

Improvements in digital implant prosthetics

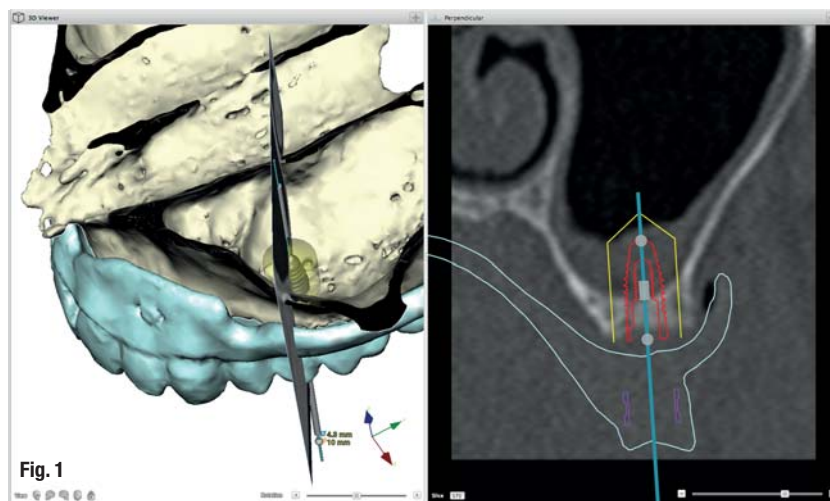
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_Introduction

In contemporary dental medicine, computers and implants are closely linked. By dealing with this topic, the question arises whether one can speak about a(n) (r)evolution in planning and manufacturing of implant-supported reconstructions in the field of implant prosthetics.

Dental prosthetics are concerned with the restoration of lost teeth and tooth-bearing tissues in the oral cavity. Loss of teeth and edentulism are quite frequent in old age and often the main reasons to visit a dentist. Hence, dental implants have become important means of therapy, whereby computer-assisted procedures play an increasing role in the daily routine of the dental practice. Thus, it is no contradiction to use modern computer tech-

Fig. 1_Virtual implant-planning based on volume tomography.



nology and new materials equally for young and old people.

The continuous advancement of specialised fields in radiological imaging, manufacturing methods in the engineering industry and dental implantology have extended the possibilities of decision making, planning and surgical as well as prosthetic realisation of a therapeutic plan. Actually, this proceeding of dental medicine only has been made possible by bringing together these formerly independent disciplines, which basically depend on the increased performance of digital data processors.

_Revolution or evolution?

Despite these developments, many colleagues do not consider a computer a helping advice in their daily routine. Any digitalisation of a certain practice area needs a modification and adaption of the whole team's workflow, depending on the scope of digitalisation. This requires a large effort of all employees involved, the willingness to learn from earlier mistakes and to keep pace with the progressing digital technologies. One thing is certain: Innovations in dental medicine do occur more often and faster nowadays. Therefore, evolution or revolution does not depend on the given digital possibilities but rather on the individual experience and know-how.

In dental medicine, computer technology is no more a real technological revolution. Virtual implant-planning based on volume tomography has

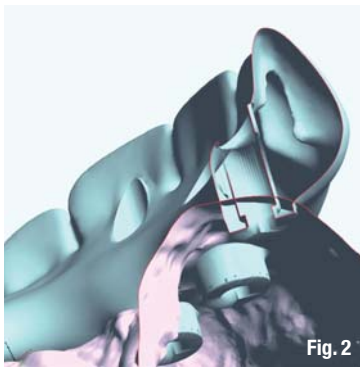


Fig. 2



Fig. 3

Fig. 2_Design of CAD/CAM-FDP framework.

Fig. 3_Full-ceramic reconstructions screwed together on the implant's level.

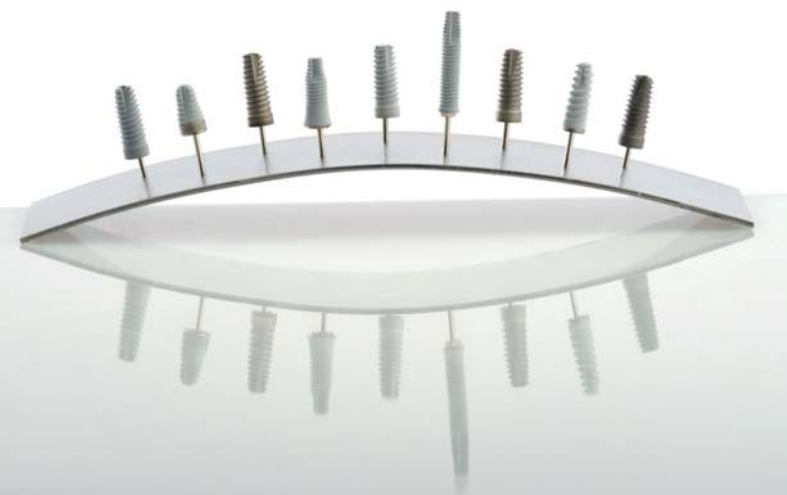
facilitated the decision making and information for a patient for quite some time now (Fig. 1). Computer-assisted implant placing occurs with high precision in partially or fully edentulous patients.¹ Here, the so-called backward planning ensures a high level of predictability of the surgical and prosthetic result. The surgical realisation of the 3-D planning with stereolithographic splints is an important advancement in complex cases and can contribute to less invasive and rapid proceedings in selected cases. By this, one can precisely determine whether a completely "flapless" procedure is possible for single or all planned implants in the jaw and which augmentative technique is indicated.² Espe-

cially for older patients with relatively more risks when implanting, a well-planned, minimally-invasive proceeding with a shortened operation time is of advantage.^{3,4}

