THE DENTAL
SOLUTIONS
COMPANY™

Dentsply Sirona

Shaping the future

CAD/CAM in university training

dentsplysirona.com/clinics

Content

Jörg Vogel
Vice President
Sales International
Clinic Solutions

Dear readers,

When it comes to the future in dentistry, we at Dentsply Sirona Clinic Solutions are fully behind digitisation. It is our goal to support dentists in daily hospital routine with innovative solutions offering the greatest possible additional benefit for practitioners, teachers and patients.

What distinguishes us? We are continuously filing away at our ideas and technologies, putting our visions into practice, thinking and acting on a solution-oriented basis. For example in the field of prosthetics: At many universities, prospective dentists are still only receiving theoretical preparation for a digital future. However, digitisation is not a pipedream, but reality. That’s why the latest digital technologies must accompany students from the preclinic through daily clinical practice to postgraduate training.

CEREC is a system which offers future security. Dentistry students should also feel this and be optimally prepared for professional integration. For handling digital technologies, such as CEREC, forms part of a modern dentist’s know-how and opens up diverse career perspectives.

This brochure shows how optimally preparing students for digitally supported dentistry can pay off. With exciting reports from everyday teaching and clinical practice in Giessen, Mainz, Groningen and Santiago de Chile.

I hope you enjoy reading.

Sincerely
Jörg Vogel

Did you know …

… that it is over 30 years since CEREC ushered in the digital revolution in dentistry? And since its inventors Dr. Werner Mörmann and Dr. Marco Brandestini at the University of Zurich began to realize their idea for CAD/CAM supported prosthetics? Let us shed some light on further exciting facts about CEREC and Dentsply Sirona here.

Fostering future generations of dentists

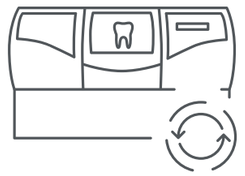
500
projects worldwide,

incl. **2,000**
simulation units
in the last 10 years

600
scientists and engineers
work on the largest **R&D** platform in the dental industry

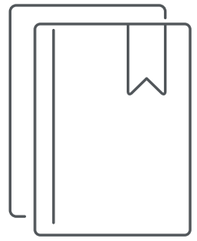
125 million
US dollars invested annually by Dentsply Sirona in **R&D**

An impression is taken every **4 seconds** using an intraoral scanner by Dentsply Sirona



Some
35,000
CEREC units
are installed worldwide

Our worldwide largest production site for the dental industry in **Bensheim** employs some
2,000 staff



50 studies
testing products and solutions are supported by Dentsply Sirona

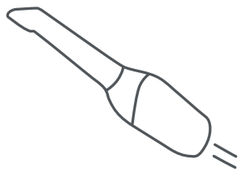
2,100
students
a year undergo a **CEREC Curriculum***

*You can find out on pages 8 – 11 what a CEREC Curriculum is.

1 billion
patients a year are treated with **our products**

>1 million
cases a year are processed through the **Connect Case Centre Portal**

7.3 million
digital impressions a year with CEREC Omnicam



85% of hospitals in the **USA** are **fitted out with CEREC**

28 out of 30 universities have **CEREC in Germany**

“Contemporary training is essential for universities”

Using four reference cases, this brochure shows how CAD/CAM implementation is succeeding in university training, what experience has already been gained and is currently being had and what the prospects are. In the following interview the people responsible for hospital business at Dentsply Sirona, together with Jörg Vogel and Klaus Lehmann, describe the rationale on which the company bases its support for universities.

Jörg Vogel

Klaus Lehmann

Dentsply Sirona has been fostering the CAD/CAM curriculum at colleges and universities for over 20 years. What specifically do you do here?

Lehmann: We are inviting universities to incorporate the latest CAD/CAM methods into their training. We support them in developing a curriculum and instruct them on technology and handling at the start. We further offer training for the teaching staff, train-the-trainer courses and also training when there are software updates.

You put considerable effort into this. Why is CEREC so important for training?

Vogel: Today CEREC is a recognised method in computerised prosthetics manufacture. So students should be prepared for everyday clinical routine with digital impressions and the direct manufacture of ceramic restorations. Here CEREC is the only system to provide a complete workflow and in prepCheck contains an unrivalled control and practice tool. We would see a gain for universities, if in future CAD/CAM were to play a larger role in studies and the dental licensing regulations. What we are able to do in a supportive role, will materialise.

For the next generation of dentists: digital dentistry starts while studying.

How do universities rate Dentsply Sirona’s commitment?

Lehmann: Initially our commitment was greeted with scepticism because of course every company also pursues economic interests. After many years in which only isolated universities “took part”, we are now involved in 45. They have all realised that up-to-date training modules are essential to them, as otherwise they stand to lose out image-wise. Today we can say that a veritable win-win situation has come about from cooperation with universities: Universities offer improved training standards and Dentsply Sirona benefits from dentists setting up practices that can assess the value of modern CAD/CAM supported methods in their investment decisions.

On the pages ahead instructors from four different university hospitals report on their experience with CEREC in university training. What is the take-away message for other universities?

Vogel: First of all various ideas on how integration can succeed. Universities vary quite a lot here – such as when it comes to overcoming administrative hurdles. You can also easily see student flexibility in terms of their timing when they use prepCheck. There are universities such as the one in New York which are open to students seven days a week. They do not constantly have a lecturer standing by to appraise their work. This is where prepCheck comes in.

And what are your prospects? Along what lines do you want to evolve the CAD/CAM curriculum in future?

Lehmann: We plan to broaden the regions in which we actively implement the curriculum. Apart from instruction and training in the systems, we will be expanding capabilities in building and operating networked systems so as to be able to meet our clinic clients’ special requirements. And, of course, in the future we don’t want to be just suppliers for universities, but also partners in training, teaching and research. You see: the transformation to end-to-end digital workflows in patient care is in full swing. This is true for all areas of dental activity – from restorative dentistry through prosthetics and surgery all the way to orthodontics. Henceforth imaging systems, CAD/CAM systems, software applications and production systems for prosthetics or ancillaries such as templates are going to merge into a holistic system where Dentsply Sirona covers every individual field. We want to contribute to the challenges arising from this situation at training centres being mastered in a professional and contemporary manner. And we want to enable students to share in all developments as early as possible.

