

Reconstruction of Single Tooth Loss with One-Piece and Two-Piece Zirconia Implants: Case Report

Tek Diş Eksikliklerinin Tek Parça ve İki Parça Zirkonya İmplantlarla Rekonstrüksiyonu

Bilge TURHAN BAL,^a
Meral KURT,^a
Merve BANKOĞLU GÜNGÖR,^a
Handan YILMAZ,^a
Seçil KARAKOCA NEMLİ^a

^aDepartment of Prosthodontics,
Gazi University Faculty of Dentistry,
Ankara

Geliş Tarihi/Received: 15.01.2016
Kabul Tarihi/Accepted: 31.05.2016

Yazışma Adresi/Correspondence:
Bilge TURHAN BAL
Gazi University Faculty of Dentistry,
Department of Prosthodontics, Ankara,
TÜRKİYE/TURKEY
bilgeturhan@gmail.com

ABSTRACT Reconstruction of single-tooth loss with dental implants has become a common treatment option. Dental implants and abutments are generally manufactured from titanium because of its high survival rates and mechanical properties. However, the gray metallic color of the titanium can cause gray or blue discolorations of the surrounding soft tissues. In addition, metal allergy may limit their usage. Zirconia implants and abutments have been used as an alternative to titanium, due to their superior physical properties, biocompatibility, and aesthetic. In this clinical report, the treatments of 4 cases with single-tooth loss in the anterior region were presented. The first and second cases were treated with one-piece zirconia implants, and 6-year follow-up evaluation were achieved. The other cases were treated by two-piece zirconia implants with 3-year follow-up. Satisfactory esthetic results of implant-supported restorations were defined by the patients and they did not complain any problems regarding their restorations.

Key Words: Dental implants; tooth loss; zirconium oxide

ÖZET Tek diş eksikliklerinin dental implantlarla rehabilitasyonu yaygın bir tedavi seçeneği haline gelmiştir. Dental implant ve dayanaklar, yüksek başarı oranı ve iyi mekanik özellikleri nedeniyle genellikle titanyumdan üretilmektedir. Ancak titanyumun grimsi metalik rengi etrafındaki yumuşak dokuda mavi-gri renklenmelere sebep olmaktadır. Ayrıca metal allerjisi de titanyumun kullanımını sınırlandırmaktadır. Zirkonya implant ve dayanaklar iyi fiziksel özellikleri, biyouyumluluğu ve estetik olmaları nedeniyle titanyuma alternatif olarak kullanılmaya başlanmıştır. Bu olgu sunumunda 4 hastada ön bölge tek diş eksikliklerinin tedavisi anlatılmaktadır. Birinci ve ikinci olgu tek parça zirkonya implantla rehabilite edilmiş ve 6 yıllık takibi gerçekleştirilmiştir. Diğer iki olgu ise iki parça zirkonya implantla tedavi edilmiş ve 3 yıllık takibi yapılmıştır. Hastalar implant destekli restorasyonlarından estetik olarak memnun kalmış ve herhangi bir problem yaşamamıştır.

Anahtar Kelimeler: Diş implantları; diş kaybı; zirkonyum oksit

Türkiye Klinikleri J Dental Sci Cases 2016;2(2):60-5

The current commercial dental implant material of choice is pure titanium, however dark grayish color of titanium implants and abutments often gives rise to discolorations of the surrounding soft tissues and the recessions of the gingiva may lead to exposure of the metal abutment.¹⁻³ Recently, research was oriented towards new generation ceramic materials such as zirconium oxide, which has more favorable mechanical properties (high flexural strength 900-1200Mpa, hardness 1200 Wickers, and Weibull modulus 10-12). Zirconia has high biocompatibility and low

doi: 10.5336/dentalcase.2016-50209

Copyright © 2016 by Türkiye Klinikleri

plaque adhesion and several animal studies showed long-term osseointegration of zirconia dental implants and bone-to-implant contact similar to titanium.⁴⁻⁹ Also, favorable esthetic properties enables the use of zirconia in case of thin biotypes or soft tissue recessions.¹⁰ Zirconia implants can be manufactured as one-piece or two-piece designs.¹¹⁻¹⁶ Firstly one-piece implants were introduced.¹⁷ However there are ambitions to fabricate two-piece zirconia comparable to two-piece titanium implants.¹³ The purpose of this article is to give information about the dental zirconia implants and present 4 cases treated with one-piece and two-piece zirconia implants located in the anterior maxillary region.

