QUINTESSENZ
ZAHNTECHNIK

10/23 | October 2023
Volume 49

DENTAURUM

SPECIAL REPRINT

Why CAD/CAM is not a department!

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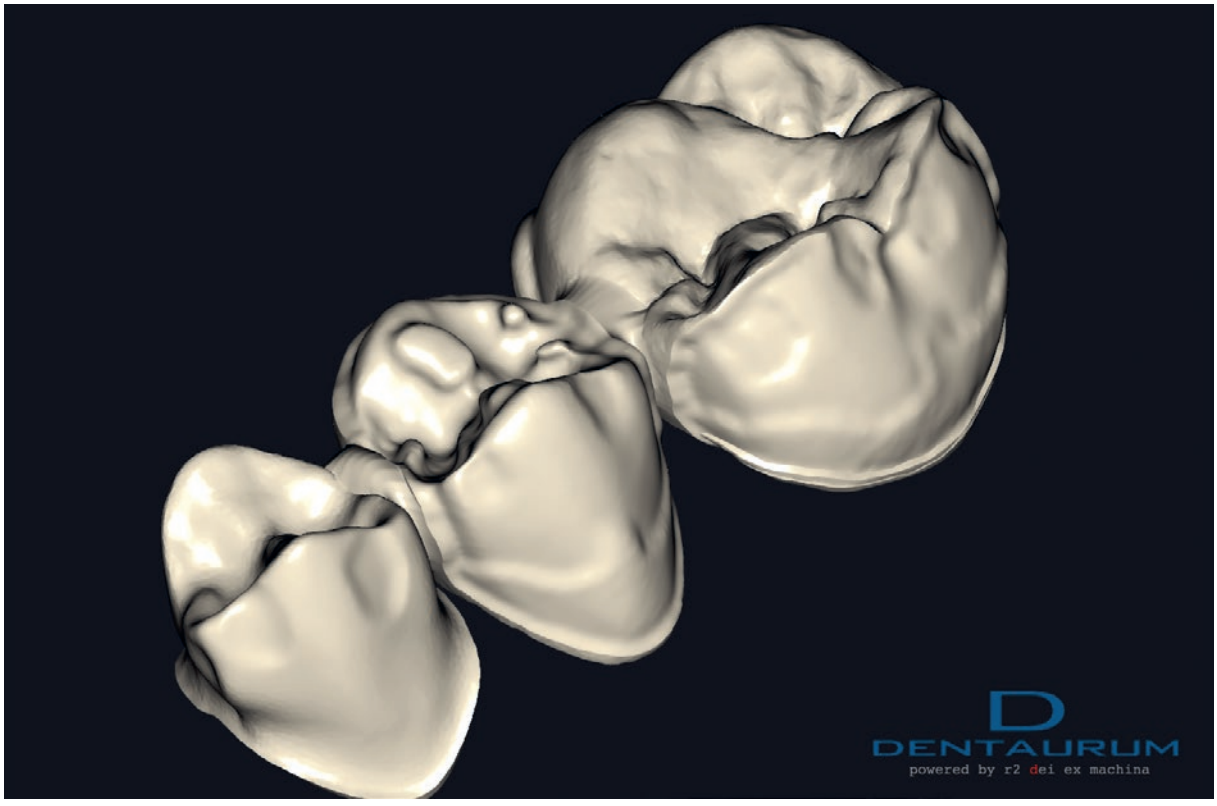

