CE article
Utilizing the Tempcap abutment with CAD/CAM

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case report
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Digital technologies are everywhere in our daily life. We no longer go to post offices to send letters to our friends; we e-mail them instead. We no longer have walls of CDs or DVDs, but a tiny hard drive containing thousands of albums and movies. Newspapers, books and magazines are available in digital format and we store them in our tablets to take them wherever we go. In this context, dentistry is no exception and the last decade has seen the rise of the digital age in dentistry. As a result, the range of digital equipment available to dentists has increased significantly. New technologies in dentistry offer patients modern treatments for their dental problems.

An increasing number of dentists and laboratory technicians are adopting a digital workflow, and the uptake of digital technologies has been more rapid for dental laboratories than dental practices. For many of them, the high cost of equipment, apparently long learning curves, and selecting the most suitable and up-to-date equipment are still reasons for hesitation. Like all revolutions, the digital revolution has started slowly while the technology has grown and matured.

During the last several years, we have seen an increasing number of new intra-oral scanners in the dental market. With these, dentists are able to achieve faster, more accurate digital impression taking, which is more comfortable for patients. Systems rely on a single image and video camera to record the digital file that is the foundation for an accurate outcome. There is no doubt that in the near future intra-oral scanners will be cheaper, smaller and integrated into dental units.

Intra-oral scanners are a wedge technology for in-office CAD/CAM solutions. With the adoption of this technology, dentists will be able to produce same-day single-unit restorations using in-office milling systems. As the majority of restorations fabricated for dental offices are single-unit restorations and three-unit bridges, in-office milling machines will become increasingly indispensable equipment in dental offices. Therefore, the market for chairside milling will grow at a faster pace than today. New companies are gaining a large share of the market, which is currently led by CEREC and E4D.

Chairside milling systems will be the impetus for new millable material. A large spectrum of materials that can be processed via digital options are available. Companies are investing significant amounts in developing new millable materials. Eventually, analogue methods and materials will be replaced by fully digital workflows.

Dental laboratories have been quick to make the transition from analogue to digital. They will be a valuable resource for dentists, offering immediate restoration to dental practices in close proximity. Nothing can take the place of a dental technician and a dentist working together to manufacture high quality restorations; there is still no replacement for skilled professional handwork on the horizon.

In this decade, dental CAD/CAM has reached a very high level of development. According to forecasts, more than 50 per cent of dental services will be performed using CAD/CAM technology by 2050. This figure demonstrates the importance of keeping pace with this fast moving technology. As the leading companies in dentistry are investing in this area, we would be wise to investigate it for our future.

I can say without question that the age of CAD/CAM dentistry is here. It is time to be part of it.
editorial

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Utilizing the Tempcap abutment with CAD/CAM
Combination of Tempcap, in-office CAD/CAM and e.max allows for final restoration

Abstract

The E4D in-office CAD/CAM unit (Editorial note: Planmeca E4D Technologies) has been employed in an investigative laboratory study to design and mill an unconventional IPS e.max restoration that would be coupled with the Tempcap as a final implant-supported crown. The combination of the Tempcap, in-office CAD/CAM procedures and IPS e.max allows the clinician to create an immediate final restorative product with ideal characteristics.

Introduction

The procedure is a simple, efficient and effective solution for the restoration of implants.

Background

Following the surgical placement of a dental implant, several requirements must be met to maximize healing and osseointegration of the implant body to bone:

- Minimal forces, if any, should be exerted on the implant body, permitting proper healing and preventing a non-osseous union.
- The gingival architecture must be managed meticulously to prevent contamination, minimizing the risk of peri-implantitis and possible failure.

Author

Dr Les Kalman, USA
There must be sufficient time for the process of osseointegration. Temporization and immediate restorations should not violate these factors.

The Tempcap is a healing cap and restorative platform combined (Fig. 1). It has an all-metal construction, and it contains two to three retentive pin projections (Fig. 2). Tempcap is available in different widths and heights to accommodate different implant sizes (Fig. 3) and is compatible with existing instrumentation (Fig. 4).

The function of the Tempcap is:
- to allow for optimal gingival healing;
- prevent contamination of the surgical field;
- minimize forces and micro-vibrations on the implant;
- facilitate the simple yet successful restoration of the implant (Fig. 5).

CAD/CAM stands for computer-aided design and computer-aided manufacturing. CAD enables the individual to digitally capture an image of a pre-
pared tooth or structure and then design an indirect (out of the mouth) restoration by using software.² After the ideal restoration has been produced, the design is then fabricated out of a material by a milling machine. In-office E4D units (Editorial note: Planmeca E4D Technologies) are currently available to allow for immediate chairside fabrication without the use of a commercial laboratory.

IPS e.max (Ivoclar Vivadent) is a relatively new metal-free dental material used in indirect restorations. It is an aesthetic material composed of lithium disilicate and has ideal physical and aesthetic properties, allowing it to be the first choice for CAD/CAM restorations. IPS e.max has strength second only to gold and has the ability of detailed CAM production.³

_Methodology_

The Tempcap was selected and placed on an Ankylos (DENTSPLY Implants) implant body (master cast with soft tissue) (Fig. 6). Digitization was
achieved by using an E4D camera (Editorial note: Planmeca E4D Technologies) (Fig. 7), in which several images were captured to compile an accurate image (Figs. 8 & 9). CAD design was used with E4D software (Editorial note: Planmeca E4D Technologies) to determine and delineate margins (Fig. 10).

Tooth design was initiated incorporating several parameters:

- ideal aesthetics and emergence profile (Fig. 11);
- adequate proximal contacts;
- appropriate occlusal scheme;
- material thickness requirements;
- internal surface morphology to adapt to Tempcap;
- design that can be milled via CAM technology.

Numerous design iterations were required to achieve the desired design requirements (Figs. 12–14). IPS e.max was selected for milling (Fig. 15) and was executed by an E4D CAM unit (Editorial note: Planmeca E4D Technologies) (Fig. 16). Milling limitations, such as bur contact and pros...
thesis fracture, required CAD design modifications. Reiterations in CAD/CAM design were carried out until a successful restoration was achieved (Fig. 17).

The unfired IPS e.max crown was tried for fit and aesthetics and then subsequently fired (Fig. 18), resulting in its colour change. The crown was further stained, glazed and fired (Fig. 19), resulting in a highly aesthetic final restoration (Fig. 20). The restoration's internal aspect (Fig. 21) was assessed for path of insertion, retention and fit.

The IPS e.max prosthetic crown was further assessed for fit, taking into account marginal fit, occlusion and proximal contacts (Fig. 22).

A secondary investigation utilized a more complex Tempcap to assess the limit of the CAD/CAM unit’s capability. A stand-alone Ankylos (DENTSPLY Implants) implant body was coupled with a Tempcap abutment with three retentive pin projections (Fig. 23). The abutment was digitized with the same methodology as described. An IPS e.max crown was executed and assessed (Figs. 24 & 25).

_**Discussion**_

This study has determined that the Tempcap can be successfully and accurately digitized and milled by in-office CAD/CAM technology (Editorial note: Planmeca E4D Technologies) to create an ideal prosthetic crown from IPS e.max within a laboratory setting. CAD software can be manipulated to generate forms beyond the scope of the unit.

Complex units, such as the three-pronged Tempcap may be successfully designed and milled. IPS e.max has the capability to be milled in complex patterns, while still maintaining its structural integrity.