Can you also see limits to digital dental technologies?

Vogel: There will always be a natural limit: people. This is because despite all the standardisation, many processes in dentistry are still in the hands of dentists. Outcomes are still going to depend on their expertise and skill. And that’s OK. I fundamentally consider digital technologies to be a meaningful support for human effort and not a replacement for it.

What personal experience have you picked up from the universities as an employee of Dentsply Sirona?

Lehmann: We are both continually at universities and see today’s students as bona fide “digital natives”. They grew up with computers and smartphones and do not have any inhibitions. Likewise, they are also very open-minded in relation to CAD/CAM technologies.

To conclude, please complete the following sentence: In five years time in universities CEREC will be …

Vogel: … a standard product to be used just like an x-ray unit or an autoclave. ■

Digital dentistry in teaching: personal, practical, future-oriented

Dentistry is now hardly imaginable without digital technologies. But how are students being prepared for it? What can a course of study provide here in light of the wider curriculum? The dentistry faculty at the University of Giessen has developed a CEREC Curriculum for this in the preclinic under the direction of Prof. Dr. Bernd Wöstmann including support from Dentsply Sirona.

One and a half days of CAD/CAM! The CEREC Curriculum for the fifth semester at the University of Giessen has got the lot. It was developed by a team led by Prof. Dr. Bernd Wöstmann with the goal of teaching students how to handle computerised prosthetics. Intraoral scanner technology has significantly improved in recent years, many prominent dental manufacturers nowadays offer such systems. “But we attach importance to digitisation as an aid, not as a replacement for our medical and manual work,” explains Dr. Maximiliane Schlenz, assistant dentist at the Polyclinic for Dental Prosthetics.

» Digitisation is an aid for our work.

CAD/CAM technology in dentistry has not been a regular fixture at dental university clinics for long. In Giessen they started to incorporate it into training within prosthetics ten years ago. Besides practical exercises, this also includes teaching theoretical basics such as material-dependent preparation, digital data formats or how to use intraoral scanners. Schlenz: “Our students should get to know different systems and interface critically with them. We impart the knowledge and teach them the capacity to profitably utilise digitisation in their working lives.”

Compact CAD/CAM training

The CEREC Curriculum, which in the fifth semester is held as a one-and-a-half day workshop, was started in the preclinic two years ago. It begins with an introductory lecture about digital impressions. This involves students getting to know the various imaging principles: active triangulation, confocal microscopy and stereo measurement. The most evident difference between intraoral scanners is in the imaging technology which is either based on images of individual teeth or video sequences. Further, CEREC is introduced – the system, which first brought intraoral scanning into surgeries and is currently the only one on the market to offer the full workflow from the scan to the finished restoration and to feature operation that can be validated. After an induction the students immediately get the possibility to perform scanning exercises on models which a tooth was previously prepared on.

» prepCheck gives direct objective feedback on the preparation.

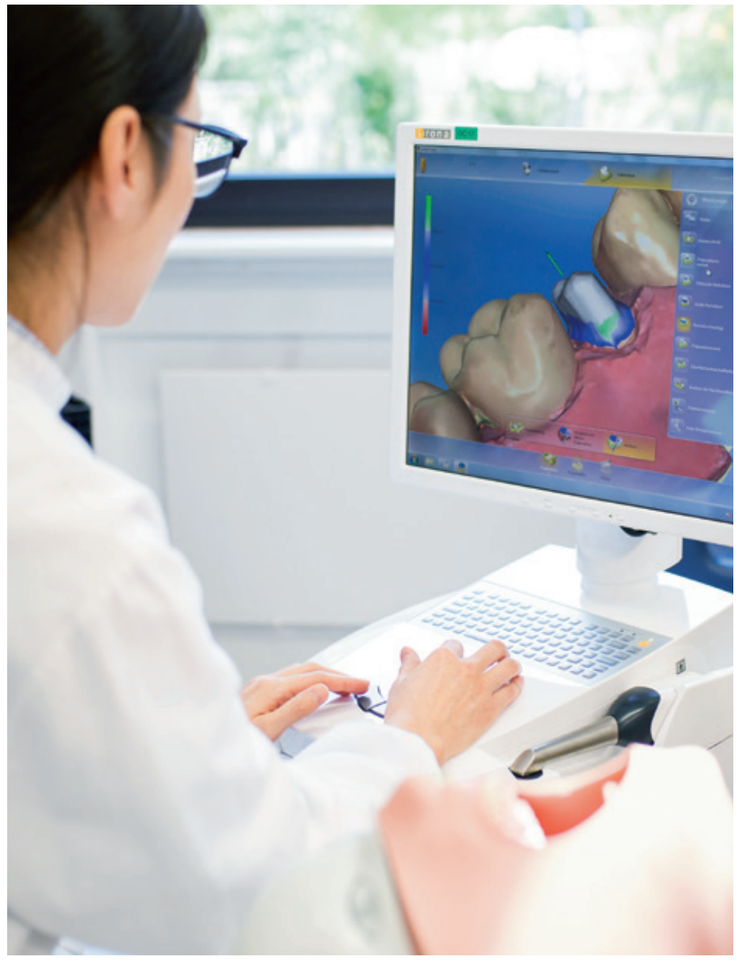
Initially everybody is still cautious in handling the equipment set up for this workshop by Dentsply Sirona. Holding the CEREC Omnicam properly takes some practice, the mode of working is still unfamiliar. Questions addressed to the assistants and Roland Felber, Key Account Manager Digital Dentistry at Dentsply Sirona, frequently have to do with using the technology. Even if students’ everyday lives are pretty much digitised: the requirements in computerised production of restorations are a different kettle of fish, not everything works from the word go. “That’s OK too,” assures Schlenz. “The students are here to learn – also having to deal with results that turn out differently from what was planned.”

