CAM technology offers significant advantages compared to conventional manufacturing techniques. Fabricating high quality prosthetic restorations was always associated with time-consuming laboratory processes requiring meticulous care and experience in the dental laboratory. The application of CAD/CAM technology offers, amongst others, three significant benefits. The availability of biocompatible materials such as oxide ceramics, homogenous materials and a standardised precision as well as reasonably low costs paired with clinical versatility. There are several clinical benefits.

**Oxide ceramics**

Oxide ceramics where introduced to the dental market in conjunction with advancements in CAD/CAM technology, since they cannot be manufactured by conventional means. While initially the esthetic potential was in the focus of applying high-strength all ceramic restorations, the true benefit of e.g Y-TZP/ZrO2 (yttria stabilised polycrystalline tetragonal zirconia) is its excellent biocompatibility paired with flexural strength values that allow for application in any area of the oral cavity for both natural teeth and dental implants. When in close contact with the surrounding tissues, the reduced plaque and bacterial accumulation as well as the development of currently undefined pseudo-attachments leads to long-term tissue stability around these components (Fig.7).

**Homogenous materials and standardised precision**

Casting a multi-unit framework requires a dental technician with considerable knowledge and skills, and is often associated with time consuming adjustments that the dentist and technician must perform in order to achieve an adequate fit. There are several steps that are prone to potential error. In many clinical situations, cast bars or frameworks must be sectioned and splinted intraorally during a try-in examination, followed by soldering the sections together in the laboratory to improve the fit.

Soldering and resoldering can result in weakened inhomogeneous material quality at the solder joints. With the application of CAD/CAM technology restorations are not only milled about the author

**Hans Geiselhöringer**

first trained to become a dental technician in Germany. In 1991 and 1992, he embarked on further training in New York, USA focusing mainly on anaplastology/epithetics, followed by further education to become a technical business administrator, completing his studies in 1994. After this, he took up the position of business manager and laboratory manager, concentrating on implantology and ceramics until 1998. Since 1998, he has worked on an independent basis with the company he founded in Munich – a laboratory specialising in CAD/CAM technology, implantology, anaplastology as well as functional and aesthetic reconstructions. His expertise is reckoned to multinational enterprises who he advises as a consultant. Besides being a member of multiple professional organisations he is a distinguished and highly respected lecturer throughout the world, and since 2008, Hans Geiselhöringer is Global Head of the new NobelProcera and Guided Surgery business unit at Nobel Biocare, Zurich.

**Fig.4:** Intuitive and user-friendly software (NobelProcera system software) supports the user in fast and efficient framework design. Providing custom design components for the specific clinical situation does not only support the concerning material or surrounding soft tissue but ensures clinical long-term success through adequate design and material thickness.

**Fig.4a:**  **Fig.4b:**

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from homogenous block material such as titanium, non-precious alloys (eg CoCr) or ZrO2, but the high precision of industrial milling machines reduces the risk for subsequent clinical adjustments and recurring complications such as abutment screw loosening or fracture of components upon long-term clinical loading.

Versatility and low cost
One of the greatest advantages of CAD/CAM technology is its clinical versatility, not only the clinical situation, but also patients’ expectations and means can be met. Whether a low-cost non-precious alloy substructure is veneered with resin or ceramic material or a high-end all-ceramic solution is requested, whether a conventional denture set-up is retained by an overdenture bar or an implant retained removable restoration is finished with custom all ceramic or a high-end all-ceramic material or a high-end all-ceramic solution is requested, whether a conventional denture set-up is retained by an overdenture bar or an implant retained removable restoration is finished with custom all ceramic teeth and individualised gingiva-colored composite, the base components such as copings, frameworks and bars always guarantee maximum precision, material homogeneity and stability for all patients.

