The rehabilitation of an edentulous mandible with a CAD/CAM zirconia framework and heat-pressed lithium disilicate ceramic crowns: A clinical report

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This clinical report describes a complete arch, implant-supported prosthesis with a zirconia framework and monolithic lithium disilicate crowns. The design of the computer-aided design/computer-aided manufacturing zirconia framework with cemented crowns with screw access is useful in facilitating retrievability and adequate fit, and may reduce the likelihood of porcelain chipping. (J Prosthet Dent 2014;111:443-447)

Dental implants are considered to be a predictable treatment for restoring edentulous mandibular arches.[1-3] Computer-aided design/computer-aided manufacturing (CAD/CAM) systems have been used for restoring edentulous arches with implant-supported fixed restorations[4,5] because they facilitate the fit between implants and superstructures better than conventional metal alloy castings.[6,7] Various methods for fabricating these types of restorations have been reported. Some suggest acrylic resin and denture teeth processed onto a CAD/CAM milled titanium framework,[8] and others recommend the use of a screw or cement-retained 1-piece zirconia framework with veneering porcelain.[9,10]

A zirconia framework is superior to a metal alloy or titanium framework in terms of esthetics and biocompatibility.[11-14] However, concerns have been reported regarding long-term degradation, aging, and veneering porcelain chipping.[15,16] Even though long-term degradation is known to decrease the flexural strength of zirconia, the fracture of zirconia infrastructures has rarely been reported and is unlikely to cause clinical catastrophic failure.[17] Veneering porcelain chipping has been reported with zirconia-based fixed dental prostheses (FDP). Suggested causes include a lack of compatibility in terms of the coefficient of thermal expansion between the zirconia core and the veneering porcelain,[18-21] a framework design that does not provide proper support for the veneering porcelain,[22] rapid cooling rates, and relatively low fracture toughness and low flexural strength of the veneering porcelain.[23-25] To address these concerns, new layering porcelains with an adequate coefficient of thermal expansion and adequate mechanical properties have been developed.[26,27] However, the veneering porcelain may still chip, and the repair process may become complicated and time consuming. In addition, porcelain chipping is the most frequently reported prosthesis-related technical complication of implant-supported ceramic FDPs.[28-30] To reduce the likelihood of defects in veneering ceramics, alternative techniques such as monolithic zirconia restorations or pressing the veneering porcelain to the zirconia framework have been introduced.[31-33] Another frequent implant-related technical complication is abutment screw loosening.[34] The purpose of this clinical report was to describe the use of lithium disilicate monolithic heat-pressed ceramic crowns with holes for abutment screw access that are bonded onto a zirconia framework to restore the edentulous mandible while decreasing the risk of veneering porcelain fracture and facilitating retrievability.

CLINICAL REPORT

A 49-year-old man presented to the prosthodontic clinic of Gowoon Guide Dental Hospital with generalized advanced chronic periodontitis and missing teeth in the right posterior mandible and multiple teeth missing in the maxilla (Fig. 1). His chief complaint was difficulty in masticating. His medical history was noncontributory, with the exception of controlled hypertension. A clinical evaluation revealed class II to class III mobility (according to the Miller classification) of the mandibular teeth and gingival swelling with probing depths that exceeded 5 mm. The maxillary remaining teeth were in good condition except for wear due to sleep bruxism. A panoramic radiograph showed an edentulous atrophic posterior maxilla with pneumatization and significant alveolar bone resorption in the mandible (Fig. 2). Because of financial concerns, the patient wanted to have the mandible treated first with an implant-supported complete fixed

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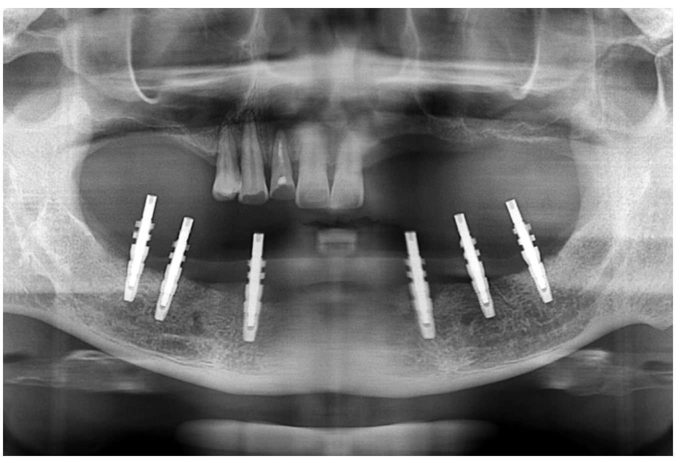
1 Preoperative photographs: frontal view.