Challenge of getting a precision fit

The production of a posterior tooth crown with CEREC follows the first scan. This involves the students using two possibilities to check the accuracy of their preparation and their scans. First the ceramic crowns milled in the first exercise are filled with silicon and placed on the model. Where is it a perfect fit, where not – and why? Here the prosthetics team’s expertise is repeatedly called upon. Especially as to the question: how can the precision of fit be improved by preparation and by scanning?

» Not everything works immediately – but that is all right.

The following lecture on the topic “Phantom head 4.0 – Introduction to new technologies for objective preparation analysis” transitions into the digital part of checking the preparation, preparation margin and wall thickness. →



A student uses the prepCheck software to compare her preparation with the master preparation while receiving suggestions for improvement at the same time.

prepCheck Report: The assessment of the preparation analysis is combined in a PDF document and emailed to the students after the course.

Teamwork on the CEREC Curriculum: The prosthetics team of the University of Giessen (from the left): Dr. Karin Michel, Dr. Maximiliane Schlenz, Dr. Alexander Schmidt, Dr. Kerstin Wegner and Roland Felber of Dentsply Sirona

Dr. Maximiliane Schlenz briefs the students on the functioning of CEREC prepCheck software: “The software gives immediate objective feedback on the preparation. This involves comparing the scanned preparation to a master preparation.”

» The software is great – but also brutally honest.

Clear quality test

The students directly test this function themselves: they scan their prepared models, draw a preparation margin using the software and store the data. Upon starting prepCheck, the stored file is opened and compared to the master preparation. The software precisely analyses the students’ work and checks how well they have made the preparations in terms of height, angular position, margin and distance to the antagonist. Coloured marks show where the preparation fits, where rework is needed and the sites in which major errors have appeared. The software thus answers questions such as: Are there undercuts in the preparation? Is the preparation angle right? Do I have sufficient space for a restoration occlusally and cervically? Is the preparation margin clean and unambiguously prepared? Is every edge rounded off?

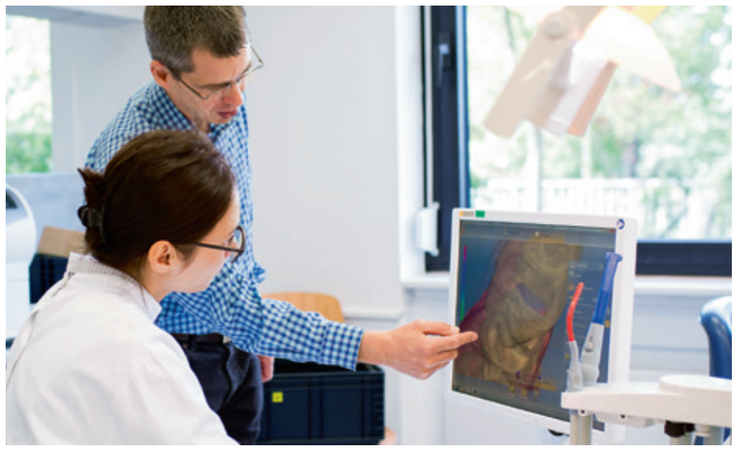
The students prove to be fascinated by CEREC, experiencing it sometimes for the first time in their lives. Moritz Liebel finds that “the workshop is exciting on account of the many practical exercises and brings real variety to studies”. “On one hand checking our own preparation with prepCheck is great, but on the other it is brutally honest,” explains Marko Felsch with a grin. Abdul Simsek adds: “It is important for us to see exactly what we have done wrong – it’s the only way to improve. The objectivity of software also makes it easier to accept the error analyses constructively.” But the software cannot replace the teaching staff. Schlenz: “We see prepCheck as a useful supplement. However, some questions and manual issues are best discussed in person; for which we are pleased to take the time.”

» We wonder how students will put the digital options into effect.

Teaching digital technologies practically

Teachers and students can save the results of the prepCheck check in a PDF document to enable the analysis to take place at a later time, too. This is helpful for reviewing learning progress, for example at the start and the end of a semester. Maximiliane Schlenz is also going to email them to the curriculum participants at the end. “I am pleased to do this for this manageable group of 26 students,” says the assistant dentist. “It helps them get a realistic picture of their own work and also boosts their motivation to use the self-study times and check other preparation.” Following completion of the CEREC Curriculum, the practical application on a patient then follows in the eighth semester.

“We attach importance to teaching the options in prosthetics to our students in a practical manner,” says Schlenz. “CEREC offers them the chance within the prosthetics field to get to know the full digitally supported workflow, to test materials for it and self-test their manual abilities. We very much appreciate the CEREC Curriculum as part of studies and wonder how students will put the digital options into effect on the patient.” ■



Roland Felber, Dentsply Sirona, in conversation with a student on digital impression matters.

Thrilling moment, the self-designed crown being milled in the CEREC MC XL.

Dr. Maximiliane Amelie Schlenz

- Polyclinic for Dental Prosthetics, Justus-Liebig University Giessen
- Since 2016 research assistant / dentist at the Polyclinic for Dental Prosthetics, focus: digital dentistry
- 2018 graduated as Dr. med. dent. at the Justus-Liebig University Giessen
- Since 2017 studying while employed on a “dental prosthetics” Master’s programme at the University of Greifswald
- 2010-2015 studied dentistry and licensed as a dentist at Justus-Liebig University Giessen

The future of dentistry is digital: CAD/CAM training at universities makes the difference

Digitisation allows for better dentistry because standardised and first and foremost precise workflows elevate treatment quality to a new level. But young trainee dentists have to be prepared for the digitised work environments from the very start. Dr. Gilbert Alex Jorquera Rivera, head of the Digital Dentistry division, describes how this is being achieved at the health centre of the University de los Andes in Santiago de Chile.

Dr. Gilbert Jorquera Rivera and his training team have implemented CEREC CAD/CAM training at the University de los Andes in Santiago de Chile.