**About the author**

Dr Stefan Holst studied dentistry at the Medical University of Hanover and obtained his doctorate in 2001. In 2006 he completed his Habilitation thesis and obtained his docent degree from the Department of Prosthodontics at Louisiana State University, USA. He was appointed assistant professor at the Dental Clinic 2 – Prosthodontics, Friedrich-Alexander University Erlangen-Nuremberg, Germany in 2001. In 2006, he completed his habilitation thesis and obtained his Dr med. dent. habil. (PhD equiv) degree from the University of Erlangen-Nuremberg. His field of specialisation encompasses aesthetic dentistry with an emphasis on implantology, prosthodontics and complex interdisciplinary treatments. His research work focuses primarily on digital dentistry, all ceramic restorations and material sciences and biomechanics. Dr Holst is appointed clinical associate professor and senior lecturer and heads the research lab and large quantities of materials such as gold alloys and available burn-out copings. The new CAD/CAM software system allows for computer virtual design of any type of bar structure needed following a mere scan of the master model/impression and a wax-up (a,b). Industrial manufacture will provide highly polished frameworks with excellent precision of fit and a broad range of additional attachments to be selected (c,d) – here NobelProcera Overdenture bar with Locator attachments on XiV e, Friadent, implants.

Fig.7: Removable implant-retained overdentures have been quite cost-intensive in the past, as manufacturing required time, skills and large quantities of materials such as gold alloys and available burn-out copings. The new CAD/CAM software system allows for computer virtual design of any type of bar structure needed following a mere scan of the master model/impression and a wax-up (a,b). Industrial manufacture will provide highly polished frameworks with excellent precision of fit and a broad range of additional attachments to be selected (c,d) – here NobelProcera Overdenture bar with Locator attachments on XiV e, Friadent, implants.

**Fig.7a:** Zirconium dioxide is ideally suited for restorations in close contact with the surrounding tissues (NobelProcera, Anatomic Shaded Zirconia).

**Fig.7b:** Consistent product quality and precision of fit (here: NobelProcera, framework milling unit).

**Fig.7c:** EDO – Excellence in Orthodontics and DentoFacial Orthopaedics (EDDO)

**Fig.7d:** IS PROUD TO PRESENT...

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The challenge of aesthetics

Markus Jedlinski explains how the HeraCeram Matrix system from Heraeus can help to create perfect aesthetic restorations

It’s a constant challenge for dental technicians to fabricate natural, aesthetic restorations.

The ability to carry out aesthetics does not require a creative spirit, but the ability to copy to produce the perfect imitation. Success, however, also depends on which materials can most perfectly imitate the optical properties of the natural tooth structure. The HeraCeram Matrix system from Heraeus has been used in the following case history.

Case study
First assessment of the initial situation indicated a highly abraded dentition (Figure 1). The patient wanted the natural tooth shape and length restored. A slight diastema was also to be closed. The purpose of treatment was to restore the anterior/canine guidance as well as to correct premature contact of the occlusion.

The aim was to fabricate a perfect restoration taking aesthetic and functional aspects into consideration. In consultation
with the dentist, it was decided that the best option was full re-
habilitation of the upper denti-
tion, which should be as mini-
mally invasive as possible.

The canine was so heavily
abraded in the initial situation
that the premolars had already
assumed lateral incisor guidance
(Figure 1a). The dentist there-
fore decided to raise the bite by
two millimetres in order to re-
construct the anterior teeth to the
correct length.

First wax-up
With all the restorations, as
in this case, it is helpful to fab-
ricate a wax-up first. This is
particularly practical when cor-
correcting malocclusions in order
to identify and remedy any faults
at the beginning of treatment.
The wax-up gives an idea of the
planned restoration.

Before pouring the model,
the impression was degreased
using a silicone wetting agent to
guarantee a porous-free model. The
dental arch was then trimmed,
pinned, based and provided with a
split cast.

The upper model was then
mounted on an articulator ac-
cording to the cranial relation-
ship and the lower model was ar-
ticulated using a myocentric bite
registration. A removable gin-
gival mask is recommended to
integrate the gingival situation
into the subsequent working
stages. A silicone index is fabri-
cated on the unsectioned work-
ing model and the mask silicone
can then be syringed into the
index after the model has been
sawn and prepared.

