SEAMLESS INTEGRATION OF THE EXOCAD MODEL CREATOR WITH THE STRATASYS EDEN260V 3D PRINTING SYSTEM

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ABSTRACT

The digital dental landscape is in a state of constant technological evolution. For the discerning dental professional, being at the forefront of these changes ensures enhanced, long-term business viability. For example, exocad® GmbH's computer-aided design software and solutions are utilized by many dental CAD/CAM providers and resellers as platforms in their own digital design software. The company's versatility and breadth of solutions provide the digital dental professional with robust solutions for the dental treatment team. Among the many solutions available, the exocad Model Creator add-on module allows a physical model to be printed directly from an intra-oral or impression scan with different pinning modalities. This white paper illustrates the seamless integration of the exocad Model Creator with the Objet® Eden260V™ 3D Printer from Stratasys®.

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OVERVIEW

Digital design solution providers throughout the world use exocad software as a platform for their solutions, including some of the foremost innovators in the digital dentistry arena. These technology providers have sold numerous systems comprising the lion's share of the computer-aided design (CAD) and computer-aided manufacturing (CAM) market. They selected exocad because of its ease of use and shortened learning curve, which in turn, allow dental laboratories and technicians to minimize training costs and maximize productivity. Its open-architecture CAD software platform easily allows it to seamlessly integrate with other digital solutions, including CAD and CAM. The software is remarkably intuitive to use and has extensive capabilities to design some of the most complex dental restoration options.

exocad GmbH introduced the Model Creator add-on module in late 2013; it offers dental practitioners the ability to take intra-oral or impression scans, and then create a digital file that is used to build a physical model. The physical model can be created in multiple pinning modalities, allowing the dental professional to remain in control and validate the process throughout the dental treatment. Model Creator supports solid or hollow clinical casts with independent dies or pin-based model creation for maximum flexibility. The Objet Eden260V 3D Printer offers seamless integration with Model Creator and easily accepts the design file to produce an accurate, clean and smooth dental model.

CASE PRESENTED

Segmented with removable dies

An intra-oral scan of a patient's mouth is captured with a chair-side dental acquisition unit, illustrating a detailed rendering of the existing dental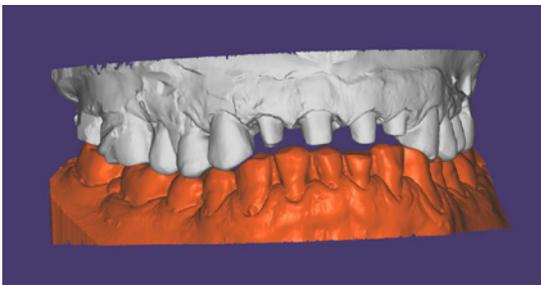 topography (Figure 1). The scan is sent to the dental laboratory in an STL file format and downloaded into the exocad software. An STL file is open formatted, which means it's possible for additional open digital systems to accept, retrieve and manipulate its digital data. This output allows users to be selective with their digital solutions, yet seamlessly integrate the process through multiple systems to achieve an optimal restorative solution. The user opens the STL file with the Model Creator add-on module and imports the scan for assessment and virtual design manipulation. After all of the corresponding data is correctly imported, the model design is initiated by adding pre-fabricated bases, called Baumann plates, to create the detachable segmentation possibility (Figure 2).
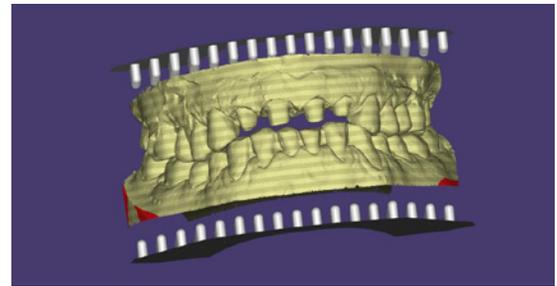

Figure 2: Inserting the Baumann plate.

The user then aligns the detachable plates with the virtual model, which is anchored or pinned to the detachable segmentation of the working die in place.

Once the user establishes the base position and identifies preparations that need restorations in the software, the software proposes a set of strategic cuts in the clinical cast. This auto-selection function proposes these cuts with consideration for the geometric considerations, to ensure strength and stability with regard to the removable dies (Figure 3). The design user remains in complete control throughout the design phase and can either accept the software's proposal or alter the cut strategy to individual specifications.
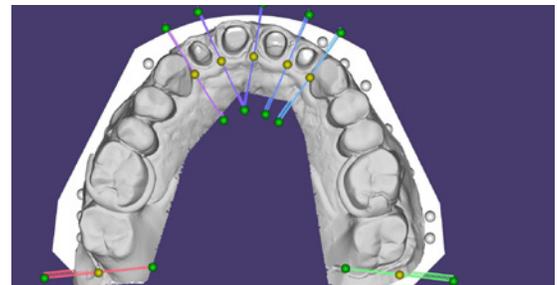

Figure 1: Loading a dental scan file.

Figure 3: Auto-selection of the cut sections.

After choosing which virtual cuts to make, the user approves the segmented section and proceeds (Figure 4).
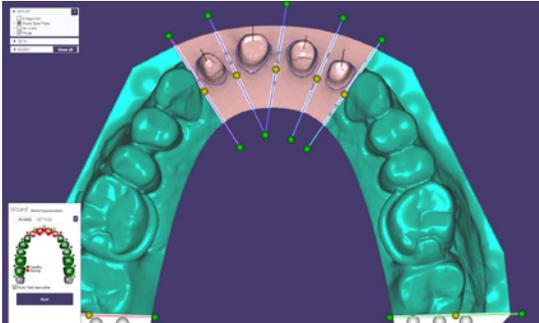

Figure 4: Segmented sections approved by the user.

