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Case report

A single-retainer zirconium dioxide ceramic resin-bonded fixed partial denture for single tooth replacement: a clinical report

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Abstract: This clinical report describes a treatment for the replacement of a missing mandibular anterior tooth using a cantilever single-retainer resin-bonded fixed partial denture (RBFPD), fabricated from zirconium dioxide (ZrO_2) ceramic. No clinical complications were observed at the 2-year 6-month follow-up examination after placement of the ZrO_2 ceramic RBFPD, and satisfactory functional and esthetic results were achieved. A treatment modality using a cantilever ZrO_2 ceramic RBFPD is an alternative for single anterior tooth replacement. Further clinical studies are required to evaluate the long-term potential of cantilever single-retainer ZrO_2 ceramic RBFPDs. (J. Oral Sci. 47, 139-142, 2005)

Keywords: adhesive restoration; CAD/CAM; zirconium dioxide ceramics.

Introduction

For the replacement of a missing mandibular incisor, commonly-used treatment alternatives are a conventional 3-unit fixed partial denture (FPD), a single-tooth implant supported restoration, or a resin-bonded fixed partial denture (RBFPD). The 3-unit FPDs require the removal of substantial amounts of tooth structure, and preservation of pulp is difficult. For mandibular incisors, tooth preparation is challenging because of their small axial diameters. Due to limited space and insufficient quality or quantity of both hard/soft tissues, single-implant supported restorations are not always able to fulfill all the biomechanical and aesthetic requirements. Metal-ceramic and all-ceramic RBFPDs with a 2-retainer design have been proposed as a conservative treatment approach for the replacement of a missing mandibular incisor with caries-free abutments (1-4). Kern et al. (5) and Koutayas et al. (6) reported that the clinical application of cantilevered single-retainer all-ceramic RBFPDs in the mandible arch may be an alternative to all-ceramic RBFPDs with 2 retainers. In these previous studies, glass-infiltrated aluminum oxide (Al_2O_3) ceramics were used as the framework material of RBFPD. In a recent clinical study, use of a cantilever single-retainer Al_2O_3 ceramic RBFPDs as a promising treatment alternative to 2-retainer RBFPDs in the anterior region was confirmed (7).

Zirconium dioxide (ZrO_2) ceramics have been used for hip-joint prostheses in the orthopedic field since 1985, due to their favorable physical properties (8). Since ZrO_2 ceramic exhibits a higher flexural strength and fracture toughness than the other available dental ceramics (9), it has been made available in the dental field for use in orthodontic brackets (10,11) and post-core systems (12,13). Recently, with the use of dental CAD/CAM technology, fully sintered ZrO_2 ceramic frameworks for fixed prostheses can be machined with improved firmness of the grinding machine (14-16). Although the long-term clinical results of ZrO_2 ceramic FPDs have not been previously reported, ZrO_2 ceramic FPDs are being employed for placement in premolar and molar regions (16).

There are limited published clinical data on the use of the cantilever all-ceramic RBFPDs made from ZrO_2 ceramic for the replacement of a missing anterior tooth.

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Kern (7) reported the technical instruction of a case of single tooth replacement using a ZrO_2 ceramic RBFPD. This clinical report describes the treatment for a missing mandibular anterior tooth using the cantilever single-retainer ZrO_2 ceramic RBFPD as well as the clinical results at the 2-year 6-month follow-up period.

Clinical Report

A 52-year-old patient, with an unremarkable medical history, presented with the chief complaint of pus discharge from her mandibular incisors (Fig. 1). Since the mandibular right and left central incisors exhibited severe chronic periodontitis, it was decided to extract these teeth (Fig. 2). After discussing some of the possible treatment options for tooth replacement, the patient opted for the fabrication of an all-ceramic RBFPD using ZrO_2 ceramic. The opposing maxillary anterior teeth were favorably positioned and within normal physiological tooth mobility.

An impression was made with a custom acrylic resin (Megatry, Megadenta, Radebergtray, Germany) tray using polyether impression material (Impregum, 3M ESPE, Seefeld, Germany) and without tooth preparation. A provisional restoration was fabricated from an auto-polymerizing resin (Ivocron, Ivoclar Vivadent, Schaan, Lichtenstein) according to a diagnostic wax-up and secured using auto-polymerizing resin, without etching the tooth surface. The RBFPD had a cantilevered single-retainer design using one abutment tooth (Fig. 3). A framework of the all-ceramic RBFPD was fabricated using ZrO_2 ceramic manufactured by a CAD/CAM system (Precident DCS, DCS dental AG, Allschwil, Switzerland) (Fig. 4) and veneered using feldspathic porcelain (Triceram, Degudent, Hanau, Germany) (Fig. 5). The bonding surface of the retainer of the completed RBFPD was treated with a tribo-chemical silica coat (Rotate system, 3M ESPE) (17,18) and ultrasonically cleaned in 96% alcohol. The abutment tooth was initially cleaned with a rubber cup and a fluoride-free cleaning paste (Pollex, Have-Nots, Bioggio, Switzerland),

Fig.1 Facial view of the mandibular incisors pre-treatment.

