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Replacement of Unesthetic Posterior Metal Crowns with Monolithic Zirconia Crowns: A Case Report

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Abstract

Advances in metal-free materials and the popularization of Computer-Aided Design and Manufacturing (CAD/CAM) have led to the wide clinical use of all-ceramic crowns for esthetic restorations. A 72-year-old woman presented to our hospital with unesthetic restorations on the right upper and lower posterior teeth. Intraoral examination revealed poorly fitting metal crown margins. Defective prostheses were removed, and provisional restorations were provided to stabilize the mandibular position. Optical impressions and the maxillomandibular relationship were recorded using an intraoral scanner, and monolithic zirconia crowns were fabricated using CAD/CAM technology for complete veneer crown restorative treatment. Occlusal examination revealed an improvement in occlusal force distribution at initial examination (right side: 33.5%, left side: 66.5%) after placement of the zirconia crowns (right side: 54.9%, left side: 45.1%). Occlusal force and occlusal force distribution area also showed an increasing trend. The Oral Health Impact Profile short form (OHIP-14) score decreased from 7 points at initial examination to 0 points after prosthodontic treatment. Appropriate diagnosis and treatment planning contributed to the increased occlusal force and balanced occlusal force distribution. Therefore, the present case indicates the potential of monolithic zirconia crowns to achieve both esthetic and stable functional outcomes.

Keywords

Monolithic Zirconia Crown, Intraoral Scanner, Computer-Aided Design and Manufacturing

1. Introduction

Conventionally, porcelain-fused-to-metal crowns are used for esthetic dental restorations. However, advances in metal-free materials and popularization of Computer-Aided Design and Manufacturing (CAD/CAM) have led to the extensive clinical use of all-ceramic crowns, which are suitable for patients with metal allergies and provide excellent esthetics.

The use of digital workflows facilitates the development of ceramics like Lithium Disilicate (LD) and Zirconia (ZC) [1]. LD is one of the most extensively used glass-ceramic materials. On the other hand, ZC is one of the highly promising oxide ceramics for full crowns owing to its high resistance to cohesive fractures [2].

Therefore, we report a case of unesthetic posterior metal crowns that were replaced with monolithic zirconia crowns, leading to successful esthetic and functional outcomes.

2. Case Summary

A 72-year-old woman presented to us in July 2022 with the chief complaint of esthetic impairment in the right upper and lower posterior teeth region. She had received metal crowns on these teeth more than 10 years ago at a local dental clinic. Initially, she considered getting ceramic crowns, but feared that they might crack under biting forces. The patient had hypertension, but no other relevant medical history, and had received metal crowns on her right upper and lower posterior teeth more than 10 years ago at a local dental clinic. However, her family had recently pointed out that these crowns appeared unesthetic.

Intraoral examination revealed poorly fitting metal crown margins at teeth 16, 15, 14, 45, 46, and 47 with cervical caries. The overall plaque control was good, and no gingival erythema or edema was observed. Periodontal examination revealed a generalized probing depth of 2 - 3 mm, with no bleeding on probing or tooth mobility. Occlusal examination performed on models mounted on an articulator revealed a 2-mm overbite and overjet. The occlusion was stable, and the lateral sliding movements on both sides exhibited group function.

Examination of the masticatory muscles and temporomandibular joint revealed no significant findings (**Figure 1**). The patient had a mouth opening of three-finger width, with no abnormality or joint noises during mandibular opening and closing.

Panoramic radiography revealed no third molar impaction. Apical radiolucency was observed at tooth 36. Additionally, mild generalized horizontal and vertical alveolar bone resorption was observed. The radiographic findings of the temporomandibular joint were normal, with no bone deformity (**Figure 1**).

The patient was diagnosed with esthetic impairment of full metal crowns on teeth 16, 15, 14, 26, 36, 45, 46, and 47. In accordance with the prosthodontic classification system proposed by the Japan Prosthodontic Society [3], a score of 59 was assigned, corresponding to Level II condition [3].

