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APPLICATION OF CAD/CAM TECHNOLOGY IN THE DESIGN AND CREATION OF FULL ANATOMIC BRIDGE FORM ZIRCONIUM DIOXIDE

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Abstract: *Daily progress of dentistry, especially in the field of prosthodontics is introducing new materials and technologies. With the increasing need for aesthetically acceptable and non-metal materials, it came to development and improvement of ceramic materials and computer based systems (CA). The patient came in order to compensate the missing left lateral incisor. Since the adjacent teeth are brushed and the print was taken, casted model has been scanned using 3Shape D800 laboratory scanner. Dental restoration has been designed using 3Shape DentalSystem Premium software and the available tools. After completing the virtual design, the data are sent to the program responsible for CAM Zenotec® mini CAD/CAM device. As a result, the compensation with the full morphology was obtained without the need for finishing works.*
Key words: *CAD/CAM, zirconium dioxide, dental restorations*

Primena CAD/CAM tehnologije u projektovanju i izradi mostova pune anatomske forme na bazi cirkonijum-dioksida. *Stomatologija, posebno stomatološka protetika svakodnevno napreduje uvođenjem novih materijala i tehnologija. Kako se javlja sve veća potreba za estetski prihvatljivim i bezmetalnim materijalima, došlo je do razvoja i unapređenja keramičkih materijala i računarima podržanih sistema (CA). Pacijent se javio radi nadoknade nedostajućeg levog bočnog sekutića. Pošto su susedni zubi zbrušeni i uzet otisak, izliven je model koji je skeniran pomoću 3Shape D 800 laboratorijskog skenera. Zubna nadoknada je dizajnirana pomoću 3Shape DentalSystem Premium softvera korišćenjem raspoloživih alata. Nakon završenog dizajna virtuelni podaci su poslati u program odgovoran za CAM Zenotec® mini CAD/CAM uređaja. Kao rezultat, dobijena je nadoknada pune morfologije bez potrebe za doradivanjem.*
Ključne reči: *CAD/CAM, cirkonijum-oksid, zubne nadoknade*

1. INTRODUCTION

By introducing new materials and technology in the filed of dentistry, especially in prosthodontics, it is rapidly progressing. With increasing popularity of intraosealnih implants, there was an expansion of fixed dental restorations [1]. With the increasing need for aesthetically acceptable non-metal materials, developments and improvements of ceramic materials and computer supported systems (CA) progressed. In CA systems, wich have the greatest application in the field of dentistry, are including 3D digitization systems, computer aided design (CAD) with reverse engineering (RE) and computer aided manufacturing (CAM) [2].
CAD / CAM systems enable efficient creation of high-quality dental restorations with high precision and accuracy in one visit [3]. On the other hand, the main disadvantage of such restorations is aesthetics that was not at a high level. The blocks of compensation was made, and it is obtained with the use of rototillings cut method, they had been uniform and could not fully imitate tooth structure that differ in color and translucency without finishing by dental technicians. In this way the time needed for tooth reparation is extended which is increasing the costs of their production. For this reason, for a long time CAD/CAM system was only used as a method for making metal-free base compensation, then the dental technician inflict the veneers ceramics. Zirconium oxide ceramic has excellent biocompatibility and mechanical characteristics compared to conventional ceramics [4]. However, the main disadvantage of this ceramic system states breaking a part of veneering ceramic layer [5-8]. The solution of this problem is the creation of one-piece restoration using CAD/CAM system. From zirconium-oxide ceramics it is possible to produce a single large compensation with the full range of the morphology, which has no need for veneering.

2. CASE STUDY: CAD/CAM APPLICATION IN THE DESIGN AND CREATION OF FULL ANATOMIC BRIDGE

The patient sought to compensate the missing left lateral incisor. After examination and discussion he suggested that the missing tooth compensate with the bridge of zirconium. In the next visit the adjacent teeth are milled, left central incisor and canine and prints are taken.

2.1 3D Digitization

After taking impressions, models are casted of special plaster for scanning (Fujirock EP OptiXscan, GC, Japan). The model was scanned using 3Shape D800 laboratory scanner (Fig. 1) supported with 3Shape DentalSystem Premium software. This scanner has two cameras with resolution of 5.0 Mpix, red light laser technology and accuracy of 20 microns.

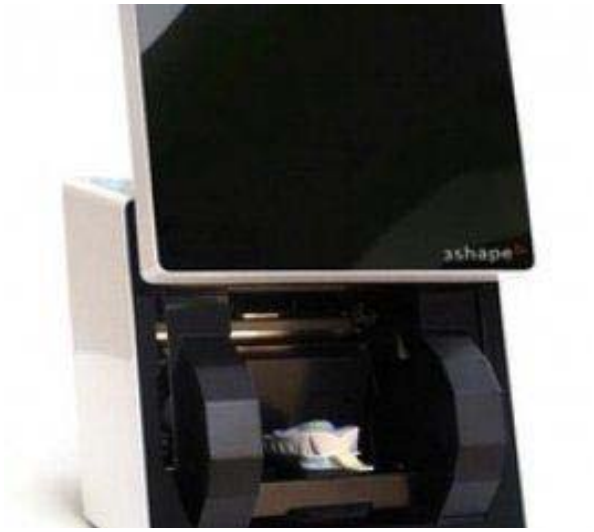

Fig. 1. 3Shape D800 labaratory scanner

After the 3D digitization is complete, the virtual model appeared on the screen (Fig. 2).