However, further laboratory studies, quantitatively assessing stresses and strengths and utilizing a larger sample size, are required to validate the concept. Subsequent clinical investigations are required to assess the clinical significance and viability of the Tempcap with CAD/CAM technology. The potential to fabricate the Tempcap entirely from e.max should also be considered.
Conclusions

In-office CAD/CAM technology can be utilized and manipulated to generate digitized forms beyond the scope of the morphogenesis. CAM manufacturing has limiting factors that must be realized when producing modified prostheses. CAD modifications must account for these discrepancies. IPS e.max has the ability to be milled in extremely detailed designs.

The Tempcap can be optically scanned and digitized in order to design and create a CAD/CAM IPS e.max restoration using E4D technology. The utilization of the Tempcap as a successful provisional abutment has been documented; the utility of the abutment as a simple, efficient and cost-effective component seems promising. These advances simplify the procedure and reduce the cost, ultimately allowing a greater accessibility for both patients and clinicians.

Editorial disclaimer: Dr Les Kalman is the co-owner of Research Driven and the inventor of the Tempcap.

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References


about the author

Dr Les Kalman, DDS, graduated from the University of Western Ontario with a doctor of dental surgery degree in 1999. He then completed a GPR at the London Health Sciences Centre. He has been involved in general dentistry within private practice since 2000. He has served as the chief of dentistry at the Strathroy-Middlesex General hospital. In 2011, he transitioned to full-time academics as an assistant professor at the Schulich School of Medicine and Dentistry. Kalman’s research focuses on medical devices, including the Virtual Facebow and the Tempcap. Kalman is also the Director of the Dental Outreach Community Services (DOCS) program, which provides free dentistry within the community. Kalman has authored articles ranging from pediatric impression to immediate implant surgery in both Canadian and American journals. He has been a product evaluator for several companies, including GC America and Clinician’s Choice. Kalman is the co-owner of Research Driven, a company that deals with intellectual property development. Kalman is a member of the American Society for Forensic Odontology, International Team for Implantology, Academy of Osseointegration, American Academy of Implant Dentistry and the International Congress of Oral Implantology. He has been recognized as an Academic Associate Fellow (AAID) and Diplomate (ICOI). In his spare time, Kalman enjoys photography as an accredited MotoGP photjoournalist. He can be contacted at: lkalman@uwo.ca.
Introduction

Based on studies on the accuracy of the scanning methods employed\(^1\)\(^2\), as well as the resulting models\(^3\)\(^4\) and restorations\(^5\)-\(^7\), it appears that the combination of intra-oral scans and CAD/CAM-based restorations is today regarded as standard in conventional prosthetics. The question that arises is how this workflow is realised for implant prostheses. The special requirements of implants for intra-oral scanning have led to changes in the information to be transferred and to the principles of the present implant workflow. This needs to be considered when developing a scanning protocol for implant-borne restorations.

Case report

A 48-year-old female patient presented with a gap that had been left untreated for many years after extraction of tooth 46. The adjacent teeth had been restored prosthetically and were free of caries. It was decided to provide restoration with an implant rather than a bridge restoration. Owing to the lack of loading, bone resorption had already commenced in a buccolingual direction. The soft
tissue was healthy and exhibited a broad region of keratinised gingiva.

Procedure

Treatment planning

An implant-borne full-ceramic single crown cemented on to a titanium abutment was planned to reconstruct the lost tooth. The patient did not wish to undergo augmentation measures in the bone area.

Surgical procedure

Implant placement in region 46 was performed with a crestal incision only, while maintaining the papillae in regions 45 and 47. As planned, a Straumann Standard Regular Neck implant (SLActive; D 4.8 mm, L 12 mm) was inserted in a central position. The implant was left submerged for two months to heal and a healing cap was inserted after uncovering the implant and left in situ for four weeks for soft-tissue healing (Fig. 1).

Prosthetic procedure

For the intra-oral scan, the healing cap was replaced with an intra-oral Regular Neck Straumann CARES Mono Scanbody (D 4.8 mm, L 10 mm; Fig. 2). Here, the occlusal inclined section was aligned buccally on the implant. The mouth was kept dry with OptraGate (Ivoclar Vivadent) and the
entire area to be scanned was lightly powdered (Fig. 3).

With the aid of the 3M True Definition Scanner (3M ESPE), the mandible could be imaged with the Scanbody, as well as the maxillae (Figs. 4 & 5). For digital bite registration, scanning of habitual intercuspation, the Scanbody was unscrewed again, as the standard height of 10 mm did not allow unimpaired occlusion in this case (Fig. 6).

This was followed by checking of the digital image of the Scanbody in region 46 for complete image capture of all of the surfaces, as well as the approximal areas of the adjacent teeth. The occlusal surfaces, as well as the relationship to the antagonist teeth and bite registration, could then be checked prior to defining the precise reconstruction area in region 46 with appropriate marking of the different data volumes for later transfer (Figs. 7 & 8).

As part of the order to the laboratory, using the 3M True Definition Scanner software, the implant data was described alongside the patient data, including information on the position of the tooth, abutment material (titanium/zirconium dioxide), implant platform (Wide Neck, Regular Neck, Narrow Neck, Regular CrossFit Connection or Narrow CrossFit Connection) and the type of restoration (abutment and/or superstructure).
The dental model was produced by Innovation MediTech after online transfer via Straumann CARES based on the STL files. Then the appropriate repositionable Straumann Regular Neck implant analogue was placed in region 46 (Figs. 9 & 10). In parallel, the planned abutment, customised via Straumann CARES X-Stream, and the corresponding zirconium dioxide coping were fabricated and transferred to the model situation (Figs. 11–13). Veneering of the crown cap was performed using a suitable veneering porcelain (Figs. 14–16).

For integration purposes, the CARES titanium abutment was screwed firmly into the implant. After try-in and adaptation of the peri-implant gingiva, the crown was definitively cemented using RelyX Unicem (3M ESPE; Figs. 17 & 18).

**Conclusion**

The success of implant treatment does not depend on correct implant surgery alone. Prostheses too can contribute to avoiding peri-implantitis and to the long-term success of an implant by creating an optimal emergence profile. In this context, the individual abutment is to be regarded as the basis for successful implant prostheses. The intra-oral scan and consequent dispensing with plaster models ensure that the digital prosthetic workflow is integrated right from the start (Fig. 19).

This leads to significant simplification of the fabrication steps, with increased precision, and avoids sources of error. Individual abutment shapes can thus be designed and fabricated optimally via CAD/CAM together with the corresponding restoration. In addition, this procedure enables reduced changing of screws and manipulation of the implant, which can lead to a reduction in peri-implant bone resorption.8,9

Dental technicians and prosthodontists should be aware of the importance of an emergence profile at the time of temporary and definitive prostheses. It should therefore be the goal of any fixed implant restoration to come as close to these requirements as possible via customised reconstructions.

Maintaining gingival dimensions and health is a decisive factor for the long-term success of implant reconstructions; after all, a healthy and functional peri-implant gingiva forms a barrier against the penetration of micro-organisms and bacteria. This enables long-term preservation of the peri-implant bone (not considering bone resorption induced by malfunction or overloading).9

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He has maintained a practice specialising in periodontology and implant dentistry in Munich in Germany since 2002. He has been an affiliated dentist of the Arabella hospital in Munich since 2002. He is a regular speaker on oral surgery and implantology, as well as fixed prostheses, particularly regarding aesthetics, at national and international conferences, an author on these topics and a member of the editorial board of an implantology journal.

