Implantology—the perfect art of camouflage thanks to CAD/CAM

When I graduated from the Faculty for Dental Technicians in Warsaw Medical School in 1987, I had no idea that my profession would change so much over the course of the next quarter of a century. At that time, I enthusiastically welcomed every new innovation, many of which I pioneered the use of in Poland.

Looking back today after more than 20 years, I can confidently say that dental technology has undergone a profound technical revolution. After all, nowadays, it is difficult to imagine a modern dental technician's laboratory where CAD/CAM technology remains unknown.

My first experience with CAD/CAM was in 2004 when I decided to buy a device from DeguDent. I intentionally use the word 'device' here, since it was not what we would today consider a CAD/CAM system based on scanning and virtual modelling. However, I was overwhelmed by the potential this machine offered me at the time. For a brief while, dental technicians and dentists were divided into proponents of and opponents against CAD/CAM. The latter were mainly against the system because of ignorance and a fear of new technology. I myself used the machine for two years until at last I succumbed to the temptation and bought another technical novelty.

I first saw this machine, produced by Wieland, at the International Dental Show in Cologne. The thing that was so innovative about it and such a great advance on previous models was the 3Shape scanner that was able to scan the model and transfer data to the CAD software, thereby making it possible to produce a virtual model of the construction.
The system was such a breakthrough and the possibilities it offered so enormous that in 2006 I began using the 4820 model. The volume of orders that my laboratory handled increased dramatically, since in contrast to the DeguDent machine, which could initially cut four-unit and later seven-unit bridges, Wieland’s CAD/CAM system allowed me to cut 14-unit constructions from various types of material (plastic, steel, titanium).

Based on my own observations and my many years of experience, I can boldly say that the greatest progress in terms of technology has been achieved by scanners. The newer machines have only increased the amount of bone that can be cut and accelerated cutting speed. It is the scanners that have ensured revolutionary advances in the development of CAD/CAM.

A major role in the development of scanners has been played by 3Shape, which is currently the undisputed leader in the field. A modern user of CAD/CAM has all he needs to ensure a perfect prosthetic appliance, i.e. everything from a temporary crown right up to complex implant-supported restorations. Moreover, all the work can be done today in virtual articulation, which overcomes the technological problems that traditional methods faced.

Patients today require fast and inexpensive therapeutic solutions, while ensuring the highest standard of work. CAD/CAM systems help reduce production costs significantly. Hence, the high purchase price of investing in a CAD/CAM system pays off. The limitless opportunities it offers for co-operation between laboratories also attest to the superiority of CAD/CAM technology. Just as the development of airlines made rapid relocation to any corner of the globe possible, so CAD/CAM promotes work between laboratories from all over the world. And herein probably lies its greatest success: international co-operation that connects people brings its own benefits and satisfaction. There have been many occasions in my professional practice when I have performed work to order without ever being face to face with clients. This is proof of the importance of Internet communication in the dental industry.

Obviously, the CAD/CAM system is only half the story, for the hands of the dental technician are still irreplaceable when it comes to veneering porcelain.

Fig. 6. Temporary abutment.  
Fig. 7. Gingiva forming with temporary crown.  
Fig. 8. Expected emergence profile.  
Fig. 9. Position of implant axis with regard to bed of crown.  
Fig. 10. Properly constructed temporary crown.

Fig. 11a. Duplicate of temporary crown made from pattern resin.  
Fig. 11b. Intra-oral examination.  
Fig. 11c. Impression at implant level.
Case report

A 27-year-old female patient presented to our dental office to achieve a more aesthetic smile. At the age of 17, she had suffered an accident (she was hit by a swing), as a result of which her tooth #21 had shifted significantly in an upwards direction owing to significant bone atrophy and root resorption (Fig. 1). The young age of the patient and her still progressing bone growth did not augur success. Only when she was 27 did she pursue improving her appearance. The situation required that she have her tooth extracted, undergo an implant procedure and have a prosthetic crown placed. The first problem that emerged during the preliminary analysis prior to the implant procedure was that the amount of bone and the thickness of the bone plate would

of the quality of the work. This is increasing in proportion to general advances in people's lifestyles. The majority of us want to remain young and look beautiful forever. Hence, more and more people view dentition in terms of the need not only to restore missing teeth but also to correct those they still have. A good example of this is the boom in orthodontics, and the demand for teeth whitening and improving their smile using veneers.

Another very important factor in prosthetic art is that it requires the collective effort of an entire team—everyone from an attending dentist, an orthodontist, and a surgeon/implantologist, right up to a dental technician. I have had the great fortune to work with partners who have chosen to work in the same area of technological development and aesthetic prosthetic work. One of the doctors working closely with my laboratory on a daily basis often remarks, "as the dentist so the technician and vice versa." Probably, these words reveal how close the ties have always been between the dental technician and the dentist. The restoration case study I will present here reflects my belief that prosthetic work is a combination of modern technology with its skilful use and a high level of artistry in the hands of the technician.

Case report

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substructure. No system can apply porcelain in such a way that the restoration looks like a natural tooth. Hence, the ideal is to combine the possibilities offered by CAD/CAM with the artistic abilities of the dental technician. A properly prepared construction, good marginal seal and the choice of material are all very important factors, but the final finish of the crown still depends on the aesthetics attained through the skill of human hands. The work of the dental technician requires knowledge of many different materials and how they are fashioned, as well as extensive manual skills in working easily with both colour and shape.

