Management of full mouth prosthodontic rehabilitation using high-strength CAD/CAM zirconium-oxide crowns

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_VDO is defined as the vertical measurement of the face between two selected points superior and inferior to the oral cavity when the occluding members are in contact. Various methods have been proposed for the assessment and re-establishment of the VDO. The difference between the vertical measurement of physiological rest position, which should have a higher value than the VDO, and the VDO is referred to as the inter-occlusal rest space, which is essential for normal patient function._

**Introduction**

**Prudent clinical judgement** and careful consideration of the risks and benefits of various treatment options are essential for the treatment planning and long-term success of prosthodontic treatment. It has been established that loss of the vertical dimension of occlusion (VDO) may pose significant clinical difficulties in prosthodontic treatment. Yet, the re-establishment and maintenance of a new VDO is seldom taught in undergraduate dental curricula.
As teeth are worn down, the alveolar bone may undergo an adaptive process that may compensate for the loss of tooth structure.5 The VDO should be carefully assessed before the initiation of restorative procedures.

Traditional porcelain-fused-to-metal anterior crown restorations require the placement of labial crown margins below the free gingival margin, in order to mask the hue and value transition between the root surface and porcelain-fused-to-metal restoration. However, intra-crevicular placement of crown margins is technique-sensitive and related to adverse periodontal tissue response.6–9 From a periodontal point of view, preparation margins are best kept away from the free gingival margin.8,9

The dentition, masticatory muscles and temporomandibular joints form a Class 3 lever system. In such a lever system, functional load is inversely proportional to the length of the lever arm. Anterior teeth are under a reduced functional load in comparison with posterior teeth. Porcelain-fused-to-metal restorations are commonly used in the posterior teeth because of their well-documented long-term clinical track record in anterior and posterior teeth.10–17 Newer zirconium-oxide-based materials are usually prescribed in the anterior region owing to their demonstrated promising physical properties18,19 and reasonable clinical longevity.20 In vitro studies also show that the wear of metal occlusal surfaces against porcelain occlusal material is acceptable when there are no bruxing activities.21

This article describes the prosthodontic management of a mutilated dentition using high-strength zirconium-oxide crowns.
Clinical report

A 63-year-old fully dentate male patient presented with discoloured teeth and multiple areas of loss of tooth structure. The patient desired the restoration of function and aesthetics. He presented clinically with defective restorations, insignificant loss of VDO and compromised aesthetics (Figs. 1–3). There were signs of loss of enamel at the occlusal and labial surfaces of most of the teeth. The pre-treatment radiograph was within normal limits (Fig. 4). In spite of the overall condition, the natural teeth were free of active dental caries and oral hygiene was good. An occlusal examination revealed a stable maximal inter-cuspation position with insignificant centric relation to maximal inter-cuspation slide at the teeth level. No para-functional habit was reported.

A diagnostic dental wax-up on mounted maxillary and mandibular casts in a semi-adjustable articulator was performed (Hanau Wide-vue, Teledyne Waterpik; Fig. 5). The proportions of the anterior teeth were corrected to the estimated 0.618 width-to-height ratio of central incisors using the golden proportion22–25 as a guideline. The results indicated that no increase of VDO was needed at the incisal pin level in order to restore proper incisal anatomy and anterior guidance. The overall treatment plan included placement of fixed, high-strength zirconium-oxide base restorations in the maxilla and mandible.

The maxillary and mandibular teeth were prepared in the usual manner for complete coverage crown restorations (Figs. 6 & 7). The margins of the tooth preparations were prepared at the gingival level under magnification, and no gingival displacement procedures on the prepared teeth were necessary prior to definitive impression making. High-viscosity vinyl polysiloxane material (Aquasil Ultra Heavy, DENTSPLY DeTrey) was carefully injected onto all tooth preparations, ensuring that all teeth surfaces including the margins were recorded. A stock tray loaded with putty material (Aquasil Putty, DENTSPLY DeTrey) was seated over the entire dental arch to make the definitive impression. A jaw relation record was made with a vinyl polysiloxane material (Regisil PB, DENTSPLY DeTrey). The maxillary and mandibular definitive casts were mounted in the centre of the articulator using standard settings.26,27 Provisional crown restorations (Luxatemp Automix, Zenith/DMG) were placed on the prepared teeth at the established VDO.

The development of the planned definitive crown restorations was carried out using CAD/CAM. The maxillary and mandibular definitive casts (Figs. 8 & 9) were scanned (Zeno Scan, Wieland) and the crown copings were designed using a software programme (3Shape D700). The copings were milled in zirconium base material (ZENO ZrBridge, Wieland) with a milling machine (ZENO 4030 M1, Wieland; Fig. 10). The copings were sintered according to the manufacturer’s recommendations. Subsequently, overlaying low-fusing porcelain material (IPS e.max, Ivoclar Vivadent) was manually applied onto the exterior to create proper anatomic form. All maxillary and mandibular anterior teeth were fabricated using the same process. The completed restorations were cemented in resin-modified glass-ionomer luting agent (RelyX Unicem, ESPE; Figs. 11–12 & 15).

The patient was evaluated post-operatively. Anterior guided occlusal schemes were verified intraorally before and after prosthesis cementation (Figs. 13 & 14). The patient reported no discomfort and adapted well to the new restorations. No abnormal clinical signs were noted.

Discussion

The maintenance and re-establishment of the VDO is a crucial element in full mouth fixed prosthodontic rehabilitation. It was necessary to make impressions that registered all teeth preparations at once.

As the patient desired a high level of aesthetics, full ceramic restorations were chosen for all restorations. The minimum core thickness for this full ceramic system is 0.4 mm, this enabled conservation of tooth structure and achievement of reasonable aesthetics simultaneously.

By prescribing full ceramic restorations, intra-sulcular placement of crown margins on the labial surfaces become less important from an aesthetic point of view. In this report, the teeth were essentially caries free, teeth preparation margins were made at
Gingival level and gingival retraction procedures were eliminated. As gingival retraction cord placement was not required, there was less physical trauma to the gingival tissues and less clinical time was needed. This is particularly beneficial for thin gingival biotypes.

Full mouth rehabilitation using fixed prostheses usually requires longer-term provisional restoration in order to facilitate a predictable treatment outcome. In this patient, owing to his busy travel schedule, long-term provisional restoration for verifying his adaptability and multiple professional clinical adjustments of provisional restorations were not feasible. The anterior teeth were restored based on the diagnostic wax-up without long-term provisional restoration before definitive cementation of the definitive crown restorations. This treatment sequence left almost no room for clinical errors in the execution of the planned treatment.

Intra-oral verification of the new occlusal scheme and detailed in situ clinical adjustment of the restorations on the day of prostheses insertion are essential for proper treatment execution. In this unique treatment approach, the patient should be informed of the potential financial and time implications should any need for re-fabrication of the definitive restorations arise.

**Conclusion**

The functional management of complex prosthodontic rehabilitation is a clinical challenge. A relatively new restorative material was used in this case. The use of high-strength full ceramic restorations enhances the overall aesthetic outcome and functional predictability over the long-term.

*Editorial note: A complete list of references is available from the publisher.*

**Fig. 11** Occlusal view of completed definitive maxillary full ceramic crown restorations.

**Fig. 12** Occlusal view of completed definitive mandibular full ceramic crown restorations.

**Fig. 13** Side view at right latero-trusion, canine-guided occlusion.

**Fig. 14** Side view at left latero-trusion, posterior teeth were out of occlusion during eccentric movement.

**Fig. 15** Anterior view of the completed maxillary and mandibular crown restorations. The crown margins were placed at the gingival margin with no sub-gingival extension.