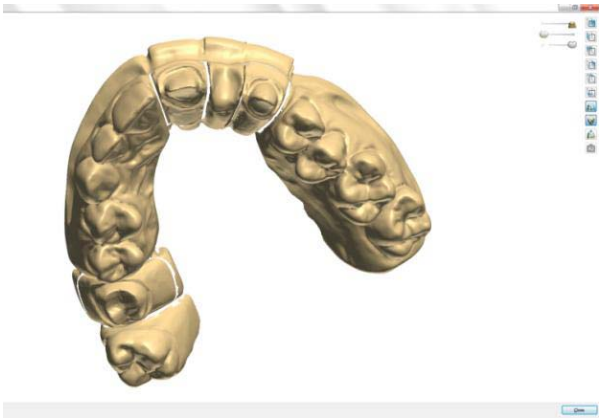

Fig. 2. The result of 3D digitizing

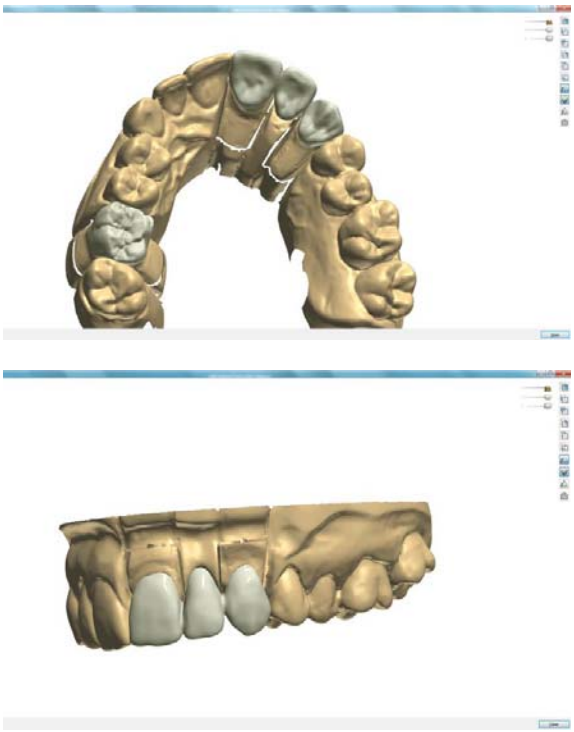

Fig. 3. Finished compensation design

2.2 Restorations CAD design

The begining of designing compensation involves determining the lines of demarcation. The computer automatically gives the proposal of the demarcation line, but the user interface allows for manual corrections. The next phase is the determination of entering way of compensation. Then, from the data base are choosen cheapest morphological files. The files vary in height and number of nodules, fissure complex, and ridge morphology. Further adjustments are allowing compensation of group movement, correction of individual teeth axis or correction of individual zones with tools for adding or removing material (Fig. 3).

2.3 CAM compensation

Virtual project is automatically converted into the STL file and then electronically sent to the program responsible for the CAM process. In this case, STL file is imported into the program rototillings Zenotec® mini CAD/CAM (Wieland Dental) (Fig 4). The compensations are then milled from non-ferrous single-zirconium discs (color T1). Usually, coloring requires a separate working step which is comprising to application of the liquid coloring matter based on metal oxide, dipping or by using the brush technique before sintering. For colored discs, the colors are added to the zirconium powder and are homogenized during the industrial production process.

Fig. 4. Zenotec® mini CAD/CAM device

As a result the compensation of highly homogeneous color was obtained (Fig. 5). The need for manual veneering can exist in extremely attimis works, while more simple aesthetic forms can simply paint the surface and is additional advantage when creating compensation which is time saving. The consistency of color is another advantage that should not be ignored. Contact points in the zirconium dioxid ceramics should be highly polished, thus preventing abrasion of antagonist.

Fig. 5. Final compensation

3. CONCLUSION

Displayed zirconium oxide ceramic has excellent mechanical characteristics, aesthetic performance, excellent biocompatibility and as well as the abrasion resistance, as compared to conventional ceramics. In contrast to the glass-ceramics, which are less stable in the mouth, they are limited to restoration of individual or small bridges [4], from zirconium - oxide ceramics and it can make long-span bridges with full morphology. Thanks to the materials and painted homogenized discs, finishing work by dental technicians can be minimized, and the finished work can be obtained quickly, easily and reliably using CAD/CAM technology.

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