2 Preoperative panoramic radiograph.



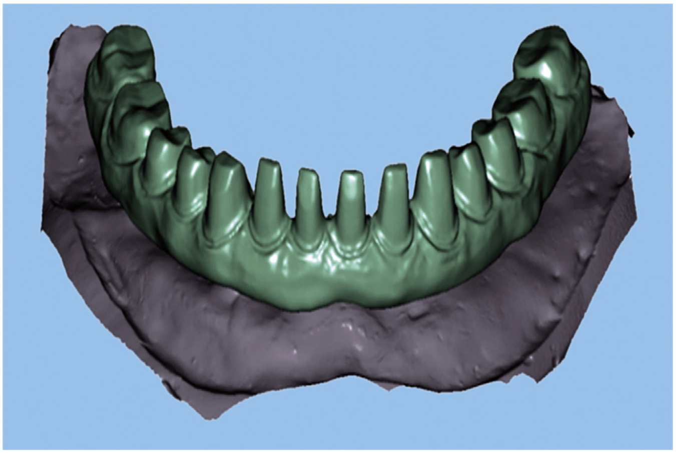
3 Panoramic radiograph after connecting interim abutments to implants.

prosthesis and then to have the maxilla treated with a partial removable dental prosthesis. An interim mandibular complete denture was inserted and relined with tissue-conditioning material (Soft-liner; GC Corp) immediately after extraction of the remaining teeth and was used for evaluating esthetics, phonetics, and the occlusal vertical dimension. A clear acrylic resin surgical template (Vertex Rapid Simplified; Vertex Dental) was made with a duplicate of the interim denture.

Three months after extraction, 6 endosseous dental implants, 10 mm in length and 4.3 mm in diameter (Implantium; Dentium Corp) were placed with the 1-stage approach. Because of patient fatigue and reduced treatment compliance and because of the length of surgery, an early loading interim denture was planned. After 1 week, 6 impression copings (Impression Coping Pick-up; Dentium Corp) were connected to the implants and used as interim screw-type abutments (Fig. 3). The prefabricated fixed detachable interim prosthesis made by duplicating the interim complete denture, with access holes for the interim abutments, was placed and evaluated for proper occlusion and clearance between each access hole and its corresponding interim abutment. Successively, autopolymerized acrylic resin (Jet denture repair resin; Lang Dental Mfg Co) was applied to the holes, and an interim fixed prosthesis was placed for 4 months until a maxillary partial removable dental prosthesis was fabricated.

Subsequently, a definitive mandibular impression was made with a custom light-polymerized open tray (Vertex Light Curing Trayplates; Vertex Dental) and open-tray impression copings (Impression Coping Pick-up; Dentium Corp). The impression was poured with Type IV gypsum material (Fujirock EP; GC America Inc) to fabricate the definitive cast. Six yellow abutments for direct milling (Dual Milling abutment; Dentium Corp) with titanium nitride coating were connected to the implant replicas on the definitive cast. These were milled with a 2-degree milling bur to fabricate a cement-type zirconia superstructure. Subsequently, all the abutments were transferred to the oral cavity, and their positions were confirmed with an abutment positioning device. A centric relation record was made with a recording device (GC Pattern Resin; GC America Inc), and casts were mounted in a semiadjustable articulator (Hanau modular articulator; Whip Mix Corp). An anatomic contour waxing was made and converted into an acrylic resin prosthesis (GC Pattern resin; GC America Inc) by using putty index (Lab Putty; Coltène/Whaledent, Inc). Light-polymerized composite resin (Rigid Transparent + Blue; Zirkonzhan) was used free hand to correct each tooth shape. This complete contour simulation was inserted intraorally to verify the occlusal vertical dimension and soft-tissue support (Fig. 4). Each tooth of the simulated restoration was cut back approximately 2.0 mm to permit the fabrication of the definitive restoration, with the silicone matrix as a reference. The acrylic resin framework

4 Vertical dimension and soft-tissue support evaluation.



5 Scanning of acrylic resin framework.

6 Zirconia framework before final sintering.

7 New centric relation record.

was scanned (Optical scanner S600; Zirkonzhan), and the CAD/CAM zirconia framework was fabricated (Prettau; Zirkonzahn). The intaglio was also cut back for gingival porcelain addition, and the framework was sintered (Figs. 5, 6).