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“One cannot just replace a technician with a machine”

Interview with the Agnini brothers, dentists and prominent specialists in fixed prosthetics, periodontology, and implantology

Author: John Battersby, Singapore

Brothers Dr Andrea Mastrorosa Agnini and Dr Alessandro Agnini presented a series of lectures on digital dentistry and mastering the fully digital workflow at IDEM Singapore 2014 in April. The doctors were two of the star speakers at the Dental Technician Forum introduced for the first time at this year’s IDEM Singapore. Between their packed schedule of lectures and open panel discussions, the brothers took time out to answer some questions on their experiences in Asia, the current state of digital dentistry, CAD/CAM, and 3-D printing, and the direction in which they see these technologies developing in the future.

John Battersby: Have you observed any difference between Asian and European technicians when it comes to their familiarity with and adoption of the latest dental technology?

Dr Andrea Mastrorosa Agnini: We have not really had the opportunity to work closely with any Asian technicians yet, so we do not know with which technologies they are familiar or which technologies have already been widely adopted in Asia. What we have seen is that there is massive and growing interest in all aspects of digital dentistry, not only among technicians but also among all members of the modern dental team.

Dr Alessandro Agnini: Yes, this is why there are more events like the Dental Technician Forum at IDEM Singapore and other similar events around Asia, just like one sees in Europe and the US. We were here in Singapore last November for the CAD/CAM conference and we will be back again later this year for another.

John Battersby: How did you find your Asian audiences at IDEM Singapore? We (Asians) have a reputation for being very shy when it comes to asking questions; did you have many questions or much feedback?

One cannot just replace a technician with a machine
Dr A. Agnini: Actually, we had quite a few questions from the floor and via the SMS system they used for the Dental Technician Forum. The audience can text any questions they have to a number and we can answer them after the presentation during the Q & A session.

Dr A. M. Agnini: The SMS system worked really well because people could ask us anything and often they asked us about something we had not had time to cover in the presentation or had not included because we were not sure whether it would interest people. With such questions, we thus could cover such topics too.

It has been suggested that Asia might not be as quick to adopt digital technologies as Europe and the US because skilled labour costs here are still comparatively low, so there are not the same savings to be made by giving some of the technicians’ jobs to machines. Do you think that is true?

Dr A. M. Agnini: One cannot just replace a technician with a machine. In Europe or anywhere else, one still needs a dental technician who is well trained in using all these new digital technologies; it is not easy for anyone to use these new digital technologies for the first time. One needs a great deal of training to fabricate a final restoration that is precise, predictable and of the same quality as that achieved via traditional protocols and craftsmen technicians. Software can help the clinician, the technician and the patient, but on its own cannot solve the problem; one still needs a skilled person behind the machines to tell them what to do.

Dr A. Agnini: The machine does not know what to do; it cannot look at a restoration and see where we need more support, or whether a molar needs to be done this way or another way. We need a person with the skills, knowledge and training to decide how to shape this framework if we are to achieve the outcome of long-term predictable restorations.

But now, a well-trained and knowledgeable technician using CAD/CAM can dramatically improve his or her productivity.

Dr A. Agnini: That is true, one advantage of CAD/CAM is one can speed up production. Another advantage for the dental technician is that one can reduce the variables without reducing the quality. The third advantage is that it can level the playing field between technicians and make standards more homogeneous. Before, especially for large restorations, the technicians’ skill with their hands was...
crucial in producing high-quality restorations, but with new technologies perhaps technicians who are less skilled in traditional manual manufacturing techniques can produce high-quality restorations.

While everyone agrees that digital dentistry is the way of the future, there does seem to be one area where not everyone agrees. Everyone agrees that the first two steps of the process, that is the acquisition of data via some form of scanning and CAD, are essential, but when it comes to the CAM component, there seems to be a divergence of opinions.

One of the other speakers at IDEM Singapore, Mr Rik Jacobs, seems to think that 3-D printing can already cope with most laboratory manufacturing and, once the latest biologically compatible materials currently being developed have been tested and approved, 3-D printing will be able to do everything, including implants. Do you see that happening or do you think precision milling will be with us for many years to come?

Dr A. Agnini: We do not have much experience with 3-D printing machines. For sure, they will one day revolutionise the future of dentistry, but right now I do not think they can match the precision achieved by milling machines. For the time being, I think milling machines are a gold standard that will be difficult to surpass.

As scanning and CAD/CAM technologies, and especially the software that links the three stages, improve, do you think more dentists or at least the larger dental practices will start to do more manufacturing in-house rather than using external laboratories? And if that is the case, what can laboratories and technicians do to retain their customers?

Dr A. M. Agnini: The in-house milling process is a hot topic nowadays in dentistry. Everything has to begin and end with the quality of the final restoration in mind, and that will always have to be the deciding factor. Today, the clinician has the option of organising his or her work as he or she prefers, but doing everything by himself or herself is, in our opinion, something that is not convenient or practical.

It is a different matter if the clinician has in his or her clinic a well-trained dental team who can manage the digital workflow from beginning to end. Such a team would have to include an expert dental technician devoted to studying and mastering all of the latest digital possibilities. Only this way can this quality be achieved and the clinician be satisfied from a business and economic standpoint.

Another solution is to team up with an external expert laboratory that can design, customise and produce the prosthetic elements. This way, one does not have to invest in the initial start-up costs involved in setting up a dental laboratory.

In summary, on the one hand, the craftsmanship of the dental technician cannot be replaced by digital dentistry; it will still be necessary to work with someone in-house or externally who is capable and up-to-date with the technology. On the other hand, if the dental laboratories want to keep themselves in business, they have to incorporate the latest digital solutions into their practice, understand and invest in them, and work out how to make the most of them. It is the only way dental laboratories will survive this digital dentistry era.

The buzzwords at this year’s IDEM Singapore were definitely “CAD/CAM” and “3-D printing”, but what do you predict the buzzwords will be in 2018?

Dr A. Agnini: I think in 2018 the buzzword will be “full digital workflow”, meaning a completely predictable digital process, and “full-arch rehabilitation” Today, it is still too early to manage complex cases with the intra-oral scanner; the average error is still too large...
Non-precious dental alloys on nickel-chrome base System KN and System NH

Non-precious dental alloys on cobalt-chrome base System NE and System Duro

Partial alloy System MG

CAD/CAM discs on cobalt-chrome base System NE-Blank and System Soft-Blank

CAD/CAM disc on titanium base System Ti5-Blank
In dental implantology, the optimal and truly passive fit of the framework is essential for the long-term success of a restoration owing to the physiology of bone tissue around implants. For a multiple-unit implant-supported restoration, the traditional pouring technique is rather complex and challenging. The difficulty of achieving a passive fit is directly correlated to the number of components used and the volume of the framework. CAD/CAM technology provides such a high level of accuracy that it has revolutionised the field of restorative dentistry.

Today, many implant manufacturers collaborate with industrial companies to develop state-of-the-art machining solutions for their implant-supported frameworks. In that regard, the concept developed by Simeda (Anthogyr) is innovative and supported by many years of proven success in the fabrication of CAD/CAM dental restorations. The major advantage of CAD/CAM technology is that it guarantees a highly accurate and predictable fit (< 10 µ). This clinical case report demonstrates the high potential of this novel digital solution.

Patient presentation

The male patient was a former smoker and 51 years old when the treatment was initiated. He presented...
with high blood pressure and took Tahor (Pfizer) on a daily basis. In addition, he had been on Kardegic (Sanofi) therapy since a heart attack in 2005. For functional and aesthetic reasons, he wanted a fixed prosthesis in his maxillary arch (Figs. 1a & b).