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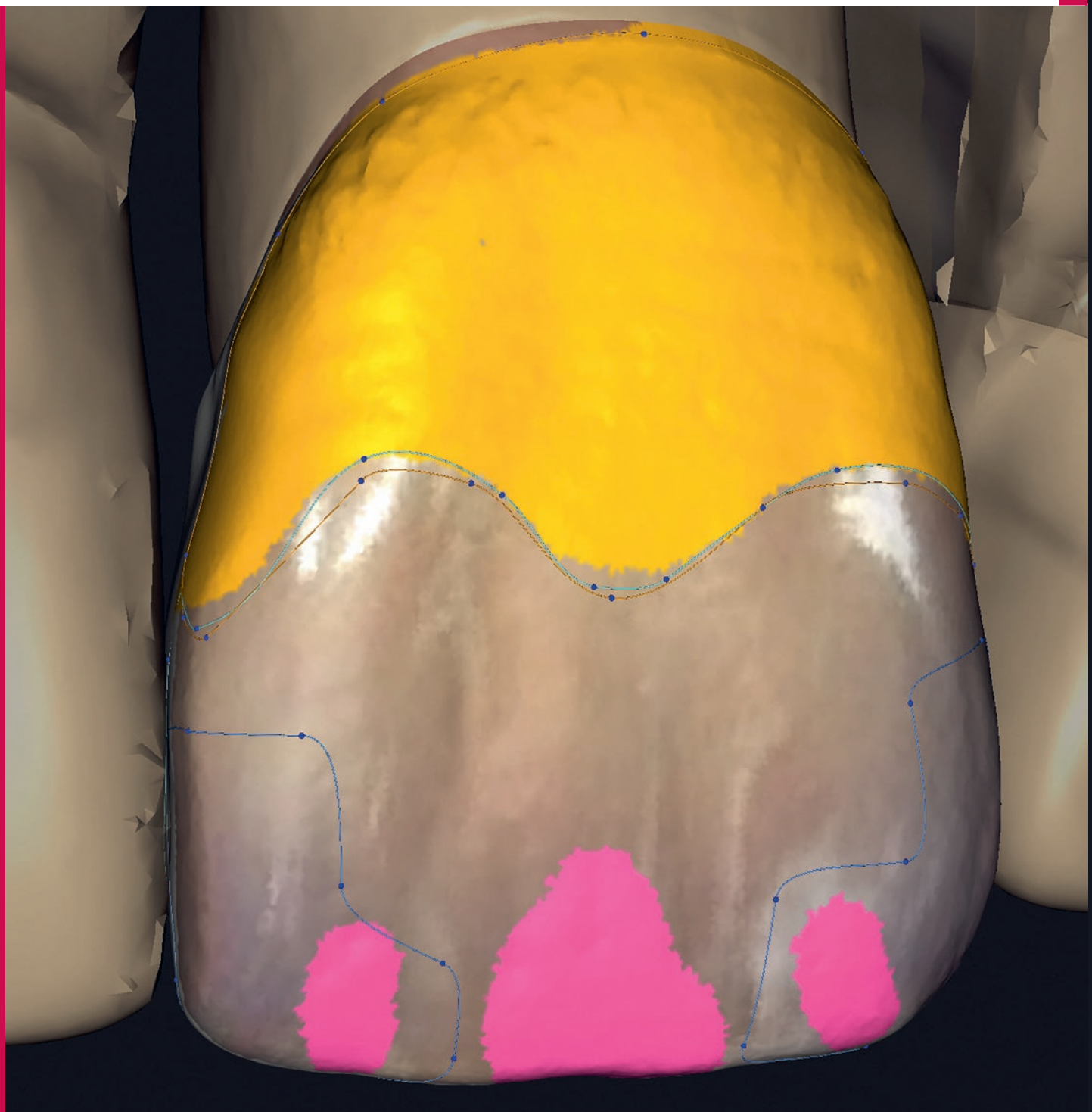


Introduction

The dental technician trade combines state-of-the-art technologies such as 3D scanning, CNC manufacturing, digital design and planning, as well as 3D printing and manual ceramic layering, finishing, and finalizing. Technological innovations imply new fields of activity that often appeal particularly to our urgently needed young talents than our "old" technologies. Nostalgia is not for the young, and thus traditional professions can only attract capable young talent if the job description is "up-to-date" from a technology point of view, or even better, if it is innovative. Manual dental prosthetics will "team up" with digital technology, thus giving us a dental technician's job description which combines state-of-the-art manufacturing technologies with the skills of craftsmanship. Digital transformation will play a central role in this process. But constantly redefining the digital processes in your own laboratory is not merely necessary to attract new employees. The smooth flow of digital and analog processes will become essential for business success.

Possibilities

Digital transformation means organizing the laboratory structure such that digital processes are integrated as a component in all departments (Fig 1). This avoids wasted effort and frustration, and makes processes more efficient. Moving all the digital work steps to a CAD/CAM department tends to be more of a hindrance to an optimized workflow (Fig 2). By the same token, a great deal of dental technical expertise is lost, which is, after all, available in the individual departments. Which work step is to be performed digitally by which technician and when must be analyzed in advance according to one's own laboratory structure. Often, the process specified by the CAD software providers needs to be questioned here. In most cases, opportunities for optimization are found in places where a specialized CAD technician is required to perform cross-departmental design work

Abstract
Digital and analogue technologies are part of everyday life in dental laboratories today, but they can hardly be separated from each other. With the constant new developments, new fields of activity are now also emerging in the laboratories, which have an impact on the organisation of work. The article describes how the laboratory structure can be organised in such a way that digital processes are integrated into all departments.