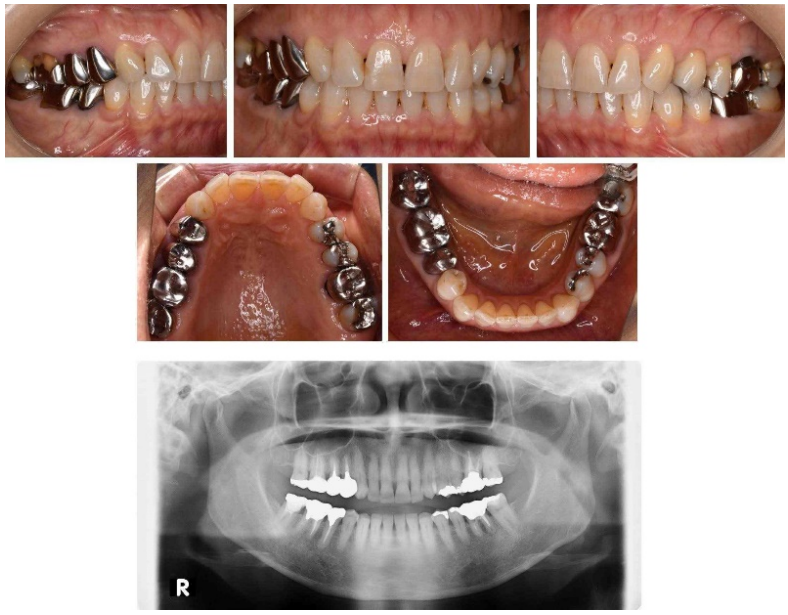

Figure 1. Intraoral photographs and panoramic radiograph at initial examination.

3. Treatment and Outcomes

3.1. Treatment Planning

Considering the mechanical requirements of posterior restorations for withstanding masticatory forces, as well as the esthetic preferences of the patient, we selected monolithic zirconia (hereafter referred to as zirconia) for the restoration of the right upper and lower posterior teeth.

3.2. Treatment Details

Despite the patient's good oral hygiene, professional scaling was performed and tooth brushing instructions were provided for maintenance of periodontal health. The treatment was explained to the patient, and the form of the final prostheses was reproduced using a diagnostic wax up (Figure 2). We removed the full metal crowns on 16, 15, 14, 45, 46, and 47 and prepared the underlying abutments. The extent of preparation was confirmed using a silicone rubber core fabricated based on the diagnostic wax up. Provisional restorations using acrylic resin (Provinice Fast; Shofu, Japan) were prepared and placed intraorally. We observed the patient's periodontal health, occlusion, and temporomandibular joint for approximately 2 weeks to confirm normal findings and the achievement of a stable mandibular position. Following this, we obtained optical impressions with gingival retraction and recorded the maxillomandibular relationship using an intraoral scanner (Trios3®, 3Shape, Denmark) (Figure 3). Additionally, we verified the taper, clearance, and margin morphology of the abutment teeth, as well as the maxillomandibular relationship, on the three-dimensional reconstructed model. After that, we asked Grand Lab (Kasugai, Japan) to make a monolithic zirconia crown.

Figure 2. Diagnostic wax up to reproduce the morphology of the final prostheses.

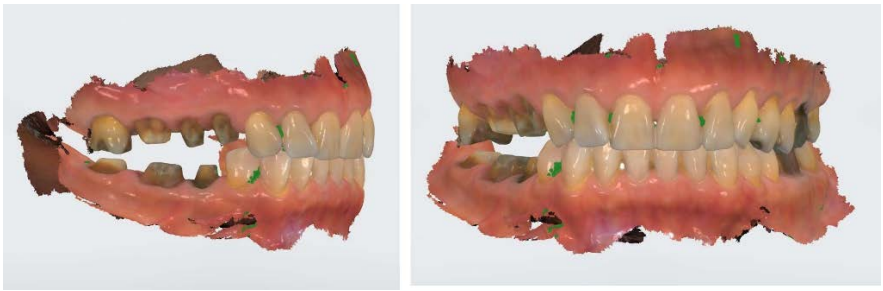

Figure 3. Optical impressions and maxillomandibular relationship records taken using an intraoral scanner (Trios3®).

Zirconia crowns were fabricated based on this model. They were then tried in the oral cavity, and the necessary occlusal adjustments were made. The inner surfaces of the crowns were alumina blasted, followed by application of Clearfil® Ceramic Primer (Kuraray Noritake Dental Inc, Tokyo, Japan), which contains the acidic functional monomer 10-methacryloyloxydecyl Dihydrogen Phosphate (MDP). The tooth surfaces were polished with a fluoride-free dental polishing agent, followed by etching with 37% phosphoric acid (K-etchant gel, Sunmedical Inc, Tokyo, Japan) and application of Panavia V5 Tooth Primer (Kuraray Noritake Dental Inc). The restorations were polished (ZircoShine; Shofu, Japan) to achieve a mirror-like finish and placed on the teeth with a dual-cured resin cement (Panavia V5).