Additionally, the digitalised anatomical and prosthetic conditions can be analysed virtually and with the help of clearly-formulated criteria contribute to the decision making in case of either fixed or removable implant-borne reconstructions.⁵ It has turned out that the proportion of bone in the upper jaw is clinically often overestimated.⁶ According to the characteristics of an atrophy of the alveolar ridge, the prosthetic-oriented planning

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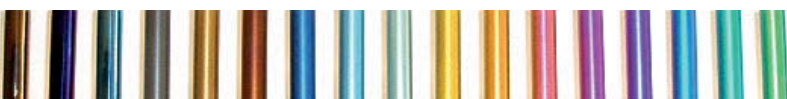
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Figs. 4 & 5 Fitting accuracy below 50 µm seems to be possible for full-arch reconstructions.

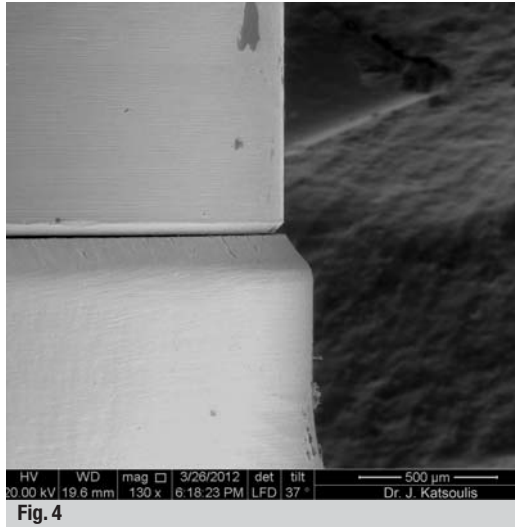


Fig. 4

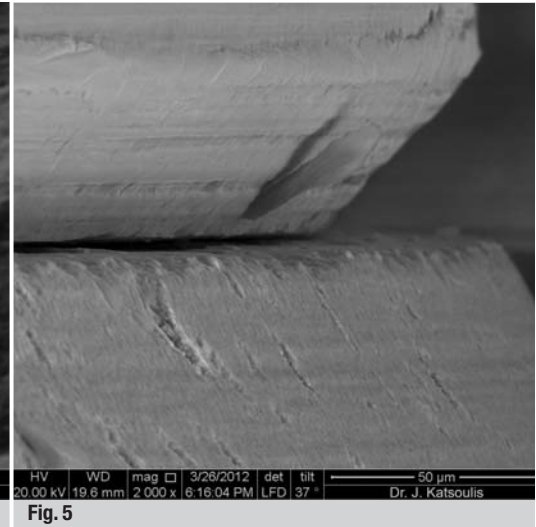


Fig. 5

will control the implant positioning and type of reconstruction of the operation virtually in advance.

CAD/CAM technologies in implant prosthetics

Closely connected to computer-assisted implant planning is the CAD/CAM technology (Computer-Aided Designing/Computer-Assisted Manufacturing), which has significantly changed the dental medicine in the course of the past twenty years.⁷ The more parallel dental implants can be planned and clinically placed, the easier and more stable the design (Fig. 2) of CAD/CAM frameworks/FDPs (Fixed Dental Prostheses) and bars made of titanium or zirconia can be kept. These materials are also characterised by improved technical and biological features. Consequently, technical and biological complications are to be expected less often.^{8,9}

Depending on the connection type of implant systems, also full-ceramic reconstructions can be screwed together directly on the implant's level (Fig. 3).

The fitting accuracy of implant-borne CAD/CAM-titanium and -zirconia reconstructions are significantly higher than the conventionally produced bridges with cast alloys.¹⁰ By now, most of the major manufacturers offer their own CAD/CAM systems and have centralised production facilities for manufacture of frameworks and bridges at their disposal. Thus, a fitting accuracy below 50 µm (Fig. 4 & 5) seems routinely possible for full-arch reconstructions with the required care and know-how of the production process.¹¹⁻¹³

The CAD/CAM production is specific for metals like titanium and ceramics, as for example zirconia.

For milling with CNC-machines, especially suited milling cutters are used. After the milling of zirconia in the overdimensioned green-/white-body, the final crystallisation (sintering and HIP) of the work piece is made. Despite of automated and mechanical processes, the CAM step requires the experience of specialised engineers who are able to oversee the processes and step in if problems occur.

The current development efforts and advancements take place in the area of software possibilities and the connection of individual digital sub-areas. Thereby, a universal data format (STL) enables the forwarding of data by intra- or extraoral scanners via CAD- and CAM software. However, it probably might take some time until the various providers will open their systems completely and thus enable users to freely choose between the digital work steps.

Editorial note: A list of references is available from the publisher.

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