Key words
CAD/CAM, Work organisation, digital workflow, ceramics, reduce

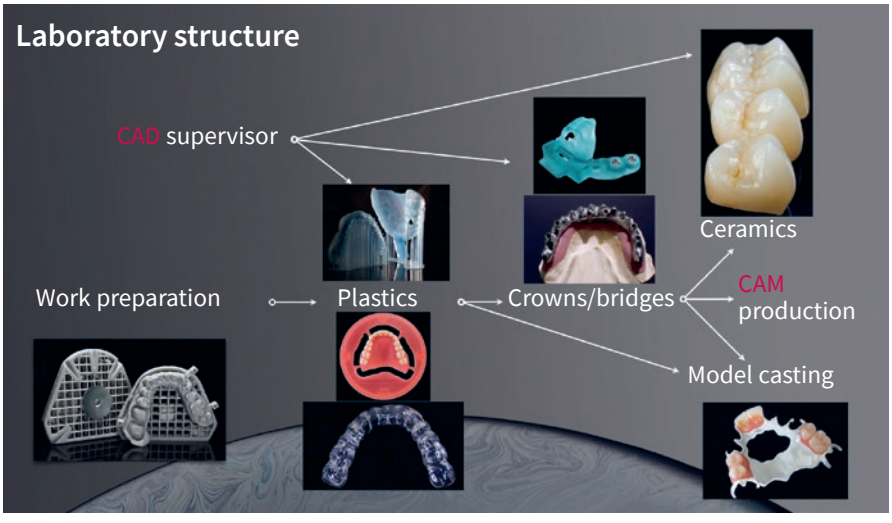
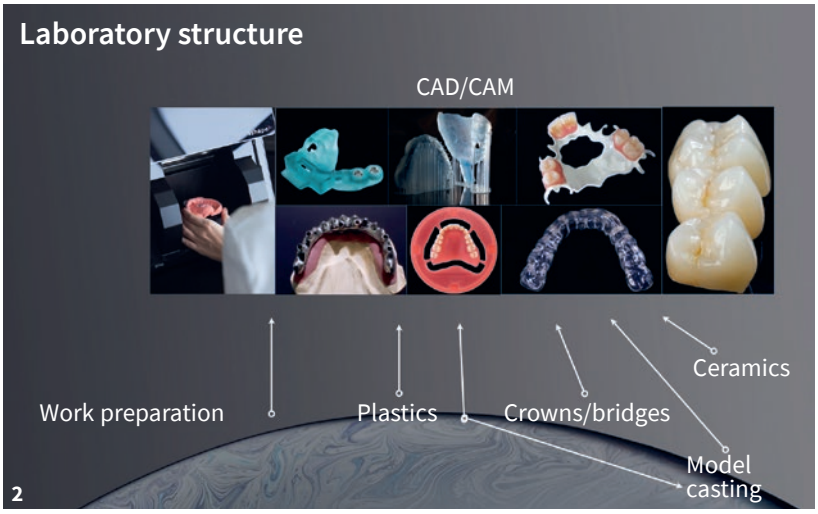


Fig 1 Laboratory structure with CAD integration in the departments.



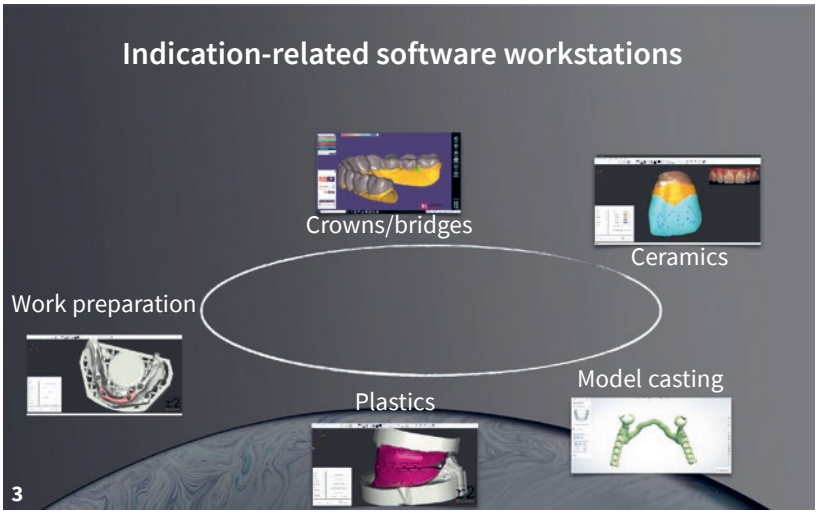


Fig 2 Laboratory structure with autonomous CAD department. **Fig 3** Indication-related software workstations in the departments.

