It can be difficult to achieve a natural appearance in the anterior region with implant-supported restorations because metal components may show through the soft tissue. Zirconia implants, therefore, should be considered as an alternative treatment for improved esthetics. The goal of this clinical report was to evaluate a new 2-piece zirconia implant system for the maxillary anterior region. A 2-piece zirconia dental implant was placed in the maxillary left lateral incisor position and left in place for 6 months to osseointegrate. Panoramic and periapical radiographs were examined for bone-implant osseointegration. The plaque control record (PCR), bleeding on probing (BOP), and probing depth (PD) were measured after the cementation of the definitive restoration and a 6-month follow-up period. The PCR, BOP, and PD values were compared and the marginal bone level was also evaluated by making standardized periapical radiographs. The results showed that over the 6-month follow-up period, the marginal area was healthy and presented no bleeding on probing, no plaque accumulation, and no change in periimplant marginal bone level. (J Prosthet Dent 2013;109:70-74)

Replacing teeth with implant-supported restorations in the anterior maxilla is one of the most complex treatments used to provide an esthetic result.1-4 Titanium implants are successful and their clinical survival rates are good, but the grayish color of the implants and/or soft tissue shrinkage and recession can result in an unnatural appearance.5-8 To overcome this problem, zirconia, with its good long-term results as a medical implant and with its more natural color, has recently been suggested for dental implants.9-14

The main reasons for the clinical use of zirconia implants are their biocompatibility, good chemical and dimensional stability, high flexural strength (900 to 1200 MPa), adequate hardness (1200 Vickers) and Weibull modulus (10 to 12), tooth-like color, low thermal conductivity, machinability, comparable osseointegration to titanium implants, reduced plaque affinity, and low corrosion potential.11,12,15-18

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The long-term success of an implant requires a sufficient degree of osseointegration of the material.13 Animal studies have demonstrated encouraging results regarding the osseointegration of zirconia implants.1,9,11-13,15,19,20 Kohal et al20 compared loaded titanium implants with loaded zirconia implants in the same monkey model. No implant was lost over an observation period of 14 months, and no mechanical problem was reported. Histological examination showed no difference in the bone tissue response between the titanium and zirconia implants. The osseointegration and removal torque of zirconia and titanium implants investigated by Sennorby et al11 in an animal study showed similar osseointegration, but the removal torque of pure zirconia implants was lower.

Zirconia implants present acceptable osseointegration, but only minimal information about the biomechanical behavior of zirconia oral implants is available.21-28 In a biomechanical study, Caglar et al27 compared the different kinds of stresses occurring on implants, abutments, and surrounding bone by using 3-dimensional finite element analysis in the anterior maxilla. A single titanium implant with a titanium abutment, a single titanium implant with a zirconium abutment, and a 1-piece zirconia implant were evaluated in this study. The results showed that the zirconia implant generated the lowest stresses in cortical bone and the von Mises and compressive stresses were lower than the titanium abutment when compared with the zirconia abutment. In an in vitro investigation, Kohal et al28 evaluated the effects of cyclic loading and preparation on zirconia implants. It was concluded that loading can decrease the fracture strength of the zirconia implants.

Zirconia implants can be manufactured in 1-piece3,7,28-30 or 2-piece10,20,24,31 designs. Clinical experience with zirconia implants is limited, but some patient treatment reports3,10,29-32 and some retrospective long-term clinical studies7,17,33 have been published. The

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The purpose of this clinical report was to evaluate a single tooth, 2-piece zirconia implant located in the anterior maxillary region.

**CLINICAL REPORT**

A 23-year-old man with endodontic failure of his maxillary left lateral incisor was referred to the Department of Prosthetic Dentistry at Gazi University, Faculty of Dentistry. After clinical examination, panoramic and periapical radiographs were obtained (Figs. 1, 2). A zirconia implant was used because of the esthetic expectation of the patient. The treatment protocol, comprising risks, benefits, and alternative treatments were explained to the patient, who signed an informed consent form based on the revised Helsinki Declaration. A cylindrical screw type, subgingival, platform switched, 2-piece zirconia implant (Zit-Vario; Ziterion GmbH, Uffenheim, Germany), 4.0 mm in diameter and 11.5 mm in length, was placed in the maxillary left lateral incisor position (Fig. 3). The buccal defect area was filled with a xenogenous bone graft (Bio-Oss; Geistlich Biomaterials, Wolhuser, Switzerland). The implant surgical procedure was performed under local anesthesia (Ultracain DS Forte; Sanofi-Aventis, Istanbul, Turkey).

The implant was left in place for 6 months, the recommended healing period for dental implants in the maxilla, to osseointegrate. During this period, the patient wore an interim removable prosthesis, replacing the missing dentition.

After the 6-month healing period, panoramic and periapical radiographs were made and examined for osseointegration (Fig. 4), and the definitive restoration was begun. The implant was uncovered, the abutment healing cap removed, and an abutment analog placed in order to choose a suitable abutment. The abutment analog was made of a biocompatible synthetic material with the same geometry as the zirconia abutment.