Debridement and pre-implant surgery

Owing to the periodontal condition of his remaining maxillary teeth, all of them were atraumatically removed. Then, mechanical debridement was performed through alveolar curettage and copious irrigation with Betadine. A maxillary complete overdenture was fabricated and placed on the same day of the extractions.

After a healing period of four months, DentaScan images (GE Healthcare) were obtained to evaluate the bone height. The scans showed significant bone resorption in the posterior sections of the maxillae (Figs. 2a–c): SA-4, according to Misch’s classification, since the residual ridge height was less than 5 mm. Sinus grafting was deemed necessary and implant placement had to be delayed by five to six months, until complete healing and good initial stability had been achieved.

Bilateral sinus lift was performed under local anaesthesia from a lateral approach using the technique described by Tatum. The Schneiderian membrane was lifted gently. As there were no perforations, platelet-rich fibrin was used for coverage of the sinus floor. Maxgraft (botiss biomaterials) allografts were placed to elevate the maxillary sinus floor, and then covered with a Bio-Gide (Geistlich) collagen membrane and platelet-rich fibrin.

After a healing period of five months, the patient underwent a CT scan wearing a scan prosthesis of

Fig. 3. Scan prosthesis.
Fig. 4. An osteotensor.
Fig. 5a. Implant placement planning in SIMPLANT (DENTSPLY Implants) software.
Fig. 5b. Implant placement planning in SIMPLANT (DENTSPLY Implants) software.
Figs. 5c–d. CT cross-sections.
A trans-parietal approach was used for insertion of the Bone Matrix Osteotensor (Victory) after a minimally invasive flapless protocol (Fig. 4). Endosteal stimulation results in osteogenic activation and allows evaluation of the mechanical strength of the grafted areas by probing. Owing to this simple and minimally invasive technique, the initial quality of the future recipient bone site is easily assessed. These techniques have been successfully used in orthopaedics for ten years. In view of the excellent response to osteogenic activation, it was decided that implants would be placed 45 days later.

_Treatment planning_

The case was planned in the SIMPLANT (DENTSPLY Implants) treatment planning software. The scan prosthesis is critical for determination of the correct position and axial alignment of the implants; visualisation of the emergence profile; and determination of the size, position and axial alignment of the abutments. Furthermore, it allows optimal use of the available bone height. At this stage, special attention should be paid to 3-D positioning of the implants and particularly to the emergence profile in order to facilitate the fabrication process of the final restoration. Straight or angled conical abutments are now clearly visible on the vestibulo-lingual cross-sections. Ten Axiom PX implants (Anthogyr) were planned for a maxillary screw-retained bridge restoration (Figs. 5a-c).

_Implant placement_

Implant placement was performed under local anaesthesia using the case-specific surgical guide. For this patient, I used a specific implant design (Axiom PX, Anthogyr) with symmetrical double-lead threads (self-drilling and self-tapping) and a reverse conical neck (Fig. 6). Its unique design, combined with a special drilling protocol, promotes bone condensation even in soft bone, ensuring excellent initial fixation. The BCP (biphasic calcium phosphate) sandblasting technique yields an implant surface with superior osteoconductive properties that positively influence the development of osteoblastic cells in the early stage of osseointegration. A flapless technique was used for implant placement. The flapless technique has definite advantages: preservation of the subperiosteal blood vessels, and improved patient comfort owing to a shorter operating time and simple post-operative care.
**Temporary bridge and immediate loading**

It was agreed with the patient that the implants would be immediately loaded, provided that good initial stability was obtained. The temporary removable prosthesis would be worn for a limited period. Fortunately, adequate stability was achieved, allowing for immediate loading. Each implant (except #27) was torqued to 35 Ncm or more. On the same day, an impression was made using the pick-up technique, with a previously prepared impression tray. First, the final straight conical abutments were hand tightened into the implants using a torque of 15 Ncm. They were intended to accommodate the screw-retained provisional and then the final screw-retained prosthesis.

The Axiom PX implant system offers two major advantages: platform switching and indexing trilobe Morse taper connection. The latter greatly facilitates abutment placement. A tight stable connection guarantees integrity of the soft tissue (Fig. 8).

In the laboratory, the master model with the embedded analogue was used to fabricate a master plaster cast. A high-rigidity cobalt–chromium and resin temporary bridge was fabricated, tried in, and transferred to the patient’s mouth 48 hours after the implants had been placed. This provisional device would serve as an external fixator during osseointegration of the implants.

A control radiograph was taken to confirm the passive fit of the framework. The temporary bridge was hand tightened to a torque of 10 Ncm. The occlusion was accurately adjusted (Figs. 7a–c). The patient wore the temporary bridge for six months. During that period, a number of parameters were evaluated, including occlusion, osseointegration status, oral hygiene, mastication, phonetics, aesthetics and lip support. The

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**Fig. 8.** Healing status at six months post-op.
**Fig. 9a.** The impression.
**Fig. 9b.** The interconnected pick-up transfer copings.
**Fig. 9c.** The wax bite block.
**Fig. 9d.** The master model.
**Fig. 10.** A wax-up of the framework.
**Figs. 11a–d.** CAD of the model.
case report  _ full-arch restoration

temporary bridge should be rigid (framework) and easily removable (screw fixation). Site #27 healed uneventfully, protected as it was from mechanical stress.

Final bridge

At the end of the six-month healing period, preparation for the final restoration began. Wearing the temporary bridge had allowed adjustment of the above-mentioned parameters (e.g. aesthetics, phonetics and lip support) and validation of the vertical dimension and intermaxillary relationship.

The temporary bridge was removed, an implant stability percussion test was performed, and control radiographs were taken. The straight conical abutments that had been placed concomitant with the implants were tightened to 25 Ncm (as recommended by the manufacturer), except abutment #23, which was angled (Fig. 8).

An impression of the final bridge was taken with the same impression tray used for the temporary bridge. Pick-up transfer copings were interconnected using LuxaBite resin (DMG), and the impression was made using Impregum (3M ESPE). The master model, including the conical abutment analogues and silicone soft tissue (representing the patient’s gingiva), was fabricated and then validated in the dentist’s office via a wax bite block (into which extra-hard plaster material was poured). The wax bite block was then tried in (Figs. 9a–d).

Using silicone indices (vestibular, occlusal and palatal) from the temporary bridge, a wax-up was fabricated in the laboratory (Fig. 10). The wax-up had to meet the aesthetic demands of the patient and be an exact replica of the temporary bridge (both anatomically and aesthetically). The validated master model and wax-up were sent to the SIMEDA machining centre, where the master model was scanned and a CAD model was designed (Figs. 11a–d). A PDF 3-D file is used to validate the design, after which the manufacturing process can be initiated. All pieces are machined from titanium blocks using high-precision five-axis milling machines (Figs. 12a–c).

Titanium is a lightweight material and, more importantly, it is highly biocompatible and has superior mechanical properties. It is four times lighter than commonly used semi-precious alloys. Actually, it is the lightest metal used in dentistry. Furthermore, titanium is a self-passivating metal: it readily reacts with oxygen in air to form a tough layer of oxide, which protects against corrosion. Titanium is known to resist corrosion and chemical attacks extremely well. Furthermore, it is bactericidal, a key advantage for dental implants.
Material density is a crucial factor in implantology. We believe that the weight of a maxillary implant-supported prosthesis is the most important factor for the outcome of the restoration.