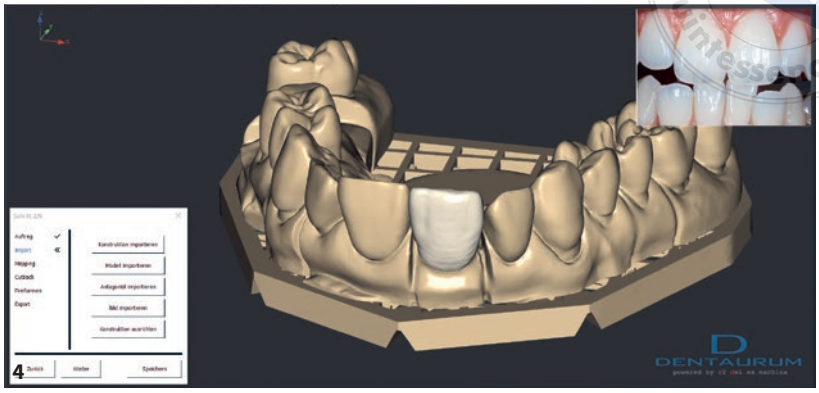
which does not relate to his/her core area of expertise. For example, this means that the CAD technician for crowns and bridges must now also design bite registrations, impression trays, models or partial and full dentures. It would make more sense here for the know-how of the employees in the various departments to be used in digital production as well. Technicians from all departments must receive access to digital construction (Fig 3). This does not mean that all employees are to become CAD/CAM experts, but rather that they can contribute their knowledge to the areas of design where their expertise lies. This way, knowledge acquired over the years in manual processes can be transferred and does not have to be left up to a CAD technician who has an affinity for computers but is not versed in the indication.

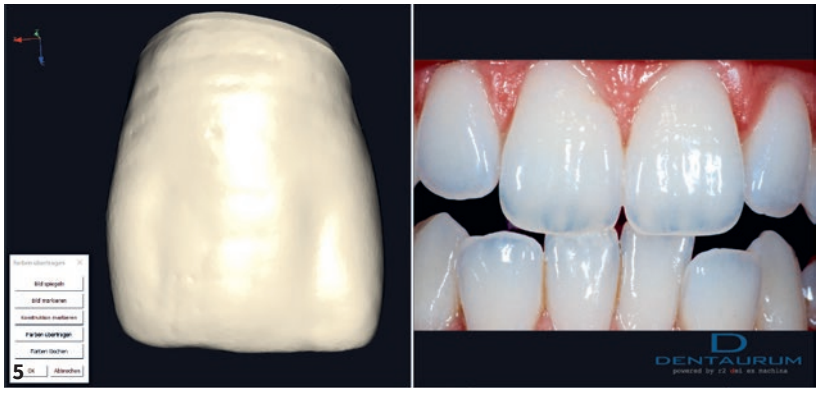
A systematic approach is required to implement this integration of employees into the digital process. First, the inefficient cross-departmental interfaces need to be identified. This is followed by considering how integration into the department can take place and what software adjustments or new installations are necessary. The next step is to train employees on explicitly this application.