Removable dies are an essential part of the dental model. They provide the dental laboratory with access to the peripheral extent of the preparation called the margin. In order for the restoration to be sound in the mouth, the crown must conceal the margin precisely. Furthermore, removable dies facilitate the contouring of the restorations and the proper inter-proximal contact placement. Use of the Baumann plates allows for a consistent positive retrieval of the removable dies to the clinical dental model. The digital design proposal is converted to an STL file and imported to the Objet Eden 260V 3D Printer (Figure 5).
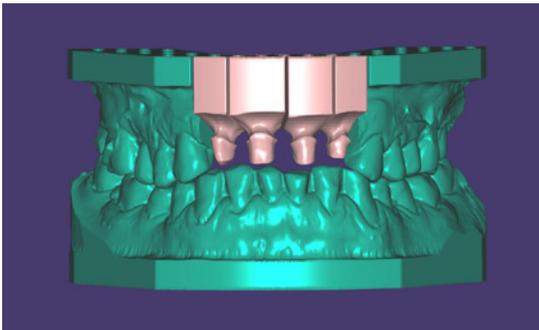

Figure 5: The model is ready to print and can be exported as an STL file.

Non-segmented dental model

If segmented dies are not desired, a removable die within the clinical dental cast can be attained by virtually annotating and segmenting near the margin (Figure 6). The die will appear as a wedge within the clinical cast that is easily removable. Removal of the die is necessary to complete the restorative fabrication

functions, however, it is critical that the die is seated back into the clinical cast in the identical position it was before removal. When choosing this protocol, consider two preparation sites: the first being the shaft by which the die will be situated, and the second being the die itself, including the pin. The recommended setting for horizontal shaft gap is 0.15 mm and the vertical shaft gap is 0.15 mm. These gaps provide a small space between the die and the rest of the model for ease of removal. The minimum thickness of the wall – the outer membrane of the model, or the gingival portion of the patient's oral cavity – needs to be no less than 0.95 mm to ensure stability and no perforation. If the wall is perforated, the die will not have a positive seat and therefore introduce unwanted discrepancies in the position of the preparation.
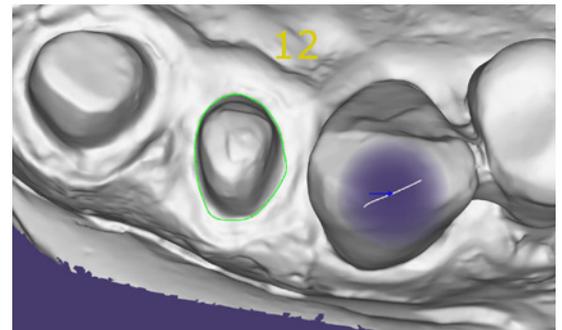

Figure 6: Tooth annotation for relevant restorations.

Shifting attention to the removable die and its characteristics, the wedged die needs to be established with a ditch width of 0.67 mm and ditch average of 0.50 mm. The preparation margin extrusion should be 0.23 mm, with a seating width of 0.72 mm and a pin height of 1.80 mm. Finally, in order to create an anti-rotational mechanism that ensures minimal movement and a consistent seating position, a groove should be established with a width of 1.74 mm and depth of 0.95 mm. Once the user sets and approves all the printing parameters, the design proposal is ready to be exported to the Eden260V 3D Printer. After printing, the clinical model and removable dies, which are printed separately, are used to verify the treatment protocol. A cost-reduction feature in the software allows the user to set parameters within the program. The non-sectioned components aren't required to be made of solid printed material (Figure 7). In areas where removable dies are unnecessary and a long span of printed material is present, the long span is stable enough to be hollow and/or void of printed

material. This feature, however, should not be used in areas where preparations are present so that the stability of the dental model is not compromised. With multiple cases and full arch printing capabilities, this cost-reduction method can yield a significant cost savings in material and time.
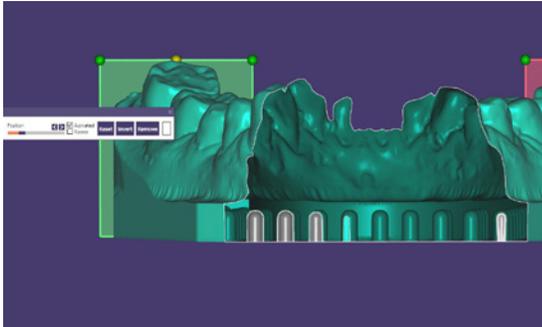

Figure 7: Side view of the Baumann plate prepared automatically.

CONCLUSION

Digital dentistry is quickly becoming a staple for dental treatments among discerning dental professionals. 3D printed models can now easily, quickly and cost-effectively validate the intricacies of oral topography via inta-oral or impression scans (Figures 8 and 9). Since its introduction, exocad has been one of the premier digital design software products in the market, but with the Model Creator add-on module, users can now seamlessly and effortlessly integrate files with the Objet Eden260V 3D Printer to create optimal 3D model solutions.

Plateless Model Design Settings	
Horizontal shaft gap	0.15 mm
Vertical shaft gap	0.15 mm
Ditch width	0.67 mm
Ditch depth average	0.50 mm
Pin height	1.80 mm
Preparation margin extrusion	0.23 mm
Seating width	0.72 mm
Groove width	1.74 mm
Groove depth	0.95 mm
Wall thickness	2.50 mm

Figure 10: Recomended plateless model design parameters. All parameters can be found in the pre-loaded settings "defaultparameters.xml".

Figure 8: A clean segmented 3D printed model with easily retrievable dies.

Figure 9: A 3D printed model made from VeroDentPlus™ by Stratasys.

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