). The slice plane view was used to check the space between the tooth preparation and the restoration (Figs. 26u, v).

This is done to check for possible areas that may prevent the final restoration from completely seating on the preparation or for areas that may be over milled. Over-milling reduces the thickness of the material. This view also illustrates the lack of preparation on the axial wall and the minimally invasive approach taken. The location of the sprues were noted and adjusted as needed in the milling preview (Fig. 26x).

The fit of the restorations was then verified intraorally prior to final seating (Figs. 26y, z). Occlusion can be verified intraorally with Empress CAD blocks prior to bonding in place is not recommended.

Checking occlusion with Empress CAD blocks prior to bonding in place is not recommended.

The restoration for #3 was then glazed and crystallized in a Programmat CS2 furnace (Ivoclar Vivadent). The restoration was allowed to cool to room temperature upon completion of glazing and crystallization. The restoration was then cleaned with a steam cleaner. Five percent hydrofluoric acid was used to etch the e.max restoration for 60 seconds. The Empress restoration was etched for 20 seconds.

The etchant was rinsed with a steam cleaner. Ivoclean (Ivoclar Vivadent) was applied for 20 seconds on both restorations to clean their internal surfaces. Monobond Plus primer (Ivoclar Vivadent) was applied to the internal surface of the restorations for 60 seconds. The primer was lightly air dried after 60 seconds, taking extra care not to allow primer on the outside surfaces of the restorations.

The teeth were isolated using Isolite (Fig. 27). Multilink Primer A/B was scrubbed onto the entire bonding surfaces using a microbrush for 30 seconds. Excess material was dispersed with blown air until the mobile liquid film was no longer visible, leaving a glossy appearing surface (Figs. 28 & 29).

An OptraStick Application Aid (Ivoclar Vivadent) was used to seat the restorations on the teeth because onlays and partial crowns can be difficult to handle. Initial tack curing was completed using a Bluephase curing light (Ivoclar Vivadent) for three seconds at each interproximal area. The resin was then removed easily using a 36/37 scaler from Brasseler. Liquid Strip (Ivoclar Vivadent), a glycerine gel that prevents an oxygen-inhibited layer of the resin cement, was applied to the margins prior to final curing (Figs. 30 & 31).

Final curing of the restorations was then completed (Fig. 32). The initial #00 cords were removed...
after final curing so proper tissue management could be maintained until curing was completed.

Occlusion was checked with the patient chair at a 45-degree angle. Bausch articulating paper, horseshoe shape, 200 microns thick, was used first, and the patient was instructed to chew on the paper as if chewing gum. Next, the patient was instructed to tap straight up and down on red Troll Foil articulating foil. Any marks from the chewing strokes that weren’t covered by the red paper were removed to eliminate interferences and reduce the risk of material fracture (Figs. 33a–c).

The restorations were then polished (Fig. 34). For #3 e.max restoration, the burs were NTI Cera Glaze — green, blue and yellow, in order. The green prepolisher was not used on the Empress restoration for #4.

The final result was minimally invasive restorations that appear and function naturally, while decreasing risk of tooth fracture, and minimize further risk to the teeth. (Figs. 35a–36b).

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References

About the Author
Dr. Michael L. Young graduated from the University of Michigan School of Dentistry in 1994. He has a private general dentistry practice in Sterling Heights, Mich. He has been practicing chairsde CAD/CAM dentistry since 2004. Young is a mentor for the Kois Center for Advanced Dental Learning. He is a member of the American Dental Association, Michigan Dental Association and the Detroit District Dental Society.
CAD/CAM technology and materials are currently used in a number of clinical applications, including the fabrication of indirect restorations. CAD/CAM gives both the dentist and the laboratory an opportunity to automate fixed restoration fabrication. Both chairside and chairside–laboratory integrated procedures are available. The properties of these restorative materials and their indications and appropriate use must be understood in order to enable the achievement of predictable and aesthetic results for patients.

Introduction

In the past decade, the demand for all-ceramic restorations has increased in both anterior and posterior teeth and the search for materials with improved properties has expanded.1 The need for a uniform material quality, reduction in production cost, and standardisation of manufacturing process has encouraged researches to seek to automate the manual process via the use of CAD/CAM technology since 1980.2

Computer-aided design (CAD) and computer-aided manufacturing (CAM) technology systems use computers to collect information and design, and to manufacture a wide range of products.3 The introduction of the first digital intraoral scanner for restorative dentistry was in the 1980s by a Swiss dentist, Dr Werner Mörmann, and an Italian electrical engineer, Marco Brandestini, that developed the concept for what was to be introduced in 1987 as CEREC by Sirona Dental Systems LLC, the first commercially CAD/CAM system for dental restorations.4,5 Ever since research and development sectors at a lot of companies have improved the technologies and created in-office intraoral scanners.

All the existing intraoral scanners try to face with problems and disadvantages of traditional impression fabrication process and are driven by several non-contact optical technologies and principles.

The purpose of this present publication is to provide an extensive review on the CAD/CAM technology and to emphasise the application of this technology in restorative dentistry.

CAD/CAM techniques

The major goals of the impression-taking process in restorative dentistry are obtaining a copy of one or several prepared teeth, healthy adjacent and antagonist teeth, establishing a proper interocclusal relationship and then converting this information into accurate replicas of the dentition on which indirect restorations can be performed.6

Traditional restorative techniques for fixed restorations require the use of impression materials to record the contours and dimensions of the preparation. This
is followed by the pouring of stone models and dies prior to laboratory fabrication of the definitive fixed restoration. Taking an accurate impression is one of the most difficult procedures in dentistry, requiring careful retraction or removal of soft tissue around preparation margins, haemostasis, and selection of an appropriate impression material and tray for the technique used.

By using a CAD/CAM restorative technique, a number of steps can be simplified or eliminated. Digital systems now offer the opportunity to avoid traditional, analogue impressions, including the usual impression materials, time, and handling limitations associated with them. Intraoral scanners have the potential to offer excellent accuracy with a more comfortable experience for the patient and more efficient workflow for the office. But care must be taken to ensure that the whole preparation is scanned, to avoid introducing errors.

Two techniques can be used for CAD/CAM restorations: the chairside technique or the integrated chairside-laboratory procedure.

Chairside technique

The development of CAD/CAM technologies for dental applications has enabled clinicians to prepare and indirectly restore tooth tissue with an aesthetic all-ceramic restoration, manufactured at the chairside in a single patient visit.

Chairside CAD/CAM techniques offer advantages to the patient, including eliminating the laboratory procedure and the requirement for intra-visit temporisation of the prepared tooth structure.

It eliminates several cumbersome dental office tasks, such as selecting trays, preparing and using materials, disinfecting and sending impressions to the laboratory. It also removes a source of discomfort and gagging. Moreover, it enables the clinician to take a digital impression, design and mill the restoration in-office, and fabricate cosmetic crowns, onlays and veneers, with full management over contours and tooth shade. Finally, it enhances the accuracy of adaptation of the restoration to the preparation.

In summary, with these systems, final restorations are produced in models created from digitally scanned data instead of plaster models made from physical impressions.

There are three main sequences to this workflow. The first sequence is to capture or record the intraoral condition to the computer. This involves the use of a scanner or intraoral camera.

During scanning, the clinician must ensure that all margins of the cavity are captured by the scan and visualised. The accuracy of CAD/CAM restorations depends on the scanner’s ability to visualise the margin. A true laser scanner/digitiser takes precise digital images of the preparation, including the margin, the undercuts, the contours, the adjacent dentition, and the gingiva. It captures hundreds of thousands of points of reference with each image, and then utilises a million data points to create an exact replica of the prepared tooth and neighbouring dentition.

Depending on the system, a light and rapid dusting of an opacifier may be required prior to capturing the digital scans of the preparation arch, opposing arch, and buccal bite registration. Once the data has been recorded to the computer, a software programme is used to complete the custom design of the restoration. The preparation is shown on the monitor and can be viewed from every angle to focus or magnify areas of the preparation. Inadequate images are automatically detected.

The “die” is virtually cut on the virtual model, and the finish line is delineated by the dentist directly on the image of the die on the monitor screen. Then, a CAD system, called “biogeneric”, provides a proposal for the final restoration.
of an idealised restoration and the dentist can make adjustments to the proposed design using a number of simple and intuitive on-screen tools.

The software identifies matching morphological characteristics (fissures, cusps, marginal ridges, gliding contact angle) and then inserts corresponding cusps, fossae, fissures, contacts surface into the virtual model of the restoration. On the basis of the contact point distribution, the cusp apexes and the proximal contacts, the software is capable of creating a well-matched tooth and detecting possible collisions with the bite registration.

This biogeneric modelling process creates natural, individual and functional occlusal surfaces.

A pre-manufactured block is inserted into the machine and is milled using diamond burs. The final sequence requires a milling device to fabricate the actual restoration from the design data in the CAD programme.

Digital systems

The CEREC Bluecam (Sirona), E4D intraoral digitizer (Planmeca), and iTero scanner (iTero) are considered single-image cameras. They capture a series of individual digital images that overlap one another. The overlapping images are "stitched" together by the computer software programme to process a single three-dimensional (3-D) virtual model.

The CEREC AC system powered by Bluecam is a light-emitting diodes (LEDs) camera that projects a changing pattern of blue light onto the object using projection grids that have a transmittance random distribution and which are formed by sub-regions containing transparent and opaque structures.

Thus, the intensity of light detected by each sensor element is a direct measure of the distance between the scan head and a corresponding point on the target object. As a disadvantage of the system, the triangulation technique requires a uniform reflective surface since different materials (such as dentin, amalgam, resins, gums) reflect light differently. It means that it is necessary to coat the teeth with opportune powders before the scanning stage to provide uniformity in the reflectivity of the surfaces to be modelled.

The earlier versions of CEREC employed an acquisition camera with an infrared laser light source. The latest version employs blue LEDs; the shorter-wave-length intense blue light projected by the blue LEDs allows for greater precision of the output virtual model.