Subsequently, the patient requested restorative treatment of teeth 26 and 36. Using a similar approach, we placed a zirconia crown on tooth 26. Tooth 36 underwent root canal treatment and filling, followed by construction of the abutment using a fiber post and Clearfil DC Core Automix (Kuraray Noritake Dental Inc). The patient expressed a preference for final restoration with a composite resin CAD/CAM crown, and the crown was fabricated and placed intraorally using standard procedures (Figure 4).

Figure 4. Intraoral photographs taken after placing the prostheses.

3.3. Treatment Outcomes and Follow-Up

After placing the restorations, the patient was provided a stabilization splint to wear at night as a preventive measure against sleep bruxism. The patient has been recalled every 3 months for follow-up. The follow-up appointments comprise mechanical cleaning and reinforcement of oral hygiene instructions, as well as occlusal examination and adjustment of the restorations as necessary. At the most recent follow-up, the patient had no signs of caries on the abutment teeth, periodontal inflammation, or issues with the restorations.

3.4. Postprocedural Functional Assessment

Treatment outcomes were objectively evaluated through occlusal contact examination using a pressure-sensitive film (Dental Prescale, GC, Tokyo, Japan). The occlusal force distribution area increased from 21.6 mm^2 at initial examination to 31.4 mm^2 after placing the restorations. Further, the force distribution at initial examination (right side: 33.5%, left side: 66.5%) improved on placement of the restoration (right side: 45.1%, left side: 54.9%). The occlusal force increased from 711.4 N at initial examination to 994.5 N after restoration placement, and the bilateral distribution at initial examination (right side: 42.7%, left side: 57.3%) improved after restoration placement (right side: 48.4%, left side: 51.6%) (**Figure 5**). Moreover, the Oral Health Impact Profile short form (OHIP-14) score [4] decreased from 7 points at initial examination to 0 points after the restorations were placed.

An occlusal contact test using a silicone rubber test material can measure the contact area in the same way as a pressure-sensitive film. However, it is difficult to measure bite force with silicone rubber test material. Therefore, we evaluated using a pressure-sensitive film.

4. Discussion

In the present case, replacement of esthetically impaired metal crowns in the right upper and posterior tooth regions with zirconia crowns resulted in good esthetic and functional outcomes. The clinical application of zirconia, a high-strength