Computerised dentistry has covered much ground in recent years. When it comes to planning and performing dental treatments, digital technologies have become an indispensable clinical tool for us at the university. We can therefore offer our patients functional, aesthetic and plannable solutions for their oral and dental problems. In addition, treatment times shorten, which patients very much appreciate. On the other hand, we can minimise errors in practice and laboratory activities.

CAD/CAM, i.e. CEREC, is synonymous with these digital technologies and has inspired me from the very start. I became aware of CEREC six years ago in a basic user course here at the University de los Andes in Santiago de Chile. I was amazed how simple and intuitive the system is to operate. At that time what I found most impressive was to see the preparations enlarged and displayed in 3D, to check them and to understand what I have to improve.

Today I mainly work in the field of restorative and aesthetic dentistry and use my CEREC knowledge to check preparations and restorations directly on screen. Working with this system has definitely made me a better dentist. I think the students perceive that too. And they notice that dental treatments are simpler with a standardised workflow.

Involving the patient

With CEREC we can work more precisely because scanners along with grinding and milling machines support us in producing restorations. We have the possibility to discuss and analyse treatment in detail with patients because we can show them the desired result and the individual treatment steps on the computer. Further, workflows from various areas such as imaging, implantology, orthodontics and restorative treatments can be interconnected.

As a teaching hospital I see us in a very important role when it comes to embedding digital technologies in dentistry. The idea is to unleash students with ambitions and innovative ideas into the work environment so that they can continue on from their training and contribute to the advancement of new technologies.

» CEREC made me a better dentist.

I see it not as a matter of course, but as a privilege that we work with CEREC at our university clinic's health centre, because at the outset we had some obstacles to overcome. The first one consisted of making it clear to all those involved in the project that this is not just a technology for manufacturing a crown or a bridge, but a system to facilitate self-study and teaching. The second was and is to be found in us humans, in our access to technology. I am very glad to have received the support of the university authorities and that the dean Dr. Cristián Bravo Palma himself supervised the process of integrating CEREC into the faculty for dentistry.

From my perspective, an important argument for this project has been and is the possibility to show and also be able to teach the complete workflow from the impression to the finished restoration. I see CEREC as a system for computerised teaching in dentistry which aids students in learning the scanning and design of restorations. This involves directly using what has been learnt in subjects such as integrated dentistry or restorative dentistry. And, in addition, knowledge about dental materials is linked to the laboratory processes. That is exactly how our hospital management envisaged it.

» CEREC facilitates self-study and teaching.

Objective quality control with prepCheck

The fact that the whole teaching staff actively pulled together was another key factor in the success of the concept. We have trained the instructors who were still unfamiliar with CEREC and we organise the student courses with the additional presence of a so-called "superuser teacher". This always ensures learning success.

prepCheck supports here too. This software which Dentsply Sirona specially developed for university teaching has stood the test in training, because it provides students with an instrument for self-testing: they can check their preparations according to criteria predefined by us teachers and therefore improve their clinical abilities. The students very much appreciate this: software provides evaluations according to objective criteria which students can easily relate to. I am happy every day that this works, even today. →

Using CEREC software, inaccuracies can be found fast and jointly discussed.

Designing impressions and restorations – always supported by the teaching staff.

In day-to-day study we also use prepCheck as an aid in creating reports and in mapping a student's development over time. This information is very important for the teaching staff because it enables us to support each student in the individual sections of the training process according to their individual needs. Thanks to the objective and orderly process, students experience their lecturers as partners who help them to develop their missing clinical abilities.

CEREC also in training lecturers

To ensure that our students are taught the latest in technological developments, we have set up a programme at the university which envisages ongoing training courses for all lecturers. This involves hours of practical exercises and lectures on theoretical principles which are accompanied by national and international speakers.

Dentsply Sirona supports us here as a partner, for example by coordinating these speakers and providing us with technical and scientific information about the system and the materials. Further, we are regularly involved in dialogue with experts from Dentsply Sirona in order to always keep the training concept up to date.

» We support everyone according to their individual needs.

In addition, working protocols and tutorials are available to help with uncertainties. The leaders of the working groups who use these technologies also have this task. Their role in supporting students and establishing the workflows is very important.

Reviewing workflows, furthering developments, trying out new ideas – these are tasks that we perform in teaching as partners of industry. At our university, research work regarding CEREC is orientated toward using the system as a tool for training clinical skills. We are currently working on evaluating the clinical skills of fourth and fifth year students in manufacturing onlays and crowns using prepCheck. This involves determining and improving the critical steps for our students.

CAD/CAM makes a difference in training

Students are fascinated by how this technology works when used on a patient. And they are convinced that training in the CAD/CAM field will make a difference to them in their future careers.

Many stay on with us to work in research or take diploma courses, which enables them to make a further improvement in work with CEREC. Then again, thanks to university patient care, CEREC CAD/CAM technology also reaches patients who otherwise would have no access to cost-intensive and high-quality dental treatment. Our students and also we ourselves as teachers have a very positive view of this social effect.

» We anticipate further innovations linked to virtual reality.

I am pleased that our students really appreciate the value of the training offered by the university. It also makes it clear to me that digital dentistry and CAD/CAM systems represent both the present and the way forward in dentistry. Here we anticipate further innovations linked to virtual reality technologies and simulated training environments. I hope that in future too there will be advances in the field of software for computerised training and for self-study. Because: the options the system offers for training and daily improving clinical processes by interconnecting workflows not only help me to be a better dentist, but also a better teacher. ■

From the 6th semester, students can start working with CEREC on the patient.

In a well equipped simulation laboratory students can learn the individual steps from preparation through to restoration.

Dr. Gilbert Jorquera Rivera

- Dental surgeon – Universidad de Chile
- Specialist for dental, oral and maxillofacial surgery – Universidad de Chile
- Master's degree in training management – Universidad Europea de Madrid
- Associate professor Faculty of Oral Rehabilitation – Universidad de los Andes
- Director Faculty of Digital Dentistry – Universidad de los Andes
- Diploma Coordinator for Aesthetics in Oral Rehabilitation – Universidad de los Andes

This is how to implement CEREC in training at your clinic

For many institutes CAD/CAM technology is already a permanent feature. Those who now decide to integrate CEREC into training have various options. Dentsply Sirona develops tailor-made concepts in close cooperation with each of the universities.