The E4D Dentist system was introduced in early 2008. It consists of a cart containing the design centre (computer and monitor) and laser scanner head, and a separate milling unit. The IntraOral Digitizer is a single image camera with red laser light. It also works by recording reflected data from the hard and soft tissues.10

The Cadent iTero digital impression system by Cadent LTD, came into the market in early 2007. The iTero system employs a parallel confocal white and red laser light camera to record series of single images to create a 3-D model. The scanner emits a beam of light that is reflected off the tooth surface. Only data reflected back through the filtering device at the correct focal distance is recorded.11

Using this technique, the iTero captures all structures and materials found in the mouth without the need to apply any reflective coating to the patient’s teeth.

Integrated chairside-laboratory procedure

An integrated chairside-laboratory technique requires two visits.

The clinician can either scan the preparation directly and then send the scan to the laboratory, or can
take a traditional impression, after which a stone model is poured and the laboratory scans the stone model. The digitalisation of the dies was performed by a laser scanner (Cercon eye, DeguDent) and the substructures were designed on the CAD programme of the system. Digital impression systems are designed to electronically transmit the recorded data file to the dental laboratory for restoration fabrication. Efficient chairside assistants will increase the overall production of dental practices by aiding dentists in completing their procedures more quickly and more effectively.

Other systems are also used by laboratories to create copings, substructures, and abutments by CAM, after which hand fabrication of any required ceramics and finishing is conducted either by the same laboratory or by the laboratory that scanned and referred the case for milling of the substructure. Ceramic blocks for laboratory-milled restorations are available as zirconia (zirconium oxide) and lithium disilicate glass blocks. Zirconium oxide can be used to create accurate and strong copings and bridge substructures. After milling, the unit can be adjusted using an external liner (Zirliner, Ivoclar Vivadent) that enables characterisation before the outer ceramic suprastructure is created. The external ceramic layer can be created either using press ceramics (in the same manner as for a traditional bridge) or layering ceramic material onto the substructure using a fine brush and powder/liquid.

Advantages of a laboratory CAD/CAM milled restoration include reduced chairside time and increased accuracy. Since a stone model is not used, stone pouring errors are eliminated as well as errors associated with abrasion of the adjacent and opposing teeth due to manipulation of the models during fabrication that could result in overcontouring, tight contacts, and excessive occlusal height. In addition, reduced time is required for fabrication of the substructure.

Materials

CAD/CAM restorative materials are currently available in number of sizes in many shades and translucencies, including multiple shades within one dense gradated restorative block. The material used depends on functional and aesthetic demands and on whether a chairside or laboratory CAD/CAM restoration is fabricated.13

A range of dental ceramic substrates have been developed for chairside machining and are represented as prefabricated blocks, manufactured using processing routes identified to reproducibly control the resultant ceramic composition and microstructure.14–16 For chairside CAD/CAM restorations, an aesthetic, strong material requiring minimal post-milling aesthetic adjustment to minimise chairside time is needed.17–19 Leucite-reinforced glass ceramics (IPS Empress CAD, Ivoclar Vivadent; Paradigm C, 3M ESPE) and lithium disilicate glass ceramics (IPS e.max, Ivoclar Vivadent) can be used for chairside and laboratory CAD/CAM single restorations. Leucite-reinforced material is designed to match the dentition for strength and surface smoothness and to offer aesthetic results by scattering light in a manner similar to enamel.20

A study has been done to evaluate and compare the marginal gap, internal fit, and fracture load of resin-bonded, leucite-reinforced glass ceramic mesio-occlusal-distal (MOD) inlays fabricated by computer-aided design/manufacturing (CAD/CAM) or hot pressing: as a result, they provided clinically acceptable marginal and internal fit with comparable fracture loads after luting.21

Ceramic blocks for laboratory-milled restorations are available as zirconia (zirconium oxide) and lithium disilicate glass blocks. Zirconium oxide (IPS e.max ZrCAD, Ivoclar Vivadent; Cercon, DENTSPLY Ceramco) can be used to create accurate and strong copings and bridge substructures. Zirconia offers some significant physical properties that are advantageous for dental restorations besides its high strength. It has a similar colour to natural teeth, which reduces the need to opaque it or mask it as would be done for a metal substructure. Zirconia also has good opacity. This may be an advantage when trying to block out underlying discolored teeth or restorative materials. It may also be a disadvantage when trying to develop a more translucent appearance to the crown. Some manufacturers can colour the zirconia substructure to simulate dentine shades to improve the desired aesthetic result.22

After milling, the unit can be adjusted using an external liner (Zirliner, Ivoclar Vivadent) that enables characterisation before the outer ceramic suprastructure is created. The external ceramic layer can be created either using press ceramics (in the same manner as for a traditional bridge) or layering ceramic material onto the substructure using a fine brush and powder/liquid.

Composite resin blocks are also available for CAD/CAM restorations.23 Another option is the use of a new resin nanoceramic block that consists of ceramic clusters within a highly cross-linked resin matrix. The resulting block is homogenous, and the restoration can be CAD/CAM-milled chairside or in the laboratory.
Marginal adaptation is an important factor affecting the longevity of all-ceramic restorations. Considerable research has been invested in the marginal fit and internal adaptation of CAD/CAM restorations. Software limitations, as well as accuracy of milling devices, may affect the fit of CAD/CAM restorations. Most clinicians agreed that marginal gap should not be greater than 100 μm. It has been reported in the literature that restorations produced by CAD/CAM systems can have marginal gaps of 10–50 μm which is considered to be within the acceptable range.

Giannetopoulous and Al investigated and compared the marginal integrity of ceramic copings constructed with the CEREC3 and the EVEREST system, employing three different margin angle designs. They explored to what extent these CAD/CAM machines can produce acute marginal angles, creating restorations with acceptable margins. They found that the average chipping factor (CF) of the CEREC copings was: 2.8 per cent for the 0° bevel angle, 3.5 per cent for the 30° bevel angle and 10% for the 60° bevel angle. For the EVEREST copings, the average CF was: 0.6 per cent for the 0° bevel angle, 3.2% for the 30° bevel angle and 2.0 per cent for the 60° bevel angle. Univariate Analysis of Variance and multiple comparisons showed that there was a statistically significant difference in the quality of margins between the two systems for the 0° and 60° bevel angle, 3.2% for the 30° bevel angle and 10% for the 60° bevel angle. For the EVEREST system and a single-layer system, Ten standardised copings, the average CF was: 0.6 per cent for the 0° bevel angle, 3.2% for the 30° bevel angle and 2.0 per cent for the 60° bevel angle. Univariate Analysis of Variance and multiple comparisons showed that there was a statistically significant difference in the quality of margins between the two systems for the 0° and 60° bevel finishing line.

Mjör and Al have evaluated CAD/CAM restorations and found that they have a marginal fit as good as or superior to that of traditional impressions. A further benefit found with CAD/CAM restorations has been the reduced incidence of secondary caries (the leading cause of direct restoration failure with both amalgam and composite materials), attributed to the high accuracy of the approximal fit and the ability to ascertain that this is accurate prior to completion of the restoration and cementation.

Another study evaluated the accuracy of marginal and internal fit between the all-ceramic crowns manufactured by a conventional double-layer CAD/CAM system and a single-layer system. Ten standardised crowns were fabricated from each of these two systems: conventional double-layer CAD/CAM system (Procera) and a single-layer system (CEREC 3D). Marginal discrepancies of Procera copings were significantly smaller than those of Procera crowns and CEREC 3D crowns (P > 0.05). On internal gaps, CEREC 3D crowns showed significantly larger internal gaps than Procera copings and crowns (P < 0.05). Within the limitations of this study, the single-layer system demonstrated an acceptable marginal and internal fit.

On the other hand, depending on the preparation design, either an adhesive or a non-adhesive luting cement can be used with these materials.

CAD/CAM restorative materials can be cemented with either traditional luting cements such as zinc phosphate, polycarboxylate cement, glass ionomers, or resin-modified glass ionomers. Materials that can be sealed with these include zirconia, lithium disilicate, alumina, and resin nanoceramics.

With regards to resin adhesive cements, they offer superior aesthetics and low viscosity. They chemically bond to the restoration surface and the tooth surface, either providing all of the retention or, for retentive preparations, improved retentive strength. They also have greater compressive strength.

Meanwhile zirconia fixed partial dentures showed good to sufficient marginal integrity in combination with Panavia/ED, Compolute/EBS and RelyX Unicem.

When evaluating the initial and the artificially aged push-out bond strength (PBS) between ceramic and dentine produced by one of five resin cements, there was a significant effect of resin cement (P < 0.0001): RelyX Unicem showed significantly higher PBS than the other cements. Syntac/Variolink II showed significantly higher PBS than SmartCem2 (P < 0.001). No significant differences were found between SpeedCem, SmartCem2, and iCem. The predominant failure mode was adhesive failure of cements at the dentine interface except for RelyX Unicem, which, in most cases, showed cohesive failure in ceramic.

Digital impressions tend to reduce repeat visits and retreatment while increasing treatment effectiveness. Patients will benefit from more comfort and a much more pleasant experience in the dentist’s chair.

The quality of adaptation of CAD/CAM–generated restorations is an area of current interest. Studies demonstrate the clinically acceptable durability of CAD/CAM restorations for colour matching, interfacial staining, secondary caries, anatomic contour, marginal adaptation, surface texture, and postoperative sensitivity.

Adhesive cementation seems to be the key for the long-term clinical success of CAD/CAM inlays and onlays.
WIDE RANGE OF MATERIALS
CoCr, Zircon, Titan, PMMA, wax, composite, glass ceramic

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PROFESSIONAL SUPPORT
Latest trends in prosthetics
Total maxillary rehabilitation with a Toronto Bridge using digital technologies

Authors: Massimiliano Rossi, Fabrizio Molinelli & Dr Ilaria Caviggioli, Italy

_Introduction_

This article presents a clear example of the increasing importance of new technologies and, more specifically, digital technologies in dental prosthesis planning and fabrication. By presenting a real case, this article aims to provide an overview of the benefits arising from the use of a new protocol in this field. The entire process of total maxillary rehabilitation with a Toronto Bridge will be presented, giving attention to 3-D scanning technologies, smile design software and CAD system. The article concludes that digital technologies are being increasingly implemented in the everyday work of both dentists and dental technicians because they provide more precise working protocols.