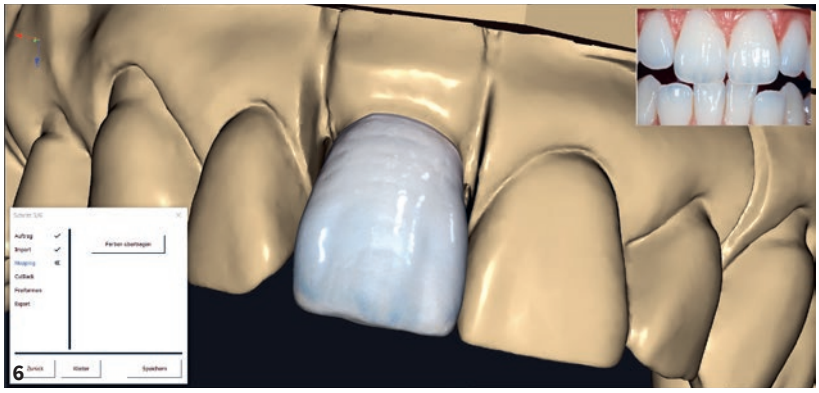
The integration of design steps in the ceramics department can act as an example here. Particularly in the microlayering technique, where the dependence of framework design and creating the tooth shade forms an intrinsic element. Faulty frameworks always lead to time-consuming rework as well as frustration in the ceramic department and, in the worst case, can also result in a refusal to apply this layering technique. The solution certainly cannot be that the ceramist inefficiently works with the CAD technician to customize the framework during the construction phase, or that the ceramist takes over the entire framework design in a time-consuming manner. Here it is more efficient to create a distinct interface. The CAD technician designs the fully anatomical framework in his/her familiar CAD software as usual. The ceramist then performs the color-relevant reduction independently in a special software application. This way, the appreciation of color and of speedy construction are combined efficiently.

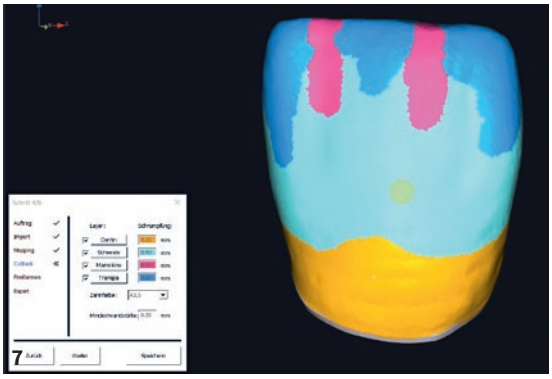
The redesigned workflow thus starts as usual with the CAD technician, who designs a fully anatomical crown/bridge in the already existing CAD software. The ceramist then imports the STL files of the construction and the models into the standalone cadBack software (r2dei-exmachina) (Fig 4). If available, a digital photo of the patient can be uploaded in addition. Using “color-mapping” (merging STL data + digital photo), a photorealistic 3D representation of the tooth color areas is transferred to the design data set. (Fig 5) This simplifies the selection of the reduction areas in the next work step (Fig 6). The ceramist then marks the

different cut-back areas directly on the fully anatomical design data set (Fig 7). The definition of these areas can be done by painting or placing a spline (Fig 8). All defined areas can be provided with different reduction levels. The ceramist can thus precisely enter different reduction areas according to his/her experience and preferences (Fig 9). This subsequently creates a reduced framework which is optimized for the microlayering technique as well as for layering ceramics (Fig 9). The competence of the ceramist with regard to shape and color is therefore incorporated in the construction (Fig 10). The data then continue in the familiar CAM process and are processed further. The result is an optimal reduced framework design, matched to the preferences of the veneering technician. The latter can then start directly with finishing using ceramic materials without any irritating correction grinding or cursing of the framework designer. (Fig 11)