A few days later, we received the framework for try-in. It had a perfect passive fit and was returned to the laboratory for veneering. The metal preparation in the laboratory entailed sandblasting, titanium etching and the application of opaque porcelain to conceal the metal core. The bisque-baked restoration was then tried in to allow the patient to validate the aesthetics of the restoration. This step is necessary to assess static and dynamic occlusion and perform minor adjustments (Figs. 13a–g). The bisque-baked restoration was then returned to the laboratory for fine tuning and glazing.

_CAD/CAM benefits_

Although conventional casting techniques have evolved, they are still fraught with inaccuracies owing to the nature of the materials and to their handling. This includes the risk of errors during investment processing, risk of metal deformation and poor metal homogeneity. The CAD/CAM technologies used for producing metal frameworks are essential to the quality of the final restoration (Fig. 13i). The CT scan data is converted into a format that allows the 3-D images to be utilised by the selected treatment planning software. The case is then planned in the software.

The CAD software has databases that allow the creation of virtual models for the desired restoration using different materials, including zirconia, titanium, cobalt-chromium, IPS e-max and PMMA.

If the dental laboratory has its own scanner, an STL file is sent directly to the production centre by e-mail. Otherwise, both the model and the wax-up are forwarded to the production centre by courier.

If the computer settings are correct, one is ensured of perfect reproducibility in the manufacturing process and consistency in the result (i.e. a truly passive framework fit). Optimal setting of the coping thickness parameter or the pontic connection parameter may prevent torsion or deformation of the framework during firing of the ceramic. Subtractive manufacturing, combined with digital modelling, eliminates the risk of alteration of the material structure. The resulting metal framework will have optimal homogeneity and density.

As regards fabrication of implant superstructures, machining is the technique of choice for achieving high precision and near passive fit. Practitioners can expect consistent and reproducible results, excellent framework fit, and regular, accurate prosthetic seals.

_Coauthor CAD/CAM_

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Immediate implantation and full-ceramic restoration in the maxillary anterior region

**Authors** Dr Arndt Happe & Andreas Nolte, Germany

**Introduction**

Implant-supported single-tooth crowns in the aesthetic zone are a special challenge, particularly when immediate implantation is planned—if there is insufficient bone volume and a thin biotype. A whole chain of critical factors need to be considered here, including implant positioning, hard- and soft-tissue management, and the natural design of the crown. These days, a number of digital methods are available to simplify the process and make it safer.

Depending on the initial situation, that is maximum aesthetic demands, however, many dentists prefer analogue methods, as in the following example.

**Initial findings and planning**

A young female patient with full-ceramic crowns on teeth 12 to 22, presented at our clinic desiring bright and natural new restorations. Her medical history was unremarkable and her gingival type was classified as thin. Tooth 11 had undergone root canal therapy, could not be saved and would have to be replaced with an implant.

In order to obtain the most accurate assessment of the initial situation, the dental technician photographed the patient in his laboratory. Using the photograph and initial models, he defined the shape and colour of the planned restorations and carefully analysed their position in the arch for the temporary restoration. Based on the data obtained, a temporary bridge was fabricated for teeth 12 to 21 once tooth 11 had been extracted.

**Immediate implantation and temporary restoration**

In order to extract tooth 11 with as little trauma as possible, the surgeon first severed the periodontal fibre system with a periotome and expanded the coronal alveolar gap with piezo-surgical instruments. First, the crown was luxated and extracted with extraction pliers, then the root, again with piezo-surgery, a sharp lever and diamond pliers. This revealed that the thin buccal bone lamella was connected to the root. The osseous margin of the alveolus was examined carefully with a periodontal probe (bone sounding).

Despite a lack of bone wall, an immediate implantation was planned according to the protocol of the University Medical Center of the Johannes Gutenberg University of Mainz, Germany. With the aid of the guide prepared in the laboratory, the positions were marked prior to preparing the implant bed. Pilot drilling and further drilling steps were performed by the surgeon without a guide and with drill extension for optimal cooling. Insertion of the implant (CONELOG, CAMLOG; 3.8 mm diameter, 13 mm length) was also performed without a guide.

Correct 3-D orientation of the implant was checked with the final drill and using the drill guide. The buccal implant shoulder should be 3 mm apical of the marginal soft tissue and distinctly palatal to the dental arch. This ensures that the subsequent implant-supported crown can be screwed in palatally. The gap between the implant and buccal soft tissue was filled with bone material. This was a mixture of autologous bone gained during preparation. Granular autologous bone harvested from the retromolar area and bovine
After removing the temporary crowns on teeth 12 and 21, the supra-alveolar periodontal attachment of tooth 11 was severed with a periotome.

The root was extracted after atraumatic removal of the crown. The buccal bone lamella connected to the root surface was lost during the process.

The palatal margin of the alveolus was marked with the pilot drill through a deep-drawn guide prepared in the laboratory.

When inserting the implant, the surgeon oriented himself along the palatal bone wall.

The implant was palatally displaced in the correct position; the buccal bone lamella no longer existed.

The position of the implant in the dental arch was checked with the aid of the guide.

A retromolar bone cylinder was harvested with a trephine drill to obtain autologous bone for augmentation of the buccal lamella.

The space between the implant and buccal soft tissue was filled with a mixture of autologous bone and bovine bone replacement material.

In order to obtain optimal buccal contours, a connective-tissue graft harvested from the palate was drawn under the soft tissue and sutured.

The temporary bridge was cemented with the healing cap without contact with the pontic.

The sub-crestal bone position and good cervical join of the temporary bridge are shown on the post-operative X-ray.

Good healing and successful integration of the connective-tissue graft are evident one week after immediate implantation. The white-yellow deposits are fibrin.
After a three-month healing period, the implant was successfully osseointegrated and the soft tissue had stabilised for final impression taking.

The peri-implant soft tissue is well formed and largely irritation free under the temporary bridge.

Good perfusion of the peri-implant soft-tissue well can be observed. Buccal tissue thickness exceeds 3 mm.

Impression taking of the prepared teeth and the implant.

Following reinsertion of the temporary bridge, excess soft tissue was observed in the area of the implant (position 11).

Individual stumps made of super-hard plaster with grooves to prevent rotation were fixed in the impression with instant adhesive.

Preparation of the master model. The wax pins served as access to the stumps on the master model.

The precise periodontal and peri-implant soft-tissue situation was represented on the master model.

The marginal border of the planned implant crown was transferred to the plaster surface.

The peri-implant emergence profile was expanded and the papillae sharpened to provide a harmonious gingival profile.

Optimal hold of the wax-up during try-in through filled implant interface.

Overview of abutment options (from left: CONELOG Esthomic abutment (1.5 to 2.5 mm gingiva height) prior to and after customising, the CONELOG Titanium base CAD/CAM.
Implant-supported single-tooth restoration

Bone augmentation material were used to prevent resorption (Figs. 10 & 11).

In order to obtain the best possible soft-tissue conditions in the sense of a thicker gingival type, the surgeon harvested a connective-tissue graft from the palate. Using the tunnel technique according to Azzi, this was pulled between the bone granulate and the buccal soft tissue and fixed with a monofilament, non-absorbable suture material (Fig. 12). Then a CONELOG wide-body healing cap (4 mm height) was screwed in and the temporary bridge cemented (Fig. 13). This supported the soft tissue; but did not contact the healing cap, so that the lower section of the pontic could be cleaned with super floss. Figures 14 and 15 show the post-operative X-ray and the situation at the check-up one week after immediate implantation.