_Total maxillary rehabilitation with a Toronto Bridge_

New technologies allow conventional steps to be performed digitally. In this way, we can achieve a more efficient workflow, which saves time and costs.

The first step of the digital dentistry workflow is evaluation of the clinical situation. In particular, for relevant rehabilitations, our protocol starts with patient image management. With just two photographs of the patient, a photograph of his or her smiling face and an intra-oral photograph, we can easily create a clinical, functional and aesthetic design of the smile using an innovative software program called Digital Smile System (DSS).
Through a guided workflow, the software allows the user to quickly create a custom aesthetic test of the virtual smile, contextualizing it against the entire face of the patient, with a self-managed digital elaboration.

Owing to the eyewear marker, DSS is able to automatically align the two images and to guide the design. This particular calibration system permits users to study the morphology of the patient’s face and to acquire very reliable measures in order to facilitate the work of both the dentist and the technician (Figs. 1–3).

The mathematically controlled algorithms of the prosthetic tool for edentulous patients allow DSS to suggest the most suitable commercial dental library to be used (Figs. 4–7).

In this first phase, digital dentistry and, more specifically, the clinical use of DSS represents an incredible advantage for the planning of both the work and the information flow. Indeed, it will be easier for the dentist to present the final prosthetic result to the patient (Figs. 8 & 9a & b) and to provide the necessary information to the dental technician for fabrication of the prosthesis.

After completing the pre-visualization, the dental arch was prepared for transfer to the CAD system. Owing to direct integration with Dental-CAD (EGS), DSS can automatically export compatible 3-D output to support modelling in the CAD environment (Figs. 10–13).

Once the aesthetics have been defined, the workflow moves to acquisition of the 3-D data.
Second step of the digital dentistry workflow. First, we used a desk scanner with blue structured light technology (DScan3 Blue Light, EOS) to acquire data from the model. This provided very accurate data (up to 15 μ) to the laboratory for an effective and efficient result (Fig. 14).

We then used a body scanner to acquire the facial data with great precision (Fig. 15). This scanning step was fundamental for the volume construction and for the consequent fabrication of the underlying framework (Fig. 16).

At this point, all of the data collected was transferred to DentalCAD, now in Version 4.2. We then created the framework using its simple 3-D modelling tools and by importing the volumes studied in DSS (third step of the digital dentistry workflow). Using the 3-D data of both the face and the mouth, we were able to study the occlusal aspects, as well as the relationship between the teeth and lips. It was possible to align the 3-D scan of the face with the 3-D scan of the mouth owing to an additional scan taken with an extra-oral landmark (Figs. 17–22).

The very high quality of the mesh created with DentalCAD allows 3-D printing of the framework in PMMA in order to try it on the patient. In accordance with the procedure, all of the customizations necessary for the fabrication of the final prosthesis were performed in a very short period by screwing the prototype directly into the oral cavity of the patient (Fig. 23).

The use of these technologies offers several benefits, in particular, the repeatability of the shapes designed and the prototype creation. The prototype obtained can be considered definitive and fabrication of the definitive prosthesis will be simplified, since the project files will be stored digitally. In addition, the patient is shown a concrete
pre-visualization using the prototype (Fig. 24). The prototype is also very important for the dentist in order to check the relationship between the teeth and lips (in terms of aesthetics, phonetics and support of the soft tissue).

After this step, according to the volumes obtained, the framework to support the acrylic teeth was constructed in DentalCAD (Figs. 25a & b). Our goal was to create a framework in titanium by reducing the prototype on which the teeth were to be placed—exactly as planned in DSS. We created and submitted the CAM file for order processing through software integrated into DentalCAD.

After the milling cycle (fourth step of the digital dentistry workflow), the product was carefully adapted to the model in order to finalize the work. In particular, the titanium framework was prepared and the acrylic teeth positioned using a verticulator (Fig. 26).

By means of these new digital technologies, the dental technician is given the opportunity to express and enhance his or her skills and creativity by focusing on finalization of the aesthetics and functionality.

As can be seen, the final result is perfectly in accordance with the schedule established with the patient during the first step of the digital dentistry workflow (Figs. 27 & 28).

Following a precise workflow, the protocol covers all stages of the project, from the material choice to the production and finalization, aiding the work of both the dentist and dental technician and providing several new benefits to the patient too.

**Conclusion**

This article clearly demonstrates the precise working protocols provided by digital technologies and the reason they are being increasingly implemented in daily work in dental practices and laboratories. In particular, it has shown how the use of 3-D scanners and dedicated software is becoming part of the digital workflow in dentistry. It allows a complete aesthetic and functional preview of the final result and facilitates working in CAD with very accurate data. The digital dentistry workflow presented with this particular example has shown that the benefits arising are not limited to the work (a time and cost saving, as well as more accurate results), but also extend to the patient, who is given a reliable preview of the treatment outcome.

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Digital possibilities for making implant prosthetics

Author: Dr. Joannis Katsoulis, Switzerland

Introduction

In contemporary dental medicine, computers and implants are closely linked. By dealing with this topic, the question arises whether one can speak about an (r)evolution in planning and manufacturing of tooth- and implant-supported reconstructions in the field of implant prosthetics.

Dental prosthetics are concerned with the restoration of lost teeth and tooth-bearing tissues in the oral cavity. Loss of teeth and edentulism are quite frequent in old age and often the main reasons to visit a dentist. Hence, dental implants have become important means of therapy, whereby computer-assisted procedures play an increasing role in the daily routine of the dental practice. Thus, it is no contradiction to use modern computer technology and new materials equally for young and old people.

The continuous advancement of specialised fields in radiological imaging, manufacturing methods in the engineering industry and dental implantology have extended the possibilities of decision making, planning and surgical as well as prosthetic realisation of a therapeutic plan.
Actually, this proceeding of dental medicine only has been made possible by bringing together these formerly independent disciplines, which basically depend on the increased performance of digital data processors.

Revolution or evolution?

Despite these developments, many colleagues do not consider a computer a helping advice in their daily routine. Any digitalisation of a certain practice area needs a modification and adaption of the whole team’s workflow, depending on the scope of digitalisation. This requires a large effort of all employees involved, the willingness to learn from earlier mistakes and to keep pace with the progressing digital technologies. One thing is certain: Innovations in dental medicine do occur more often and faster nowadays. Therefore, evolution or revolution does not depend on the given digital possibilities but rather on the individual experience and know-how.

In dental medicine, computer technology is no more a real technological revolution. Virtual implant-planning based on volume tomography has facilitated the decision making and information for a patient for quite some time now (Fig. 1). Computer-assisted implant placing occurs with high precision in partially or fully edentulous patients. Here, the so-called backward planning ensures a high level of predictability of the surgical and prosthetic result. The surgical realisation of the 3-D planning with stereolithographic splints is an important advancement in complex cases and can contribute to less invasive and rapid proceedings in selected cases. By this, one can precisely determine whether a completely “flapless” procedure is possible for single or all planned implants in the jaw and which augmentative technique is indicated. Especially for older patients with relatively more risks when implanting, a well-planned, minimally-invasive proceeding with a shortened operation time is of advantage.

Additionally, the digitalised anatomical and prosthetic conditions can be analysed virtually and with the help of clearly-formulated criteria contribute to the decision making in case of either fixed or removable implant-borne reconstructions. It has turned out that the proportion of
Figs. 4 & 5. Fitting accuracy below 50 μm is possible for CAD/CAM full-arch reconstructions providing passive fit with minimal stress.

bone in the upper jaw is clinically often overestimated.6 According to the characteristics of an atrophy of the alveolar ridge, the prosthetic-oriented planning will control the implant positioning and type of reconstruction of the operation virtually in advance.

_CAD/CAM technologies in implant prosthetics_

Closely connected to computer-assisted implant planning is the CAD/CAM technology (Computer-Aided Designing/Computer-Assisted Manufacturing), which has significantly changed the dental medicine in the course of the past twenty years.7 The more parallel dental implants can be planned and clinically placed, the easier and more stable the design (Fig. 2) of CAD/CAM frameworks/FDPs (Fixed Dental Prostheses) and bars made of titanium or zirconia can be kept. These materials are also characterised by improved technical and biological features. Consequently, technical and biological complications are to be expected less often.8, 9

Depending on the connection type of implant systems, also full-ceramic reconstructions can be screwed together directly on the implant’s level (Fig. 3).

The fitting accuracy of implant-borne CAD/CAM-titanium and -zirconia reconstructions are significantly higher than the conventionally produced bridges with cast alloys.10 By now, most of the major manufacturers offer their own CAD/CAM systems and have centralised production facilities for manufacture of frameworks and bridges at their disposal. Thus, a fitting accuracy below 50 μm (Fig. 4 & 5) seems routinely possible for full-arch reconstructions with the required care and know-how of the production process.11-13

The CAD/CAM production is specific for metals like titanium and ceramics, as for example zirconia. For milling with CNC-machines, especially suited milling cutters are used. After the milling of zirconia in the overdimensioned green-/white-body, the final crystallisation (sintering and HIP) of the work piece is made. Despite of automated and mechanical processes, the CAM step requires the experience of specialised engineers who are able to oversee the processes and step in if problems occur.

The current development efforts and advancements take place in the area of software possibilities and the connection of individual digital subareas. Thereby, a universal data format (STL) enables the forwarding of data by intra- or extraoral scanners via CAD- and CAM software. However, it probably might take some time until the various providers will open their systems completely and thus enable users to freely choose between the digital work steps...

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

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Periodontal and peri-implant tissue management in the aesthetic zone

Author: Dr. Riccardo Verdecchia, Italy

Initial situation

A 38-year-old male patient with a non-contributory medical history presented owing to a vertical fracture of the maxillary left central incisor (tooth #21). The patient showed a combination of risk factors that together had led to the fracture: the absence of the ferrule effect, short posts, bruxism, and occlusal overload due to premature contacts during protrusive movements (Figs. 1–3).

