Preparation Junctions For All-Ceramic CAD/CAM Crown And Bridge Restorations

SUMMARY

Background: The preparation junction type is determined by a number of factors that need to be taken in consideration with CAD/CAM Fixed Prosthodontics: the used material; the condition of the retainer teeth, their periodontium and the occlusion; the design software and the type of drills; the working protocol; the cement and the method of cementation. The aim of this article is to describe the optimal preparation junctions for CAD/CAM crown and bridge restorations made by ceramics based on zirconium dioxide and the basic factors that affect them.

Materials and methods: Chamfer and radial shoulder preparation junctions are suitable (width 1 - 1.5 mm). Trimming of 1.5–2 mm dental tissues is necessary on the occlusal surface. The homothetic tooth reduction is optimal. The surface has to be smooth and the edges rounded.

Results: The preparation width depends on the size and vitality of the tooth. In stained teeth the removal of more tissues provides a greater volume needed for masking the dark color. Vestibular preparation under the level of the gingiva is preferable to ensure optimal aesthetics. The preparation junction is determined also by the CAD/CAM software abilities, the type of drills and protocol of impression taking (classical or digital). The creation of a working model with an intraoral scanner is greatly facilitated by preparations above the gingival margin.

Conclusions: Knowledge about the criteria for selection of preparation junctions is essential for fabrication of accurate and aesthetic CAD/CAM restorations.

Keywords: preparation junctions, CAD/CAM, all-ceramic crown and bridge restorations

Introduction

The type of preparation junction is determined by a number of factors that need to be aligned with CAD/CAM fixed restorations: the material of which the construction will be made; the type and condition of the retainer teeth of their periodontium and the occlusion; the design software, the CAM setting and the type of drills; the working protocol – starting with a working cast poured of a classical impression (by laboratory scanning) or a digital model (made by intraoral scanning); the type of the cement and the method of cementation.

The aim of this article is to describe the optimal preparation junctions for CAD/CAM crown and bridge restorations made by ceramics based on zirconium dioxide and the basic factors that affect them.

Materials and methods

The suitable preparation junctions are chamfer (Figure 1) and radial shoulder (Figure 2) (width 1 - 1.5 mm). Trimming of 1.5 - 2 mm dental tissues is necessary on the occlusal surface. The axial reduction is between 1 and 1.5 mm with about 3° inclination of the walls. The
surface has to be as smooth as possible (Figure 3). The homothetic reduction of teeth is optimal (Figure 4). It can be simplified by initial depth guides preparation and by the use of a silicone key for control. Depending on the CAD/CAM technique variations in their position are possible. In intraoral scanning protocol, especially in the area of distal teeth, preparations over the gingival margin are preferred (Figure 5). In laboratory scanning of a dental stone working cast the level of the junctions is on or under the gingiva (no more than 1 mm in the depth of the gingival sulcus for prevention of the biological width).

Results and discussion

The width of the preparation junction depends of the volume and vitality of the tooth\(^2\). In stained teeth and those built with metal pins removal of more tissue provides a greater volume needed to disguise the dark color. In such cases the vestibular preparation under the level of the gingiva is preferable to ensure optimal aesthetics (Figure 6).
Preparation junction is determined also by CAD/CAM technology - the type of milling cutters, the way of impression taking (classical, with a real working cast and laboratory scanner or with a digital model made by the intraoral scanner). The rounded heads of the drills for example for the CAM 5 - S 2 Impression, VHF define the necessity of preparations with rounded angles (Figure 7) (unlike CEREC, Sirona where the milling cutters heads are flat with sharp angles and the optimal preparations are with sharp internal and external angles).

Furthermore as more abilities for rotation in the CAM device as more complicated crown margins can be milled. For example CAM 5 - S 2 Impression, VHF is 5-axis CAM device. Its drills mill apart not only along the axes X, Y and Z, and also along two more additional - A (the axis to which the disc is rotated through 360 °) and B (an axis of rotation of the disc in the chamber ± 30 °).

Two types of fixed all-ceramic restorations CAD/CAM manufactures are possible – a full contour or a ceramic cap fabrication that is additionally finished with dentin and enamel ceramics, glaze and shades. For full contour only shades and glaze are necessary. The full contour fabrication for distal teeth can be done only on digital impression, without pouring a real gypsum working cast. This makes the process simple, reduces the technological time and the risk for mistakes in the additional laboratory steps.

The preparation junctions over the level of the gingiva make the process of impression taking (real or digital) easier, improve the local oral hygiene and therefore the periodontal health. The preparation junctions on or under the gingival margin do not disturb the biological width if they are positioned till 1 mm depth in the gingival sulcus.

Obtaining so called J - preparations (named on the shape of the English letter „J”) (Figure 8) must be promptly corrected, because the preserved enamel edge hinders further manipulations - adjustments and cementation.

### Conclusion

Knowledge about the criteria for selection the preparation junctions is essential for fabrication accurate and aesthetic CAD/CAM restorations. Number of factors have to be taken into consideration: the material of which the construction will be made; the type and condition of the retainer teeth, of the periodontium and the occlusion; the design software, the CAM setting and the type of drills; the working protocol – digital or classical type of impression; the cement and the method for fixation of the restorations.

The homothetic reduction of dental tissues releases enough volume (1.5 – 2 mm) for the ceramics that ensures strength and aesthetics. The rounded heads of the milling cutters define the necessity of preparations with rounded angles. The 5-axes CAM device simplifies the milling process and makes it more precise. Creation of a working model with the intraoral scanner is greatly facilitated by the positioning of preparation junctions over the gingival level. When the option with classical impression and scanning working model in the laboratory scanner is chosen the preparations may finish on the level of the gingiva or in the gingival sulcus but not deeper than 1 mm.

With proper correction of the J-preparations the problems with the following adjustments and cementation decrease significantly.

**Note**: The results of this paper were presented as a part of an invited lecture at the 21st BaSS Congress.

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