After three months of implant healing, the peri-implant and periodontal tissues were ready for final impression taking (Figs. 16 & 17). To this end, double 0 sutures soaked in glycerine were placed in the sulci and the preparation borders placed slightly subgingivally as part of final fine preparation. Then a thicker retraction cord, strength 0, soaked in epinephrine was placed (adrenaline; Fig. 18). The healing cap was unscrewed (Fig. 18) and a CONELOG impression post for open trays screwed in (Fig. 19). Impression taking was performed after drying and removal of the thick retraction cord (Fig. 19) in one step with an individual open tray and a two-phase polyvinyl siloxane (A-silicone). Following arbitrary transfer of the occlusal relations with a bite fork, facebow and bite registry, the healing caps and temporary bridge were reinserted. A temporary crown was fabricated for tooth 22 (Fig. 20). The marginal gingiva in the region of the implant had to be moved slightly in an apical direction with the definitive restoration owing to the excess tissue.

Fabrication of abutments and final crowns

Using super-hard plaster, the dental technician fabricated root-shaped (conical) stumps to prevent rotation. These were placed in the impression to fabricate the master model and extended with wax pins (Figs. 21–23). A new wax-up was prepared based on the updated aesthetic analysis and the outer cervical contour of the implant restoration was transferred to the model (Fig. 24). The anatomical shape of the emergence profile was then created with a fine milling machine. The implant crown was thus given a natural emergence contour. The papillae were slightly sharpened and smoothed to give an optimal gingival contour. The optimised shape of the papillae avoided concavities occurring later in the cervical, slightly subgingival ceramic areas, which are difficult to clean and can lead to irritation of the gingiva (Fig. 25). The wax-up was fitted with a pin at the implant position, which engaged with the implant interface for better fixation of the wax-up during try-in (Fig. 26).

A suitable abutment was selected from the CONELOG Esthomic abutment set and the silicone indexes based on the wax-up. In this case, the CONELOG Titanium base CAD/CAM was too low owing to the...
apical position of the implant shoulder. Therefore, the dental technician decided on a considerably longer, straight CONELOG Esthomic abutment, which was customised for use as a titanium bonding base (Figs. 27–29). He modelled a secondary abutment with wax on the customised titanium base (primary abutment), which was to be fabricated from zirconium oxide. Subsequent bonding with the titanium base resulted in a hybrid abutment with full anatomical contours, both in the palatally and subgingivally positioned emergence area through the soft tissue. Room was left on the buccally visible area for a pressed ceramic veneer to be fixed by bonding (Fig. 30). Using a double scan, the dental technician imported the 3-D shape of the primary abutment and the wax model of the secondary abutment into the planning software (Abutment Designer, 3Shape; Fig. 30).

Then the secondary abutment was ground from zirconium oxide ceramic with CAM technology and immersed unsintered into a fluorescent solution (Fig. 31). The screw channel was prepared prior to sintering. As zirconium oxide cannot be etched, the dental technician had to fire a thin layer of etchable, highly fluorescent zirconium oxide veneer ceramic on to the buccal surface and preparation margin of the hybrid abutment prior to modelling the cap for the pressed ceramic veneer (Fig. 32). Fluorescence ensures the transmission of light in the gingival area. This has a positive effect, particularly in the case of a thin gingiva. Then, the dental technician fabricated and veneered the pressed ceramic caps for the crowns and veneers (Figs. 33–35).

After a successful aesthetic try-in in the laboratory (Figs. 36 & 45), the individual parts were combined. First, the titanium base was sand-blasted and conditioned, then the secondary zirconium oxide abutment was conditioned. Both parts were bonded with special composite. Then the inner side of the veneer and the sintered zirconium oxide veneer ceramic of the hybrid abutment were etched with hydrofluoric acid, conditioned and bonded with dual-curing composite (Fig. 37). Then, the transition areas were smoothed and polished (Fig. 38).

**_Insertion_**

The crowns were mounted by bonding and the implant-supported veneer crown was screw-retained (Figs. 39 & 40). This was followed by a careful check of the approximal contacts and function. The final X-ray confirmed successful osseointegration of the implant and harmonious emergence of the implant-supported restoration from the bone (Fig. 41). Figures 42 to 45 show the aesthetically successful outcome and a very satisfied patient.

**_Discussion_**

The example demonstrates successful immediate implantation in the anterior maxilla of a female patient with a thin biotype and high smile line. In addition, the buccal bone lamella was missing, so that the bone and soft tissue had to be augmented as part of immediate implantation—without preparing a flap. This demanding task can only succeed when the surgeon and if
Implant-supported single-tooth restoration

The prosthodontist and the dental technician work together as an optimal team and use suitable methods and materials. In the case presented, surgery and prosthetics were performed by the same dentist, who had been working together intensively for many years with the dental technician in the same location. At the beginning of treatment, the patient presented to the laboratory for an aesthetic analysis to give the dental technician a detailed understanding of the situation.

In order to obtain adequate tissue volume in the implantation area, the surgeon employed proven bone and soft-tissue surgical procedures. These included using a bone mixture for augmentation and a tunnel technique for thickening the buccal soft tissue. Literature shows that stable tissue volume and a constant marginal soft-tissue border can be achieved in this way even in the case of an impaired implantation site with missing bone lamella. This procedure is not recommended in the current consensus statements by the professional associations owing to difficult predictability of individual results.

A specialty here is the use of a two-part hybrid abutment as the base for the pressed ceramic veneer. In order to obtain a biochemically optimal titanium bonding base, a straight CONELOG Esthomic abutment was customised in place of the alternative CAD/CAM component. The secondary zirconium oxide abutment was waxed up. Then, both components were scanned. This is where the CAD/CAM process came into play with the fine-tuning of the design on the screen and machine fabrication of the zirconium oxide secondary abutment. Despite using a titanium primary abutment, the dental technician achieved a natural light effect by the consequent use of fluorescing materials.

As all components of the implant-supported restoration were bonded in the laboratory, the dentist was able to screw them in place together as a single piece and in a single session. This meant fewer treatment sessions for the patient, who did not have to return to the practice after impression taking until final insertion. The aesthetic try-in before final bonding of the individual parts was performed in the laboratory. The procedure described is only possible in close cooperation and with full confidence between the team partners.

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

**Analogical and digital**

A large part of the treatment and technical work steps were performed with conventional surgical prosthetic and craft-dominated technical dental methods (analogical). Computer-supported planning was not employed, so that the surgeon was not guided but implanted freely in accordance with the surrounding structures. This requires a precise clinical and radiographic analysis of the initial situation, appropriate planning and a high degree of expertise. Impression taking also followed conventional techniques. Editorial note: A list of references is available from the publisher.
An implant-supported prosthetic restoration concept for edentulous atrophied maxillae

**Author** Dr Frank Zastrow, Germany

_Autogenous bone block grafts_, bone grafting material or a combination of both can be used to restore an implant site of adequate dimensions in an atrophied maxilla. If the vertical height of the bone is inadequate in the posterior region, a sinus floor lift is often indicated to stabilise the implants safely.

In the case presented here, surgical treatment based on Prof. Fouad Khoury's biological concept for bone grafting using a combination of autogenous bone block grafts and particulate bone chips is described.

The case report also describes the layering technique as part of a sinus floor lift in conjunction with bone grafting material. The objective of the treatment is a restoration with long-term stability and a good aesthetic result. An implant-supported bar-latch design based on Dr Friedrich-Wilhelm Pape's prosthetic concept (Schellenstein concept) was used.3
Initial situation

The 60-year-old patient was referred to the practice with a telescopic restoration on natural abutment teeth 11, 21, 22 and 23. Crown and bridge restorations were used in the mandible; however, teeth 21 and 22 could not be preserved and were extracted. Abutment teeth 11 and 23 could not be preserved, but served as abutments for the temporary restoration until fabrication of the final prosthetic restoration.