The individual solutions are especially adapted to the circumstances in the seminar rooms and laboratories. Hospitals are usually equipped with a system landscape consisting of phantom heads, x-ray units and laboratory work stations. Here optimisations can be made as required to integrate CAD/CAM. As an alternative, the preclinical training can be conceptually revised. "Our strength in such cases is that we have technologically leading complete systems," says Roland Felber, Key Account Manager Digital Dentistry at Dentsply Sirona. "Some universities also actively seek dialogue with us on the topic of digitisation," explains the CAD/CAM expert. "We sound out together in such discussions whether, for example, the concern is preclinical training or equipment for clinical treatment at a university clinic that is integrated into the local supply network."

Prospective dentists in Santiago de Chile also like to work with CEREC.

Technical start and workshop in the preclinic

There is an opportunity for clinics which previously have not gone for CAD/CAM training to get to know it in an initial step: for example on a device with an intraoral scanner, software for designing a restoration and a milling and grinding machine. Teachers can thus familiarise themselves with the system and form ideas for how CAD/CAM can be integrated into training. An extremely useful tool for students is prepCheck software which helps them to check their own preparations and improve further. A CEREC workshop within preclinical training is a pragmatic solution which Dentsply Sirona supports with specialists and devices. The University Hospital in Giessen opted for this route (see pages 8 – 11). ■

This is how to perfectly equip your clinic for CAD/CAM training

- integration of an intraoral scanner into the student work station
- a CEREC AC unit for 3 – 5 students
- a CEREC AC unit for teaching work incl. connection to a large display for demonstration purposes
- use of prepCheck from the first day
- at least 2 grinding and milling units
- additional single intraoral scanners for orthodontic training
- regular use of "Train the Trainer"
- CEREC for treating patients in the clinic

Flexible training with a CEREC Curriculum

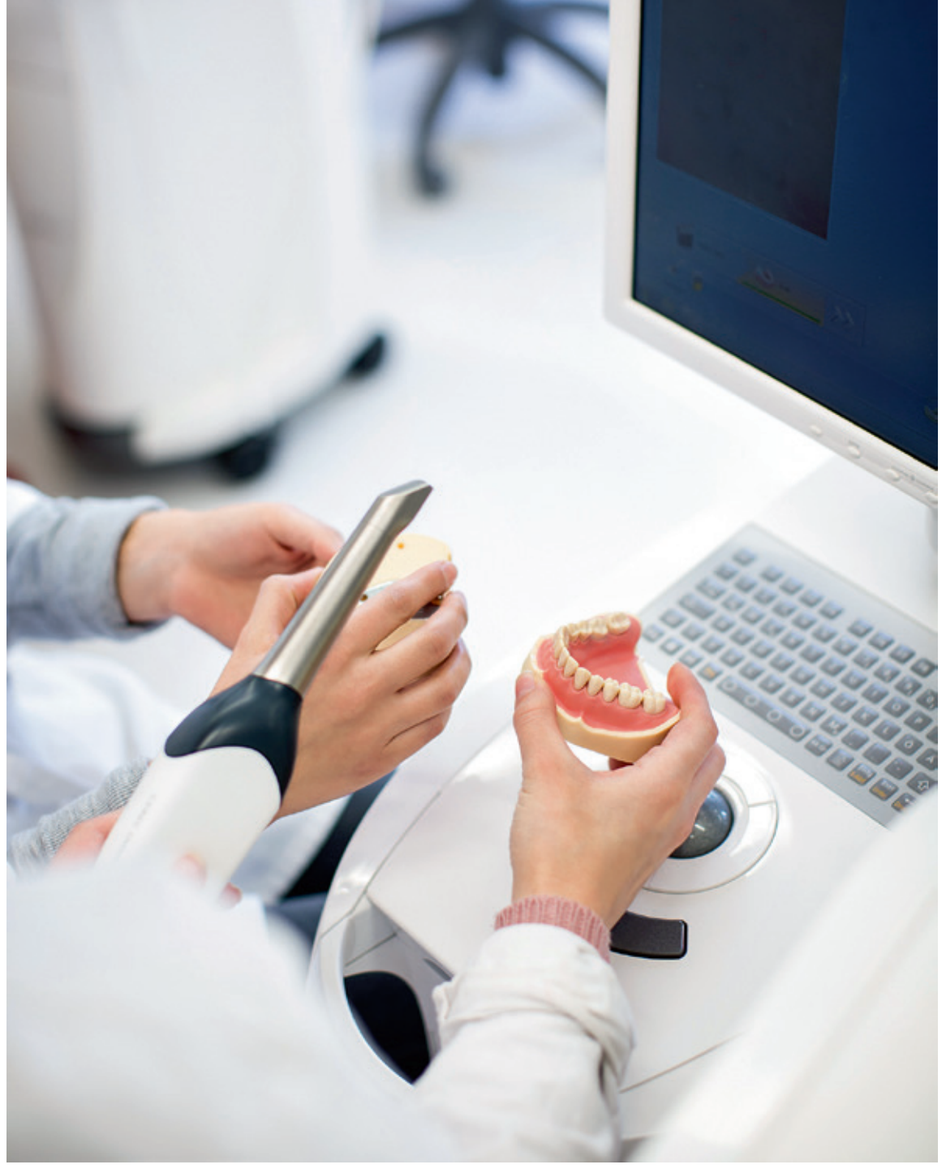
The idea of a CEREC Curriculum was first realised in the University Hospital in Mainz. "28 out of 30 university hospitals in Germany now use this concept, adapting it to their needs," says Roland Felber. Possible modules can be:

- introduction to CAD/CAM in the 2nd or 5th semester
- preparation with inspection by prepCheck
- workshop with freely selectable indications
- integration of orthodontic applications
- integration of dental aspects
- planning implants and their prosthetic restoration
- application on a patient (hospital)

"If there are any questions, wishes or just the need for dialogue, a Dentsply Sirona team is always on standby," explains Felber. "We support our customers at any time, for instance by means of training events for lecturers. The 'Train the Trainer' concept ensures that a hospital always keeps up-to-date in the CAD/CAM field."