Treatment plan

Based on the clinical and radiographic examination, the aesthetic risk profile was determined to range from moderate to high on the International Team for Implantology's aesthetic risk assessment guidelines. Horizontal and vertical bone defects were detected, with a distance of 6 mm from bone level to the contact points (Fig. 4). A delayed implant placement (Type 2) was planned in order to...
achieve complete healing of the soft tissue before the guided bone regeneration procedures and implant placement. In order to minimize the number of surgical appointments and reduce the overall morbidity, a simultaneous approach of periodontal and implant surgery was preferred. The periodontal tissue of tooth #11 was modified along with implant surgery on region #21 with two different objectives: (a) to increase the ferrule effect and move the mid-facial soft-tissue margin slightly upwards to improve the harmony of the scalloped mucosal line (Fig. 5); and (b) to hide the dark underlying appearance of the root with a connective tissue graft (Fig. 2).

The initial phase involved the removal of the fractured tooth #21 utilizing a periotome. The extraction socket was filled with a collagen plug to achieve stabilization of the blood clot during the initial healing of the soft tissue. A Maryland bridge was cemented on the same day and modified to avoid interferences during protrusive movements (Fig. 6).
case report_tissue management and CAD/CAM restoration

Procedure

First surgical procedure

Six weeks later, periodontal and implant surgery were performed. A mid-crestal incision was executed on the implant site. At this stage, scalloped incisions were applied on the palatal and buccal sides of tooth #11. Afterwards, bucco-oral ostectomies on the root were performed for the previously described goals. The tiny interproximal bone peak was treated with due respect and left untouched (Fig. 7). Subsequently, a Straumann Bone Level implant (ø 4.1 mm, SLActive 12 mm) was inserted in the correct 3-D position to replace tooth #21 (Fig. 8). Shortly afterwards, autogenous bone chips were harvested locally and applied to cover the dehiscence-type defect. A layer of Straumann BoneCeramic (400–700 μm) was placed to overcontour the external surface of the facial bone. The grafting material was covered with a non-cross-linked collagen membrane in accordance with guided bone regeneration principles (Fig. 9). A double-layer technique was used to improve the stability of the membrane. Once perfused with blood, the membrane could be easily adapted to the alveolar bone crest and did not require any additional fixation. Tension-free primary wound closure was achieved with horizontal mattress sutures after splitting the periosteum at the base of the flap (Fig. 10). The ovate pontic was ground to avoid pressure on the tissue below. The provisional bridge was then recemented (Fig. 11).

Second surgical procedure

The stability of the provisional bridge allowed an extended interval (four months) for the final flattening of the ridge contour due to remodelling of the alveolar bone. A roll flap technique was then regarded as adequate to compensate for a mild horizontal discrepancy at region #21 (Figs. 12 & 13). Meanwhile, a very thin (≤ 1 mm) connective tissue graft was harvested from the premolar area of the palate and inserted with a tunnel technique in a supra-periosteal pouch, with the purpose of hiding
case report  tissue management and CAD/CAM restoration

the dark aspect of the nearby root of tooth #11 (Figs. 14 & 15). In both surgical appointments, vertical papillary incisions, which had been deemed not necessary, could be avoided.

Prosthetic procedures

A screw-retained provisional crown remained in situ for six months on the implant while maturation and stabilization of the peri-implant soft-tissue contours were established. During this period, modifications in form, contour and outline were effected to improve the aesthetic outcome using a light-curing composite material (Fig. 16). Proper implant placement allowed the establishment of an optimal final subgingival contour (Fig. 17). A customized impression coping was then fabricated to capture the transition zone contour created by the provisional restoration. For the final restoration, a CAD/CAM zirconia abutment was selected and Straumann CARES CADCAM was used to fabricate the frameworks (Figs. 18 & 19). The screw access position allowed the use of a one-piece restoration. The abutment was veneered using a pressable ceramic system. After the try-in and colour correction by the laboratory, the final crown was delivered to the patient and tightened at 35 N cm. The access hole was sealed with gutta-percha and a light-curing composite resin.

The prosthetic procedures on the root of tooth #11 involved the delivery of a longer golden post in order to reduce the risk of root fracture. For the same purpose, it was essential to perform prosthetic preparation of the palatal aspect of the gold abutment to create 1.5–2.0 mm of space for the zirconia framework and pressable ceramic. The final goal was to avoid interference during protrusive movements.

Conclusion

The surgical and prosthetic challenge in this clinical case was to develop a natural scalloped mucosal line on the maxillary central incisors and to obtain a good aesthetic outcome with the prosthetic crowns, despite the various existing dental and skeletal asymmetries and the bone defects at the implant site.

Of utmost importance was knowledge of the hard- and soft-tissue remodelling around the implant in region #21 and around the root of tooth #11 after the surgical steps.

A benefit resulting from the conservation of the root of tooth #11 was the maintenance of the interproximal height of the tiny bone peak, which provided support to the papilla mesial to the implant. Furthermore, this approach was highly beneficial to the natural appearance of the prosthetic crowns (Figs. 20 & 21). The periapical radiograph (two-year follow-up) shows the stable crestal bone levels around the implant (Fig. 22).

about the author

Riccardo Verdecchia, DMD, maintains a private practice in Rome (Italy) specializing in periodontology, implant dentistry and fixed prosthodontics. He is a member of the International Team for Implantology and the Società Italiana di Parodontologia e Implantologia (Italian society of periodontology and implantology). He can be contacted at riccardoverdecchia@hotmail.com.
Digital impression taking helps me be a better dentist

Dr Simon Kold, owner of Herning Implant Center in Denmark.

Dr Kold studied at the Department of Dentistry at Aarhus University with his wife, Louise. In 2006, they started Herning Implant Center, a referral clinic for surgery, implantology and major prosthetic reconstruction.

The centre currently has a dental laboratory and 18 employees, including a permanent anaesthetist and anaesthetic nurse. It has provided implant treatments for more than 20 years.

Dr Kold is a popular and active lecturer, delivering seminars at leading dental industry events around the world.

TRIOS allows you to move more naturally. You can stop and then start up scanning again from the same place, and you can even rescan selected areas and merge them into a complete impression. All of this makes it much easier and faster to obtain good impressions every time.

What initially made you move from traditional impression taking to digital impressions?

Dr Kold: Our clinic has been working with guided implant surgery since 2005. With the emergence of new technologies, we saw huge potential in combining digital impressions with CBCT scans to ensure both accurate and aesthetic implant treatment. After trying various intra-oral scanners on the market, we finally found the best choice in terms of consistent accuracy and adequate detail in the scan. Today, we use the 3Shape TRIOS digital impression solution for most types of cases.

What made TRIOS stand out for you?

It was mainly because it was so easy to use. With the many other intra-oral scanners I tried, I needed to keep my hand completely steady while scanning. The slightest movement, of the patient or my hand, was enough to make the scan useless for clinical work. I would have to start over from the beginning.

What about digital impressions in terms of accuracy?

Shortly after we started using the TRIOS system, I successfully completed a maxillary reconstruction with 14 new teeth, all based on digital impressions. Both scanning and the whole workflow with the laboratory went smoothly and all 14 teeth were seated without making any adjustments.

To be on the safe side, I also took a traditional impression during the process. Later, out of curiosity, I sent the physical impression to the laboratory and asked them to assess its precision in relation to the scan. The laboratory estimated that the sources of error had been reduced by up to 70 per cent. Even half of that would have impressed me.

Was it as easy for your clinic to adapt to the new technology?

One thing that surprised me was how excited everybody was about working with the new technology. It clearly boosted the staff’s professional self-esteem. Today, I can really see how the change has made a difference for our clinic. Installing and using the digital impression system has developed us, made us better, and is still moving our business and careers in new directions. The technology has caught the attention of patients as well: they ask questions and seem impressed. I think that they like the idea of being treated by a top modern facility with the best equipment.

What was the learning curve like?

Naturally, our staff had to learn how to scan optimally for specific cases. Like any new tool, the more you work with it, the better you get. The first day we received the system, we scanned six patients in a row with 3Shape experts giving instructions.
After that, we were ready to work on our own. Here at our clinic, assistants scan as often as dentists because the TRIOS system is so intuitive.

As an experienced user of intra-oral scanning, what do you see as the key advantages?

Digital impression taking offers many advantages, and some systems include a few benefits that go beyond just taking an impression. In general, digital impression taking avoids the uncertainties and potential errors that can come with traditional impression taking and casting in plaster. Precision becomes significantly higher. There are other advantages that come with the technology, including the things that can be done while taking the impression rather than as extra steps. For example, with TRIOS, I can take shade measurements as I scan and snap high-definition photographs for capturing important details that help the laboratory fabricate a better restoration for my patients. The impression’s colours are amazingly lifelike and I thus use the 3-D image to discuss treatment with patients.

Does digital impression taking make you a better dentist?

It has always been challenging to define an adequately precise margin and this places demands on the dentist’s preparation skills. Now I find it easier to assess the quality of my impression because I can see the preparation right away in 3-D and in the high-definition photographs that I take with the scanner while scanning.

The complete digital workflow that TRIOS enables makes us a better provider of implant treatment, which represents our core business. The digital impression merged with CBCT scans is used to virtually plan implant positions, model the restoration, and design low-cost surgical guides that can be produced by a 3-D printer. The digital method enables us to offer patients guided surgical treatment that is faster and cheaper so that more patients can afford implant solutions.

Does the technology have any cost benefits for patients?

One great option with TRIOS is that we can make model-free crowns in full zirconium dioxide and IPS e.max (Ivoclar Vivadent). Skipping the physical model makes the whole workflow faster and cheaper, giving us an alternative to conventional crown treatment. This allows a large number of patients, who would otherwise have chosen composite treatment to save money, to have this treatment.

Do you have any advice for dentists still considering digital technologies?

Yes. Don’t wait! Start now so that you are ahead of the game. Yes, it is a significant investment, but one that saves time, costs and most significantly will help develop your clinic’s reputation, dental skills and business success. That is how it worked for us. Laboratories and dental schools all over are starting to train technicians to give preference to CAD/CAM and workflows using digital impressions. Soon, all laboratories and clinics will be working digitally because the technology offers so many benefits. You do not want to be left behind.