CLINICAL REPORT

This report presents 4 cases who treated with one-piece or two-piece zirconia implants in the anterior maxilla. Treatment plan was explained to patients and informed consent was signed by the patients. Descriptions of the cases are shown in (Table 1). One-piece zirconia implants were placed in the prepared implant sockets, and then provisional acrylic crowns were fabricated and cemented avoiding centric and eccentric occlusal contacts. Six months after surgery, abutment part of the one-piece zirconia implants were prepared

to achieve correct axes and lengths using diamond burs suited for zirconia. Implants were finally restored by all ceramic zirconia crown made with CAD-CAM system (Lava Frame; 3M Espe, St. Paul, MN). Two-piece zirconia implants were left submerged for 6 months to osseointegrate. After 6 months healing periods, panoramic and periapical radiographs were examined for bone-implant osseointegration, then zirconia implants were uncovered and suitable abutments were selected. Abutment was cemented into the implant with a self-adhesive universal resin cement (RelyX Unicem; 3M ESPE, Seefeld, Germany) which was recommended by the manufacturer. Excess cement was removed from the implant-abutment interface. Zirconia framework was tried-in and definitive restorations were cemented on the implant using self-adhesive universal resin cement. The cement remnants were removed after setting.

All restorations were protected from occlusal contacts in centric occlusion and lateral excursions. The patients received oral hygiene maintenance instructions. Clinical parameters of probing pocket depth, plaque index, and bleeding on probing were evaluated with a calibrated probe (Click-Probe; Kerrhawe S.A., Bioggio, Switzerland) (Figure 1). Standardized periapical radiographs were obtained using the Rinn alignment system with customized

TABLE 1: Descriptions of the cases.

Case	Age	Gender	Implant Location	Implant Type	Implant dimensions		Implant Manufacturer	Follow-up	Vertical Bone Loss	
					Diameter (mm)	Length (mm)			Mesial (mm)	Distal (mm)
Case 1	45	Man	Left lateral (22) (maxilla)	One-piece zirconia	4.0	10	Whitesky, Bredent Medical, Germany	6 years	0,04	0,06
Case 2	52	Man	Right lateral (12) (maxilla)	One-piece zirconia	4.0	10	Whitesky, Bredent Medical, Germany	6 years and 6 months	0,9	1,04
Case 3	19	Man	Right lateral (12) (maxilla)	Two-piece zirconia	4.0	11,5	Zit-vario; Ziterion, Uffenheim, Germany	3 years	1,6	1,01
Case 4	24	Woman	Right lateral (12) (maxilla)	Two-piece zirconia	4.0	11,5	Zit-vario; Ziterion, Uffenheim, Germany	3 years	0,93	0,80

silicone bite (Figure 2). Marginal bone loss was evaluated using a special software (ImageJ) (Figure 3). The periapical radiographs taken at baseline and after follow-up evaluations were digitalized. The implant length (measured from the implant shoulder to the implant apex) was used to calibrate the measured bone loss. The distance from implant shoulder to crestal bone level was measured and recorded in mm. For the first and second cases approximately 6-year follow-up and for the other cases almost 3-year follow up were achieved.

In all cases, there was no sign of inflammation including erythema, edema, and bleeding after the follow-up periods. All patients were satisfied with their prostheses. Any biological, technical or esthetical problems were not observed. The implants were stable and under function. Initial and definitive views and periapical radiographs of the patients are shown in Figures 4-7.

DISCUSSION

Implant restoration has become a predictable treatment for single-tooth replacement, but advance case planning for adequate implant placement is es-



FIGURE 1: Evaluating pocket depth with calibrated probe.



FIGURE 2: The Rinn alignment system with customized silicone bite.

sential to meet the esthetic demands of the anterior maxilla.¹⁸⁻²³ Today commercially available zirconia implants are produced as one-piece or two-piece designs. Each one has advantages and