Roland Felber, Key Account Manager Digital Dentistry during a CEREC Curriculum at the Justus-Liebig University, Giessen

The CEREC MC XL mills a restoration with utmost precision from a block of zirconia



Preparing for the needs of a modern digital dental practice: CEREC in university teaching

The dental clinic in Mainz has been one of the first university hospitals to establish training in CAD/CAM systems. Dr. Helmut Dietrich, lecturer at the Polyclinic for Dental Prosthetics and Materials Science of the University of Mainz, has made it his focus from the very beginning, partly determining and further developing teaching content. His credo: What is practised in daily treatment should also be part of training. He traces the Mainz approach in conversation and explains why he finds training in digital technologies so important.

Dr. Helmut Dietrich has been managing the topic of CAD/CAM at the University of Mainz for almost 20 years.

Dr. Dietrich, you incorporated CAD/CAM technology into teaching at your university in the year 2000. What thinking preceded that?

Although at that time CAD/CAM technology was not new in dentistry, we did primarily observe it in dental laboratories. For us in university training this meant coordinating teaching content in prosthetics with it too. In addition, there was the fact that we already cared for patients in our hospital with CAD/CAM support – so it also stood to reason to teach our students what we do each day. Our concern was not only to perform intraoral scans and plan and design the restoration in 3D, but also to actually produce it. This is where Dentsply Sirona, in CEREC, was the only company to offer a complete system.

» Students are also meant to produce prosthetics themselves.

How do you best get students into digital technologies?

This has changed quite substantially over the last 18 years. Today digital technologies are part of a student's everyday life, starting with a smart phone and navigation systems in the car and then inevitably continuing in the profession they aspire to.

The first semesters of a dentistry curriculum are still very much in an "analogue" mould. Students in prosthetics learn a lot from the field of dental technology, have to cast models and produce their own prosthetics in the classical manner. This is also important, so as to understand the process and learn what is key in prosthetics.

The dentistry curriculum schedules two prosthetics courses: The Prosthetics I course, held in the preclinic in the fourth semester, teaches the basics of dentistry. In the ninth, the fourth clinical semester, we then get really involved. I introduce CAD/CAM in two blocks of lectures. There follows a three-day course, supported by Dentsply Sirona with the relevant equipment. This allows students to have first contact with the devices, to perform scans on a model and on a phantom head, afterwards design a crown or a partial crown, then also produce and finally individualise it. I feel it is important for everyone to undergo the full workflow, not only theoretically, but also in practice.

» An understanding of what goes on in a laboratory is important

48 students per course can work here on a total of ten CEREC systems with four grinding and milling machines per course. Our assistants support the students as they orient themselves with the software in three-dimensional space. Parallel to this, there are presentations on the ceramic materials, which I consider to be important as they are a critical success factor: Students learn which preparation type is right for which material and how the restoration needs to be attached. They see how the blank is changed by the processing and learn to paint and glaze a self-produced crown. They also again develop a broadened understanding here of what goes on in a dental laboratory.

We are currently working on presenting intraoral scans in more detail in the preclinic, for the purpose of which we have procured six CEREC Bluecams. The prepCheck software is then employed here, too. The goal is to enable students to make a robust and objective assessment of their preparation and to provide them with an instrument for self-testing. →

Students learn the basics of digital impression – taking in a three-day course.

Each student produces at least one restoration with CEREC and also has it milled.

In CEREC you provide training with a mature CAD/CAM technology. For what reasons do you deem this to be important?

Our students, of course, are given an overview of all the CAD/CAM systems on the market. But, there is only one which provides a self-contained process from scanning to production. Students are extremely interested in the result, want to evaluate its quality and compare it with the analogue route. If you only move in virtual space, you miss the end product, i.e. you miss a key factor. In CEREC, Dentsply Sirona provides us with a system which offers exactly this aspect.

I have been working for many years with CEREC, I even still have a CEREC 1 unit. If you track the story through to today, you will see that there has never been a lull. I know of no other system, besides CEREC, to have been constantly developed and to have demonstrated that it simply works. I see a further benefit in the fact that the full system does not give us any problem with interfaces, process quality is always ensured.

» Economy is a concern for many.

What questions do students most often approach you with? Where is most explanation required?

It really varies with some 50 students to oversee in each course. I see four groups: The first group is highly motivated students with a technical interest who test themselves and test the limits of the system. They always complete the first restorations rapidly and then extensively analyse and evaluate them.

I would describe the second group as rather more reserved, more cautious. Here the standards they learned in the metal restorations are applied and checked. Their own experience is again readjusted, and it is interesting to observe the changes when they ask about marginal gaps, preparation margins and wall thicknesses. The students try something out, see at once what happens and then self-correct.

In the third group I encounter students asking about costs and economy. The background is often that these students know CEREC from their parents who are dentists. Contacts from Dentsply Sirona then help us with such questions.

But there is also a fourth group. This is where I put the students I cannot win over for CAD/CAM. There they are then confirmed in their opinion that it is not their cup of tea; which doesn't matter either.

» With CEREC process quality is ensured.

Do your students also have the possibility to use the system directly on a patient?