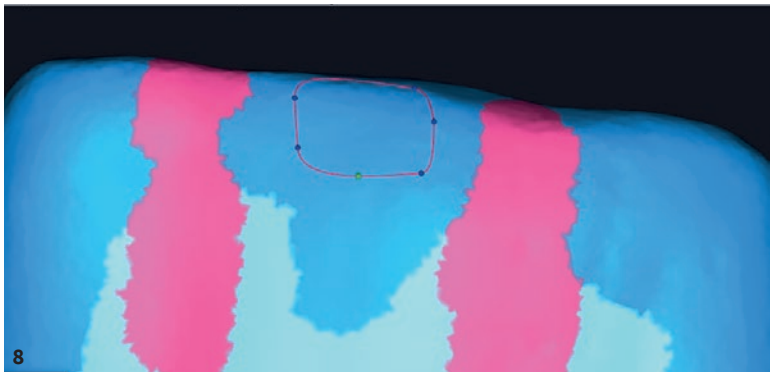
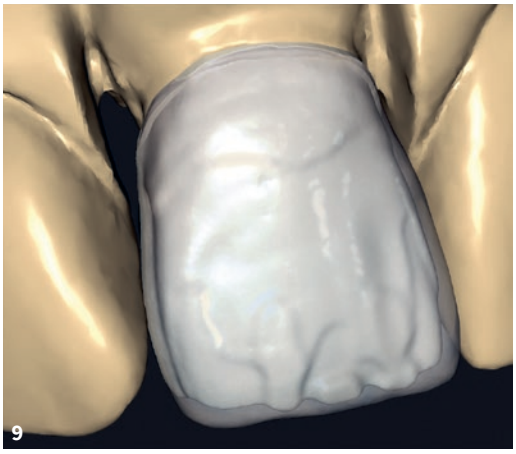
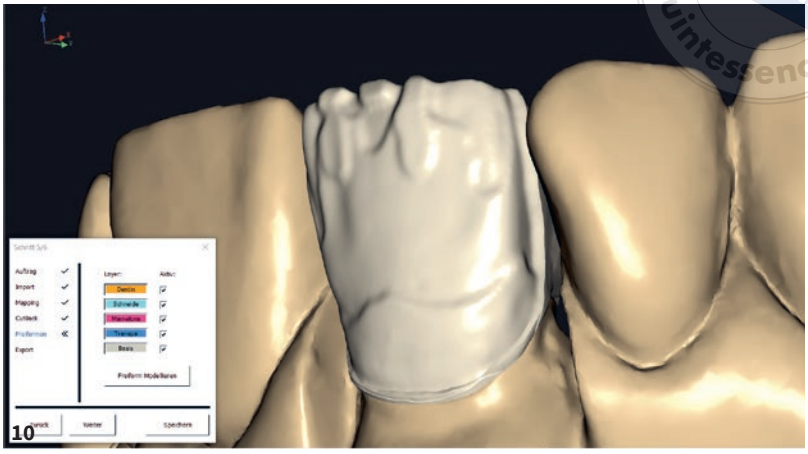


Fig 4 Loading the CAD restoration and the jaw data. **Fig 5** Color transfer from digital photo to crown surface. **Fig 6** Display of the color areas on the STL data set. **Fig 7** Marking the desired reduction areas. **Fig 8** Selection can be made by painting or creating a spline.





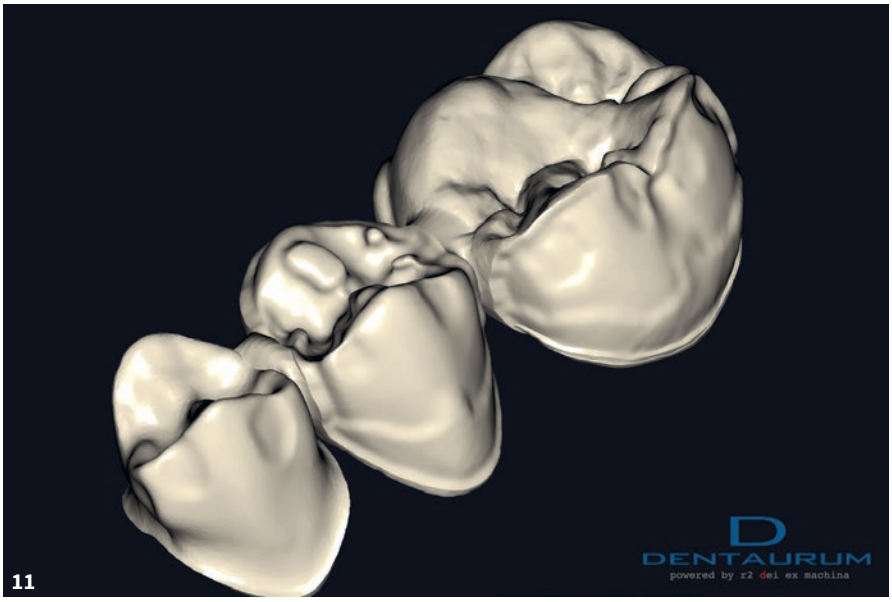


Fig 9 Reduced surface with depicted outer contour. **Fig 10** The reduced framework for the milling process. **Fig 11** Bridge framework reduced according to different settings.

Summary

In future, the success of a laboratory will depend decisively on the smooth integration of digital processes. Dividing the laboratory into analog and digital will not prove sustainable in the long term.

The software operation should only be the "tools of the trade". The required competence in the respective indication area and thus the dental technical knowledge is the more valuable asset. In order to operate economically and quality-oriented, the workflow in the CAD/CAM department needs to be rethought. Integrating the existing employees and departments into the digital workflow becomes a critical management task.

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