ALL-CERAMIC APPLIANCES FOR PROSTHETIC REHABILITATION IN YOUNG PATIENTS

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Abstract

The aim of the present study was to assess a possible fixed rehabilitation in young patients, by means of CAD-CAM techniques. Materials and method. The CERCON subtractive technique with zirconium oxide blanks was applied. Discussion. The obtained prosthetic structures are characterized by a better aesthetic integration, optimum marginal adaptation and suitable clinical longevity. Conclusions. All-ceramic prostheses appear as a biological solution in the prosthetic rehabilitation of young patients, as they require reduced removal of both enamel and dentin, while obeying the biological conservative principle of treatment.

Keywords: computer-aided design/computer-aided manufacturing, CERCON, dental prosthesis, dental rehabilitation.

1. INTRODUCTION

Young patients address the dental medicine office complaining of complex clinical situations, which require a specific approach – if considering the age of the subjects – for obtaining optimum therapeutic results. The algorithm to be performed – starting from diagnosis, establishment of the treatment plan and realization of a prosthetic substitute - is frequently challenging, if considering the large number of clinical variables involved, which may require a rigorous evaluation and quantification, as well as corroboration of the decision to be taken on the different technological solutions at hand and materials now available on the specialized market.

Oral rehabilitation of the edentulous prosthetic area in young patients is a major objective, aiming at applying a correct prosthetic solution, and involving specific and non-specific preparation stages, namely the prothesizing operations as such and also patient monitorization. In adolescents and young adults, the presence of coronary lesions or of edentations requires a prompt intervention, usually of interdisciplinary nature (orthodontic, conservative, prosthetic). [1,2]

2. MATERIALS AND METHOD

A recent prosthetic alternative is represented by rehabilitation with prosthetic pieces built up of all-ceramic systems processed by additive or subtractive techniques. System CEREC 3, available since the year 2000, represents a continuous development of its previous versions. The main difference refers to the modular division of the two components: registering and milling, which confers flexibility not only spacially, but also for integration of the working flux. The modular construction offers numerous configuration variants for the two components, the connexion between them being made either with a cable or wireless. The integrated card network permits milling control outside the dental office for several locations, and a Modem may be linked to a second Com Interface. If two units and milling elements are employed, the radio receiver is connected through Com Switch. [3]

The new Cerec Scan module for direct data acquisition, combined with the milling unit, assures a positive efficiency-cost ratio, while a Cerec 3 receiving unit may be subsequently
added. The new Cerec Link program permits utilization of the Cerec 3 system soft, when a Cerec 2 system is available. Cerec 3 may be connected with a Cerec In Lab system, designed for dental technicians. [4]

The stages for the realization of a crown of presinterized ("green stage") zirconium, through computer-aided milling from a block having the basic colour of the tooth, will be illustrated in the following.

For the realization of a zirconium structure, the laboratories should observe the following rules:
- the model should be casted with mobile dies
- the model should contain either pins or Bafix- or Accu Track-type systems
- the threshold should be wholly visible
- the model should be sent together with the occlusion recorded with siliconic masses
- the dies should not be covered with a die spacer. [5]

The main advantage for the preparation of monolithic crowns is a more reduced tooth polishing (space being necessary for only one material). Consequently, they may be applied even in the absence of a large occlusal space, or in young patients who need minimum invasive interventions. Preparation should meet the following requirements:
- reduction of the axial walls will be of 1 mm;
- total occlusal convergence will be of 6 - 8°;
- reduction at the level of the central pit may vary between 0.5-1.5 mm. When the occlusal space is below 1 mm, the crown will have sufficient resistance, however the final form of the occlusal surface will not reproduce most faithfully the natural morphology;
- the cervical threshold will be of chamfer type;
- the width of the threshold should be of 0.3-0.5 mm
- the angles and margins should be completely rounded;
- reduction of the supporting cuspide should range between 1-1.5 mm. [6,7]

The computer is equipped with a 3D camera for data taking over, a flat screen and a microprocessor with double control and Video card, permitting real time recording and processing of the optical impressions in combination with the intraoral Camera Siromcam 2, from Sirona, which provides unmodified colour images.

Unlike the direct recording obtained with an intraoral camera, utilization of the CEREC Scan module permits an indirect obtaining of the model.

Due to its organization into independent modules, the receiving unit may be used during milling in connection with other procedures.
Starting from the data provided by the dental library, the design is automatically established, on also considering the adjacent teeth. Crown alignment according to the equilibrium of the dental arch and establishment of the height of the interproximal marginal ridges take into consideration the adjacent teeth. There follows automatic calculation of the position of cusps and marginal ridges, and establishment of their height, after which all the other lines are automatically drawn, so that an immediate initiation of milling is permitted.