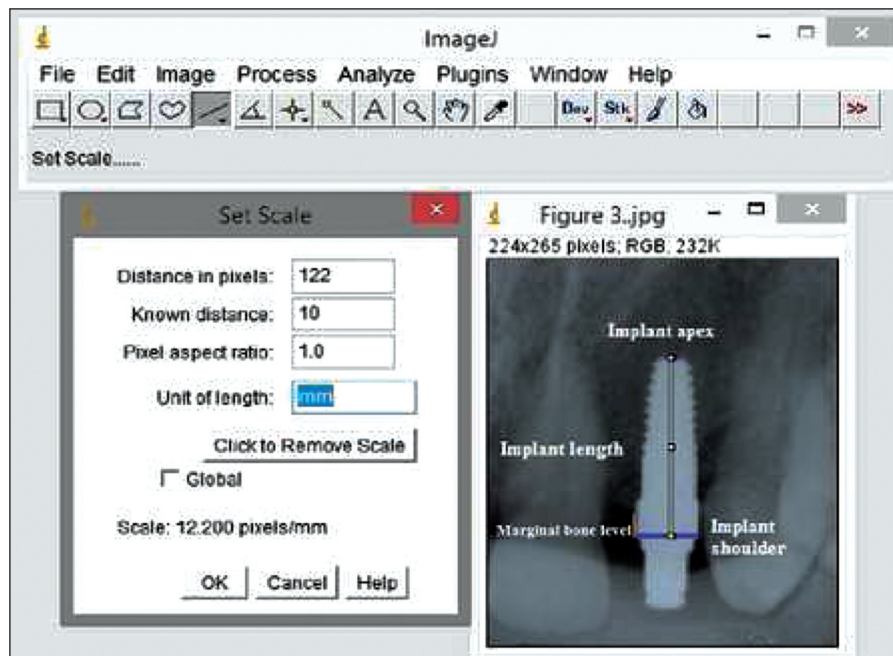


FIGURE 3: The implant length (measured from the implant shoulder to the implant apex) was used to calibrate the measured bone loss.



FIGURE 4: a) Preoperative view of case 1. b) Periapical radiograph of inserted implant of case 1. c) View of abutment of case 1. d) View of cemented restoration of case 1 after 6 months. e) Periapical radiograph of cemented restoration of case 1 after 6 years.



FIGURE 5: a) Preoperative view of case 2. b) Periapical radiograph of inserted implant of case 2. c) View of abutment of case 2. d) View of cemented restoration of case 2 after 6 months. e) Periapical radiograph of cemented restoration of case 2 after 6 years and 6 months.



FIGURE 6: a) Preoperative view of case 3. b) Periapical radiograph of inserted implant of case 3. c) View of abutment of case 3. d) View of cemented restoration of case 3 after 13 months. e) Periapical radiograph of cemented restoration of case 3 after 3 years.



FIGURE 7: a) Preoperative view of case 4. b) Periapical radiograph of inserted implant of case 4. c) View of abutment of case 4. d) View of cemented restoration of case 4 after 6.5 months. e) Periapical radiograph of cemented restoration of case 4 after 3 years.

disadvantages that limit their usage. One-piece systems are in one part, inserted during the surgery. The transmucosal part of one-piece implants is integrated with the implant.¹² Using one-piece implants for everyday practice provides flapless surgery with minimal surgical invasion and provides soft tissue preservation.²⁴ Placing healing caps with second minor surgery is eliminated, so it is not

required to wait for the healing of the soft tissue after the second surgery. The treatment time becomes shorter.²⁵ Another benefit of one-piece implant design is that the implant can be inserted and immediately restored with a provisional crown, which may effect the patient positively. Furthermore, screw joint complications are avoided with one-piece implants.¹²

Lack of angled abutment option for one-piece zirconia implants creates a major drawback in the esthetic zones. Especially in the anterior region, one-piece implants must be placed at perfect anatomical position to establish aesthetic appearance of the restoration.²⁶ Similar problem was experienced in case 2 due to limited abutment options of the implant system for thick gingival tissues and deep implant insertion levels. In one-piece implants, the location of the prosthetic margin is defined by intraoral preparation and preparation is generally required to achieve correct axis.²⁶ However, it has been reported that grinding Y-TZP can effect monoclinic phase transformation and introduce microcracks that may negatively influence the mechanical properties.^{14,26} Andreiotelli and Kohal reported that the in-vitro preparation negatively influenced the fracture strength of the zirconia implants.²⁴ Gahlert et al. reported a fracture rate of one-piece zirconia implants of nearly 10% after an average follow-up period of 38 months from prosthetic loading. In the present study although intraoral grinding was performed for case 1 and 2, any implant fracture was not observed during approximately 6 year follow-up.²⁷