In the premolar region specifically, pronounced horizontal and vertical bone defects that required comprehensive augmentative measures were identified in the preoperative 3-D CBCT images (Figs. 1–4).

Surgical treatment

The surgical treatment consisted of three procedures, each performed at three-month intervals. In the first procedure, performed under general anaesthesia, a FRIOS MicroSaw (DENTSPLY Implants) was used to harvest a bone block from the retromolar region of the right mandible (Figs. 5 & 6). The harvested bone plate was thinned and then placed at a distance using osteosynthesis screws (micro-screw, Prof. Khoury and stoma) for horizontal expansion of the right maxilla and the resulting space was filled with particulate autogenous bone chips (Fig. 7).

Particulate bone causes an increase in the surface and therefore better vascularisation of the augmented bone. In the second quadrant, an external sinus floor lift was performed based on the layering technique (Fig. 8). A slow resorbable phycogenic bone grafting material (FRIOS Algipore, DENTSPLY Implants) was placed in the cranial region, while the caudal region was filled with autogenous bone chips. This arrangement of bone grafting material and autogenous bone chips meant that the implants were placed in approximately 10 mm of autogenous bone, accelerating the healing phase. With this technique, the bone grafting material introduced in the cranial region prevented rapid resorption due to the pressure of the maxillary sinus.

The sinus window was covered by a non-resorbable membrane made of medical-grade...
case report _ restoration of atrophied maxillae

A mucoperiosteal flap was used for soft-tissue coverage in which the periosteum was slit to ensure tension-free closure over the grafted bone.

In the course of this first procedure, four XIIVE implants (DENTSPLY Implants) were inserted into regions 12, 22, 24 and 26 (Fig. 11).

After three months, as a part of the second surgical procedure, the previously augmented area was opened. The site appeared to be well regenerated and vascularised. In the procedure, two additional XIIVE implants in regions 14 and 16 were inserted, resulting in a total of six implants available with uniform abutment distribution in the maxillae as a basis for later prosthetic restoration (Figs. 12–15).

After another three-month healing phase, the last surgical procedure exposed the implants...
by means of an apical sliding flap. The natural mucogingival junction was then restored and gingiva formers inserted (Figs. 16–18).

**Impression**

The soft tissue took three weeks to heal around the gingiva formers. For the prosthetic treatment phase, four appointments were necessary for completion of the final restoration based on Dr Pape's prosthetic concept. In the first session, an impression was taken with the repositioning technique with transfer copings inserted into the implants (closed-tray impression) and an initial impression taken with a stock tray (Fig. 19).

This impression was used in the laboratory to fabricate an initial cast and to prepare a second impression using the pick-up technique. The impression posts were rigidly attached to the cast using PATTERN RESIN (GC). This index was separated again between the implants in the laboratory and the impression posts were placed in the patient's mouth in the second session (Fig. 20).
case report _ restoration of atrophied maxillae

The separation gaps were reconnected intra- orally with PATTERN RESIN to ensure high pre- cision for the second impression (Impregum, 3M ESPE) by stiffening of the posts (open impres- sion with custom tray). In the laboratory, a master cast with a gingival mask was fabricated and a tooth set-up prepared for aesthetic try-in (Fig. 21).

_Prosthetics_

In the third prosthetic session, the wax try-in (aesthetic try-in) was carried out on the patient. The master cast, related antagonist bite impression and tooth template were sent to the milling centre in Hasselt in Belgium for fabrication of the CAD/CAM framework (ATLANTIS ISUS, DENTSPLY)

Fig. 21. The master cast with a gingival mask and the tooth set-up in wax.

Fig. 22. Bar try-in with teeth 11 and 23 extracted.

Fig. 23. Tension-free fit of the bar before positioning of the final restoration.

Fig. 24. Buccal view of the bar with “bolt eye” clearly identifiable.

Fig. 25. Radiographic control after bar placement. Proper fit is easily recognised.
the free ATLANTIS ISUS Viewer software in the laboratory to view in 3-D and finalise digitally the bar design proposed by the milling centre. The bar was then milled from cobalt–chromium at the milling centre and the restoration shipped to the dentist’s private laboratory. Owing to the precision of the impression and industrial fabrication, the bar framework exhibited a tension-free fit and served as the basis for fabricating the final superstructure in the laboratory.

In the final session, before positioning the finished restoration, the fit of the bar in the patient’s mouth was checked using the Sheffield test. The fit of the bar again appeared tension free, allowing the bar to be permanently screwed to the implants (Figs. 22–24).

The primary splinting of the implants by the bar gives the restoration great stability in the augmented bone in particular. Owing to the uniform distribution of the implants in the ridge and creation of a large support polygon, good force distribution across the implants is possible, which in turn achieves a good long-term result. Because the bar construction is screw-retained, the risk of leaving excess cement in the peri-implant region, which poses the risk of peri-implantitis and should not be underestimated, according to the latest studies, is avoided.

The removable palate-free prosthesis is provided with latches (MK1 attachment) on both sides to anchor the prosthesis to the bar firmly. The latches counteract pull-off forces and prevent abrasive wear on the bar when the canine guidance is set and the resulting friction loss of the bar-latch design (Figs. 25 & 26).

**Conclusion**

Owing to primary splinting of the implants with a bar construction and the large support polygon created, maximum stability is achieved directly in the augmented bone. In atrophied maxillae, it is often observed that the maxillae are smaller than the mandible owing to centripetal shrinkage. The advantage of the bar restoration over a telescopic restoration with regard to this problem is the decoupling of tooth and implant position. The bar can be placed in front of the alveolar ridge and, despite an unfavourable initial situation, still achieve good occlusion and lip support.

The bilateral latches for this restoration give the patient direct control of the anchoring of the restoration and thus a feeling of security. In addition, access for cleaning is not affected in any way because the restoration is removable. The use of latches takes into account the patient’s desire for a fixed restoration and the requirement for long-term stability, which is the basis of the easy-to-clean design. Furthermore, the removable restoration allows quick and easy repair, and chipping is never an issue because ceramics are not used.

Unlike a fixed restoration, no aesthetically or phonetically compromising cleaning channels are required. The cleaning channels of fixed implant bridges often make it difficult for patients to form the ’s’ sound. This can bring into question the success of the entire restoration because it can make the patient feel uncomfortable and insecure owing to speech impediment. In contrast, the restoration presented here does not affect pronunciation at the buccal plate.

The final restoration exhibits a functional, aesthetically pleasing, and phonetically unimpaired result that meets the patient’s wishes. Therefore, this treatment concept is a good option for restoration of edentulous atrophied maxillae.

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

**_about the author_**

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“It is fantastically simple!”

In this interview, Vanik Kaufmann discusses the advantages of KaVo’s new ARCTICA CAD/CAM system.

When it comes to state-of-the-art CAD/CAM technology in dental laboratories, patients are in good hands with master dental technician Vanik Kaufmann-Jinoian. His numerous lectures on the subject are impressive proof of this. The proprietor of the Cera-Tech dental laboratory in Liestal near Basel has been a CAD/CAM user from the very beginning, as well as provided valuable input into the technology’s development through his active participation in it. Recently, he became a user of KaVo’s new ARCTICA CAD/CAM system. We asked him about his first impressions of working with the system.

CAD/CAM: You recently started using KaVo’s ARCTICA CAD/CAM system. You have extensive experience with CAD/CAM systems. What do you consider ARCTICA’s advantages to be?