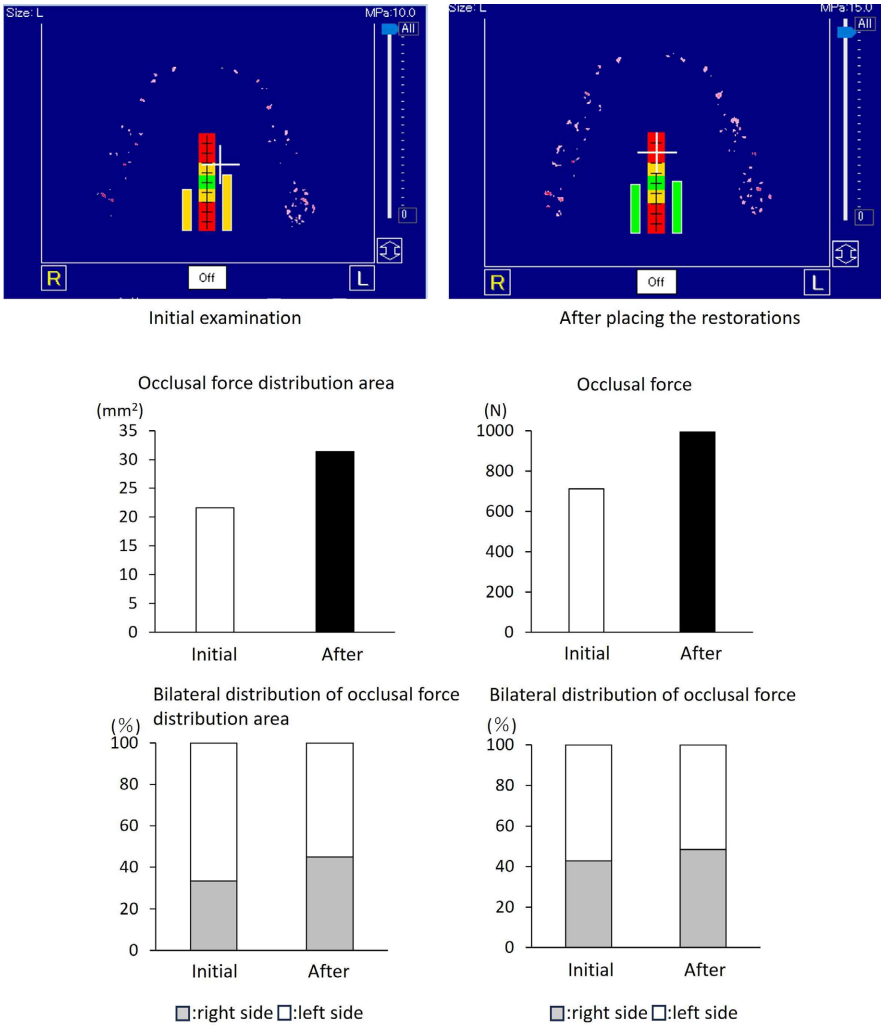

Figure 5. Objective evaluation of the treatment effect on occlusion.

ceramic material, is widespread. Its mechanical strength is superior to that of porcelain-baked materials and lithium disilicate-containing ceramics used in conventional full ceramic restorations. Additionally, high-translucency zirconia, while slightly reduced in strength compared to conventional zirconia, allows for excellent esthetic restorations [5]. Zirconia crowns are often fabricated using optical impressions taken with intraoral scanners.

Pretreatment occlusal assessment showed that only 33.5% of occlusal forces were distributed on the right side, indicating the need for occlusal treatment. The patient first received provisional restorations, which were adjusted to qualitatively increase occlusal contact points and contact area. The patient was closely monitored to ensure stable stomatognathic function, and the final restorations were fabricated based on optical impressions taken using an intraoral scanner.

The final restoration was cemented following surface treatment of the underlying abutments. The tooth surface was polished with a fluoride-free tooth surface polishing material, followed by etching and application of a tooth primer. Zirconia restoration was treated as described by Le *et al.* [6], who reported

that the bonding of zirconia could be improved by applying an MDP monomer-containing bonding agent on the inner surface of the restoration after alumina sandblasting.

Mundhe *et al.* [7] evaluated the effects of natural enamel, zirconia, and metal-ceramic crowns on the wear of the natural enamel of the opposing teeth 1 year after prosthetic restoration. They found that zirconia caused less wear compared to metal-ceramic crowns, but more wear compared to natural enamel. Lohbauer *et al.* [8] reported that monolithic zirconia crowns (LAVA Plus) resulted in acceptable wear of the opposing natural enamel or ceramic surfaces after 2 years. However, some reports also suggest that the wear of the opposing natural enamel due to a well-polished monolithic zirconia surface is less than that occurring between enamel surfaces [9] [10]. The wear of the opposing teeth is complex and may adversely affect the stomatognathic system. In the present case, the monolithic zirconia crowns were polished after occlusal adjustment to achieve a mirror-like finish. Additionally, a stabilization splint was provided to protect the prosthetic restorations from the effects of sleep bruxism.

The patient originally presented with esthetic concerns regarding the right upper and lower molar restorations. However, on completing prosthodontic treatment, she expressed esthetic concerns related to restorations on teeth 26 and 36 as well. This concern may have resulted from the patient's increased interest in aesthetic improvement. Posttreatment occlusal examination indicated an improvement in occlusal force distribution on the left and right sides. Further, the OHIP-14 score of the patient indicated an improvement in oral health-related quality of life following restorative treatment. The patient will continue to undergo monitoring of changes in occlusal contact points and eccentric movements once every 3 months as part of maintenance therapy.

5. Conclusion

In the present case, esthetic impairment in the right upper and lower posterior tooth region was corrected with monolithic zirconia crowns. These crowns were fabricated using CAD/CAM technology based on optical impressions and maxillomandibular relationship records. Occlusal assessments after restorative treatment indicated an increase in occlusal force and improvement in their bilateral distribution. The OHIP-14 score also indicated improvement in the patient's oral health-related quality of life. The present case suggests that appropriate fabrication of monolithic zirconia crowns can help achieve stable esthetic and functional outcomes.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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