Editorial note: This interview first appeared in 3Shape News.
The definition of 'value chain' depicts the stages of production as an ordered series of activities. These activities create values, consume resources and are linked to one another in processes. According to the approach taken by Michael E. Porter¹, 'Every firm is a collection of activities that are performed to design, produce, market, deliver, and support its product. All of these activities can be represented using a value chain.' Another definition describes the value (adding) chain as 'the stages of the transformation process that a product or service passes through, from starting materials to final use.'² Value added is the difference between the income that the product generates and the resources employed.

To be specific, this means that the value chain is represented by the sum of all values added (margin) of each individual market participant. All market participants who wish to participate in a value chain together make up the value chain system of an industry. If this is applied to our industry, we must consider the specific situation of the market participants, 'industry, dental lab, dental practice and patient.' All those involved are part of the value chain. In the past, industry generated its value added by manufacturing consumables or equipment for the dental technician or dentist, the dental technician generated his value added by making traditional dental restorations and the dentist generated his value added by rendering services for patients. The chain has changed more and more over the past 20–30 years, mainly due to the introduction of digital technologies. The following outline presents selected developments based on use of digital technologies, plus a future-oriented project for the integration of total prosthetics into digital technology.

Analogue meets digital (change in occupation profiles)

The whole field of digital technologies in dentistry has now become so extensive that not all aspects can be covered in this article. For example, digital technology has an impact on the following.

The profile of a dental technician’s occupation, which is no longer a 'plaster room' job but rather a computer workstation position. As a result, however, the requirements change for candidates because the modern-day 'skilled trade' calls for future applicants to be interested in...
computer aided design (CAD) for crowns, bridges, telescopes, abutments, etc and the programming of milling strategies for transforming the CAD design into an end product that is made by subtractive or additive processes. It is advisable and essential to integrate such requirements into dental technician training at an early stage.

The rendering of dentistry services is calling for increasing use of state-of-the-art digital instruments and methods. In future, a dentist will not only make a diagnosis but chiefly focus on treatment preparation, surgery and the insertion of a dental restoration (conservative or prosthetic). The other activities will be replaced by digital work processes.

There would probably have not been any change in the value chain that had applied for decades (see Fig. 1) if companies like Sirona had not introduced the first digital technologies to dental practices and dental labs in the 1980s. And even though the concept of the shift in value added was already an integral part of the system, initially only work steps and work processes in the dental lab were facilitated, speeded up and thus made more efficient in implementation at the beginning of this digital evolution, by using scanners and CAD/CAM milling machines. Only in a subsequent step were other market participants included, e.g. milling centres in Germany and abroad or also industrial companies that want to participate in the value added (Figs. 2 & 3).

**Digitisation— an opportunity for the dental lab?**

For a long time now, innovative and marketing-oriented dental labs have recognised the advantages of digitisation and been benefiting from their timely entry to the world of CAD/CAM. Their wide range of services covers the entire dental technology portfolio with modern, state-of-the-art framework materials and veneering materials. Standard restorations in particular, such as crowns and bridges are made by CAD/CAM—nowadays that is already state of the art. But what impact have these change processes had in the dental lab? The fact is that there has been a shift in the focuses of activity in in-house production towards more services in the digital

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**Role of market participants in the value adding process, NOT INCLUDING digital steps taking a precious metal-based crown as an example**

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special digital technologies

Role of market participants in the value adding process, INCLUDING digital technology
taking a ceramic crown as an example

Fig. 3. Basic model of market participants in the value adding process, including digital dental technology.

Fig. 4. Mandibular BDLoad, after milling process.

planning and coordination process and the process chain has been minimised. In terms of quality not much has changed, even though it may have been expected. Without doubt, material quality is perceived by the patient only in terms of shade (from gold to white) and the fit/security of a dental restoration is still dependent on the job instructions that have been received from the dental practice. Process quantity has seen a major change—nowadays only half of the original dental lab processes are necessary in the lab in order to produce a functional, highly aesthetic dental restoration. Although in economic terms it means high capital investment costs for the dental lab owner, it also means that, depending on the amortisation period and the quantities to be made, he is able to make competitive prices when faced with market participants who attempt to penetrate the market by price dumping.

These days, the dental lab is—more than ever—a service provider for the dental practice and less and less a skilled trade. That naturally involves risks for the skilled occupation, but it also offers substantial opportunities. A dental lab owner can highlight his locational advantage and provide his special services and cooperation in a spirit of partnership.

What type of dental lab are you? Do you rank among the dental labs that are still highly characterised by craftsmanship? Are you extremely uncertain and waiting to see what happens or do you lack the required knowledge of economics or marketing to also embark on the path of digitisation? The fact is that anyone who fails to have an open mind about digital technology will no longer have a major player role among the dental labs.
The more dental practices invest in digital workflow and exchange relevant data, the more dental labs have to adapt and serve it technologically. It is still the responsibility of dental labs to support the dentist, and hence the patient, by providing optimal process chains. That is why dental labs should regard digitisation as an opportunity.

**From stand-alone solutions to value chains**

At the beginning of the digital dental world there were stand-alone solutions, single work steps, but nowadays there is more and more consideration of complex dental lab processes that can be implemented on a totally digital basis. It all started with implant navigation, digital function diagnostics, and the production of aesthetic dental restorations in the form of crowns and bridges, and nowadays these have already become mainstream, so to speak, in an innovative, modern-day dental lab. The next step in a dental world that is becoming increasingly digital is advancement towards the consideration of entire value chains—including the process of making full dentures.

**Backward planning for full dentures—the digital value adding process in reverse!**

While in the past the introduction of digital technologies chiefly aimed at indication-related solutions for individual work steps, the focus of digital dental technologies is now on entire value adding processes. One of the last groups of topics and areas of indications, which, in digital terms, has so far only been dealt with in passing, is total prosthetics. Here in particular, though, there are innovative digital approaches that will simplify and speed up production. This is where pioneer-
special digital technologies

Production of a full denture becomes economically viable by using Merz Dental's innovative Baltic Denture System (BDS) with a considerably reduced process flow.

After all, total prosthetics does not merit the reputation of being an 'unloved child.' For dentists and dental technicians it still does not have the same level of importance as other prosthetic restorations. But why? It is certainly not due to the fact that patients are so difficult, or total prosthetics generally is so unattractive to dentists and dental technicians. On the contrary. Production of a precision-fit, functional and aesthetic prosthesis is often a major challenge to dentists and dental technicians. Especially because with edentulous patients important information is frequently missing to be able to achieve an optimal reconstruction of the jaw and mouth. The main reason is rather that the dentist's and dental technician's services to be rendered for a full denture are both extensive and elaborate and the fee chargeable for the service cannot cover the costs incurred. In Germany, between 300,000 and 400,000 full dentures are still being made every year.

And according to expert opinion, the figure will tend to remain constant in years to come owing to a longer life expectancy and sociodemographic change. With an average total fee rate of approx. € 1,000–€ 1,400 per full denture this market segment has a volume of over €300 million—and that only applies to Germany. Consequently, total prosthetics still ranks as one of the most important areas of prosthetics.

The complexity of today’s production process for a full denture is illustrated by the following flow chart.

Production of a conventional prosthesis is currently based on complex interaction between the dentist, dental technician and patient. In an idealised process flow, there are at least five appointments for the patient and dentist, which can take several days or even a few weeks. From the very first appointment the work starts to be dispatched, from the first impression, functional impression and occlusal record to the first wax model, until, after much to and fro between the dental practice and the dental lab, the final denture can be fitted in the last appointment. The dentist’s net treatment time in the chair can then total about 2.5 hours. Quite often another one to two more appointments are required. Per appointment there is a calculated preparation and follow-up time of at least 5 minutes so if there are five appointments another 25 minutes have to be added on. Consequently, dental practice time soon totals 3 hours or more for a full denture.

At the dental lab end, the level of complexity is even higher. From initial model impression taking...
to final completion the dental lab can expect to have dental lab work amounting to 6–8 hours. This does not include pick-up and delivery times for commuting between the dental lab and the dental practice. Even after denture incorporation there is often rework, which is time-consuming and not included in the service fee.

The conventional workflow (Fig. 5) for making a full denture therefore positively cries out for an approach to address the last bulwark of the conventional dental process chain and make a digital solution available.

The future of the full denture is digital

That is definite. Although nowadays there are ways of simplifying individual work steps with a scanner and a CAD/CAM milling machine (prosthesis baseplate or basing arches made from industrially prefabricated blanks), consideration of the process chain as a whole has so far been missing. This is the approach adopted in the following illustrated solution with a full denture based on completely digital development and production. The entire solution concept is based on the principle of backward planning. In real terms this means that a full denture completed by a master craftsman is customised to suit the patient's oral situation, with just one appointment! Very soon the production of a full denture will take place in a fully digital process—from digital impression taking to production, completely devoid of dust and plaster. Unfortunately the digital scanning systems available at present are not yet able to provide the option of comprehensive collection of oral situation information in a single appointment, but it is definitely only a matter of time. Until then the jaw relation, palate, centric relation and aesthetics will be recorded by analogue means and then transferred to the digital system. By this method, all the data for making the prosthesis later is collected in just one appointment.

The process is followed by comparing the digital data with a prosthesis database, selecting the appropriate milling blanks with previously polymerised dental arches, and the modelling of the gums, which vary from patient to patient. After transferring it to the CAM module all that has to be done is mill the respective maxillary/mandibular pair. That is followed by finalisation in the dental lab.
lab and a second appointment at the dentist’s for the purpose of incorporation. The finished product is a functional, precision-fit, highly aesthetic dental restoration of master craftsmanship quality, made in Germany!

This new future-oriented method called Baltic Denture System uses digital technologies to make the production of a full denture economically profitable again for the dental practice and the dental lab, for the first time in years. Despite digitisation, market participants remain the same and the value adding process takes place within the familiar, implemented structures.

