CAD/CAM in dentistry—Does it pay off?

An interview with Prof. Dr Albert Mehl, University of Zürich, Switzerland

The International Dental Exhibition & Meeting in Singapore showcased some impressive advancements in CAD/CAM dentistry. For private dentists, however, there is much uncertainty regarding these developments. DT spoke to Chief Johannes Eschmann who took charge of the Centre for Dentistry and Oral Medicine at the University of Zürich, about whether investing in CAD/CAM pays off and for whom.

Johannes Eschmann: Most failures of conventional technology occur during impression preparation (insufficient illustration of the preparation margins, insufficient drainage). Oneing to auto-mixing technology (cartridge systems, Previs, etc.), mistakes caused by the material are rare and fully acceptable in a perfect-fit restoration, even when using conventional technology. Do CAD/CAM systems offer for the dental practice?

Prof. Albert Mehl: Most importantly, treatment times are reduced because the dental restoration can be manufactured in the same session as the preparation (chairside method). Temporary become obsolete, thus making uncomfortable, time-consuming transition times a thing of the past. In addition, cohesive adhesive technology, sufficient retention for a temporary, sometimes not available because of the minimally invasive preparation. Furthermore, the latest studies demonstrate improved bonding to teeth with freshly cut dentine and enamel.

Computer-aided milling and polishing allows the use of high-quality materials, which are manufactured industrially under optimal conditions, resulting in longer-lasting restorations compared to conventionally manufactured restorations. This has already been documented in numerous scientific studies. Through the combination of time saving, cost reduction and increased quality, the chairside method offers an interesting perspective for modern dentistry. This pertains mainly to single-tooth restorations but we can expect new possibilities in the production of fixed partial dentures with small span widths in the near future.

The time needed to manufacture a digital impression is the same for both techniques. The preparation is equally complex and partly requires more working steps such as powdering or opaque coating. How does the significant investment in digital impression technology pay off?

When considering concepts that entail the sending of data of a digital impression to a decentralised production site via the Internet, one can say that the time-frame equals that of conventional impression techniques. The extent to which the to the tooth and surrounding soft tissue will be preserved is another major advantage both for the patient and the dentist. The more economical and time saving, cost reduction and increased quality, the chairside method offers an interesting perspective for modern dentistry. This pertains mainly to single-tooth restorations but we can expect new possibilities in the production of fixed partial dentures with small span widths in the near future.

According to the industry, amortisation could be achieved through the cost savings of computer-aided production in production centres, software updates and systems for the chairside production of single-tooth restoration, and extension to diagnosis and treatment planning software (in combination with digital imaging, implant treatment planning and online exchange of information between specialist groups).

The enormous potential of digital scanning has been recognised by the industry and thus is currently in heavy development. As soon as quality and practicability have been demonstrated within clinical environments, amortisation will no longer be an issue.

How can the aesthetic disadvantages of single-session treatment (CEREC/E4D) be solved in the future? Staining is only a remedy here, because the colour wears off rather quickly.

Sophisticated, aesthetic single-session treatment systems are currently not available in the anterior region are difficult and achievable only with much experience. Hence, most dentists will probably choose to apply the different veneer layers manually. However, aesthetically pleasing results can be obtained using multi-coloured blocks. It is expected that these blocks will be improved by optimising the form and position of the layers and that the software will use this information in the computerised restoration within the block for optimum colour effects. In order to standardise this process, the use of tooth colour measurement systems may also be relevant.

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about how critical this level really is, but we apply this standard, and surfaces should be scanned with a grid of at least comparable size. Double resolution (25 µm) would be even better. An average molar surface of 2 cm², for example, would yield 320,000 measuring points.

The ideal number then depends on the data processing. By combining several scans, these numbers can be increased significantly. The software can then calculate the optimum distribution of measuring points, thereby improving the results even more.

These technical details principally influence accuracy and clinical adaptability. However, we cannot fully evaluate the quality of intra-oral scanners based on these details because they only constitute a small percentage of the overall complex measurement systems. In addition, there is the decisive factor of software interplay. Clinical and scientific experiences of each measuring system are far more important.

What are the advantages and disadvantages of digital bite registration versus traditional bite registration with subsequent manual adjustment? With iTero, for example, the required material thickness can immediately be calculated and a post-preparation can be done, in case it has been reduced insufficiently.

The software allows a more precise positioning of the jaw and a superior analysis of the occlusion compared to the conventional, manual procedure on the plaster model, on condition that the digital impression ensures a high degree of measurement accuracy for the jaw impression. In addition to the controlling of the restoration material thickness, contact patterns can be analysed, 2-D slices can be adjusted for visualisation in different areas, and articulation movements can be measured. Using software, the resilience of teeth can be simulated, enabling new possibilities for diagnosis of the contact situation.

iTero and E4D do not require powder coating. Why isn’t this possible with CEREC and 3M ESPE? Powder-free impressions are the preferred option. However, they still are a significant challenge in intra-oral scanning technology. Based on my experience, I am not able to evaluate whether this is possible with sufficient accuracy at the present stage. There are many different approaches to analysing the light reflected from tooth surfaces without using powder; however, the accuracy of the measurement is dramatically reduced. At the end of the day, it is the result that counts and it is up to us to analyse these closely.

Do you believe that prostheses manufactured via rapid prototyping, for example, laser sintering or Fused Deposition Modelling, can be done in practice with better aesthetic quality and without the assistance of a dental technician?

There is debate about whether this is possible. While this procedure has become common in some milling centres with regard to metal and acrylic resins, restorations with aesthetic materials such as dental ceramics and composites have shown some principal and unresolved issues. Basic research is needed in this field. As a second step, production devices should be made compact so they become more cost-efficient for dental practices. In conclusion, this technology is unlikely to experience a major breakthrough in the medium term.

Thank you very much for this interview.