A long-standing acquaintance of mine, the outstanding master of dental technology Klaus Mütter-Thies, stresses repeatedly that form takes precedence over colour. The patient focuses first on the way the prosthetic restoration harmonises with his natural teeth. If the form is disturbed, colour defects appear together with details that do not have too important an influence on the overall appearance of the crown.

Although the majority of patients do not know how to assess a prosthetic restoration accurately, I have noticed a growing awareness among them
have forced us to add grafting material. The patient did not consent to such a solution and expected a predictable cosmetic effect with the stress on very good final aesthetics.

In the first stage, we made a Maryland bridge (Fig. 2). Such a solution provided protection for the patient during the osseointegration period. Several months after the surgical procedure, the implant (in this case Ankylos, DENTSPLY Friadent) was exposed. It turned out that the implant was positioned in an excessively palatal direction. The challenge was to restore a symmetrical line to the patient’s cervical margins, as well as a natural biological gingival margin. The backward position of the implant required the use of an angled abutment of 30°. Unfortunately, the system we used effectively restricted such an approach, since at the time that the above procedure was performed it was still impossible to achieve customisation in a dental laboratory (this is definitely possible today).

A decision to make an all-zirconia abutment with an angle of inclination above 15° is quite risky. Hence, the solution we adopted was to modify the crown while not changing the shape of the abutment. Such an approach requires the attending dentist to play a major role in the process so that the preparation and transfer of the emergence profile of the abutment and prosthetic crown correspond perfectly to the natural tooth. Using composite material, the doctor shapes the temporary restoration to retain the place for the final crown for a period of several weeks so that it later can serve as a model for the definitive crown. It is important to remember that as the gingiva is being shaped the patient must at all times be provided with a temporary restoration, guaranteeing support for the soft tissue.

Therefore, the doctor transferred the emergence profile with the help of a doubling of the crown with the abutment. After the crown had been removed, pattern resin was applied in its place. Simultaneously, a standard zirconia abutment was modified in the dental laboratory into the desired shape using a water-cooled high-speed bur and then scanned. An image of the scan was modified by superimposing a second scan over the projected emergence profile of the crown. Both parts were joined together in the CAD programme and the structure thereby created was cut from the Provi Disc composite material (Robocam), which is often used for temporary restorations. At this stage, the best approach is to try in the cut-out substructure and if necessary im-

Fig. 16 Abutment and coping prior to firing and bonding.
Fig. 17 Palatal view of veneered crown bonded to the abutment.
Fig. 18 Visible emergence area, free of ceramic.
Figs. 19a, b & c. Finished crown in situ.

Fig. 19a Fig. 19b Fig. 19c

Fig. 20 Palatal view of screw-retained crown.
Fig. 21 Crown in full smile.
prove its size and shape. Only if the fit is perfect will a substructure be cut out from zirconium dioxide.

The choice of material is something that should be considered very carefully. Observing the rule of "what, where and when?", the choice will depend on the position of the abutment, its colour characteristics and the quantity of light diffusion needed. The last factor has a great impact on the natural appearance of the prosthetic restoration. For this very reason, I try above all to use all-ceramic materials, especially in the anterior section.

The material used in the present case study was zirconium dioxide (Robocam), which is processed in a machine supplied by the same company called Robomill 5. The machine mills all available soft materials and the water cover makes it possible to cut IPS e.max ceramics (Ivoclar Vivadent).

Following a consultation with an attending dentist, it was agreed that owing to the large superstructure of the mucosal section on the vestibular side the restoration would have to be screw retained. Such a solution ensures that the patient’s oral hygiene can be examined frequently in that area. The abutment and crown were joined together in the laboratory in order to avoid any possible complications owing to excess cement left after the restoration had been placed in the patient’s mouth. The part serving as the emergence profile of the crown from the gingiva was not covered with veneering porcelain. It was only polished to a shine without covering it with glazing. The surface of the zirconia prepared in such a way has a greater chance of adhering tightly to the patient’s gingiva.

The present case study confirms that modern prosthetics could not exist without modern solutions such as CAD/CAM.

Summary

What other innovations will surprise us in the not-too-distant future? Will traditional layering and firing of ceramics be replaced by other methods? This remains an open question, but perhaps the profession of the dental technician will soon be limited to working only and exclusively with computers.

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All the prosthetic restorations were made using the CAD/CAM Robocam, and the materials used were Robocam zirconium dioxide, IPS e.max (Ivoclar Vivadent) and Vision veneering ceramics.

About the Author

Robert Michalik graduated from the Faculty for Dental Technicians in Warsaw Medical School in 1987. After two years of work in the Medical University’s dental laboratory, he opened his own dental laboratory, Inter-Dent, which he is still running. In 2003, he was the first in Poland to start working with dental CAD/CAM systems. In 2007, he began development of the first Polish CAD/CAM system in collaboration with Delcam and 3Shape. Also in 2007, he submitted an application to patent a method of creating telescopic crowns with intermediate crowns. He is the author of several articles for the trade press.

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