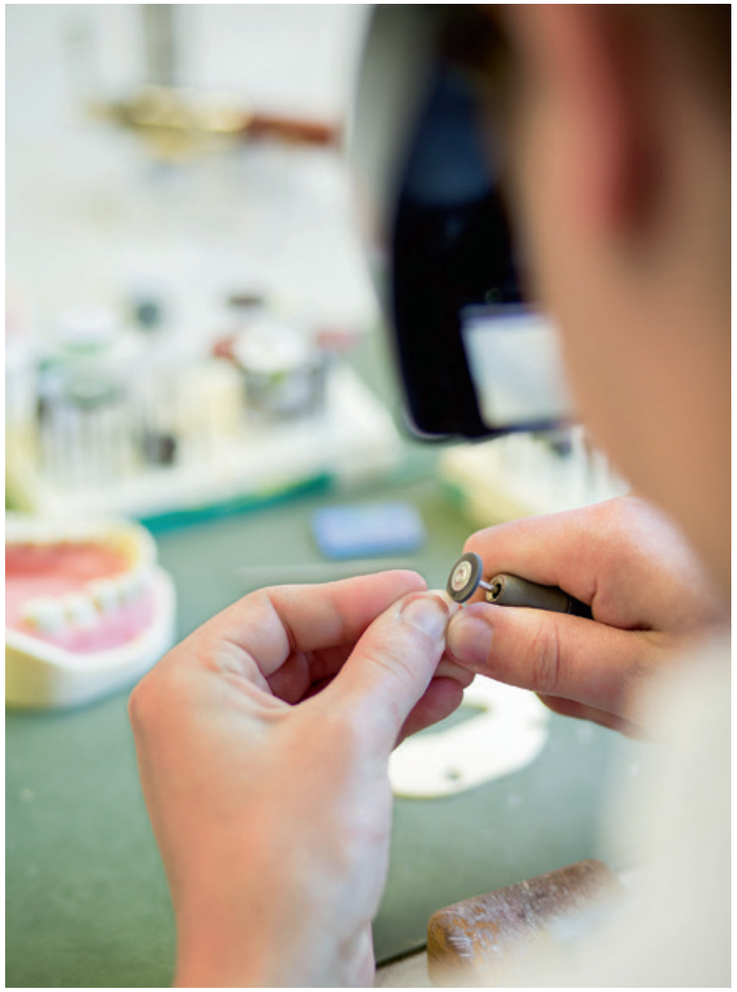
Our university has three CEREC systems with which we also treat patients. We observe, however, that students prefer to take an impression, produce a physical model and then scan for design in 3D. They just need some extra time until they are really content with the result, they are hesitant to scan directly. If, as an exercise, the students treat each other, things go differently: Restorations are then made very fast – even chairside.

You implemented CEREC at Mainz University back in the year 2000. Looking back – how would you consider the outcome?

I feel the decision to integrate a CAD/CAM system into routine daily training to be absolutely right. It was not a foregone conclusion for Prof. Dr. Herbert Scheller as clinic director to have gone along with and promoted this concept because it had a price-tag. I am just a little proud to have stayed the course and to continue to be enthusiastic about it to the very day. We have had CEREC as an examination subject, and I thought it was a highlight to see students succeeding in a perfect implementation.

There is also another aspect: As a university which has integrated CEREC into the curriculum, we are an important partner for the manufacturer. We are in dialogue with Dentsply Sirona about the system and our experience with it, we give feedback from the study courses and thus contribute to further development. The students appreciate that their ideas are heard and valued.

The finished restoration is tried on and fixed on the model.



Direct reworking and polishing as required.

Let's look to the future. Where is the journey taking CAD/CAM at the university? What wishes, what expectations do you have?

I see the future with eager anticipation: In the future we want to integrate the basics of dentistry in the CAD/CAM training package within prosthetics. Here analogue will become digital; we will no longer cast models, but print them.

In addition, I would like to see continued good co-operation with industry: From my viewpoint this co-operation spurs on development, this know-how can be integrated into the courses. Perhaps we should understand CAD/CAM as a subject to be taught. In our profession digital technologies are not the future, but reality.

» Digital technologies are not the future, but reality.

In my view, training with more CAD/CAM content makes study more exciting and more vivid. Personally I would like us to teach students modern dentistry in which they can also critically scrutinise. Dental know-how should enable them to develop prosthetic solutions for their patients together with dental technicians. In addition, prosthetic products are becoming more complex – implantology cannot now even be mentioned without CAD/CAM. I would like our graduates to be able to use digital technologies in their professional activity for what they are – an aid in order to successfully treat patients. ■

Dr. med. dent. Helmut Dietrich

- 1983 to 1989 studied dentistry in Mainz
- Since July 1989 employed as a research assistant in the Polyclinic for Dental Prosthetics in Mainz
- November 1997 appointed as consultant
- Fields of activity: function analysis, dental technology
- Since April 2000 implementing digital work processes with the CEREC system in teaching and medical care

University of Groningen's medical faculty is the second oldest in the Netherlands. But as to architecture and dental installations it is ultramodern.

Preparing students for the digital age in dental practices by engendering respect for technology

Digital technologies are now established in the dental practice. Teaching is being gradually adapted at universities. How university is managing to prepare prospective dentists for the requirements of a modern practice in view of digitisation in dentistry is described by Dr. Ulf Schepke, director of the dental preclinic and lecturer at the University of Groningen in the Netherlands, taking CEREC's integration into the preclinical curriculum as an example.

If anyone asks me today, what excites me even more than using CAD/CAM technology in treating patients I say: teaching it! I find it incredibly exciting to impart a fascination which I experienced over ten years ago. It is now over 30 years since a dentist and an engineer in Switzerland developed a system enabling tooth-coloured restorations to be ground and milled from a ceramic material.

Only few people believed in this idea at the time, but one company recognized the digital technology's utility and evolved CEREC. From today's perspective I find it especially interesting that the pioneers were so sure of their idea that they even accepted disadvantages such as imprecisions of fit. This enthusiasm and absolute faith in the sustainability of the new technology is really inspiring. Of course now we have moved much further ahead: Studies show that single tooth restorations produced with CAD/CAM fit at least as well as those which are produced by analogue means.

That's also how I transmit it to my students: The question is ostensibly not just to decide whether to take impressions digitally or by analogue means. Rather I need to question: which workflow am I most at home with? How can I work best, how do I achieve the desired result? To find out, it is absolutely necessary to be master of the available methods. This is the only way to make an informed decision.

» The question is: what workflow am I most at home with?