_Digital technology as an option for additional business_

With the aforementioned method of production and by focusing on a small number of analogue processes in the dental lab there is more scope for new lines of business for dental labs. The dental lab of the future will no doubt regard itself increasingly as a partner and service unit for its dentist and be capable of taking ‘troublesome’ issues off his hands. In addition, the dental lab can manage the data stream for its client to ensure optimal results. Another field of activity that presents itself as a result of digital techniques is that of dental aesthetics! One example is the concept of lächeln2go (smile to go), which, with its volunteers, first developed the concept of dental aesthetics as a new line of business. What is impressive is the use of a two-dimensional aesthetics check that makes it easy to record dental status and aesthetic deficits.


_CAD/CAM_contact_

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Introduction

With dentistry as innovative and dynamic as it is, the progress made and the exciting new trends that result are often judged in terms of the technological or financial: We can update our equipment to have a purely digital office, or we can adopt new practices and offer new procedures to our patients that bring in extra revenue.

While these accomplishments are certainly laudable, it is time for dentistry to measure its progress by different standards, ones that affect the profession and the world as a whole. In short, we can examine how our practices and procedures influence the environment and what dentistry as a profession can do to ensure this influence remains positive.

Fortunately, dental professionals no longer have to choose between advances in technology and what is considered “eco-friendly.” In fact, practice owners can assure themselves of the best of both worlds by adopting digital technology, such as in-office CAD/CAM systems such as the Planmeca PlanScan System (E4D Technologies). While the practical and financial benefits of CAD/CAM technology are well established, the environmental benefits—though discussed less often and perhaps not as well understood—abound.

CAD/CAM: Why dive into digital?

Though not ubiquitous, digital technologies, particularly in-office CAD/CAM systems, are making their presence known. Dental professionals who integrate these advanced technologies can offer same-day dentistry to their patients; that is, they condense the restorative process of multiple appointments over several weeks down to one appointment lasting a few short hours. Clinicians can digitally scan the patient's teeth and design the restoration(s) right then and there. Once approved, the restoration(s) can be milled and seated immediately. Essentially, in-office CAD/CAM systems are revolutionizing how restorative dentistry is practiced.

This CAD/CAM revolution provides almost innumerable benefits to patients. Multiple appointments for one restoration become non-existent, so patients no longer need to make multiple trips to the dental office. Digital scans eliminate the need for messy, uncomfortable impressions that make patients gag and are prone to errors. Temporary restorations are no longer necessary, removing that extra step from the restorative process and ensuring that patients are not at risk for increased sensitivity or leakage while wearing sometimes uncomfortable provisionals for weeks. Finally, definitive restorations are fabricated and placed within hours of scanning and can be adjusted immediately, so patients no longer have to wait for that perfect laboratory restoration.

Clinicians, too, reap several benefits. Digital scans equal easier "impressions" that enable accurate reproductions of patients' dentition. Restorations can be designed in the office without communication or transfer to a dental laboratory, eliminating back-and-forth exchanges that cause delays or less than optimal results. In fact, restorations can now be fabricated with more patient input, since intuitive CAD software enables dentists to easily design restorations on-screen while remaining chairside, providing patients with that "wow" factor as they...
see what digital technology is allowing dentists to do. Once designed, the restorations can be immediately milled in the office and tried in the patient’s mouth, so a perfect fit and high-quality aesthetics are affirmed at the same appointment.

**Digital practice equal green practices**

Since CAD/CAM technology was first introduced decades ago, early adopters and technology enthusiasts have encouraged integration of these systems for various practical and financial reasons. Though generally a substantial initial investment, practices that upgrade to digital technology find that streamlined procedures and happier patients lead to a significant return on investment.

But switching to a CAD/CAM system provides an unanticipated bonus, one with a far broader impact. Using an in-office CAD/CAM system is one of the most environmentally conscious upgrades a practice can make, offering both concrete and intangible benefits for dental practices, their patients and the greater community.

CAD/CAM systems add to a practice’s green image with the many small changes they allow the office to implement. For example, now that impressions are taken with a digital scanner (PlanScan), traditional impressions—and all their associated materials, such as disposable impression trays, impression material and the water with which it is mixed—are no longer necessary. Clinicians who thought they were only saving money (and storage space) can rest easy at night knowing they’re no longer contributing to the throwaway, disposable culture in many health-care offices.

Additionally, because digital impressions can be viewed instantly with software that allows users to see potential errors, any mistakes are quickly averted with a second digital scan that requires no extra materials or waste. It is not uncommon for dentists to take a second traditional impression because of errors caused by saliva or air pockets in the impression material or to have a backup on hand in case there are problems down the road. Over time, material waste created using traditional impression methods adds up. Using digital technology not only streamlines the process but ensures that materials, time and money aren’t wasted.

Moreover, because traditional impressions aren’t needed with a digital workflow, equipment previously used to perform these procedures, such as a mixing gun for impression material, are also no longer necessary. While clinicians may think they are only saving themselves hassle or time by purchasing an easier-to-use piece of equipment, they’re also saving energy—literally. With digital systems, switching to digital systems is beneficial not only to clinicians and patients but to the environment as well.
technology, impression-taking instruments no longer need to be run through a wash cycle and sterilized. This saves time, energy and water.

While it seems like saving resources, particularly water, isn’t possible in dental practices, small steps such as these really add up. The Eco-Dentistry Association (EDA) (www.ecodentistry.org) estimates that dental practices use 360 gallons of water per day. This totals 57,000 gallons of water per year, per practice. In the United States alone, dental practice water usage totals approximately 9 billion gallons of water per year. This does not even include dental laboratories, which must use substantial amounts of water when mixing and pouring models in stone and cleaning their equipment.

In addition to the above in-office water issues, along with laboratories and their respective procedures that will always require water, these staggering statistics spell out the clear need for water conservation whenever possible, and in-office CAD/CAM supports this effort.

Greener materials:
Using all ceramics instead of amalgam

Amalgam restorations had been the standard of care in restorative dentistry for decades. With material science advancements, however, there are new contenders for that title. In particular, the use of all-ceramic materials has significantly increased in recent years, and when coupled with in-office CAD/CAM systems, their advantages are economical and ecological, in addition to aesthetic, biocompatible and functional.

The majority of the materials for same day CAD/CAM dental procedures are generally composite or all-ceramic blocks, so there is no metal involved. These metal-free restorations can often be used without reservation for various indications, including single-unit restorations, inlays and onlays. While the benefits of these materials have been expounded upon (e.g., aesthetics, ease of use, wear, optical properties), they provide tangible environmental benefits as well.

For example, the longevity of all-ceramic restorations such as in-office CAD/CAM designed inlays is well documented. In addition to a highly aesthetic restoration, patients receive restorations that will last for many years, without the concerns associated with amalgam, such as cracks, failures or potential mercury toxicity. This potentially saves patients and clinicians time, money and wasted resources that would be spent traveling to and from the dental practice, taking more impressions and fabricating new restorations.

Perhaps of greater consequence is removing toxic metal from this equation. All-ceramic and metal-free restorations mean that dental practices no longer have to worry about amalgam disposal and its accompanying mercury toxicity.

The Environmental Protection Agency (EPA) estimates that nearly 50 per cent of all mercury entering local wastewater treatment facilities originates in dental offices.

Using CAD/CAM compatible materials such as all-ceramics lessens or eliminates the contribution...
of your dental office to environmental mercury. It also means that dental practices needn’t worry about using an amalgam separator.

Currently, the American Dental Association (ADA) does not have national regulations in place for amalgam separators, so many dental practices and laboratories aren’t compelled to use them. Although designing and milling all-ceramic materials still requires energy and results in some waste materials, can they really compare with the toxic by products of metal-based restorations?

_Crunching the numbers: CAD/CAM math_

In-office CAD/CAM systems provide more than just a clear conscience about saving the environment. There are real, tangible benefits and savings that can easily be estimated to demonstrate the immense value of this digital technology.

Because same-day in-office CAD/CAM dentistry reduces the number of appointments from two (or possibly more, if the restoration does not fit) to one, it stands to reason that every dentist who incorporates these procedures would positively impact the environment by reducing the number of automobile trips patients make to the practice. This would result in a 50 per cent reduction in gasoline and oil product use.

With a carbon content of 2,421 grams, one gallon of gasoline produces approximately 19.4 pounds per gallon of carbon dioxide emissions. This is calculated by multiplying the carbon content (2,241) by the amount of carbon that remains unoxidized (0.99) by the ratio of the molecular weight of CO₂ (44) to the molecular weight of carbon (12).

Using the state of California as an example, where approximately 10 per cent of the 100 million laboratory dental restorations are completed in the United States every year, we can calculate an approximate savings. If four gallons of gasoline are used for a round trip to the dentist, a restoration needing two appointments to complete would require eight gallons of gasoline. But if these dental practices adopted same-day in-office CAD/CAM dentistry, that number could be cut in half, saving four gallons of gasoline per restoration. Four gallons of gasoline multiplied by 10 million restorations would equal a savings of 40 million gallons of gasoline for restorative procedures in the state of California alone. This, in turn, would equal a reduction of carbon dioxide emissions by 776 million pounds per gallon each year (assuming the previously calculated 19.4 pounds per gallon measurement).

If we extrapolate to the United States as a whole, we can calculate that this would equal 400 million gallons of gasoline saved and 7,760 million pounds per gallon of carbon dioxide emissions eliminated, per year. This would all be due solely to a reduction in patient automobile trips to and from the dentist for restorative procedures. While same-day dental procedures may not save the world, their potential impact, even estimated, is undeniable.

_Conclusion_

In-office CAD/CAM systems’ advantages are limitless. In addition to the clear financial and practical benefits they bring, their positive impact on the environment makes the decision to upgrade even better. They remove toxic, wasteful and disposable materials and practices from the equation, replacing them with greener practices that have a tangible influence. While the clinical advantages of CAD/CAM systems and same-day dentistry continue to be rightfully celebrated, their ecological advantages should not be overlooked.