Vanik Kaufmann: First, there is the striped light scanner. I particularly like that it is a semi-automatic design. With fully automated systems, I often encounter problems with cumbersome re-scans when the first scan was incomplete. Scans that require essentially no corrective work can be achieved with very little experience. In addition, it works extremely quickly. Even in cases in which the scan shows gaps, the model can be repositioned accordingly, perhaps by tilting, and the software applies any subsequent corrections automatically.

And what are your experiences with the grinding unit?

I really appreciate that it is a compact five-axis system that uses blanks very economically. Furthermore, I am finally able to process metal, something that until now had not been possible with small systems.

Is zirconium dioxide still important nowadays?

There are still dentists who request metal frameworks. When cobalt–chromium alloys are required, we have them externally made by selective laser sintering. When biocompatibility is required, we have to use titanium. We process a large number of titanium connecting bars and until now had to have them fabricated externally.

Now, we are able to do this in house, and the design is simple and fast using the accompanying software.

How practical is the software?

It is fantastically simple. For example, during the design of an anterior bridge, the automatically proposed crown can be moved and rotated through key combinations, making the process considerably faster and simpler than with solutions that require multiple key clicks. Also, its operation is intuitive: within half an hour of receiving it, I was able to do a bar design without a hitch and without any training. KaVo’s hotline with remote support is equally fantastic and useful, especially in the early stages when one might have the occasional problem. The consultants are highly competent, they can log in remotely and point out mistakes on your own screen and give hints on how to do things even faster.

The multiCAD dental CAD/CAM software has an open interface, but not every scanner supplier offers an open interface. To what extent can you transfer data?

We are able to do this not only with manufacturers that provide STL files, but also with those that still believe in the advantages of proprietary systems. We use Dental Shaper for Rhinoceros (CIMsystem) for this purpose; it can convert all relevant data sets to compatible STL files. One could also use a printer (Solidscope).
Do you use ARCTICA data in multiCAD as well?
Yes. We have decided to no longer do the wax coating for precious metal castings by hand, as this can be done very simply and quickly in the KaVo software. We design the framework on computer and transfer the STL data directly to the printer. The printer is very accurate and saves us a great deal of work.

Besides KaVo’s blocks of titanium, zirconium, glass-infused ceramics and plastic, there is the option of using other materials. Do you use them?
We have the open system and do both. Alongside KaVo’s materials, we use VITABLOCS RealLife and VITA CAD-Temp blocks (both Vident). We fabricate our own plastic and wax blocks too, which we can use via the exchangeable holder.

Could you share your experience with the implant module in multiCAD?
We fabricate connecting bars from titanium with bonded bases. We also use titanium bonded bases for our zirconium abutments, since we have had bad experiences with whole zirconium abutments with screw connections—they loosened over time. For lateral applications, we also fabricate titanium abutments, which we weld to the bonding base. The design of these abutments too is amazingly simple: one draws what one has in mind.

Thank you very much for the interview.

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Planmeca and the University of Turku found Nordic Institute of Dental Education

The objective of the new institute is to export and share Nordic expertise in digital dentistry on the basis of academic knowledge and technologies. (Photo: Planmeca)

Dental technology company Planmeca and the University of Turku have founded a joint venture company, the Nordic Institute of Dental Education. The institute will offer high-quality continuing education courses to dental professionals.

The objective is to export and share Nordic expertise in digital dentistry on the basis of the academic knowledge of the University of Turku and the technologies developed by Planmeca, as well as their global dental networks.

The courses will be held at the University of Turku and at Planmeca’s headquarters in Helsinki from autumn 2014. The course topics cover rapidly evolving dental technologies and their application in modern dentistry, including 3-D imaging, prosthodontics, endodontics, biomaterials science, orthodontics and CAD/CAM technologies.

The University of Turku awards ECTS credits (a standard for higher education in Europe) and course certificates to the students. The joint venture company complements Planmeca’s broad range of training activities and collaboration with universities around the world.

The University of Turku is an active participant in the export of education. “We have now established a partnership with one of the world’s leading companies in dental technology. Together with Planmeca we are a strong education provider globally,” stated Prof. Kalervo Väänänen, Rector of the University of Turku.

Course registrations: www.nordicdented.com

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Adentatec 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 is always motivated to support their customers as best as they can. The company is represented at many dental exhibitions all over the world to keep in touch with customers and to introduce its products to prospective customers face to face. Adentatec seeks to establish a mutual relationship with its suppliers, customers and business partners.
Ease of use meets restorative flexibility in the new NobelProcera Hybrid

At some point, denture wearers return to their dentist. Perhaps they need to have their denture repaired or maybe they would like a solution that feels more like their natural teeth, but cost is a concern. Whatever the reason, there is a significant opportunity for both laboratories and restorative dentists to assist this flow of returning patients. This is precisely where the new Hybrid fixed implant restoration from NobelProcera (Fig. 1) can help.

...The key to more implant treatments...

Dental laboratories today are looking for new ways to distinguish themselves. In an increasingly competitive market, they need to differentiate to develop. Fixed implant restorations like the NobelProcera Hybrid make it possible to do just that, offering great results for the patient.

The Hybrid brings together excellent acrylic support with the time-efficient workflow of a fixed implant bar at an attractive price. It offers the best of both worlds and, importantly, is manufactured to last.

As a relatively cost-effective option, the Hybrid offers an increased likelihood of patient acceptance. This means a greater number of cases for the restoring dentist and the dental laboratory, helping them to build their businesses while dramatically improving quality of life for the patient.

Furthermore, the Hybrid is compatible with the All-on-4 treatment concept. This clinically proven treatment enables the restoration of a fully edentulous jaw on just four implants. It is therefore less invasive and more affordable, further increasing the rate of patient acceptance.

...Precision and design in perfect harmony...

...Advantageous for professionals and patients...

Theoretically, every removable denture represents an opportunity to improve quality of life with the Hybrid. It is a product that perfectly embodies Nobel Biocare's goal of helping its customers treat more patients better. It increases patient flow while offering patients a better standard of care. That is surely the objective of every dental professional, and it is the reason dental laboratories should add the NobelProcera Hybrid to their offering today.

Editorial note: A complete list of references is available from the publisher.
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Bionic restoration: Take the next step. Imitate nature. Imitate the best.

Schütz Dental is proud to introduce the latest concept of "bionic restoration". This system imitates both the aesthetics and the physics of the natural tooth.

The framework for the bionic restoration is made from Tizian Zirconia Reinforced Composite, a newly developed combination of high-performance acrylics and zirconium dioxide. This CAD/CAM material stands out for both its flexibility and stability. Owing to its flexibility, the framework acts as a buffer, reducing pressure on the jawbone and temporomandibular joint. This buffering effect is particularly relevant for implant-supported restorations and bruxism patients.

The Tizian Zirconia Reinforced Composite framework is veneered with a thin layer of dialog Occlusal veneering composite. The material is both abrasion resistant and antagonist friendly. This combination ensures that restorations last longer while being gentle on the natural teeth.

This system, consisting of both materials, imitates the physics of the natural tooth. The elastic core evenly distributes masticatory forces, reducing impact. Furthermore, the tough veneer renders restorations durable and aesthetic.

The bionic restoration is suitable for permanent inlays, onlays, crowns and bridges of up to three units. More information can be found at http://sdent.eu/bionicprinciple.

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**Fig. 1** The combination of Tizian Zirconia Reinforced Composite and dialog Occlusal imitates the physics of the natural tooth.

**Fig. 2** Final treatment, up to three units.

**Fig. 3** The system is perfectly suited to implant-supported restorations.

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**Questions?**

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