One-piece implants generally require soft tissue formation after insertion due to their submucosally submerged prosthetic platform. An immediate provisionalization is recommended for one-piece zirconia implants. However loading forces emerge on the supramucosal part of the implant by mastication and tongue movements immediately after placement, and there is limited data on this topic.^{28,29} Kohal et al. reported 95.4% survival rate for one-piece zirconia implants for single-tooth replacement after 1 year which is comparable with titanium implants.¹¹ However, the radiographic bone loss after 1 year (>2 mm) was higher than titanium implants. Clinical evaluations showed that this bone loss was not related with inflammation. In the present case report, similar peri-implant bone loss was observed for case 1, which may depend on early loading forces after

placement. Primary stability and elimination of micromovements are the main factors required for successful osseointegration. Two-piece zirconia implants are preferable when optimal implant stability is not achieved at the implant placement. Bone augmentation procedures can be used with the two-piece implants.^{25,26} Transmitting unwanted loading forces to the bone implant interface can be minimized with the use of two-piece implants.²⁵

The microgap formation is one of the major concerns about screw-type implant-abutment connection. One-piece implants have an advantage that positively affects the marginal bone level that is the lack of implant abutment microgap and its microbial contamination.¹⁰ In a clinical study it was reported that it could be eliminated by the adhesive abutment fixation of the zirconia two-piece implant system.³⁰ Similarly in this report; radiographic outcomes were clinically acceptable. In our study, one-piece and two-piece zirconia implants revealed similar marginal bone loss and no microgaps at implant abutment connections that could provide marginal bone preservation. Survival rates of two-piece zirconia implants in the posterior regions were also reported. Cionca et al. reported that cumulative survival rate was 87% after 1 year loading.¹⁷ The stated failure reason was aseptic loosening, and no implants were lost after first year and the results of the other cases were good. In this clinical report, single-tooth replacement with one-piece and two-piece zirconia implant treatment in the anterior region were evaluated. First and second cases were treated by one-piece zirconia implants, and 6 years follow-up evaluation was achieved. The other cases were treated by two-piece zirconia implants with 3 years follow-up. 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. The patients functioned successfully with their prostheses and were satisfied with the final results.