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_References_


About the author: Dr Joel Strom is a former president of the California State Dental Board and former course director of “Ethics in the Practice of Dentistry” at USC School of Dentistry. He graduated from UOP School of Dentistry in 1979 and completed an NIH post-doctoral fellowship at Columbia University in 1983. He has owned an E4D milling machine and camera for five years and practices general dentistry in Beverly Hills and provides consultation and litigation support in the dental health area, including corporate clients, governmental agencies and individual dentists.
Bringing innovation back: Introducing a complete posterior solution

Fig. 1. Multiple innovations combine to create one complete posterior solution.

Figs. 2a & b. Both NobelActive (left) and NobelParallel Conical Connection (right) are available in wide-platform variants that are designed to provide optimized results in the posterior region. Anatomically shaped, the PEEK Temporary Abutments (a) and PEEK Healing Abutments (b) match the contours of the molars. In addition to supporting an improved emergence profile, this can help reduce chair time by reducing the number of adjustments needed.

Large extraction sockets, limited accessibility, excess cement that is difficult to remove and high occlusal forces—these are just some of the challenges a clinician faces when restoring a single tooth in the posterior region. With molar replacement being among the most common indications, these challenges are encountered repeatedly. A solution that addresses all these problems in an efficient and predictable way would be beneficial to both dental professionals and patients. That is precisely why Nobel Biocare is bringing innovation back to the posterior region with its new complete posterior solution: an original combination of new wide-platform implants and restorative options, all specially designed for molar sites.

An implant like no other

Multiple Nobel Biocare innovations have been combined to offer a complete solution, and the foundation for treatment success is the implant itself. Nobel Biocare offers several implant options, each engineered to the specific demands of the posterior region. All are intended to shorten time-to-teeth for the patient by enabling immediate loading whenever possible.

One option is NobelActive. Many clinicians are already familiar with this award-winning* implant. Its distinctive design and the surgical protocol form a unique combination that can enable Immediate Function in cases in which it might otherwise not be achievable.1–3

In order to condense bone gradually, its tapered body features threads that narrow towards the apex, while the apex itself features drilling blades to preserve bone by allowing a smaller osteotomy. These features are all designed for high primary stability, even in soft bone and extraction sockets.

Now, a new variant offers the benefits of the NobelActive family but with dimensions ideal for the molar region. NobelActive wide platform (WP) possesses a wider diameter implant body (5.5 mm) to better fit the large extraction sites in the molar region and a wider implant platform for an optimal emergence profile. NobelActive WP also comes in a shorter body (7 mm) to avoid critical anatomical structures such as nerves.

Stability and flexibility in parallel

Alternatively, clinicians can opt for NobelParallel Conical Connection (CC). Combining a parallel-walled implant body that is well documented with an advanced internal connection, NobelParallel CC offers extraordinary flexibility. It is engineered for use in all bone qualities and for a wide range of indications. The 5.5 mm WP option is designed for an optimized emergence profile for large molar sites.

Both experienced clinicians and those new to implantology will appreciate NobelParallel CC’s straightforward surgical protocol. It offers flexibility and shortens treatment time, benefitting the patient too.

Together, the surgical protocol and implant design form a unique combination that is intended to allow Immediate Function in more cases by providing high primary stability. The thread design and tapered apex
of NobelParallel CC are designed for under-preparation of the surgical site and bicortical anchorage—techniques that support immediate loading.4, 5

High stability during the initial healing phase is then maintained by Nobel Biocare’s unique TiUnite surface.6 In addition, patented grooves enhance osseointegration7 for a predictable end-result.

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Connecting strength and flexibility

Both new implants benefit from Nobel Biocare’s internal conical connection. This advanced connection’s conical seal and hexagonal interlocking mechanism provide high mechanical strength.8 The connection offers restorative flexibility too, being compatible with Nobel Biocare’s most innovative restorative solutions, including those designed specifically for the posterior region.

These include the new PEEK Healing and PEEK Temporary Abutments, which are anatomically shaped to match the molar contours. As the PEEK Abutments come ready-shaped for an optimized emergence profile, fewer adjustments are needed. This can simplify treatment and reduce costly chair time.

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The crown that rules them all

When it comes to the final restoration, the FCZ (full-contour zirconia) Implant Crown is designed for strength and predictability even under the high occlusal forces of the posterior region. There is no worrying about chipping either, as the full contour of the NobelProcera FCZ Implant Crown removes the need for veneering.

The biocompatibility of the materials used contributes to biological stability in the areas in which it matters most. Plus, being screw retained, the FCZ Implant Crown is completely cement free, avoiding the risks associated with cement excess entirely. Even the titanium adapter is mechanically retained.

The ability to use an angulated screw channel allows the screw access hole on the FCZ Implant Crown to be placed anywhere between 0 degrees and 25 degrees in a 360-degree radius. This means it can be angled towards the front of the mouth for easy access, even in the posterior region. It also helps avoid placing the access channel on the cusp of a tooth, where it could affect occlusion. The associated Omnigrip Screwdriver further simplifies work on the restoration. Its effective pick-up function and secure grip on the screw help the clinician to work safely and efficiently.

Natural-looking tooth colour is another benefit offered by the FCZ Implant Crown. Whichever of the eight available shades is used, the colour is applied throughout the material. This means discoloration is not a concern when making adjustments. Cut-backs and staining can also be used to achieve the desired aesthetic effect.

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Several components; one complete solution

While each product within Nobel Biocare’s complete posterior solution stands out on its own, together they are a powerful combination. Like all Nobel Biocare innovations, they are tested as one system in the patient’s mouth.

Combining Nobel Biocare components means all elements are designed to work in synergy for the optimal treatment outcome. Restoring single molars represents a clinical challenge for many reasons, but now, by uniting new and proven innovations, Nobel Biocare has the answer.

*Details of awards can be found at www.nobelbiocare.com.

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Disclaimer: Some products may not be regulatory cleared/released for sale in all markets. Please contact the local Nobel Biocare sales office for current product assortment and availability. A list of references is available from the publisher.

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www.nobelbiocare.com/bringinginnovationback

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Planmeca PlanScan is the world’s first dental unit integrated intraoral scanner

_Unique foot controlled scanning_

What also sets Planmeca PlanScan apart from other scanners is that it can be conveniently controlled from the dental unit’s wireless foot control, leaving the user’s hands free for scanning and patient treatment at all times. The foot control allows easy toggling between prep, opposing and buccal views, so that the dentist can focus on scanning without interruptions. Hands-free operation also guarantees impeccable infection control.

_Easy and flexible use_

Planmeca PlanScan has been designed for an efficient workflow—it is used just like any other dental instrument and shared effortlessly between different users. The plug-and-play scanner can also be easily installed in different dental units and different rooms. The flexible licensing system enables different CAD/CAM work phases (scanning, designing and manufacturing) to be performed simultaneously by different users.

_This is a truly innovative product that guarantees a smooth and effortless chairside workflow and lets dentists concentrate on their patients. The system is built on our Planmeca Romexis software platform—the first software in the world combining CAD/CAM and X-ray imaging. This means that all images and scans are conveniently available through one user interface_, says Mr. Jukka Kanerva, Vice President for Planmeca’s Dental Care Units and CAD/CAM. ‘Together with our other Planmeca CAD/CAM™ solutions, Planmeca PlanScan contributes to better patient care and helps to increase the clinic’s productivity._

_A smooth scanning workflow_

The ultra-fast and accurate Planmeca PlanScan can now be easily integrated with any digital Planmeca dental unit. Thanks to the dental unit’s Full HD tablet device, the dental team has constant and optimal access to live scanning data. This allows them to focus on the treatment area without any distractions. The scanner also provides practical sound guidance to ensure optimal data capture.

_Planmeca’s full range_ of open CAD/CAM solutions for dentists and dental technicians includes the world’s first dental unit integrated intraoral scanner—Planmeca PlanScan. The scanner’s unique integration with Planmeca dental units guarantees a smooth workflow, as real-time scanning data is now immediately available from the chairside tablet device. Scanning can also be controlled from the dental unit’s wireless foot control for hands-free operation.

_Contact_

Planmeca Oy
Asentajankatu 6, 00880 Helsinki, Finland

www.planmeca.com
THE NEW 2014-2015 COLLECTION

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MIS Implants Technologies launches MCENTER Europe, new digital dentistry hub in Berlin

As a dentist, what are your goals? Most likely, to provide the best possible treatment for your patients while developing your professional reputation for a successful practice. These objectives are mutually beneficial to both patient and dentist: patient satisfaction directly affects profit. Achieving your goals can be greatly accelerated using digital dentistry technology.

"Success has never been more attainable and the MIS MCENTER truly makes it simple," according to Christian Hebbecker, MCENTER Europe Manager. "We provide doctors with optimum support for quicker, more accurate surgical procedures, reduced chair-time, less patient visits, plus beautiful and predictable outcomes."

Hebbecker explained that the new MCENTER offers expert digital dentistry capabilities in support of the fast-growing MIS customer base in the region by concentrating all MIS digital dentistry products and services (from the initial treatment plan to temporary restoration) in one convenient, well-equipped location.

The MCENTER provides a comprehensive range of services covering three main products: (a) MSOFT, 3-D and 2-D virtual implant planning software for prosthetic-driven planning; (b) MGUIDE, an exclusively designed 3-D printed template and dedicated surgical kit; and (c) MLAB (CAD/CAM), for the fabrication of customized abutments and temporary crowns.

"MCENTER products represent some very exciting and innovative advances in digital dentistry technology exclusive to MIS Implants," continued Hebbecker. "The MGUIDE surgical template or guide is a lightweight, open wire-frame design that allows delivery of irrigation and anaesthesia through the template. Special slots built in to the drill permit irrigation to penetrate even while the drill is fully inserted in the sleeve. Also no drill guidance keys are needed, freeing up dentists' hands for a quicker and more accurate procedure."

Hebbecker explained additional features of the MCENTER guided surgical system, including the MGUIDE Surgical Kit (patent pending), in which all of the drills can be used as final drills and actually help collect bone during the drilling process. The proprietary MSOFT planning software, which offers a top-down planning approach, assists clinicians in creating the ideal treatment plan according to depth, position and angulation of the desired end-result. All components used in the MCENTER process are precision engineered for use with MIS implants and prosthetic parts to ensure component compatibility for optimum accuracy, reliability and fit.

