Impression-free practice, virtual construction models and articulation on Windows desktops, biogeneric occlusal surface design with intelligent software, as well as rapid prototyping, and 5-D printing are just some of the topics increasingly mentioned in lectures and publications dealing with CAD/CAM. Already, ‘conventional’ CAD/CAM technology is in use in dental offices and laboratories, and now the next step in CAD/CAM evolution is anticipated. Only a few years ago, discussion focused on exactness of fit, the reduced costs for dentists and patients, and user-friendliness. The quality of CAD/CAM restorations was viewed with cynicism, and only a few pioneers gave scientific attention to this technology. At present, the situation is quite different. The hesitant & doubtful attitude towards computer-manufactured dental prostheses has been discarded, and an accepted, standard procedure has taken its place. Many companies now invest immense resources in the further development of this technology.

What impelled this rapid change? On the one hand, the value of zirconium dioxide ceramic in particular, which can only be processed with computer-assisted techniques, became evident. This material made all-ceramic fixed partial dentures possible for the first time. Other ceramics, too, exhibited better material properties after automated milling because the blanks used could be industrially manufactured under optimal conditions. On the other hand, the technology of CAD/CAM systems has clearly improved. Based on more powerful computers and effective measuring techniques developed in the 1990s, it was possible to adapt 5-D recording/imaging systems to the needs of dentistry and simplify their operation. Continued development of CAD software enabled a multitude of construction options (Fig. 1) and an improvement in the quality of the grinding/milling units. Economic efficiency, combined with high quality restorations, is the current hallmark of CAD/CAM technology. It is not only dentists and dental engineers who benefit from standardised and excellently-controlled treatment and manufacturing methods, the patient does as well.

What is the latest in CAD/CAM development? Anyone well acquainted with the field predicted early on that manufacturing centres would play a crucial role: high capacity utilisation, specialised staff, centralised material purchasing, and high throughput, which in turn will influence the training of dental students and indirectly the treatment possibilities in practices as well, in the interests of our patients.

Another important current trend is the chairside manufacture of inlays, onlays, partial crowns, and single crowns. The dentist is this CAD/CAM procedure’s target group. The one-appointment treatment has a time-saving benefit for the patient and eliminates provisional restoration, which additionally minimises the risk of cusp fracture, enamel-margin chipping, and weakening of the dentine bond. The biogeneric formation of occlusal surfaces enables the reconstruction of missing occlusal surfaces for inlays, onlays, and partial crowns according to nature’s designs (Figs. 2, 5).

CAD/CAM and all-ceramics are often mentioned in conjunction with each other, which is understandable given the discussion above, but this doesn’t represent all the options. The enormous potential in milling procedures and, just recently, in the laser sintering of metals is often completely forgotten. The manufacture of metal restorations (e.g., non-precious metals, titanium, or gold alloys) will thus eventually become a domain of CAD/CAM technology.

What does the future of CAD/CAM technology hold? Intra-oral 5-D measuring will at least in part make the impression-free practice possible (Fig. 4). The speed, operation, and precision of the images are being continually improved and the measurement range expanded. Once a 5-D data set of tooth surfaces has been stored, a completely novel form of dental diagnostics can be conducted, by comparing data that were recorded at different time points. Thus, quantitative, 5-D progression control of orthodontic treatment, the analysis of erosion & abrasion, periodontal change, or inter-venions is possible.

A distinct advantage of computer-assisted procedures over the conventional wax-up technique also lies in the functional and morphological occlusal surface design. Complex algorithms can store an immense amount of basic knowledge about tooth structures and individual genetic contexts. Virtual articulators can simulate any programmable movement, so that considerably more natural laws and limits, as well as individual parameters, can be integrated into the restoration surface than has been possible up to now.

The needs of CAD/CAM technology have propelled basic research to new heights and thus advanced other areas of dentistry. Through cooperative ventures, universities and industry can form a useful symbiosis to promote and shape this exciting development. Until now, CAD/CAM or computer-assisted dentistry has not been a central subject at the universities. But because the technology is relatively new and the performance potential of CAD/CAM technology is tremendous, this is certain to change in the next few years, which in turn will influence the training of dental students and indirectly the treatment possibilities in practices as well, in the interests of our patients.