REFERENCES

- Hämmerle C, Sailer I, Thoma A, Hälg G, Suter A, Ramel C. All-ceramic implant supported restorations. *Dental Ceramics: Essential Aspects for Clinical Practice*. 1sted. Berlin, Germany: Quintessence Publishing; 2008. p.113-6.
- Blatz MB, Bergler M, Holst S, Block MS. Zirconia abutments for single-tooth implants--rationale and clinical guidelines. *J Oral Maxillofac Surg* 2009;67(11 Suppl):74-81.
- Tözüm TF, Bal BT, Turkyılmaz I, Gülay G, Tulunoglu I. Which device is more accurate to determine the stability/mobility of dental implants? A human cadaver study. *J Oral Rehabil* 2010;37(3):217-24.
- Doyle MG, Goodacre CJ, Munoz CA, Andres CJ. The effect of tooth preparation design on the breaking strength of Dicor crowns: 3. *Int J Prosthodont* 1990;3(4):327-40.
- Scarano A, Di Carlo F, Quaranta M, Piattelli A. Bone response to zirconia ceramic implants: an experimental study in rabbits. *J Oral Implantol* 2003;29(1):8-12.
- Depprich R, Zipprich H, Ommerborn M, Mahn E, Lammers L, Handschel J, et al. Osseointegration of zirconia implants: an SEM observation of the bone-implant interface. *Head Face Med* 2008;4:25.
- Gahlert M, Roehling S, Sprecher CM, Kniha H, Milz S, Bormann K. In vivo performance of zirconia and titanium implants: a histomorphometric study in mini pig maxillae. *Clin Oral Implants Res* 2012;23(3):281-6.
- Mueller CK, Solcher P, Peisker A, Mtsariashvili M, Schlegel KA, Hildebrand G, et al. Analysis of the influence of the macro- and microstructure of dental zirconium implants on osseointegration: a minipig study. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013;116(1):e1-8.
- Sennerby L, Dasmah A, Larsson B, Iverhed M. Bone tissue responses to surface-modified zirconia implants: A histomorphometric and removal torque study in the rabbit. *Clin Implant Dent Relat Res* 2005;7 Suppl 1:S13-20.
- Borgonovo AE, Censi R, Vavassori V, Dolci M, Calvo-Guirado JL, Delgado Ruiz RA, et al. Evaluation of the success criteria for zirconia dental implants: a four-year clinical and radiological study. *Int J Dent* 2013;2013:463073.
- Kohal RJ, Knauf M, Larsson B, Sahlin H, Butz F. One-piece zirconia oral implants: one-year results from a prospective cohort study. 1. Single tooth replacement. *J Clin Periodontol* 2012;39(6):590-7.
- Bankoğlu Güngör M, Aydın C, Yılmaz H, Gül EB. An overview of zirconia dental implants: basic properties and clinical application of three cases. *J Oral Implantol* 2014;40(4):485-94.
- Kohal RJ, Finke HC, Klaus G. Stability of prototype two-piece zirconia and titanium implants after artificial aging: an in vitro pilot study. *Clin Implant Dent Relat Res* 2009;11(4):323-9.
- Kohal RJ, Wolkewitz M, Tsakona A. The effects of cyclic loading and preparation on the fracture strength of zirconium-dioxide implants: an in vitro investigation. *Clin Oral Implants Res* 2011;22(8):808-14.
- Oliva J, Oliva X, Oliva JD. One-year follow-up of first consecutive 100 zirconia dental implants in humans: a comparison of 2 different rough surfaces. *Int J Oral Maxillofac Implants* 2007;22(3):430-5.
- Oliva J, Oliva X, Oliva JD. Five-year success rate of 831 consecutively placed Zirconia dental implants in humans: a comparison of three different rough surfaces. *Int J Oral Maxillofac Implants* 2010;25(2):336-44.
- Cionca N, Müller N, Mombelli A. Two-piece zirconia implants supporting all-ceramic crowns: a prospective clinical study. *Clin Oral Implants Res* 2015;26(4):413-8.
- Sierraalta M, Razzoog ME. A maxillary anterior partially edentulous space restored with a one-piece zirconia implant fixed partial denture: a clinical report. *J Prosthet Dent* 2009;101(6):354-8.
- Schiroli G. Single-tooth implant restorations in the esthetic zone with PureForm ceramic crowns: 3 case reports. *J Oral Implantol* 2004;30(6):358-63.
- Oliva J, Oliva X, Oliva JD. Zirconia implants and all-ceramic restorations for the esthetic replacement of the maxillary central incisors. *Eur J Esthet Dent* 2008;3(2):174-85.
- Aydın C, Yılmaz H, Bankoğlu M. A single-tooth, two-piece zirconia implant located in the anterior maxilla: a clinical report. *J Prosthet Dent* 2013;109(2):70-4.
- Kohal RJ, Klaus G. A zirconia implant-crown system: a case report. *Int J Periodontics Restorative Dent* 2004;24(2):147-53.
- Oliva X, Oliva J, Oliva JD. Full-mouth oral rehabilitation in a titanium allergy patient using zirconium oxide dental implants and zirconium oxide restorations. A case report from an ongoing clinical study. *Eur J Esthet Dent* 2010;5(2):190-203.
- Andreietelli M, Kohal RJ. Fracture strength of zirconia implants after artificial aging. *Clin Implant Dent Relat Res* 2009;11(2):158-66.
- Esposito M, Grusovin MG, Chew YS, Coulthard P, Worthington HV. Interventions for replacing missing teeth: 1- versus 2-stage implant placement. *Cochrane Database Syst Rev* 2009;(3):CD006698.
- Wenz HJ, Bartsch J, Wolfart S, Kern M. Osseointegration and clinical success of zirconia dental implants: a systematic review. *Int J Prosthodont* 2008;21(1):27-36.
- Gahlert M, Burtscher D, Grunert I, Kniha H, Steinhäuser E. Failure analysis of fractured dental zirconia implants. *Clin Oral Implants Res* 2012;23(3):287-93.
- Hobkirk JA, Wiskott HW. Ceramics in implant dentistry (Working Group 1). *Clin Oral Implants Res* 2009;20 Suppl 4:55-7.
- Payer M, Arnetzl V, Kirmeier R, Koller M, Arnetzl G, Jakse N. Immediate provisional restoration of single-piece zirconia implants: a prospective case series -results after 24 months of clinical function. *Clin Oral Implants Res* 2013;24(5):569-75.
- Payer M, Heschl A, Koller M, Arnetzl G, Lorenzoni M, Jakse N. All-ceramic restoration of zirconia two-piece implants --a randomized controlled clinical trial. *Clin Oral Implants Res* 2015;26(4):371-6.