"I'm extremely excited to officially open the doors of the new MCENTER Europe facility, and especially proud to be able to offer MIS quality and simplicity in providing our customers, doctors throughout the region, with highly accurate and efficient guided implant placement procedures and CAD/CAM solutions," concluded Hebbecker.

To learn more about MIS Implants and the MCENTER, please visit the MIS website.

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www.mis-implants.com
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IMAGINA Dental invites all dentists willing to better understand how digital technologies could change their daily practice. The congress offers a complete program to share experiences and clinical cases, from 3D imagery and diagnostic tools to guided surgery, treatment planning, implantology, Cad/Cam and Digital Smile Design. IMAGINA Dental will bring you a unique education experience in an intimate atmosphere to discover and find out how digital dentistry will change your practice.

HONORARY GUESTS: Dr Palacci & Dr Galip Gurel

www.imaginadental.org
EGS at IDS 2015: Discover the ultimate CAD/CAM upgrades in digital dentistry

During this year’s IDS exhibition, EGS will be presenting a wide range of products that cover the entire digital dentistry workflow, from digital smile design to 3-D scanning and modelling. During the show, EGS is launching the new DScan 3.2 with verticulator integration and it will be wearing an innovative outfit certain to set a trend for the whole year, the ghost cover.

But do not let the name fool you. The attribute “ghost” is not always equivalent to “scary”. EGS’s Ghost Scanner immediately grabs attention with its elegant and finished look. DScan 3.2 is a new-generation dental scanner that uses structured blue light technology, which allows faster and more accurate 3-D scanning of both the model and verticulators. Specifically designed to accommodate the verticulator (which is also shown digitally in the program), it allows automatic pairing of the models in occlusion.

DentalCAD 4.0, which now boasts a touch screen, will also be showcased at IDS. The newest software version, which offers a complete solution for the dental laboratory and supports users’ experience in dental design and modelling, allows technicians to work with their own hands but in digital mode, making the experience simple and interactive up to 3-D printing: touch it to believe it! This new version presents complete functional coverage (with just one licence), powerful wax-up functions and angled implant support and social integration to share cases and experiences on Facebook.

Moreover, EGS will be introducing the 2.0 version of Digital Smile System, the first software for designing the aesthetic and functional reconstruction of the smile. By means of simple and automatic tools, it allows users to project the final result and to export it in 3-D directly to DentalCAD. It also offers a prosthetic tool with automatic face shape detection and a complete commercial library for use in edentulous patients. This allows the user to study the patient’s morphology and determine the suitable dental library to use.

As is the case every year, EGS’s new products and solutions will be revealed through live demonstrations and presentations. Prospective partners, members of the press and anyone else interested are invited to book individual meetings for further information. Send your meeting request to Serena Santoro at marketing@egsolutions.com.

EGS is an Italian company with more than 15 years of experience in the CAD/CAM industry and is recognized worldwide for its expertise in 3-D technology. Based on its substantial knowledge in this regard, EGS is at the forefront in offering innovative solutions targeted at the original equipment manufacturer market. EGS technology is fully developed in-house to ensure maximum control, safety and quality. EGS works directly with its partners and offers full customization possibilities for both hardware and software to fulfill any specific technical requests or design adaptation.

Via Speranza 19/4, 40068 Bologna, Italy

www.egsolutions.com
Adentatec
Competence in Dental

Adentatec, based in Cologne in Germany, is a global dental company specialising in the production and distribution of non-precious dental alloys on a cobalt–chromium and a nickel–chromium base, as well as CAD/CAM discs on a cobalt–chromium and a titanium base. The medical devices distributed by Adentatec are exclusively produced in Germany and are certified to the highest standards (CE marking and US Food and Drug Administration). Adentatec is committed to the strict implementation of the quality and process requirements of DIN EN ISO 13485 and DIN EN ISO 9001 in relation to the entire manufacturing process.

The company was established in 1997 and its focus at that time was the distribution of sand-blasting material and plaster to dental laboratories all over Germany. In 2003, Adentatec started production of high-quality dental alloys, for which it implemented a quality management system. Its products undergo biocompatibility and corrosion resistance tests, among others, and are manufactured from high-quality raw materials to ensure consistent quality. Adentatec has always given priority to patient health. Since 2005, the company’s export business has increased steadily. Adentatec now has more than 20 agents worldwide who represent its product range.

The company’s brand-name products, such as System KN, System MG and System NE, have long been widely used by dental technicians. Its product range includes plaster, investment material and sand-blasting material. In 2009, Adentatec expanded the range to CAD/CAM discs on a cobalt–chromium base (System NE-Blank and System Soft-Blank). The high-quality discs are available in different diameters and heights, and can be used for all open milling systems. The discs are soft, homogeneous and easily milled. The strong oxide provides excellent metal to ceramic bonding. Importantly, the discs have high corrosion resistance and biocompatibility. In 2012, the company’s CAD/CAM disc on a titanium base, System Ti 5-Blank (Grade IV), was launched.

The Adentatec team would be pleased to welcome you at their booth at the IDS in Cologne. Please stop by at hall 10.2., booth V029 to learn more about the Adentatec products and services.

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Eisenbacher Dentalwaren ED, your specialist for NEM dental alloys

German manufacturer and supplier of NEM dental alloys Eisenbacher Dentalwaren ED offers a range of well-designed products for casting, milling (CAD/CAM) and laser sintering technologies (selective laser melting). It also manufactures high-quality consumer products for daily use in dental laboratories, such as all types of dental stone and phosphate investment materials for crowns and bridges and for model-casting processes.

With over 20 years of experience, the highly motivated Eisenbacher team produces dental and medical products of the highest quality. The company’s key strengths are its reliability, materials expertise and fully comprehensive service for customers, with quick and simple processing at reasonable prices. Eisenbacher Dentalwaren has DIN EN ISO 9001:2008 and DIN EN ISO 13485 certification, and meets the standards of the US Food and Drug Administration. It distributes its tried-and-tested products to over 75 countries.

The new cobalt–chromium sintering powder Kera S-Powder has been designed for use in the production of crowns and bridges, for ceramic veneering and for removable dentures (combined model casting) in laser sintering processes (selective laser melting). The powder has a very high degree of pourability and can be processed using common laser sintering systems. Owing to the selected composition and grain distribution, very delicate framework structures can be produced economically, with homogeneous material structures and good surface qualities.

The tried-and-tested Kera-Disc CAD/CAM milling alloy is a cobalt–chromium ceramic alloy for the CNC production of dental crown and bridge...
restorations. The circular blank alloy stands out owing to its very good machining properties and protects the milling tools for economic and effective processing. The special manufacturing method with subsequent heating process under high pressure gives the disc complete homogeneity and a very delicate grain structure, which explains its good corrosion resistance and biocompatibility. The blanks are available in different thicknesses, from 8 mm to 24.5 mm, either with or without a step, and with a diameter of 98.3 mm or 99.5 mm, and are suitable for the most commonly used milling machines. The frameworks produced using Kera-Disc can of course be veneered with all standard refractory dental ceramics.

The Kera Line milling alloy has been available for some time as a material- and time-saving alternative for the milling-based CNC production of crowns and bridges or single-piece abutments. This dosage form is available in Grade 5 titanium and as a bonding cobalt–chromium alloy in the proven composition of universal casting alloy Keragen in different diameters.

The Kera Ti 5-Disc Grade 5 titanium milling alloy is particularly suitable for the production of implant-supported dentures. The biocompatible material is available in thicknesses of 8–25 mm, with or without a step, and in diameters of 98.5 mm and 99.5 mm. It can be used in common milling machines. With a thermal expansion of $10 \times 10^{-6} \text{ K}^{-1}$, the alloy can be used with titanium ceramics.

For the conventional segment in crown/bridge technology and for model-casting processes, Eisenbacher Dentalwaren ED offers its customers a wide range of bonding/casting alloys with excellent material and processing properties. The Main Metall casting alloy, for example, has specially configured strength properties that allow it to be used for delicate and long-span bridges, as well as for implant-supported treatments with multiple pontics. The Robur 400 model-casting alloy is the perfect product for partial dentures with clips. The above-average tensile strength of the alloy ensures good strength with enough elasticity leeway for delicate and stable removable dentures.

Visit us at IDS 2015 in Hall 3.2, Booth A30/C39; we look forward to seeing you!
International Events

2015

36th International Dental Show
10–14 March 2015
Cologne, Germany
www.ids-cologne.de

Academy of Osseointegration
30th Annual Meeting
14–12 March 2015
San Francisco, USA
www.osseo.org

IMAGINADAENTAL
4th 3D & CAD/CAM Digital Dentistry Congress
1–3 April 2015
Monaco
www.imaginadental.org

BIOHORIZONS Global Symposium
16–18 April 2015
Los Angeles, USA

9th International Congress on 3D Dental Imaging
17–18 April 2015
Dallas, USA
www.i-cat.com/events/congress/

97th Annual Meeting of the Academy of Prosthodontics
28 April–2 May 2015
Austin, USA
www.academyofprosthodontics.org/2015_Austin_Texas.html

10th CAD/CAM & Digital Dentistry International Conference
8–9 May 2015
Dubai, UAE
www.cappmea.com/cadcam10/

Perspectives in Perio-Implantology and Comprehensive Dentistry
8–9 May 2015
Szeged, Hungary
www.symposiumszeged.com

EuroPerio 8
3–6 June 2015
London, UK
www.efp.org/europorio/

ICOI Summer Implant Symposium
14–16 August 2015
San Francisco, USA
www.icoi.org

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

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

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

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

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

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

Text length

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

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

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

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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.

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

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

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

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Questions?

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Hall 11.1, Stands G10/H11/H30
A complete posterior solution

Bringing innovation back

To keep pushing forward, we’re bringing innovation to the back. Connect with your entire treatment team and achieve shorter time to teeth with Nobel Biocare’s complete posterior solution. It offers new ways to overcome the challenges of working in the posterior region while reducing complexity and risks.

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