The selected definitive abutment was cemented into the implant with an autopolymerizing universal composite resin cement (RelyX Unicem; 3M ESPE, Seefeld, Germany) (Fig. 5). Excess cement was removed from the implant-abutment interface. During the soft tissue healing period, the patient wore an interim fixed prosthesis, replacing the missing tooth. After a 2-week healing period, an elastomeric impression material (Zeta Plus; Zhermack, Badia Polesine, Italy) was used to make the maxillary impression of the soft tissue. The impression was made directly of the abutment cemented into the implant. After the milled zirconia framework was evaluated clinically, a definitive crown was made of zirconia. The restoration was...
left out of occlusion, and contacts in lateral excursions were avoided. It was then cemented onto the implant by using an autopolymerizing universal composite resin cement (RelyX Unicem; 3M ESPE) (Fig. 6). Excess cement was removed and the patient was instructed in oral hygiene procedures. The esthetic appearance was improved, and the patient was satisfied with the final result.

The plaque control record (PCR), bleeding on probing (BOP), and probing depth (PD) were measured after the cementation of the definitive restoration and also after a 6-month follow-up period. The PCR, BOP, and PD values were compared and the marginal bone levels evaluated by making standardized periapical radiographs. The radiographs were made by using a long cone paralleling technique. The results showed that the marginal area was healthy and presented no bleeding on probing, no plaque accumulation, and no change in periimplant marginal bone level (Figs. 7, 8) 6 months after cementation of the restoration.

DISCUSSION

The esthetics of implant-supported restorations can be improved because of developments in ceramic materials, implant components, and surgical techniques. Zirconia ceramics have been used successfully in implant-supported restorations for abutments and crowns, but zirconia implants are a new application.

Most of the available zirconia implant systems are a 1-piece design. However, there are situations where 2-piece implant systems are indicated. One-piece zirconia implants are inserted with minimal surgical invasion and maximum soft tissue preservation and are immediately restored with an interim crown, reducing the treatment time. However, 1-piece implants have to be inserted into an accurate anatomic position and are more difficult to position perfectly.
especially in the esthetic regions. If the zirconia implant fractures, it is not possible to repair it, and it must be removed. Gahlert et al reported a fracture rate of 1-piece zirconia implants of nearly 10% after an average follow-up period of 38 months from prosthetic loading. In another study, Andreiotelli and Kohal reported that the in vitro preparation of zirconia implants significantly and negatively influenced the fracture strength of the implants.

In a long-term clinical study by Oliva et al, the 5-year success rate of 831 1-piece zirconia implants with 3 different roughened surfaces was reported to be 95%.

Primary stability and the elimination of micromovements are the main factors required for successful osseointegration. Two-piece implants can minimize the forces transmitted to the bone implant interface and can be used when accurate primary stability is not achieved. The information on 2-piece zirconia implants is limited to 1 biomechanical, 1 animal, and 2 clinical studies. In a biomechanical study, Kohal et al compared the fracture resistance of restored prototype 2-piece zirconia with restored titanium implants after artificial aging. The biomechanical performance of all tested implant groups was marginal for clinical use. A high number of failures with the titanium implants occurred at the abutment screw level, and the zirconia implant groups showed implant head fractures at relatively low fracture loads. In 2004, Kohal et al reported on the first 2-piece zirconia implant patient treatment. A custom-made zirconia implant was placed in the patient, and after a healing period of 6 months, the single ceramic crown was cemented onto the implant, demonstrating that zirconia implants could be used for the esthetic restoration of missing teeth. Nevins et al reported the histological and clinical evaluations of 2-piece zirconia implants and compared them with titanium implants. Four titanium and 2 zirconia implants were placed in a healthy woman. One 2-piece zirconia implant was removed for biopsy after 6 months. Clinical and radiographic examinations showed that both the zirconia and titanium implants achieved osseointegration. Gingival tissues were healthy, and excellent vertical bone height was demonstrated in the radiographs. The bone-to-implant contact with a zirconia implant surface was adequate to provide clinical and histologic evidence of osseointegration, demonstrating that zirconia implants provided suitable conditions for soft and hard tissue healing.

In the clinical report presented here, a 2-piece zirconia implant was placed in the anterior region. After 6 months, radiographic and esthetic outcomes were successful. The color of the zirconia was also attractive because of its similarity to the color of the natural tooth. However, the present clinical report evaluated only the short term performance of a new 2-piece zirconia implant; studies focusing on the long term clinical performance of zirconia implants are necessary.

**SUMMARY**

This clinical report presents the results of placing a 2-piece zirconia implant in the anterior maxillary region. In a short-term, 6-month evaluation, the radiographic and clinical outcomes were successful, and the patient was satisfied with the final result. In esthetically demanding situa-

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tions, zirconia implants may provide an alternative to titanium implants. To properly evaluate their clinical performance and recommend them for routine clinical use, well planned, controlled animal investigations and clinical trials with longer-term follow-up are necessary.

REFERENCES