Feeling the way toward digital impressions

We have been using CEREC for some years at the University of Groningen where I have been a lecturer since 2008. We scheduled use of the Omnicam at various times during the degree course. In the preclinic students initially learn quite basic things: It starts with impression exercises, crowns are then produced later. One of them is to be deliberately milled with a thick wall in order to identify exactly what role preparation plays. We then make the digital impression with the Omnicam. Our students can inspect the scan results with the prepCheck software. This tool proves effective here for various reasons: On one hand, the software is objective and incorruptible. This is of course sometimes hard for students, but rather easier to accept than a verdict by the lecturer.

On the other, as lecturers we can much better bring in our expertise as a coach. This is because we can give students instructions and also tips on, for example, instrument selection or handling from the result the software delivers up. We can recommend use a preparation key, occupying a different seating position and so on. Here we tend to be more in a coaching than an evaluating role. Students thus learn very well and enjoy doing so – which is great to observe. →

» Technology supports people rather than replacing them.

Dr. Ulf Schepke runs the dental preclinic and is lecturer at the University of Groningen in the Netherlands.

We want our students to understand the requirements that we store in the software using defined parameters. For I am convinced that this is the only way to better one's own performance. I feel it is important to note here that technology supports people rather than replacing them. Of course, machines can do some things better, but certainly not everything. Students realise this.

Use of the Omnicam intraoral scanner is optional in the Master's course. This means: students can continue to experiment with it and also use it in treatment. But students do not use the complete workflow: they make digital impressions with the Omnicam and then create an additional temporary restoration. The reason is that students still do not feel so confident using the system. The patient then returns a second time and gets his finished restoration. The students can in the meantime watch how the restoration is designed and milled.

CAD/CAM requires dental expertise

In order to further establish CAD/CAM technologies, we are changing the curriculum in such a way that upon completing the bachelor a ceramic crown has to be produced instead of the usual gold one. This sounds simpler than it is because subject matter must be organized in such a way that both basic content and new technologies are taught. We dentists also have to be aware that dental expertise is required for CAD/CAM in a practice. It is not sufficient to scan the situation in the patient's mouth, just to accept the proposal from the system, perhaps modify it somewhat – and then hey presto. That's why in university training ideally a dental technician or a dentist with extensive dental expertise stands by and explains the reasons attention must be paid to specific details. I am also concerned here about respect for the design of restorations. Knowledge of the background must never be lost in my opinion.

» Dental knowledge and CAD/CAM go together.

Yet: The Curriculum is not infinitely expandable, priorities have to be set and we always need to remember to prepare students for the clinical reality. As it is important to master the standards – for me dental knowledge and CAD/CAM go together!

Retaining respect for technology

Otherwise, students much appreciate lecturers' passion; I see many enthusiasts among us. Young people are used to using digital technologies in daily life. So they find it normal to do likewise professionally. Coordination usually works well from the start, and there are also those students who have a strong interest in the technological details. Besides questions on how best to hold the Omnicam so as to obtain optimum results, they also use the option to try out the software and "play" with it a little. For example, through prepCheck they are encouraged to see how they can improve still further – even if they have already passed their examination.

» The learning process isn't over after training.

I watch this with pleasure because I know: no dentist is forced to use CAD/CAM in his daily work after taking his exam at university. The trend is toward dentists specialising. I feel it is important for our dentists trained here to realise: I am proficient in what I would like to do, but also know that the learning process isn't over no matter what specialisation I opt for after my training. Even if digital systems give us dentists more options for caring for our patients quickly and reliably: a critical mind is needed in using these technologies. They are meant to serve us, not replace our know-how and our ability.

That's how I learned it, that's how I teach it, and it is nice to see how history repeats itself: I myself studied in Mainz and in Dr. Helmut Dietrich I had a very dedicated consultant when it came to CAD/CAM (see report page 18 – 21): His enthusiasm proved infectious to me. His approach to organising the Curriculum has inspired me and still does so to the very day. If this spirit passes intact to our students, I have achieved my goal. ■

Students learn to master standards in Groningen. This includes CAD/CAM.

Dr. med. dent. Ulf Schepke

- Studied dentistry at Johannes Gutenberg University, Mainz, 2005
- Graduation as Dr. med. dent. 2006 in Mainz
- Assistant dentist at Dr. Alfons Kreissl's private clinic, Frankfurt/Main, 2006 – 2008
- Since 2008 dentist in private practice and lecturer at the University Medical Centre Groningen, the Netherlands, since 2017 as director of the preclinic.
- PhD on the topic: "Digital restorative dentistry – Implementation and evaluation of some digital tools in modern implantology" 2018 in Groningen

Enjoy their work with CEREC: Madeleine Jansson Pamenius and Carl-Gustav Svensson

Training at university? We can no longer imagine life without CEREC.

Academia and CEREC – this combination has been embraced and the tradition fostered at the Karolinska Institutet in Stockholm, Sweden for ten years now. Madeleine Jansson Pamenius and Carl-Gustav Svensson are pioneers in this field. They have the final say.

Madeleine Jansson Pamenius, Department of Dental Medicine:

"At our institute, CEREC has been a core component of university training and, of course, patient treatments for many years now. We have been working with the system since the CEREC Bluecam generation and have followed all the advances with great interest. It really excites me when a company is so committed to a technology and is always developing it further. Nothing is perfect straightaway – as teachers who provide training on a daily basis we are well aware of this! At our university, CEREC offers far more than merely the opportunity to practise with the system; the associated software prepCheck can measure students' work objectively. That's why I really value CEREC in my day-to-day work."

Carl-Gustav Svensson, Department of Dental Medicine:

"We have been able to gain experience of the key benefits of using a CAD/CAM system for training over many years. With each generation of the system and students, both our know-how and understanding skills in using the technology grow – and we pass this on to our students. We have insight into the little details that allow CEREC to be put to optimal use. And, of course, we also enjoy getting positive feedback from students. They can ask for our advice and rely on the objective assessments of their work provided by prepCheck. We are delighted that, both now and in the future, we are able to familiarise students with digital dental technologies in such a professional manner."

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