Preparation under the
microscope
The preparation margins were
carefully exposed and marked
under a microscope. The die
segments were prepared for the
gingival mask. The intention
was to reproduce the anatomical
root shape of the teeth to about
the middle of the proximal area.
This created an adequate thick-
ness for the gingival mask. The
remaining dies were trimmed on
da die trimmer, hardened with
superglue and replaced in the
model base. It is important to
ensure accurate repositioning of
the silicone index.

Mandibular excursions shou-
d be taken into account when
fabricating a diagnostic wax-up.
The anterior teeth were waxed
up to the premolar region using
thin wax veneers of natural an-
terior teeth, which corresponded
approximately to the correct
shape and size (Figure 02).

Focus on the occlusal and
proximal contacts
The next stage was to wax up
the upper posterior teeth. When
waxing up the posterior teeth
particular focus should be placed
on the anterior/canine guid-
ance and contour of the occlusal
and proximal contacts. Only the
fine details of the form and func-
tion of the teeth still had to be
completed – with constant moni-
toring of the extrusion move-
ments of the mandible (Figure 5
and 4).

The advantage of such a de-
tailed, contoured wax-up is that
virtually any region can be the
starting point for fabricating the
restoration. Try-in of the diag-
nostic wax-up provided infor-
mation relating to the axis align-
ment, midline and final tooth
length. A silicone index of the
wax-up was then used to fabri-
cate a veneer framework with an
anatomically scaled down tooth
contour (Figure 5).

The first stage after pressing
was usually to devest the veneer
frameworks using two-bar pres-
sure and 50 mµ glass beads. The
next stage was then to sandblast
the frameworks using approxi-
mately 0.7-1.0 bar. This removed
any remaining investment from
the frameworks (Figure 7).

The frameworks were also
prepared under a microscope.
High spots on the inside of the
framework and any overextend-
ed margins were removed. The
gingival mask fabricated earlier
was used to check the avail-
able space (Figure 9).

The build-up concept
There was a certain amount
of flexibility, as full rehabilita-
tion of the upper was planned.
The patient wanted the shade to
match the lower teeth. The shade
of the lower teeth was between
A5 and A5.5. The natural teeth
also had staining. This allowed
characterisation to be slightly
more pronounced.

There are a number of op-
tions and techniques for fabri-
cating all-porcelain restorations.
HeraCeram porcelain from Her-
aeus was selected in this case.

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The excellent light optical results and high stability attained with HeraCeram are very beneficial for the patient – not only with respect to the aesthetics but also in terms of reliability.

**Top marks for optimum aesthetics**

High aesthetic standards are attained using the opalescent and fluorescent porcelains of the HeraCeram Matrix range (Figures 10 – 15 + 18). Opal incisal and opal transparent porcelains are used for final adjustments to the shape of the teeth (Figure 19).

After the second dentine firing, all the crowns were subjected to spot grinding and the fine details of the shape were adjusted. The interdental spaces were contoured to ensure that the interdental brush could be inserted by applying only light pressure to the gingiva (Figure 20).

The occlusal contact points were placed on plateaus (Figure 22) and the proximal contacts contoured spherically in order not to disrupt mandibular immediate side shift. This simplifies subsequent oral hygiene measures.

After glaze firing, the buccal surfaces were polished with pumice powder. This produces a natural abrasion effect on the ridges and a satin glaze finish.

The result: The all-porcelain restoration is impressive and not simply because of its optimal aesthetics (Figure 27 and 28).

**About the author**

Markus Jedlinski is a dental technician. He started his apprenticeship in 1997 in a German dental laboratory and after graduating, he's worked at several different labs, including Jan Langner GmbH in Schwäbisch Gmünd for 1.5 years. Since 2003 he's worked as a dental technician at Dental Technik Günther Knab GmbH in Crailsheim. 

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