Once sintering was completed, the zirconia framework was veneered with feldspathic gingival porcelain (Creation Zi-F; Creation Willi Geller Intl GmbH). After verifying the fit of the zirconia framework on the abutments intraorally, a new centric relation record was made (Fig. 7) and used for remounting. A complete-contour waxing was performed on each tooth preparation simulation of the zirconia framework. Subsequently, lithium disilicate monolithic crowns (Emax; Ivoclar Vivadent) were heat pressed to fit each abutment (Fig. 8).

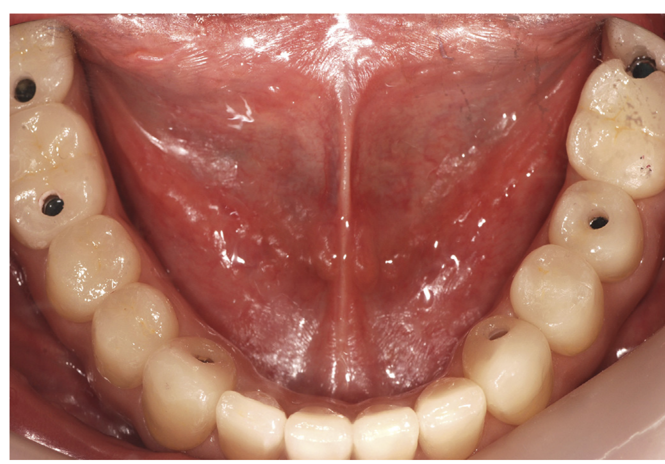
The gingival ceramic around each margin of the zirconia tooth simulation was etched for 30 seconds with hydrofluoric acid, and a primer (Z-Prime plus; Bisco Inc) was applied on the abutment margin. The crowns were etched for 20 seconds with hydrofluoric acid and silanated. Self-etching, self-adhesive resin cement (Unicem; 3M ESPE) was used to bond each monolithic lithium disilicate crown to the zirconia framework extraorally. After connecting the custom abutments with the implants in the oral cavity, the CAD/CAM zirconia framework was cemented onto the abutments with provisional implant cement (Implant Cement; Premier). To ensure the complete removal of residual cement, each abutment screw was loosened and the restoration was removed; then it was reseated, and all the abutment screws were tightened to 35 Ncm. Finally, the access holes were filled with cotton pellets, interim composite resin restorative material (Fermit; Ivoclar Vivadent), and composite resin restorative material (Filtek P60; 3M ESPE) (Figs. 9, 10). The occlusion was refined, and the patient expressed his satisfaction with the esthetic and functional outcomes. The patient was scheduled for recall at 6-month intervals and presented with satisfactory oral hygiene and no mechanical complications at the 9-month follow-up.

DISCUSSION

In this clinical treatment, each crown was fabricated from monolithic lithium disilicate and cemented onto the framework. Lithium disilicate was chosen for esthetics and strength.[35] Clinical studies on monolithic lithium disilicate crowns and FDPs have shown promising results in terms of structural integrity.[36-38] If chipping or fracture of

8 Complete contour waxing and monolithic lithium disilicate crowns.

9 Complete mandibular prosthesis in process of bonding individual lithium disilicate crowns.



10 Intraoral occlusal view of complete prosthesis.

the crowns occurs, then the prosthesis design allows the removal and replacement of the crown intraorally, or extraorally by removing the restoration. Another prospective complication with complete arch implant-supported FDPs is screw loosening or screw fracture. This type of prosthesis enables retrievability and screw management because each access hole is maintained as part of the crown.

Because crowns on this prosthesis can be easily replaced compared with a monolithic zirconia prosthesis, errors such as deficient occlusal contacts on an individual crown can be corrected. The possible disadvantage of this prosthesis is the risk of failure in the bond between the zirconia framework and the veneering gingival porcelain. Using individual crowns, as with this prosthesis, may also be more costly than conventional prostheses.

SUMMARY

This technique combines the CAD/CAM fabrication of a zirconia framework for precision with heat-pressed monolithic lithium disilicate crowns for esthetics and function. This type of prosthesis may reduce the likelihood of

porcelain fractures and allow ease of retrievability.

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