Alternatively, all structures may be gradually rendered discrete, possibly undergoing individual modifications. In a separate window, a transversal section may be rendered discrete, in view of editing the construction lines and also for determining ceramic resistance on occlusal level. [8]

Zirconium oxide possesses superior characteristics, which transforms it into an ideal restoration material, if considering its aesthetics, its biocompatibility and biomechanical parameters. [9]
The milling camera contains two pieces, one corresponding to the working part and the other – to the milling head, their special montage permitting longitudinal shifting and also rotation inside the axle in angular direction. Also present are other axes for the penetration and turning of the milling axle. The ceramic block is attached after selection of the most suitable color. The milling room is closed and the process is automatically performed for 4-8 min. The milling head is equipped with a diamond-type wheel which contacts the prefabricated ceramic block. When milling is over, restoration falls down on the floor of the camera, and the process is automatically stopped. The rotation rate of the milling head is of 35-40 m per second. The diamond-type wheel, 30 mm in diameter, has particles of 126 microns, arranged on a 0.5 mm layer. Restoration involves 200-400 steps. Different depth values in the ceramic block may be obtained, as a function of the vertical shifting of the milling device, which assures an efficient removal of the material. The trajectory is oriented by means of a hydraulic turbine with internal water circuit. No water addition and no draining are necessary, due to the microfilter mounted in the pumping system and also to a 5 L water reservoir.

After removal of the excess of material which connects the ceramic block, the internal sharp edges are rounded, the proximal surfaces are made smooth and polished. Finishing of the occlusal relief is performed after insertion of the prosthetic piece.

Prior to the first adaptation, extension of the interdental spaces is performed by means of interdental strips. If restoration is not adapted, the user may address the stored data, make the necessary modifications with an Edit program and then begin a new milling. If occlusal adaptations are preformed in the moment of checking, the crown should be re-polished, otherwise wear of the opposing teeth may occur. After steadfast adaptation there follows finishing of the occlusal relief with a diamond-type instrument, while final polishing is performed with flexible disks. For the interproximal regions, strips or Proxoshape-Files may be used. [10-12] Restoration is fixed through an adhesive technique, on using a cement with dual cure. Due to the sufficient transparency of the ceramic masses, photopolymerizable resins with a thickness up to 3 microns may be used. Air inclusions during mixing should be avoided. Materials with reduced viscosity are preferred, as they permit the introduction of restoration under the action of a reduced force. High viscosity materials allow a simple removal of the material in excess.

3. DISCUSSION

The fundamental principles governing the CAD CAM systems assume conversion into spacial information on the prepared tooth, starting from numerical data, by means of computer-aided analyses, realization of specific files and automatic control of dental prostheses. All CAD CAM systems include three stages: data acquisition, prosthesis modelling, and fabrication. Variations may occur, as a function of the complexity of the situation, selected solution and estimated working time. Numerous similarities may be mentioned among the different CAD CAM methods now in use, as the systems have distinct complexity and soft facilities. Computer-aided modelling varies with the automatization degree, each system performing data conversion through various milling procedures. The spectrum varies from the constructions of substructures with an interactive design up to wholly automated structures.

The CEREC system makes use of an optical scanner, different from the mechanical one, present in the other systems. Comparatively with the mechanical method, optical measurements are superior, as they reduce any possible error.

Dies height is essential for obtaining zirconium substructures with the desired form and dimension. As this assures the mechanical resistance of prosthetic restorations, such an aspect should be carefully analyzed when manufacturing dental works with no metallic infrastructure. A most rigorous teeth preparation is especially important for obtaining optimum adaptation. In the absence of sufficient space, of
a correct angle and visibility of the prepared margins, it is difficult or even impossible to build up high quality restorations.

Zirconium has not only a similar color to that of natural teeth, it is also opaque, which is advantageous in cases of a discolored tooth, permitting its masking. Also, the radio-opacity of zirconium is especially important to check the marginal adaptation from a radiological perspective, mainly in cases of intrasulcular preparation. [13-15]

Another aspect refers to the cementing variant and to marginal adaptation. The space also available in conventional cast workings, of 50-100 µm, is taken as a standard value in CAD CAM system design.

Marginal adaptation is different, while cementation may be performed either conventionally or by means of adhesive techniques.

Another advantage is an extremely high resistance (ca 1000 MPa), so that this type of prosthetic works may be applied even to young patients with parafunctions. [16]

4. CONCLUSIONS

To resemble the traditional methods, a computer-aided technique should permit processing of a large range of materials, possessing superior and biological properties capable of granting morphological integration and optimum functioning. Subtractive techniques show the advantage of not requiring special conditions for material processing, and a shorter treatment time, which is especially important for young patients.

Zirconium oxide appears as a viable alternative for metallic prosthetic restorations, especially for crowns applied on the lateral teeth and for combined fixed works, as they grant a better acceptance from the part of the young patient, concerned firstly with the aesthetic aspect of rehabilitation.

The translucency of the prosthetic appliance assures excellent cosmetic results, the peculiarities of the material remaining unmodified, so that a considerable clinical longevity is to be expected.

References