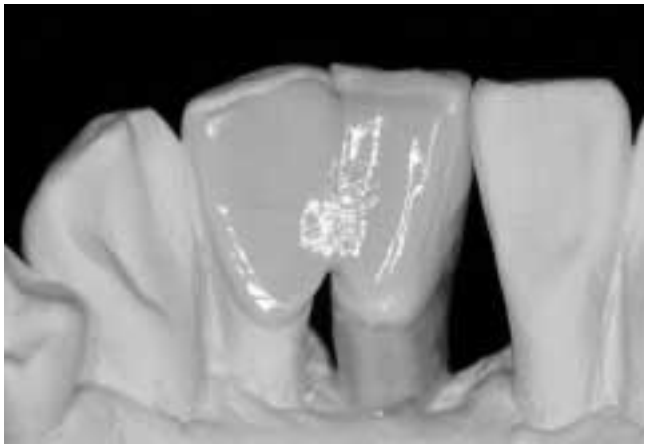

Fig. 3 Lingual view of wax-up on the master model. A lingual single-retainer was designed for the left lateral incisor.

Fig. 2 Facial view after extraction of two mandibular incisors (31, 41).

Fig. 4 Facial view of the single-retainer ZrO_2 ceramic RBFPD framework at the time of try-in.

and its enamel subsequently etched with 37% phosphoric acid for 60 sec. The all-ceramic RBFPD was bonded to the abutment tooth with the use of a dual-polymerizing resin (Panavia Fluoro Cement, Kuraray, Tokyo, Japan) (17,18) (Fig. 6). Follow-up was performed every 6 months in order to evaluate the ZrO_2 ceramic RBFPD with regard to function, fracture, and esthetics. No clinical problems or complications were observed at the 2-year 6-month follow-up examination (Fig. 7). Satisfactory functional and esthetic results were achieved in this clinical case.

Discussion

This clinical report describes a treatment option for the replacement of a missing mandibular anterior tooth using the cantilever single-retainer RBFPD fabricated from ZrO_2 ceramic. The 2-year 6-month follow-up demonstrated excellent esthetics and the stability of the ZrO_2 ceramic RBFPD was satisfactory. The patient was also satisfied with the outcome.

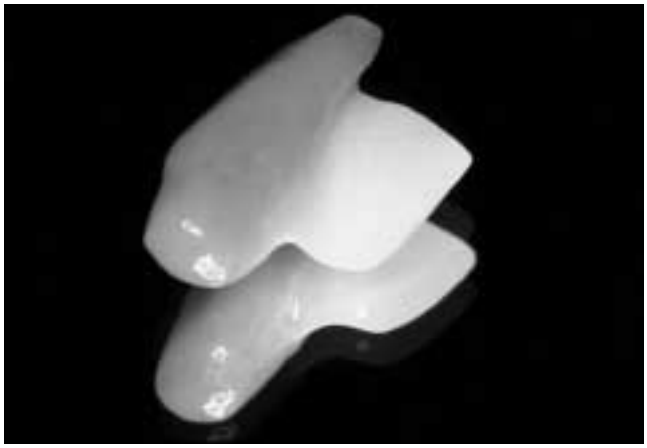

Fig. 5 Final single-retainer ZrO_2 ceramic RBFPD.

One of the main causes for failure of all-ceramic RBFPDs is fracture of the connector area (17,19,20). The fracture strength of the connector depends not only on the dimensions of the connector, but also on the mechanical properties of the materials used. ZrO_2 ceramic, as employed for the framework of RBFPD in this case, has superior physical properties to Al_2O_3 ceramic (9). The long-term result of ZrO_2 ceramic RBFPDs is therefore predicted to be more predictable than for Al_2O_3 ceramic RBFPDs. Another common cause of failure of RBFPDs is the debonding of the framework from the luting cement or the luting cement from the tooth surface (1,20). Compared to other ceramics, there are few in vitro studies on the resin bonding to ZrO_2 ceramic (18, 21-24). Some researchers have reported that airborne-particle abrasion with Al_2O_3 abrasive particles combined with use of a resin luting agent containing an adhesive phosphate monomer provide a long-term durability resin bond to ZrO_2 ceramic (21,22,24). However, the clinical application of this luting technique is not well established for the ZrO_2 ceramic RBFPD. Kern and Strub (17) have reported the clinical results over 5 years achieved using tribochemical coating, and a resin luting agent containing an adhesive phosphate monomer applied to glass-infiltrated Al_2O_3 ceramic restorations. The composition of ZrO_2 ceramic is similar to that of glass-infiltrated Al_2O_3 ceramic containing less than 5% by weight of silica. Moreover, a recent in vitro study indicated that using a tribochemical system combined with a resin luting agent containing adhesive phosphate monomer is an alternative for the cementation of ZrO_2 ceramics (18). The ZrO_2 ceramic RBFPD in this report was thus seated using tribochemical coating, combined with a resin luting agent containing adhesive phosphate monomer.

Fig. 6 Facial view of the single-retainer ZrO_2 ceramic RBFPD seated with adhesive resin.

Fig. 7 Facial view of the single-retainer ZrO_2 ceramic FBFPD 2 years 6 months after cementation.

To date, no documented failures have been reported with this system; however, long-term clinical data are required to address potential indications, efficacy, and prognosis of this type of prosthesis.

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